

Contributions of the timing and context of racial discrimination to health in Aboriginal and Torres
Strait Islander peoples

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Thesis declaration

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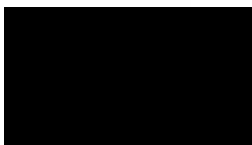
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Abstract

Background and aim: Racism is a social determinant of health linked to negative health outcomes across child and adult populations internationally. This determinant is especially salient to Indigenous populations, where historical colonial policies inform contemporary ideologies and pervade the social systems and institutions which influence health and wellbeing, as has been observed for Aboriginal and Torres Strait Islander (hereafter 'Aboriginal') populations in Australia. Recent advances in data collection and analytic techniques have generated new insights into psychological and biological responses to racism, strengthened the consistency of evidence through replication, and focused attention on causal processes underlying the association between racism and health. The aim of this thesis was to understand the contributions of the timing and context of interpersonal racial discrimination to adverse physical and mental health outcomes in Aboriginal populations, with a focus on children aged 0-17 years.

Methods: Quantitative analyses were undertaken on Australian national longitudinal and cross-sectional studies. Data from children 0-14 years was examined through *Footprints in Time: The Longitudinal Study of Indigenous Children* (LSIC) 2008-2017, a prospective cohort study. Data from adults 18 years and over was examined through the *Australian Aboriginal and Torres Strait Islander Health Survey* (AATSIHS) 2012-13, a population-representative cross-sectional study. Racial discrimination was the exposure variable in all studies, based on either self-reported or carer-reported measures. Outcome variables included emotional and behavioural difficulties, sleep difficulties, behaviour issues at school, obesity, being underweight, substance use, general health, and allostatic load.

Proportions with confidence intervals, means and standard errors, and chi-squared tests were used to estimate the prevalence of carer-reported direct and vicarious racial discrimination and associations with sociodemographic variables. Binary logistic and ordinal logistic regression, with geographic clustering, were used to model associations between racial discrimination exposure, confounders, and health outcomes (LSIC). Latent class analysis with distal outcomes was used to examine the association of latent classes and allostatic load in models dichotomised by racism exposure (AATSIHS), and to examine the association of latent classes and mental health (LSIC).

Results: The prevalence of racial discrimination experienced directly by Aboriginal children (n=1,759) increased considerably between the ages of 4-11 years, rising from 3.9% at age 4 years to 20.4% at 11 years. Vicarious racism was observed at higher rates, with 44.5% of children exposed through their primary carer and 50.5% exposed through their family by age 11. Aboriginal children with exposure to racial discrimination between 4-11 years had a two-fold risk of adverse mental health, sleep difficulties, and behaviour issues at school by 7-12 years. These children also had a seven-fold risk of trying cigarettes by 10-

12 years and a 1.7 times increased risk of obesity. Greater adverse effects on mental health were observed where Aboriginal children were first exposed to racial discrimination at 4-5 years compared with 7 years, referenced to children with no exposure. Similar effect sizes were observed in both exposure groups for sleep difficulties, and a stronger adverse effect on behavioural issues was found at 7 years relative to 4–5 years.

Mean allostatic load was found to be significantly elevated for Aboriginal adults (n=2,056) with exposure to racial discrimination in a latent class characterized by individuals experiencing financial and personal stress, low socioeconomic resources, and multiple health conditions, relative to those unexposed to racial discrimination ($t= 1.74, p=.04$). Elevated emotional and behavioural difficulties were observed for Aboriginal children 12-14 years (n=498) in latent classes characterised by high exposure to bullying, racial discrimination, high police contact, and financial stress, and by male respondents, substance use, racial discrimination, and high police contact.

Conclusions: This thesis has made several original contributions to the literature addressing the impact of racial discrimination on the health of Aboriginal Australians specifically, ethnic minority populations more generally, and the broader social determinants of health field. The findings here contribute to the few studies internationally to explicitly focus on racial discrimination in children ≤ 12 years and are the first to examine age of first exposure, incorporate racism into latent class analysis, and to link racism to allostatic load through latent classes in adults. Strong evidence for adverse mental health outcomes was observed in Aboriginal children and adolescents aged under 15 years, while evidence of physiological dysregulation was observed in Aboriginal adults with high psychosocial stress and adverse health.

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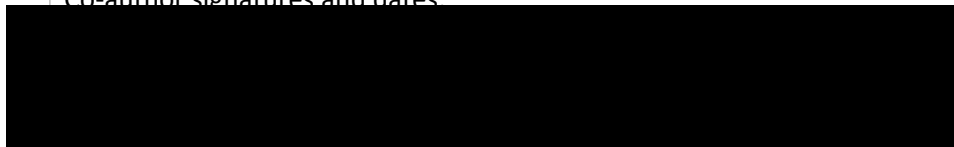
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Coordinating supervisor signature: Date: 10/12/20	

Chapter 1: Introduction

1.1 Overview

This thesis is focused on interpersonal racial discrimination as experienced by Aboriginal and Torres Strait Islander Australians. To introduce this subject, I will first offer an overview of racial discrimination and its relationship with adverse health. I will then introduce the concept of structural racism to help describe the broader context within which racial discrimination is experienced by Aboriginal and Torres Strait Islander Australians, both historically and currently. This section will then conclude with the overall thesis aim, followed by the structure and outline of the remainder of this thesis.

Racial discrimination is a phenomenon in which prejudicial attitudes, beliefs, and behaviours stereotype individuals from racial and ethnic population groups with preconceived expectations of their value, capacity, and identity which negate, accentuate, or ignore their unique personal characteristics. (1) Racism manifests across multiple levels, from the structural to the institutional to the personal, with the potential to influence health and wellbeing within each of these levels. (2) Interpersonal racism occurs when prejudice between and within different racial/ethnic population groups leads to verbal or physical abuse, differential treatment or behaviour, social exclusion, or microaggressions between individuals due to their racial/ethnic background. (3)

1.1.1 Racial discrimination and adverse health

There are several pathways by which racial discrimination negatively influences health. These include the acute effects of physical violence, changes to health behaviour from maladaptive responses to abuse or exclusion, adverse psychological responses, such as increased vigilance, anxiety or depressive symptoms, and the acute or chronic effects of the physiological stress response. (4-7) These pathways intersect with, precede, or cause one another in complex ways, potentially leading to the onset of mental health disorders, morbidity, and mortality. (4, 7-9) Critically, the causal pathway between racial discrimination and adverse health can be influenced by multiple environmental and socioecological factors, (4, 7) and is sensitive to the frequency, duration, and developmental period of exposure. (9-11) While evidence has demonstrated these effects, it is not yet fully understood how the context and timing of racism exposure relates to subsequent adverse health. These mechanisms are less well understood in First Nations compared with non-First Nations populations, despite the increased exposure of these populations to racial discrimination in settler-colonial nations. (12)

1.1.2 Structural racism

The following section provides an explanation of how structural racism occurs, giving context to the contribution of interpersonal racism to adverse health outcomes in Aboriginal and Torres Strait Islander populations. In addition, this section includes a brief overview of the social and historical conditions which have directed and continue to direct interpersonal racism towards Aboriginal and Torres Strait Islander populations in Australia.

Structural racism has been defined as:

[...] the totality of ways in which societies foster discrimination, via mutually reinforcing systems of discrimination (e.g., in housing, education, employment, earnings, benefits, credit, media, health care, criminal justice, etc.) that in turn reinforce discriminatory beliefs, values, and distribution of resources (13) p.650.

In this definition, structural racism acts as a meta-level discriminatory system which is implicated in all racial disparities and operates across multiple social domains, shaping not only policies and practices but also beliefs and values. (14) When defined as this form of 'über discrimination' (14), structural racism is differentiated from institutional racism which specifically refers to racially discriminatory policies and practices occurring within and between government and non-government institutions, either historically or currently. (15) Importantly, structural racism acknowledges that there is a feedback loop between discriminatory ideologies and actualised discrimination (e.g. residential segregation) in which each can create and reinforce the other. (16) This interrelationship often means that the causes of health disparities generated within discriminatory systems are obscured by discriminatory beliefs. (14)

At the outset, it is critical to acknowledge the history of colonisation in Australia to understand structural racism as it currently manifests for Aboriginal and Torres Strait Islander populations. This not only includes the implications of policies and legislation but also the everyday realities that colonisation enforced and maintained in generations of Aboriginal and Torres Strait Islander families. Aboriginal and Torres Strait Islander populations were and are heterogeneous, with more than 250 languages spoken prior to the 19th century (17) across populations exposed to starkly different histories, policies, and traumas during the period of European colonisation from 1788 to the present day. These exposures led Aboriginal and Torres Strait Islander communities to each experience unique social, political, and economic conditions with different implications for their health and wellbeing. However, many of the costs of colonisation were common to most, if not all, Aboriginal and Torres Strait Islander peoples, including land dispossession, marginalisation, and loss of sovereignty. Throughout the remainder of this thesis, I will refer to Australian Aboriginal and/or Torres Strait Islander peoples using the terms 'Aboriginal and Torres Strait Islander peoples' and 'Aboriginal and Torres Strait Islander populations' interchangeably and will distinguish

Indigenous populations outside Australia using the term 'First Nations', except to maintain consistency with established terms (e.g. Indigenous data sovereignty, Indigenous methodologies, etc.). I will refer to Aboriginal and Torres Strait Islander peoples as 'Aboriginal' only in tables or figures for brevity. I recognise that the term 'Aboriginal' does not differentiate between various Aboriginal language groups, homelands, or cultures and is not the preferred term for all Aboriginal people.

The staggered expansion of European settlement across Australia began on the south-east coast in 1788 and culminated in the Northern Territory by 1870-1885. (18, 19) This first century of expansion led to conflict, massacres and warfare, dispossession, denial of or limited access to natural resources, the dismantling of social and political infrastructure within Aboriginal and Torres Strait Islander communities, and exposure to epidemics of disease. (20-22) The era of Protectionism which followed then led to a succession of Acts, Boards, and Protectors with varying legislative powers to sanction the enforced movement of populations into reserves or missions, restrict access to public services and institutions including marriage, education, and employment, and penalise individuals for any continued connection to language, cultural traditions, and heritage. (23, 24) This era reached its nadir with the forced removal of children from families. (25) Although the exploitation and removal of children had occurred prior to this period, by the end of the nineteenth century the removal of children was officially sanctioned by the Protection Board of NSW. (26) Estimates of the number of removals between 1910 and 1970 vary between one in three and one in ten Aboriginal and Torres Strait Islander children, (25) leaving a 'stolen generation' profoundly psychologically impacted by trauma now known to have left intergenerational marks. (12, 27)

A period of assimilation policies ensued from 1937-1969, during which Aboriginal and Torres Strait Islander populations were nominally required to live as members of an ideologically unified Australian society within which Aboriginal and Torres Strait Islander cultures and societies would comply with 'white', Anglo-Christian social structures and values. (23, 28) However, equal rights, privileges, and remuneration were not extended to Aboriginal and Torres Strait Islander individuals – most vividly demonstrated through their not being fully included in the national population census until 1971. (20, 23, 28) Since 1972, policies of self-determination began to be developed which focused on organisational and community management of Aboriginal and Torres Strait Islander affairs. (20) Although this marked a shift in policy direction, numerous issues and challenges have been raised in response to reactive, contradictory, and politically contrived policies that have negatively impacted on the lives of Aboriginal and Torres Strait Islander people. (23, 29)

Subsequently, the abolition of self-determination policies by the Howard government in 1996, the dismantling of the Aboriginal and Torres Strait Islander Commission in 2005, (30) and the implementation of the Northern Territory Intervention in August 2007 (31) have each acted to increase the silencing of Aboriginal and Torres Strait Islander voices and deny appropriate political representation to Aboriginal and Torres Strait Islander peoples. (20, 24) More recently, contemporary neoliberal policy approaches have

concentrated focus on individual responsibility and autonomy while also maintaining interventionist services which aim to 'reform' disadvantaged populations. (23, 32) Aboriginal and Torres Strait Islander policy has been largely mainstreamed so that Aboriginal and Torres Strait Islander populations are expected to independently achieve generic and historically non-Aboriginal targets in individual welfare with minimal provisions for Aboriginal and Torres Strait Islander ways of being and knowing or acknowledgment of cultural and historical differences between Aboriginal and Torres Strait Islander and non-Aboriginal populations. (33-35) As a result, Aboriginal and Torres Strait Islander peoples can become caught in a cycle in which they are expected to address the complex social conditions resulting from intergenerational trauma, systemic disadvantage, and past discriminatory policies without these crucial determinants being acknowledged by contemporary social institutions or policies. (23, 34, 36)

Racial disparities in multiple social determinants of health are a highly visible output of structural racism. In Australia, evidence of disproportionate representation of Aboriginal and Torres Strait Islander populations have been demonstrated within both institutions and social systems, particularly within child protection, (37-41) justice, (42-44) education, (45-48) and healthcare. (49-53) Structural racism is often cited as a contributor to the social disadvantage and marginalisation which influences disparities and disproportionality across multiple domains, alongside the institutional racism within individual systems which increases prejudicial decision-making, lowers expectations of Aboriginal and Torres Strait Islander achievement, reduces resourcing, or perpetuates a lack of cultural competency and sensitivity. (38, 42, 45)

The evidence of structural racism described here is a brief overview of a complex, storied landscape. Each of these policy decisions, legislative changes, and political manoeuvres have had profound impacts on the lives of Aboriginal and Torres Strait Islander Australians and the social determinants which shape their health and development. There is no panacea that can redress this history. However, there are various initiatives widely supported by Aboriginal and Torres Strait Islander peoples which can be taken to respond to both the structural and interpersonal racism which have resulted from this history, including: Constitutional recognition and uptake of the recommendations of the *Uluru Statement from the Heart*; (54) implementation of the full list of 339 recommendations resulting from the 1987 Royal Commission into Aboriginal Deaths in Custody; (55) mandatory anti-racism and cultural competency training for staff in human services, health, education, and justice; and the implementation of a national curriculum which mandates the teaching of Aboriginal and Torres Strait Islander history and culture, and recognition of the impact of colonisation. (56) These represent major shifts in policy with broad reaching implications, requiring some substantial changes to Australia's political system which will require collaboration between multiple sectors to be achieved. However, policy shifts on a systemic level are required to address structural racism and to dismantle and challenge the prejudicial ideologies which perpetuate interpersonal racism towards Aboriginal and Torres Strait Islander populations. It is important to note that structural racism does not need to be perceived for an individual's health to be adversely affected and this form of

racism occurs across multiple levels beyond the interpersonal. In this way, structural racism may be thought of as a precondition of interpersonal racism. Another way of putting this is that wherever interpersonal racism has been observed, structural racism has preceded it.

1.2 Thesis aim

The aim of this thesis is to examine the contributions of the timing and context of interpersonal racial discrimination to adverse physical and mental health outcomes in Aboriginal and Torres Strait Islander populations in Australia, with a focus on children aged 0-17 years. This research aims to identify specific environmental and socioecological profiles, and developmental periods of exposure in which racial discrimination may have a greater or lesser effect on the physical and mental health outcomes of Aboriginal and Torres Strait Islander Australians. Evidence from this research is provided with the aim of informing advocacy efforts and practice interventions designed to highlight and address the presence of interpersonal racial discrimination in the lives of Aboriginal and Torres Strait Islander children and the resultant adverse effects on their health.

1.3 Structure and outline of thesis

This thesis has been structured around five related papers which investigate the role of the timing and context of interpersonal racial discrimination on adverse health in Aboriginal and Torres Strait Islander populations. This current chapter (Chapter 1) provides a brief overview of racial discrimination and its relationship with adverse health, followed by a critical foregrounding on structural racism as experienced by Aboriginal and Torres Strait Islander Australians.

Chapter 2 presents a systematic review of longitudinal studies investigating the link between racial discrimination and health outcomes in children and adolescents 0-17 years. This review is complemented by focused literature reviews presented at the beginning of each research paper (Chapters 5-9) relevant to each research area. Chapter 2 introduces an overview of racial discrimination as a psychosocial stressor, its relationship with adverse health, and the role of age and developmental stage of exposure to racism in the subsequent onset of adverse health outcomes, followed by an introduction to life course epidemiology as the theoretical framework around which the review is structured. Results from identified articles include: study characteristics and exposure measures from included articles; associations between racial discrimination and health outcomes from all included articles, organised by whether associations were adverse, reverse or non-significant; health outcomes organised by the age of study children; and summaries of findings from included articles examining accumulation of risk and critical/sensitive period models. Chapter 2 then provides a summary of the knowledge gaps in longitudinal studies of the association between racial discrimination and health outcomes during childhood and adolescence. Finally, this chapter concludes by highlighting that this association is complicated by the timing and duration of

racism exposure, and by variables representing broader environmental and socioecological factors which intervene on the pathway between racism and adverse health.

Chapter 3 presents an outline of the overall aim and research questions addressed throughout this thesis. Chapter 4 presents the methodological background for study designs, datasets sourced for analysis, study populations under investigation, software used to run analysis, and statistical techniques undertaken throughout the chapters which follow (Chapters 5-9). This chapter includes technical information pertaining to the methods, design, data management, and analysis undertaken throughout the thesis which were not presented within individual chapters or which were truncated for brevity. Chapter 4 also reflexively assesses my own position as a researcher conducting Aboriginal and Torres Strait Islander-specific epidemiological research using population data.

Chapters 5-9 follow the format of research publications with an abstract followed by background, methods, results, discussion, and conclusion sections. Each chapter is prefaced by a brief statement which situates the chapter within the larger narrative of the thesis and describes the content and purpose of the chapter. Copies of published papers (Chapters 2, 6, 7 and 9) and working papers (Chapter 5) have been provided. Manuscripts prepared for submission (Chapter 8) are provided in their current format.

Chapter 5 reports the prevalence of interpersonal racial discrimination in an Aboriginal and Torres Strait Islander child population aged 0-11 years, with a focus on the timing and accumulation of exposure. National data from *Footprints in Time: The Longitudinal Study of Indigenous Children* (LSIC) are used to quantify the proportion of Aboriginal and Torres Strait Islander children with exposure to direct and vicarious racial discrimination from 2008-2015 (ages 0-12 years), quantify associations between racial discrimination and key sociodemographic factors over time, and derive exposure variables to identify the age of first exposure and accumulation of exposure to racial discrimination in Aboriginal and Torres Strait Islander children.

Chapters 6 and 7 examine the effects of the duration and timing of exposure to racial discrimination on physical and mental health outcomes in Aboriginal and Torres Strait Islander child populations. Chapter 6 presents an examination of the association between exposure to racial discrimination at ages 4-11 years and subsequent late childhood mental health, behaviour, substance use, weight outcomes, and global physical health using data from LSIC 2008-2015. Chapter 7 presents an examination of the relative effects of first exposure to racial discrimination at age 4-5 and 7 years on mental health and behavioural outcomes compared with children with no exposure to racism — again using data from LSIC 2008-2015.

Chapters 8 and 9 examined racial discrimination alongside the broader contextual factors within Aboriginal and Torres Strait Islander people's lives and investigated the outcomes of mental health and allostatic load

within this broader context. This enabled an investigation into how racial discrimination affects mental and physical health for individuals with differing set of shared characteristics.

Chapter 8 identifies subpopulations of Aboriginal and Torres Strait Islander children ages 12-14 years informed by measures capturing social determinants at the individual, family, and area-levels, including racial discrimination. This chapter then examined the impact of racial discrimination on the mental health of Aboriginal and Torres Strait Islander children in the context of these social determinants of health using data from LSIC 2017 (ages 9-14 years). Chapter 9 identified subpopulations of Aboriginal and Torres Strait Islander adults using measures capturing current and previous health conditions, psychosocial and sociodemographic factors, and life stressors. An allostatic load index as a proxy for physiological dysregulation was then compared within and between subpopulations with and without exposure to racial discrimination over the past year using data from the Australian Bureau of Statistics' *Australian Aboriginal and Torres Strait Islander Health Survey 2012-2013*.

Chapter 10, the thesis discussion, aims to synthesise the findings of the collective body of work in the preceding chapters, drawing conclusions and presenting insights related to the timing and context of racial discrimination exposure in Aboriginal and Torres Strait Islander populations. This final chapter summarises the main findings from each study and highlights the relevance of these findings with reference to existing literature before describing the key strengths and limitations of this thesis overall. Chapter 10 then describes the relevance of research findings for policy and practice, outlines future research directions, and states the overall conclusions of this thesis.

1.4 Published papers related to this thesis

Original research findings from this thesis are published as the following papers:

Chapter 2: **Cave, L.**, Cooper, M.N. & Zubrick, S.R., Shepherd, C.C.J. (2020). 'Racial discrimination and child and adolescent health in longitudinal studies: A systematic review' *Social Science & Medicine*, 250, <https://doi.org/10.1016/j.socscimed.2020.112864>.

Chapter 5: **Cave, L.**, Shepherd, C., Cooper, M. & Zubrick, S. (2018). 'Prevalence of Racial Discrimination in a Cohort of Aboriginal and Torres Strait Islander Children'. *Life Course Centre Working Paper Series*, 2018-19. Institute for Social Science Research, The University of Queensland.

Chapter 6: **Cave, L.**, Cooper, M.N. & Zubrick, S.R., Shepherd, C.C.J. (2019) 'Caregiver-perceived racial discrimination is associated with diverse mental health outcomes in Aboriginal and Torres Strait Islander children aged 7–12 years' *International Journal for Equity in Health*, 18, 10.1186/s12939-019-1045-8.

Chapter 7: **Cave, L.**, Cooper, M.N. Shepherd, C.C.J. & Zubrick, S.R. (2019) 'Racial discrimination and the health and wellbeing of Aboriginal and Torres Strait Islander children: Does the timing of first exposure matter?' SSM - Population Health, 9, 10.1016/j.ssmph.2019.100492.

Chapter 9: **Cave, L.**, Cooper, M.N. & Zubrick, S.R., Shepherd, C.C.J. (2020). 'Racial discrimination and allostatic load among First Nations Australians: A nationally representative cross-sectional study' BMC Public Health, 20, 1881, <https://doi.org/10.1186/s12889-020-09978-7>.

1.5 Recognition of thesis studies

1.5.1 Oral presentations

Cave, L., Cooper, M., Zubrick, S. & Shepherd, C. 'Racial discrimination and allostatic load among First Nations Australians' Public Health Association Australia, Australian Public Health Conference. 19-30 October. Online. 2020. [Chapter 9]

Cave, L., Penny, F., Hansen, J., Cooper, M., Zubrick, S. & Shepherd, C. 'Racial discrimination and the health and wellbeing of Aboriginal and Torres Strait Islander children' Rural Health West Aboriginal Health Conference. 6-7 July Perth, Australia. 2019. [Chapters 5,6,7]

Cave, L., Shepherd, C., Cooper, M. & Zubrick, S. 'Prevalence of interpersonal racism in Aboriginal and Torres Strait Islander children' Australian Society for Medical Research – Western Australia Scientific Symposium. 6 June. Perth, Australia. 2018. [Chapter 5]

Cave, L., Shepherd, C., Cooper, M. & Zubrick, S. 'Prevalence of racism in a prospective cohort study of Aboriginal children' Public Health Association Australia, Australian Public Health Conference. 26-28 September. Cairns, Australia. 2018. [Chapter 5]

Cave, L., Shepherd, C., Cooper, M. & Zubrick, S. 'Prevalence of racism exposure in a longitudinal study of Aboriginal and Torres Strait Islander children' Australian Epidemiological Association Annual Scientific Meeting. 22-24 October. Fremantle, Australia. 2018. [Chapter 5]

1.5.2 Poster presentations

Cave, L., Shepherd, C., Cooper, M. & Zubrick, S. 'First exposure to racial discrimination at 4-7 years associated with negative mental health and behavioural outcomes in Aboriginal and Torres Strait Islander children aged 7-12' The Lowitja Institute International Indigenous Health and Wellbeing Conference. 18-20 June. Darwin, Australia. 2019. [Chapter 7]

Cave, L., Cooper, M., Zubrick, S. & Shepherd, C. 'Racial discrimination associated with health and wellbeing of Aboriginal and Torres Strait Islander children aged 7-12 years' Telethon Kids Institute, Early-Mid Career Researcher Poster Morning Tea. 30 May. Perth, Australia. 2019. [Chapter 6]

Cave, L., Cooper, M., Zubrick, S. & Shepherd, C. 'Racial discrimination associated with health and wellbeing of Aboriginal and Torres Strait Islander children aged 4-12 years' Canadian Paediatric Society 8th International Meeting on Indigenous Child Health. 22-24 March. Calgary, Canada. 2019. [Chapter 6]

1.5.3 Awards

Best Lay Summary (Clinical Science): Australian Society for Medical Research: Medical Research Week Symposium 2018, Royal Perth Hospital Medical Research Foundation, City of Perth and Institute for Respiratory Health/National Centre for Asbestos Related Diseases Award

Chapter 2: Racial discrimination and child and adolescent health in longitudinal studies: A systematic review

2.1 Preface

This chapter presents a systematic review of longitudinal studies investigating the link between racial discrimination and health outcomes in children and adolescents 0-17 years. The chapter introduces racial discrimination as a psychosocial stressor, provides an overview of its relationship with adverse health, and outlines the role of age and development in the onset of adverse health outcomes, before detailing life course epidemiology as the theoretical framework around which the review is structured. The rationale and eligibility criteria for included articles are then presented, followed by a synthesis of findings from these articles. Evidence drawn from identified articles included study characteristics, exposure measures, and associations between racial discrimination and health outcomes. Summaries of results from included articles examining accumulation of risk and critical/sensitive periods models are then presented and discussed using a life course epidemiology approach. This chapter concludes by presenting a summary of the knowledge gaps in included longitudinal studies and offering direction to studies intending to investigate the link between racism and health early in the life course using longitudinal data.

The purpose of this chapter is to systematically assess the international literature on longitudinal associations between racism and health during childhood and adolescence, providing a comprehensive overview of studies completed at the time the review was undertaken. Although the association between racial discrimination and adverse health outcomes has been documented across an increasing body of evidence, close examination of longitudinal studies limited to child and adolescent populations had not yet taken place at the time of this chapter's publication. Longitudinal studies permit investigations into the duration, frequency, and developmental period of racism exposure, which are each central to understanding the adverse effects of racism exposure, particularly during the dynamic developmental periods of childhood and adolescence. The knowledge gaps identified in this systematic review subsequently informed the thesis aims and objectives (Chapter 3). This chapter was published in *Social Science & Medicine* in February 2020 (57). The chapter which follows is a verbatim copy of the content from that published manuscript with the exception of minor modifications for readability. A copy of the typeset manuscript is available in Appendix 1 (Page 200) and online supplementary materials are available in Appendix 2 (Page 279).

2.2 Abstract

Rationale: The association between racial discrimination and adverse health outcomes has been documented across an increasing body of evidence in recent years, although a close examination of longitudinal studies has not yet taken place. This review applied a life course lens in examining the evidence for a longitudinal association between racial discrimination exposure during childhood and adolescence, and later mental and physical health outcomes.

Method: Medline, PsycINFO, Global Health, ERIC, CINAHL Plus, Academic Search Premier and SocINDEX were searched from earliest records to October 2017 for eligible articles. Results were described through a narrative synthesis of the evidence.

Results: Findings from 46 studies reported in 88 empirical articles published between 2003 and 2017 were identified. Studies were primarily based on cohorts from the United States, comprised of young people aged 11–18 years, and were published since 2010. Data were most frequently collected over two to three timepoints at intervals exceeding 12 months. Statistically significant associations with racial discrimination were most commonly reported for behaviour problems including delinquency and risk-taking behaviour, with significant adverse effects found in 74% of these associations. Statistically significant adverse effects were also reported in 63% of associations with health-harming behaviours including substance use, and 61% found associations with mental health outcomes. Consistently significant associations were reported between accumulated racism and later health outcomes, and the health effects of racism were reported to vary with developmental periods, although few studies featured these analyses.

Conclusions: Evidence from this review highlights that the duration and timing of exposure to racial discrimination matters. This review emphasises the need to gain evidence for the mechanisms linking early racism exposure to adverse health outcomes in later life. Future longitudinal research can address this need by capitalising on prospective cohort studies and ensuring that proposed analysis informs variable selection and timing of data collection.

2.2.1 Introduction

Racial discrimination is known to contribute to disparities in health between and within populations worldwide by restricting access to social resources and prompting acts of interpersonal racism. (3, 10, 58-62) Interpersonal racism negatively affects health through either direct adverse physical effects from racial violence or indirect effects as a chronic or an acute stressor. (4, 7, 63) When acting as a stressor, racism influences health by initiating physiological dysregulation, maladaptive psychological processes or changes in health behaviour, (4, 7, 63) yet susceptibility to these processes is dependent on age.

Children have been found to be more adversely affected by the negative health effects of racism. (8, 9, 64) The early years are also known to present a sensitive period for the biological embedding of adversity and stress more generally. (65, 66) Despite this, knowledge surrounding the aetiological pathways between racism and health outcomes is based predominantly on cross-sectional studies of adult populations. (4, 67) Longitudinal studies of child populations allow an investigation of the association between racism exposure during childhood and later health outcomes, generating evidence surrounding the role of age and development in this association.

The aetiological pathway between racism and negative health outcomes is also influenced by the timing of racism exposure. (68) The effect size of the association between racial discrimination and negative mental health outcomes has been observed to be weaker in longitudinal compared with cross-sectional studies, suggesting that this association may attenuate over time. (4, 8) In studies of children and adolescents, negative mental health outcomes and behaviour problems have exhibited stronger and more consistent associations with racial discrimination compared with physical health outcomes. (7) This may reflect an earlier onset of mental health and behavioural effects from racism exposure than the physical effects of physiological dysregulation. (10, 69) Alternatively, this may suggest that negative mental health contributes to nascent health conditions through changes in health behaviour. (63, 69, 70) A recent longitudinal study examining the effect of a broad measure of perceived discrimination on health found that respondents experiencing discrimination during adolescence (age 16-22) engaged in more substance use during early adulthood, compromising overall physical and psychological health by mid-adulthood (age 47-53). (71) These results suggest that engagement in substance use may occur as a coping mechanism for perceived discrimination and that these behaviour changes ultimately contribute to adverse health, although the forms of discrimination incorporated in this study's measure were broader than ethnic/racial discrimination alone (i.e. nationality, age, sex and language discrimination). Conversely, consistent physical health effects have been observed in children at birth and during childhood via vicarious exposures. (72) These significant effects have primarily been observed through maternal exposure to racial discrimination in association with low birth weight and preterm birth. (73, 74) More recently, studies have observed associations between maternal exposure and inflammation biomarkers in both longitudinal (75) and cross-sectional (76) analysis during childhood. These findings illustrate the need to better understand the causal and temporal mechanisms underlying the association between racism and health. This is particularly the case in early childhood and pre-adolescence where evidence is especially limited. (77)

Investigations into the role of age and development in disease aetiology and the causal processes through which adverse exposures influence health can be integrated through a life course perspective. This perspective is especially useful when considering the complexity of aetiological pathways through which racial discrimination contributes to negative health outcomes (10) and the broad-reaching, long-term and often intergenerational nature of racial disparities in health. Life course epidemiology examines both

biological and social risk processes to understand how exposures across different life stages can account for health disparities between and within populations. (78-80) A range of theoretical models have been developed within life course epidemiology to examine the causal and temporal pathways through which exposures influence health and wellbeing across lifetimes and between generations. (81) Central among these are the critical periods and accumulation of risk models.

Critical and sensitive periods account for the differential strength of exposures during certain developmental periods over the life course. Critical periods occur during stages of development when an individual is especially susceptible or reactive to specific risk factors, with minimal effects at other times. (82) Sensitive periods suggest a similar impact within a discrete period of time, although this impact may be reversed or modified at a later time. (81) Accumulation of risk extends on these concepts by acknowledging the effect of modifiers in later life and accounting for the additive risk of physical and psychosocial environments to health. (80, 81, 83) Although accumulation of risk was initially conceptualised as successive and potentially interrelated exposure to different factors with age, this model has more often been operationalised as a standard 'dose-response' effect from a single factor over time. (79) Operationalising critical period and accumulation of risk models within analysis can integrate examinations into both the socio-biological and causal pathways of health and disease.

2.3 Rationale

This present review aims to assess the existing evidence on the longitudinal relationship between racial discrimination exposure during childhood and adolescence, and later physical and mental health outcomes. We undertook a systematic review of available literature, applying a life course approach and investigating studies referencing critical periods and accumulation of risk models. We provide a narrative synthesis of review findings as the heterogeneity of racial discrimination exposure measures, covariates, outcomes, and study designs precluded the application of formal meta-analytic techniques.

Systematic and meta-analytic reviews of the literature have now confirmed the association between racial discrimination and adverse physical and mental health outcomes in both child and adult populations. (3, 4, 6-9, 63, 84-87) Despite this, close examination of longitudinal studies exclusive to child and adolescent populations has not yet taken place. While few studies internationally have applied a longitudinal design or drawn on panel data, there appears to be an emerging literature focused on younger age groups utilising these techniques. Recent studies have begun to elucidate the causal processes linking racism and health – including in early life – although there is a need for further application of appropriate methods to fully realise this goal. This review will investigate these findings and consider methods for future research, using a life course approach. We focus on studies referencing critical periods and accumulation of risk models in their hypothesis, research questions or analytic framework, and examine results gained from operationalising these models methodologically. The critical periods model was identified where

comparisons between developmental periods were explicitly referenced. The accumulation of risk model was identified where a cumulative measure of racism was used in analysis. We investigate study characteristics, health outcomes, and the application – and role – of mediating and moderating variables in the association between racial discrimination exposure and health. Finally, we offer a summary and critique of methods utilised in these longitudinal studies.

2.4 Methods

2.4.1 Eligibility criteria

This systematic review was limited to longitudinal studies examining the impact of racial discrimination on health outcomes in children and adolescents aged less than 18 years at baseline. As such, all cross-sectional studies were ineligible for inclusion. Case-control and intervention studies were also ineligible as the interest of this review was on determining the impact of racism exposure on health, independent of designed interventions.

Eligible longitudinal studies were required to include at least two data collection points at or prior to age 18, with health outcome data recorded at any age after exposure to racial discrimination. The racial discrimination measure used in each study was required to have been asked of participants during at least one timepoint. We limited to measures of racially or ethnically motivated discrimination and excluded studies incorporating measures which encompassed multiple forms of discrimination (e.g. sexual, gender-based or socioeconomic). All studies which included at least one discrete question about racially or ethnically motivated discrimination were eligible for inclusion.

Decisions about which health outcomes to include in this systematic review were informed by both previous systematic reviews conducted in this field (4, 7, 8, 63) and research published since these reviews. Health outcomes were broadly defined and included measures of physical and mental health alongside behavioural problems (delinquent behaviour, aggression, risk-taking behaviour, violent and problem behaviour) and health-harming behaviours (alcohol use, drug/substance use, cigarette smoking, sleep difficulties). Behaviour problems were considered eligible as they are known to have as strong an association with racial discrimination as adverse mental health outcomes in studies of child and adolescent populations. (7) Health-harming behaviours were also eligible for inclusion in this review as these behaviours are implicated in the aetiological pathway between racism and the onset of later health outcomes.

In this review, racial discrimination could take the form of interpersonal racism (e.g. unfair treatment or abuse) or systemic racism (e.g. institutional racism in a hospital). Racial discrimination exposure included both direct experiences by the child or adolescent, and vicarious experiences through the parent, caregiver or family members. Studies were eligible regardless of respondent (self-report or parent/carer). Studies

using measures of vicarious racism were eligible for inclusion regardless of whether this measure was used alone or in combination with racism directed at the child. The few studies which examined the impact of intergenerational racial discrimination exposure were also eligible if the focus of the study was on the health outcomes in a child. One study referencing unpublished data was eligible for inclusion (88).

2.4.2 Search strategy

Literature searches were conducted in the following databases and electronic journal collections from the earliest possible date to October 2017: Medline (1946-, OVID Interface), PsycINFO (1806-, OVID Interface), Global Health (1973-, OVID Interface), ERIC (1966-, ProQuest Interface), CINAHL Plus (1937-, EBSCO Interface), Academic Search Premier (1984-, EBSCO Interface) and SocINDEX (2005-, EBSCO). All searches were conducted in English. The full electronic search strategy for Medline has been included in Appendix 2 of this thesis (Page 279). Keywords and subject headings were adapted for each database.

Results from all searches were stored in Endnote X8 where titles, abstracts and full-text articles were managed and screened. Some articles with titles and abstracts in English returned full text articles in languages other than English. English translations of these articles were sourced where available. Data from studies which met the inclusion criteria was entered into Microsoft Excel.

2.4.3 Analysis

Results from all studies, mediation analysis, analysis of effect modification, and from studies utilising critical periods and accumulation of risk models are presented in tables and include all statistically significant and non-significant associations. Associations between racism exposure and health outcomes are organised by outcome into mental health, behaviour problems, physical health and health-harming behaviours (Table 2.2). The direction of association is classified as either leading to an adverse effect (e.g. racial discrimination associated with increased depressive symptoms) or a reverse effect (e.g. racial discrimination associated with increased wellbeing). Associations between racism exposure and health outcomes are then compared by age groups (Table 2.3). Results from the critical periods and accumulation of risk models are presented with the health outcomes under examination and whether the association aligned with each relevant study hypothesis or research question was found (Tables 2.4 and 2.5). The accumulation of risk model also includes the type of racism exposure, while the critical periods model includes the different ages of exposure to racism from each study. Mediating variables tested for indirect effects and moderating variables tested for effect modification are presented by health outcomes (Supplementary Tables 1 and 2). Direct associations between racial discrimination and health outcomes from included studies are summarised in Supplementary Table 3 with effect sizes, confidence intervals and *p*-values.

2.5 Results

After duplicates were removed, the initial search returned a total of 3,322 records across all databases. Following the initial (title/abstract) screening process, 218 full-text articles were sourced and further assessed for eligibility. Of these, 88 papers representing 46 studies met the inclusion criteria and were included in the systematic review (Figure 2.1). The main reasons for exclusion were the absence of a health outcome in the study and racial discrimination not being the exposure variable or being incorporated within a broader measure. Titles and the full list of reasons for exclusion of publications at this final stage are provided in Supplementary Table 4.

2.5.1 Study characteristics

Selected characteristics of all studies meeting final inclusion criteria are presented in Table 2.1. The earliest articles were published in 2003 (89, 90), while the majority (80%, $k = 70$) of articles were published more recently (after 2009). Overall, a limited number of countries were represented in this review, with the vast majority of articles based on studies conducted in the US (86%, $k = 76$) with young people aged 11-18 years (76%, $k = 67$). A further 18 articles (20%) were based on studies conducted with children aged 5-10 years and three articles (3%) reported outcomes for infants and young children from birth to 4 years. The majority of articles focused on African American/Black participants (55%, $k = 48$), followed by participants from Latino/Hispanic (36%, $k = 32$) and Asian cultural and ethnic groups (21%, $k = 18$). Two articles used country of birth as a proxy for cultural/ethnic background (91, 92) and one article used English or non-English speaking background. (93) Most articles were based on studies which collected outcomes over 2-3 (66%, $k = 58$) or 4-5 (24%, $k = 21$) timepoints, with intervals exceeding 12 months (86%, $k = 76$).

2.5.2 Exposure measures

Across the 88 articles included in this review, 53 different instruments measured exposure to racial discrimination. The Schedule of Racist Events was the most frequently used instrument (26.1% of articles), followed by the Racism and Life Experience Scales (11.4%) and the Experiences of Discrimination Scale (5.7%). Many studies revised these instruments by selecting a reduced number of items for inclusion. Exposure instruments developed specifically for individual studies were used in 36.4% of articles, including instruments combining items from multiple scales.

All articles included instruments measuring interpersonal racism, while three also included instruments measuring perceived systemic racism (94-96). Almost all articles (92.1%) included instruments measuring direct racism. All direct racism measures were self-reported by the child or adolescent excluding one reported by the primary carer (97). Several articles (14.8%) included instruments measuring vicarious racism. These articles primarily operationalised vicarious racism as a function of racism experienced by the parent/carers or family, with 12.5% of articles including vicarious racism instruments self-reported by the

parent or carer. One article used an instrument assessing vicarious racism through adolescents' self-reported perceptions of racism directed towards parents or other family members. (98) Another article used items assessing vicarious racism through adolescents' self-reported perceptions of racism directed towards other students at their school. (93) Three articles included instruments with items explicitly referencing racism directed at members of respondents' cultural/ethnic group more broadly. (94, 99, 100)

Most articles (56.8%) used instruments which did not specify an exposure timeframe. Close to three in ten articles (28.4%) used instruments specifying exposure in the previous 12 months, 12.5% used instruments referencing lifetime exposure (including being 'ever' exposed or exposed 'in the past'), and 2.3% used instruments specifying an exposure timeframe of less than 12 months. Instruments with nine or more items were used in 63.6% of articles, 2-8 item instruments were used in 30.7% of articles, and 5.7% of articles included single item instruments.

2.5.3 Health outcomes

Table 2.2 shows the associations between the racial discrimination exposure variable and health outcomes in all studies included in this review. In total, 236 associations between racial discrimination and health outcomes were reported across the 88 articles included in this review. A significant adverse effect from racial discrimination was revealed for six in ten (61%) of the outcomes examined. The proportion of significant associations between racial discrimination and health outcomes varied by exposure characteristics. Longitudinal studies with an interval between exposure and outcome of 12 months or greater reported a higher proportion of significant associations (63%) than studies with an interval of less than 12 months (53%). Studies with 4-5 timepoints had the highest proportion of significant associations (85%) compared to studies with 2-3 timepoints (57%), 6-7 timepoints (54%), and 8 or more timepoints (50%). Studies investigating exposure to racial discrimination in children 0-4 years reported 75% adverse effects, while 59% and 61% were reported in studies with children exposed at 5-10 years and 11-18 years respectively. A higher proportion of significant associations with behaviour problems and health-harming behaviours was reported for children exposed to racism at 5-10 years compared to 11-18 years (Table 3). For physical health outcomes, children exposed at 0-4 years and 11-18 years had a higher proportion of significant associations compared to those exposed at 5-10 years. However, individual physical health outcomes differed between age groups. Outcomes for those aged 11-18 included biomarkers such as allostatic load, epigenetic aging and cortisol, whereas outcomes for those aged 5-10 included asthma, blood pressure, BMI, injury and obesity. Relatively consistent proportions of significant associations were reported across age groups for mental health outcomes.

Overall, 25 articles included analysis of mediating variables along the pathway from racial discrimination to subsequent health outcomes. The vast majority (84%) of articles found significant indirect effects for at least one of the mediating variables under investigation (Supplementary Table 1). Of these, mediating

variables primarily related to mental health and behaviour, including behavioural issues such as anger and health-harming behaviours such as substance use and sleep duration. In total, 44 articles examined moderation – or effect modification – of the association between racial discrimination and health. Of these, 33 articles found at least one statistically significant interaction term (Supplementary Table 2). There was considerable variation in the subject and domain of significant moderating variables; most related to racial identity, encompassing both cultural and racial identification, orientation and affiliation alongside nativity status and ethnicity.

2.5.3.1 Mental health outcomes

Mental health outcomes were the outcomes most commonly included in longitudinal studies examining the associations between racial discrimination and health. Overall, 57% of associations related to mental health outcomes. Studies consistently found statistically significant adverse effects from racial discrimination on subsequent mental health outcomes, with 61% of mental health outcomes being adversely affected. Reverse effects were observed for 2% of mental health outcomes, where racial discrimination exposure was associated with decreased depressive symptoms or increased prosocial behaviour. Non-significant associations between racial discrimination and mental health were found in 37% of cases. Overall, a higher proportion of significant associations was found for ‘negative’ mental health outcomes, compared to the proportion found for ‘positive’ mental health outcomes such as psychological adjustment, social competence, and wellbeing.

2.5.3.2 Health-harming behaviours

One in five (20%) associations related to health-harming behaviours – of these, 63% indicated that health-harming behaviours were worsened by racial discrimination while no associations were found in 37.5% of cases. The majority of health-harming behaviours were focused on drug/substance use, with 62% of associations with these outcomes exhibiting an adverse and statistically significant effect.

2.5.3.3 Behaviour problems

Behavioural problems, including conduct disorder, aggression, and risk-taking behaviour, made up 11% of all associations under review. Significant adverse effects from racial discrimination were found for 74% of these associations, while no significant associations were found in the remainder.

2.5.3.4 Physical health outcomes

Around one in ten (11%) associations related to physical health and general health outcomes, although no significant association with racial discrimination was found in the majority (59%) of cases. In total, 41% of associations between racial discrimination and physical health outcomes were found to result in statistically

significant adverse effects, indicating that racial discrimination exposure was related to worse physical health outcomes.

2.5.4 Accumulation of exposure

Five studies included examination of the association between accumulated racial discrimination and health. (97, 101-104) Four of these studies developed an accumulation exposure variable by averaging responses to single exposure measures across multiple timepoints. (101-104) These studies included racism measures taken from respondents across a range of ages, with a minimum of two timepoints included in the accumulated racism variable. While studies that utilised this method accounted for previous exposure/s to racism, comparisons were not made between the effects of the accumulated racism variable and a single point of exposure on health outcomes. However, one study developed a variable for persistent racial discrimination which accounted for exposure in multiple waves. (97) This variable was then compared to a single exposure at any one timepoint. Only two studies (103, 104) used a time-limited measure of racism (previous 12 months), while the remaining three studies used measures which captured frequency of perceived racial discrimination or exposures that were otherwise not time-limited. (97, 101, 102)

All studies examining the accumulation of exposure found at least one significant association between accumulated racial discrimination and health. Three studies found associations with health-harming behaviours, (97, 102, 103) two studies found evidence of significant associations between physical health outcomes and accumulated racism, (97, 101) and one study found an association with behaviour problems. (104) Controlling for diet, exercise, and substance use at age 12, one US study found that greater accumulated racism experienced during adolescence was associated with less healthy eating at age 30 for all participants, while for women accumulated racism was associated with more exercise and for men accumulated racism was associated with more substance use. (102) Another US study found that, after controlling for previous substance use, accumulated racism predicted an increase in substance use in adolescents who indicated that they used substances as a coping mechanism. (103) Controlling for risky sex and substance use at age 15 within the same study population, accumulated racism was found to predict increases in substance use between ages 18 and 21 years, while risky sex behaviours at 21 were predicted through substance use and risky sex at age 18. (104) Accumulated racism was found to act on cortisol levels in a similar way to chronic and traumatic stress by flattening diurnal cortisol slopes and reducing the cortisol awakening response in both Black and White American adults, and lowering waking cortisol in Black adults only. However, cortisol across the day did not show an association with accumulated racism. (101)

Vicarious racism via the primary carer was found to be associated with sleep difficulties and asthma, while vicarious racism via the family was not associated with any child health outcomes after adjustment for covariates in one Australian study. (97) Where associations were found, the effect size for accumulated racism exposure was approximately twice that of the effect size for a single exposure to racism. (97)

2.5.5 Critical or sensitive periods

Four studies examined critical/sensitive periods in their analysis of the relationship between racial discrimination and health outcomes. (101, 105-107) Three of the four studies found that associations between racial discrimination and health outcomes varied by developmental period (101, 105, 106), while one found no difference in the strength of this association with age. (107) All studies examined critical/sensitive periods during adolescence, comparing early and middle adolescence, middle adolescence and emerging adulthood, or all three developmental periods. Studies were mixed in identifying the developmental periods in which health outcomes were more adversely affected by racial discrimination. One study identified early adolescence as being more sensitive than middle adolescence, (105) while another found that exposure during middle adolescence had a greater effect than exposure in early adolescence (106). A third study found that compared to young adulthood, exposure during adolescence more broadly was more detrimental to health. (101)

Overall, two US studies based on African American and Chinese American adolescents found associations between racial discrimination and mental health outcomes, (105, 106) while a further US study found an association between racial discrimination and physical health, via cortisol profiles. (101) This study compared the effects of racial discrimination experienced during adolescence and young adulthood on cortisol profiles taken at age approximately 32 years and found that only when racial discrimination was experienced during adolescence were significant associations found with flatter diurnal cortisol slopes, lower waking cortisol and lower average cortisol. (101) However, this study also found that exposure during young adulthood was a stronger predictor of cortisol awakening and concluded that adolescence was a more sensitive developmental period compared to young adulthood when considering the effect of racial discrimination on adult cortisol profiles. (101)

The timing of caregiver experiences of racial discrimination was found to interact with family income in determining African American adolescents' depressive symptoms. (105) In high income families, frequent caregiver experiences of racism during early adolescence (mean age 13 years) exerted a negative influence on adolescent depressive symptoms and wellbeing which attenuated by middle adolescence (mean age 17 years) but which remained for those in low income families. However, frequency of racial discrimination did not differentially impact perceived stress over these developmental periods. (105)

Socioemotional adjustment was found to differ by age among Chinese American adolescents, with impacts observed for discrimination experienced during middle adolescence but not early adolescence. (106) However, this result may have been confounded by the contemporaneous experience of discrimination and socioemotional adjustment during middle adolescence, as both measures were collected at the same timepoint. One study found no differences in the strength of longitudinal relationships between racial discrimination and depressive symptoms when comparing racial discrimination exposure during early

adolescence (12-15 years), middle adolescence (16-19 years), and emerging adulthood (20-23 years) in Chinese American adolescents. (107) Although subjects reporting depressive symptoms in early adolescence did not go on to report more racial discrimination in middle adolescence, it was found that adolescents reporting depressive symptoms in middle adolescence went on to report more racial discrimination in emerging adulthood.

2.6 Discussion

Findings throughout this review were based on an increasing number of studies undertaken in recent years which sought to examine the relationship between racial discrimination exposure prior to age 18 and subsequent health outcomes, with around eight in ten articles included within this review published since 2010 (Table 2.1). A considerable majority of studies were undertaken in the United States with a focus on exposures occurring during the adolescent stage of development. All studies included instruments measuring perceived interpersonal racial discrimination, with perceived systemic racism additionally measured in a limited number of studies. Most studies focused on direct racism exposure self-reported by children or adolescents, while several studies included a focus on vicarious racism exposure directed at and self-reported by parents or carers. The majority of studies collected data at 2-3 timepoints over intervals of 12 months or more. Evidence from these studies confirms a strong longitudinal association between racial discrimination exposure during childhood and adolescence and later health outcomes (Table 2.2). This review further confirms the finding that associations between racial discrimination and mental health outcomes are stronger and more consistent than those seen for physical health outcomes in longitudinal studies. (7, 8) Behaviour issues such as conduct disorder, aggression and risk-taking and health-harming behaviours such as substance use were also found to have strong and consistent longitudinal associations with racial discrimination.

Evidence from this review suggests that the association between early racism exposure and later health is complicated by the duration and timing of exposure. Studies integrating the accumulation of risk model into analysis found consistent associations between accumulated racial discrimination and both physical health outcomes and health-harming behaviours, although this model was featured in a limited number of studies (Table 2.4). While this provides preliminary evidence of the additive risks to child health from greater exposure to racism, it is supported by consistent findings in adult studies of a longitudinal association between cumulative racial discrimination and health. (69, 108-112) One study testing accumulated racism as a dose-response relationship found that multiple exposures to vicarious racism through the primary carer had a stronger effect on child outcomes than a single exposure. (97) However, the study undertaking this analysis did not find significant effects for racism experienced by the family and accumulated direct racism was not examined. The methodological limitations in the few studies using this model restrict our ability to make strong assertions about the impact of accumulated exposures to racial

discrimination during childhood on later health. Further longitudinal studies including an examination of dose-response relationships will test the generalisability of results from this review and assist in confirming the future utility of this model.

Three of the four studies examining critical/sensitive periods found that associations between racial discrimination and health outcomes varied by developmental period (Table 2.5). Due to the limited number of studies, it is difficult to draw conclusions on developmental stages during childhood and adolescence that may be more sensitive to the health effects of racial discrimination. A recent meta-analytic review found that the positive association between racial discrimination and socioemotional distress was stronger during early adolescence (age 10-13) than late adolescence (age 17 and over). (9) However, cross-sectional and longitudinal studies were not differentiated in this review and studies were limited to those aged mean 10-20 years. A separate study examining the age of initial exposure to racial discrimination found an increased odds of a cardiovascular-related health condition for those initially exposed during early childhood (age 0-7) and an increased incidence of cardiovascular disease with initial exposure during both early childhood and adolescence (age 13-19) compared to those with no exposure. (11) While this study was based on the recollected age of initial exposure to racial discrimination, self-reported during adulthood, both this study and Benner et al.'s meta-analytic review suggest an increased sensitivity to the negative health effects of racism during early childhood or adolescence. Overall, studies in the current review examining children exposed to racial discrimination at 5-10 years reported higher proportions of significant adverse effects on behaviour problems and health-harming behaviours compared to studies examining exposure at 11-18 years (Table 2.3). Our review also observed a higher proportion of adverse effects from racial discrimination where children were exposed at 0-4 years compared to both 5-10 and 11-18 years. While crude, this finding repeats the pattern for heightened adverse health effects from earlier racism exposure with a broader set of outcomes. Despite this, studies comparing critical/sensitive periods in our review reported inconsistent results and were focused on adolescent stages of development. No study compared the effects of exposure to racial discrimination during different developmental periods in children aged less than 12 years. This presents a critical knowledge gap as these years present an especially sensitive period for the negative health effects of environmental stressors. To accurately determine the salience of critical and sensitive periods in examining the relationship between racial discrimination and health, future studies should aim to undertake analysis across a broad range of developmental stages. Birth cohort studies are well placed for applications of the critical/sensitive periods model where analysis is hypothesis driven and informed by developmental theory.

Findings from this review provide consistent evidence that the pathway between racial discrimination and the health of children and young people is mediated by a range of factors, either partially or fully (Supplementary Table 1). Significant indirect effects were found for mental health, behavioural issues, parent behaviour, peer affiliations, and racial identity. Mediators ranged from individual-level factors such

as depressive symptoms to family-level and school-level factors such as parenting practices and school engagement. However, most mediators were related to individual mental health, particularly negative mental health symptomology such as depression and anger. Notably, the single study which examined physical health outcome variables in mediation analysis found that racial discrimination had a significant effect on physical health via mental health. (113) Emotional symptoms were found to mediate the association between racial discrimination, blood pressure, body mass index, and self-rated health. (113) This result may indicate that psychological processes play a regulatory role in the expression of later physiological outcomes or may simply reflect the comparative strength of the association between racial discrimination and mental health outcomes more broadly. It has been proposed elsewhere that the psychological and emotional effects of racism precede adverse physical outcomes. (10) Initial evidence for the mediating role of substance use on overall physical and psychological health in adulthood has been demonstrated for those exposed to a broad measure of perceived discrimination in late adolescence (71) and the lagged effect of racial discrimination on physical health has been illustrated in studies of adult populations. (69, 112, 114) Confirming whether psychological processes may contribute to the onset of later physiological outcomes requires further investigation from longitudinal studies across the life course, including during childhood and adolescence. Overall, few longitudinal studies within this review investigated associations with physical health outcomes and studies predominantly focused on exposures during the adolescent stage of development. Prospective birth cohort studies are well placed to address this limitation, particularly where exposures and outcomes are collected at timepoints consistent with proposed analytic plans.

One third of studies undertaking mediation models also ran analysis of cross-lagged effects to complement this analysis. Analysing these effects permits an investigation into the causal direction of the association between racial discrimination exposure and the health outcome of interest (e.g. whether more racism at wave 1 was associated with worse health outcomes at wave 2 and not the reverse). Racial discrimination exposure was found to be associated with subsequent negative mental health, behavioural problems, and substance use without the reverse association for all outcomes except externalising symptoms. (115) This finding suggests that temporal ordering does lead from racial discrimination exposure to adverse mental health and behavioural outcomes in adolescent populations. However, the number of studies reporting these effects was relatively small and this finding should be treated as preliminary. The incorporation of cross-lagged analysis into study designs will further substantiate hypotheses with underlying assumptions of causality or temporal ordering.

Despite the longitudinal design of studies within this review, around half of the studies analysed a mediation model in which the exposure, mediator and outcome were not temporally antecedent to one another. This violates a fundamental assumption of causal inference analysis and limits the validity of findings from these studies. (116, 117) In this assumption, mediating variables are temporally located

between the exposure and outcome variables and the exposure variable temporally precedes both the mediating and outcome variables. (116-118) However, the design of some studies did not allow for longitudinal tests of mediation due to the spacing of these variables over data collection points. Temporal spacing in mediation models should be accounted for in longitudinal study design where possible, particularly where analytic plans are known at the outset and where causal inferences are being sought.

Mixed results were revealed through moderation analysis, with a significant interaction term between racial discrimination and health outcomes observed in just over half of the studies utilising this analytic approach (Supplementary Table 2). The majority of significant moderators related to ethnic/racial identity, including racial orientation and affiliation, nativity status and ethnicity. This reflects findings from a recent meta-analysis which observed that ethnic/racial identity significantly moderated the association between ethnic/racial discrimination and adjustment outcomes (i.e. mental health, academics and cognition, risky behaviours, and physical health). (86) Overall ethnic/racial identity buffered the effects of ethnic/racial discrimination on physical health, while ethnic/racial identity exploration (e.g. 'I have spent time trying to find out about my ethnic group, such as its history, traditions, and customs') was found to exacerbate the effects of ethnic/racial discrimination on both negative mental health and risky health behaviours. (86) Similarly, ethnicity has been found to significantly moderate the association between racial discrimination and both physical and mental health outcomes in previous systematic reviews and meta-analysis. (4, 7) The apparent consistency of findings across these reviews suggests that ethnic/racial identity may be an appropriate candidate for future moderation analysis in this field. Overall, however, results from moderation analysis in the current review were predominantly inconsistent, reflecting, in part, the wide range of moderators included across analyses and the varying measures used in moderating and health outcome variables. In any case, moderation analysis may not make the most of the available data in longitudinal studies as moderation analysis is typically agnostic to the temporality of variables within the model. Few studies incorporated mediated moderation analysis to determine the conditions of the causal mechanism in which racism was associated with health outcomes. However, the possibility of conducting this analysis was dependent on the availability of appropriate variables and their relevance to the proposed hypotheses in many cases.

2.7 Conclusions

Evidence throughout this review confirms the strong association between racial discrimination and child and adolescent health and wellbeing outcomes. This review contributes to that evidence base by providing an in-depth examination of longitudinal studies which are equipped to examine how age, timing of exposure, and temporal pathways influence the association between racism and health in children and adolescents. Evidence from this review suggests that the association between racism and health is complicated by the duration and timing of exposure, and by mediators and moderators along the pathway

between racism exposure and health outcomes. However, the heterogeneity of populations, study designs and outcomes included in review studies precludes a simple summation of how age and timing influence the relationship between racism and health. Hypothesis driven analysis based on prospective cohort studies with data from birth or early childhood will be best placed to test longitudinal associations between racial discrimination and subsequent health outcomes. Studies which integrate key exposure and outcome measures at timepoints consistent with proposed analytic plans can also facilitate more rigorous investigations into these longitudinal associations. This work will provide much needed insights into the temporal and causal mechanisms underlying the association between racism and health, and inform evidence-based policies and practices aimed at addressing this critical public health issue.

Table 2.1: Characteristics of included articles (k=88)

	Number of articles	% of total
Publication year		
2000-2004	4	5
2005-2009	14	16
2010-2014	37	42
2015-	33	38
Study country¹		
Argentina	2	2
Australia	4	5
Israel	3	3
UK	3	3
Canada	1	1
US	76	86
Age at baseline (Time 1)		
0-4 years	3	3
5-10 years	18	20
11-18 years	67	76
Cultural/ethnic background¹		
African American/Black ²	48	55
Asian ³	18	21
Indigenous ⁴	8	9
Latino/Hispanic	32	36
European/White	13	15
Other ⁵	4	5
Number of timepoints		
2-3	58	66
4-5	21	24
6-7	4	5
8+	5	6
Intervals between timepoints		
<12 months	12	14
≥12 months	76	86
Type of discrimination¹		
Direct	81	92
Vicarious	13	15
Group	3	3
Respondent¹		
Child or adolescent self-report	81	92
Parent or carer self-report	11	13
Exposure timeframe		
Not reported	50	57
<12 months	2	2
12 months	25	28
Lifetime	11	13
Number of items in measure		
≥9 items	56	64
2-8 items	27	31
Single item	5	6

Percentages may not add to 100% due to rounding.

¹ Categories are not mutually exclusive (e.g. studies could include participants from multiple cultural/ethnic backgrounds or examine more than one type of discrimination).

² Black African, Black Caribbean

³ Asian American, Chinese American, Filipino American, Indian, Pakistani, Bangladeshi

⁴ Native American, Canadian First Nations, Cherokee, Navajo, Indigenous Australian, Indigenous Argentinean

⁵ Studies listing 'other' or 'mixed race' as an additional cultural/ethnic group

Table 2.2: Findings from 88 articles examining the longitudinal association between racial discrimination and health outcomes (p<0.05)¹

	Adverse effects	Reverse effects ²	No association	Total
Mental health	82 (61%)	2 (2%)	50 (37%)	134
Anxiety	4		2	
Body image	1			
Conduct disorder	1		4	
Depression	35	1	13	
Emotional difficulties	8		4	
Happiness	1		1	
Loneliness	3		1	
Positive affect			1	
Prosocial behaviour	5	1	2	
Psychological adjustment	2		4	
Resilience	2			
Self-control	1			
Self-efficacy	1		1	
Self-esteem	12		8	
Self-reported stress	3		1	
Social competence			4	
Somatic symptoms			1	
Wellbeing	3		3	
Behaviour problems	20 (74%)	0 (0%)	7 (26%)	27
Anger	3		2	
Behaviour problems	6		1	
Delinquent behaviour	7		4	
Risk-taking behaviour	4			
Physical health	11 (41%)	0 (0%)	16 (59%)	27
Allostatic load	1			
Asthma	2		1	
Blood pressure			2	
Body mass index	1		1	
Cortisol	3		1	
Epigenetic aging	1		1	
Injury			3	
Obesity	1		2	
Physical health	1			
Self-rated health	1		5	
Health-harming behaviours	30 (63%)	0 (0%)	18 (38%)	48
Alcohol use	5		3	
Cigarette smoking	5		2	
Drug/substance use	16		10	
Exercise			1	
Sleep difficulties	3		2	
Unhealthy diet	1			
Total	143 (61%)	2 (1%)	91 (39%)	236

¹ P-value refers to individual findings within each study.

² Indicates effects contrary to expected direction of association (e.g. racial discrimination associated with decreased depression)

Table 2.3: Findings from 88 articles examining the longitudinal association between racial discrimination and health outcomes by age group ($p < 0.05$)

	Adverse effects	Reverse effects	No association	Total
Mental health	82 (61%)	2 (2%)	50 (37%)	134
0-4 years	4 (67%)		2 (33%)	6
5-10 years	13 (65%)	2 (10%)	5 (25%)	20
11-18 years	65 (60%)		43 (40%)	108
Behaviour problems	20 (74%)	0 (0%)	7 (26%)	27
0-4 years				0
5-10 years	8 (100%)			8
11-18 years	12 (63%)		7 (37%)	19
Physical health	11 (41%)	0 (0%)	16 (59%)	27
0-4 years	1 (100%)			1
5-10 years	3 (19%)		13 (81%)	16
11-18 years	7 (70%)		3 (30%)	10
Health-harming behaviours	30 (63%)	0 (0%)	18 (38%)	48
0-4 years				0
5-10 years	6 (86%)		1 (14%)	7
11-18 years	24 (59%)		17 (41%)	41

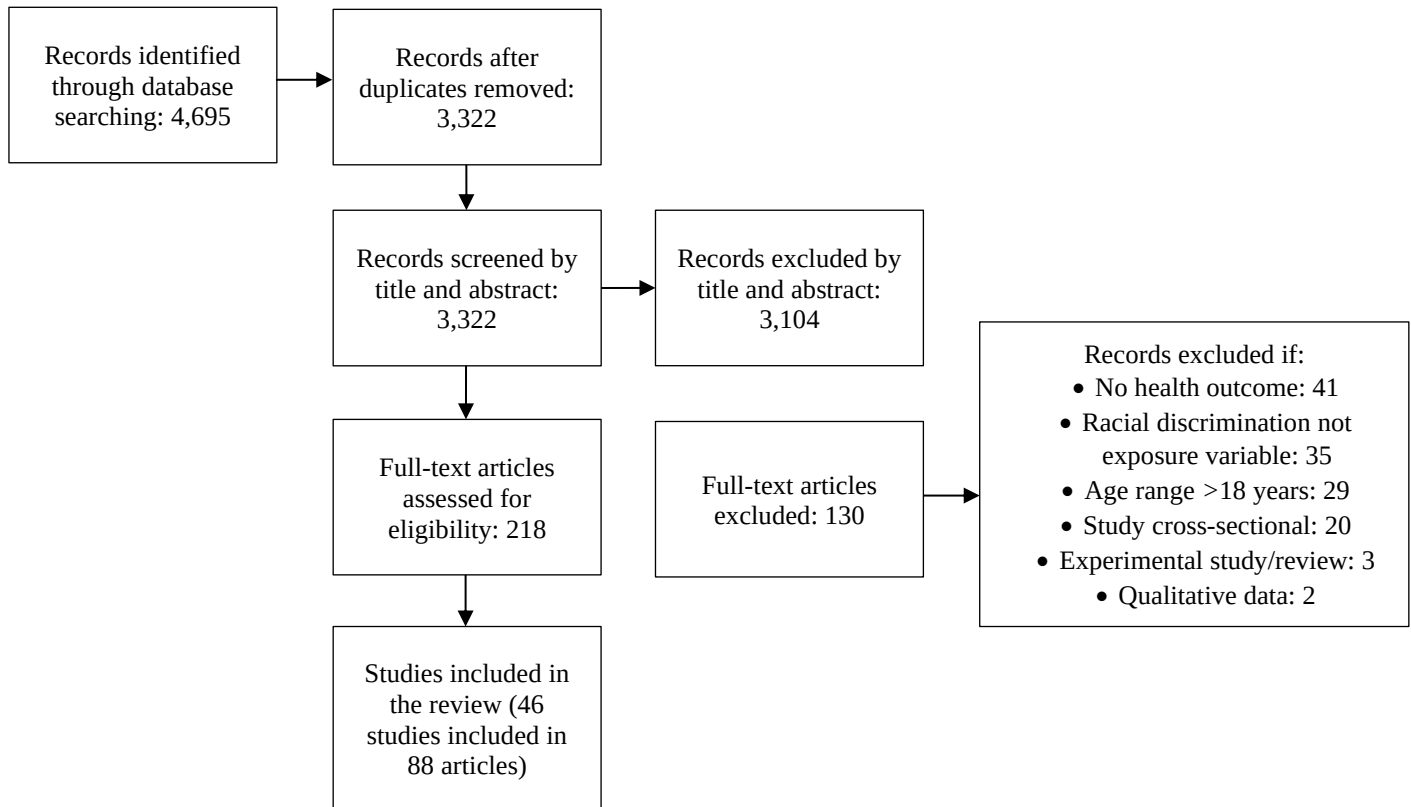
Table 2.4: Summary of results from studies examining accumulation of racial discrimination exposure

Study	Racism exposure	Health outcome	Association
Mental health			
Shepherd, et al. 2017	Primary carer experienced racism	High risk of emotional or behavioural difficulties	No
	Family experienced racism	High risk of emotional or behavioural difficulties	No
Behaviour problems			
Stock, et al. 2013	Perceived racism	Greater HIV-risk behaviours	Yes
Physical health			
Adam, et al. 2015	Perceived racism	Lower waking cortisol	Yes (African-American adults)
	Perceived racism	Lower cortisol awakening response	Yes
	Perceived racism	Flatter diurnal cortisol slope	Yes
	Perceived racism	Lower average cortisol across the day	No
Shepherd, et al. 2017	Primary carer experienced racism	Positive general health	No
	Family experienced racism	Positive general health	No
	Primary carer experienced racism	Obesity	No
	Family experienced racism	Obesity	No
	Primary carer experienced racism	Ever experienced injury	No
	Family experienced racism	Ever experienced injury	No
	Primary carer experienced racism	Ever experienced asthma	Yes
	Family experienced racism	Ever experienced asthma	No
Health-harming behaviours			
Brodish, et al. 2011	Perceived racism	Less healthy diet	Yes
	Perceived racism	More hours of exercise	No
	Perceived racism	More substance use	Yes (men)
Gerrard, et al. 2012	Perceived racism	Increases in substance use	Yes (endorse substance use-as-coping)
Shepherd, et al. 2017	Primary carer experienced racism	Sleep difficulties	Yes
	Family experienced racism	Sleep difficulties	No

Table 2.5: Summary of results from studies examining critical or sensitive periods

Study	Health outcome	Age exposed to racial discrimination	Association
Mental health			
Hou, et al. 2015	More depressive symptoms	12-15 years	Yes
		16-19 years	Yes
		20-23 years	Yes
Ford, et al. 2013	More depressive symptoms	13 years	Yes (high caregiver reported racism)
		17 years	Yes (high caregiver reported racism/ low income families)
	Higher levels of wellbeing	13 years	Yes (high caregiver reported racism)
		17 years	Yes (high caregiver reported racism/ low income families)
	More perceived stress	13 years	Yes (low income families)
		17 years	Yes (high caregiver reported racism/ low income families)
Benner & Kim, 2009	Increased depressive symptoms and alienation	Mean 13.0 years	No
		Mean 17.1 years	Yes
Physical health			
Adam, et al. 2015	Lower waking cortisol	14-17 years	Yes (African-American respondents)
		19-30 years	No
	Lower cortisol awakening response	14-17 years	No
		19-30 years	Yes (African-American respondents)
	Flatter diurnal cortisol slope	14-17 years	Yes
		19-30 years	No
	Lower daily average cortisol	14-17 years	Yes (African-American respondents)
		19-30 years	No

Figure 2.1: PRISMA screening process, flow diagram



Chapter 3: Aim and objectives

3.1 Overall aim

The overall aim of this thesis was to examine the contribution of the timing and context of interpersonal racial discrimination to adverse physical and mental health outcomes in Aboriginal populations, with a focus on children aged 0-17 years.

The systematic review in Chapter 2 provided a comprehensive assessment of international longitudinal studies which examine the association between racial discrimination and health outcomes in children and adolescents aged between 0-17 years. This assessment was framed within life course epidemiological theory and provided an in-depth examination of critical/sensitive periods and accumulation of risk models employed within the longitudinal studies under investigation.

This review highlighted two central observations underlying the contribution of interpersonal racial discrimination to adverse health:

- 1) the association between interpersonal racial discrimination and health acts across the dimensions of frequency, duration, and developmental period of exposure, necessitating investigations into the timing of exposure to understand these causal processes; and
- 2) interpersonal racial discrimination interacts with multiple ecological factors in and around individuals (e.g. genetics, physiology, psychology, living conditions, social relationships, environmental exposures, national policies/legislation, etc.) to affect mental and physical health, requiring investigations of multiple factors to understand how these interact.

These observations drove the central objectives around which this thesis is framed.

3.2 Research objectives

To support the overall aim, this thesis will undertake the following objectives:

- *Identify the prevalence of interpersonal racial discrimination in Aboriginal and Torres Strait Islander child populations, with a focus on understanding the timing and accumulation of exposure, by:*
 - I. Quantifying the proportion of Aboriginal and Torres Strait Islander children with exposure to direct and vicarious racial discrimination using large scale national longitudinal data (Chapter 5);

- II. Deriving exposure variables to identify the age of first exposure and accumulation of exposure to racial discrimination in Aboriginal and Torres Strait Islander children (Chapter 5);
 - III. Examining associations between racial discrimination and key sociodemographic factors over time (Chapter 5).
- *Investigate the association between interpersonal racial discrimination and physical and mental health outcomes in Aboriginal and Torres Strait Islander child populations, with consideration of the timing, duration, and developmental period of exposure, by:*
 - I. Examining the association between exposure to racial discrimination at 4-11 years and physical and mental health outcomes (Chapter 6);
 - II. Examining the relative effect of first exposure to racial discrimination at 4-5 and 7 years on mental health and mental health-related outcomes (Chapter 7).
 - *Examine the contribution of racial discrimination to physical and mental health outcomes in Aboriginal and Torres Strait Islander populations, within the context of broader ecological factors, by:*
 - I. Deriving a measure of racial discrimination in an Aboriginal and Torres Strait Islander child population and examining this measure within latent classes alongside broader social determinants of health to predict mental health outcomes (Chapter 8);
 - II. Deriving a measure of allostatic load in an Aboriginal and Torres Strait Islander adult population and examining the differences in allostatic load across latent classes defined by health and socioecological factors for those with and without exposure to racial discrimination (Chapter 9).

Chapter 4: Methodology

4.1 Preface

This chapter provides detailed background for the study design, datasets sourced for analysis, study populations under investigation, software used to run analysis, and statistical techniques undertaken throughout the following chapters of this thesis (Chapters 5-9). Many of these components are common across chapters. However, model inclusions and specifications, and steps taken prior to analysis have differed according to the proposed research questions and derived exposure and outcome variables.

In brief, Chapters 5-8 utilise data from *Footprints in Time: The Longitudinal Study of Indigenous Children* 2008-2017, while Chapter 9 utilises data from the *Australian Aboriginal and Torres Strait Islander Health Survey* 2012-13. Chapter 5 exclusively utilises descriptive statistics to quantify the prevalence of, and risk factors for, racial discrimination among Aboriginal and Torres Strait Islander children, while Chapters 6 and 7 use regression techniques to examine the link between differing racial discrimination exposure variables and health during childhood. Chapters 8 and 9 both use latent class modelling techniques to examine the link between racial discrimination and health in the context of broader social determinants of health.

This chapter provides a forum for technical information pertaining to the methodology, design, data management, and analysis undertaken throughout this thesis which has not been presented within individual chapters or which was presented but truncated for brevity. This chapter will also reflexively assess the study design, methodology, and my own position as a researcher conducting Aboriginal and Torres Strait Islander-specific epidemiological research using population data.

4.2 Justification for study design

Even cursory discussions with Aboriginal and Torres Strait Islander Australians on the subject of interpersonal racial discrimination will generate a flow of anecdotes, ranging from minor incidents to traumatic events which have been personally experienced or observed second-hand in others, having occurred at home, in public, in the media, or online.

The effects of exposure to racism on the minds, bodies, and everyday lives of Aboriginal and Torres Strait Islander peoples are often regarded as profound, far-reaching, and persistent. Based on these discussions, the pervasiveness of racism and its onward effects in the lives of Aboriginal and Torres Strait Islander Australians is indisputable and the requirement for an ongoing national response is urgent and critical. Quantitative research plays a crucial role in this context by offering another means through which the lived experience of racism can be examined as a critical social determinant of health. Where quantified data is viewed alongside in-depth storied accounts of racism, these powerful forms of empirical evidence can be

amplified through advocacy and ultimately utilised to raise political and social consciousness. In recent decades, growing social action in response to racism has led to an increased research interest in defining and quantifying racial discrimination in Aboriginal and Torres Strait Islander adults, (12, 119-121) children, and adolescents, (122-124) and in generating evidence linking exposure to racism with health outcomes in these populations. (97, 125, 126) In turn, this evidence can prompt stronger advocacy and a raised social awareness of the issues surrounding racial discrimination in Aboriginal and Torres Strait Islander populations, the historical origins of racism in Australia and its ongoing effects on health and wellbeing. This thesis contributes to that body of empirical research using a quantitative analytic methodology.

This methodology was chosen primarily to respond to and further the existing – predominantly quantitative – research evidence base. Results generated from quantitative methodologies can be helpful in contributing to policy statements by government and non-government organisations. These research outputs can also be useful for monitoring the progress of policy objectives and identifying new issues or trends in population health. Engagement with policies and politics aligned with the field of research to which this thesis contributes can potentially aid efforts to generate insights into and address flaws in the broader structures and systems perpetuating discrimination and health inequity within Australia. However, the use of a purely quantitative methodology in health research focused on Aboriginal and Torres Strait Islander populations also presents ethical, ideological, and analytic limitations which must be acknowledged.

4.2.1 Decolonising methodology

Despite the strengths of a quantitative methodology, its use is still framed within a western epistemological tradition which has historically allocated the meaning of research and researchers to the exclusion of First Nations perspectives and has more consistently designated First Nations populations as the passive subjects of research rather than active participants in the research process. (127) Decolonising methodologies is a movement attempting to promote the knowledge, voices, and perspectives of populations historically marginalised, ignored or silenced by mainstream – largely Eurocentric – research methods and to place First Nations epistemologies at the centre of research. (128, 129) As stated in Linda Tuhiwai Smith's seminal text, "Decolonising Methodologies", the concern is:

"[...] not so much with the actual technique of selecting a method but much more with the context in which research problems are conceptualised and designed, and with the implications of research for its participants and their communities." (129)

A critical component of this is the need for researchers to engage in critically reflexive practices to consider how their own identity, education, and experiences have shaped the ideological and political framework within which their research is conducted, interpreted, and disseminated. (130) This also includes a

requirement to ensure that research methods and approaches are driven by First Nations worldviews, cultural values and knowledge, and have a positive effect on the health of First Nations peoples. (128, 131)

In practice, quantitative methodologies can struggle to adequately account for the evolving complexities in individual lives within any population group. Introducing the added intricacy of determining how internal perceptions of racial discrimination can change physiological or psychological outcomes in an Aboriginal and Torres Strait Islander context, already layered with ideological and political meaning, only compounds this struggle. Alternative approaches such as ethnographic, anthropological, and broader qualitative methodologies can provide greater insights into these processes.

However, quantitative methodologies can and do contribute to improvements in social justice and not all qualitative or participatory action research methodologies contribute to decolonising processes. (132, 133) It is important to interrogate the assumptions underlying both research and researchers across all methodologies and to remain aware of and continue to reflect on our own position, knowledge, and actions. It is also critical that Aboriginal and Torres Strait Islander researchers are not left to resolve 'Aboriginal and Torres Strait Islander issues' alone, as though their expertise, worldview and experience confers on them sole responsibility. (134) There is a clear need for Aboriginal and Torres Strait Islander and non-Aboriginal researchers to collaborate towards the shared goal of knowledge expansion in Aboriginal and Torres Strait Islander research, with a central focus on ensuring that the needs identified by the Aboriginal and Torres Strait Islander populations involved are prioritised and met. The Indigenous data sovereignty movement can ensure that these collaborations occur while Aboriginal and Torres Strait Islander peoples have sole rights to the collection, ownership, and application of the data being used. (135) The uptake of Indigenous data sovereignty and Indigenous data governance principals and protocols within all research projects using data from Aboriginal and Torres Strait Islander populations is central to this process. I have provided a general overview of ethical considerations for conducting research with Aboriginal and Torres Strait Islander peoples applicable to the current thesis and decolonising methodologies for integration into future research as a supplement to this discussion (Appendix 8).

4.2.2 Applying self-reflexivity

Despite the need for collaboration between Aboriginal and Torres Strait Islander and non-Aboriginal researchers, the role of the non-Aboriginal researcher working in Aboriginal and Torres Strait Islander research should always be interrogated; to query the agenda, purpose, and power dynamics at play between non-Aboriginal researchers and those being researched. Reflexivity is not enough if it is used as justification to continue with 'business as usual' research after a period of forced racial introspection. Part of the reflexive process must involve the ongoing development of research practice in ways that are meaningful, tangible, and genuine. The following sections attempt to address both my position and practice as a non-Aboriginal researcher throughout this thesis.

4.2.2.1 Researcher's position

I recognise that my viewpoint inevitably informs my research through the perspective I have taken throughout the design of each study, analysis undertaken, and the interpretation of results.

As a non-Aboriginal researcher, I am conscious that I have knowingly and unknowingly perpetuated western ways of knowing and being at the expense of First Nations ways of knowing and being. I acknowledge that the western tradition of research has been harmful and disempowering for Aboriginal and Torres Strait Islander Australians historically and that the process of re-situating academic authority in Aboriginal and Torres Strait Islander individuals has only just begun. (136) Throughout completion of my PhD, I have been introduced to a variety of research practices which permit and encourage greater collaboration between non-Aboriginal researchers and Aboriginal and Torres Strait Islander community members. These practices were introduced to me through familiarity with larger-scale research projects taking place in the research institute in which I work, discussions with Aboriginal and Torres Strait Islander researchers and community members advising on research projects at the institute, and a broader awareness of best practice initiatives presented at national conferences, published in academic journals, and described within Aboriginal and Torres Strait Islander health research more generally. These practices range from training community members as community researchers, nominating community members as co-researchers, and giving community members equal responsibility for determining the focus of research, study design, interpretation of results and dissemination, to promoting opportunities for co-presenting at research conferences, co-writing research manuscripts for publication, and enabling the research process to be led by Aboriginal and Torres Strait Islander community members and researchers. Some of these practices were implemented within this PhD project, while others will be implemented in future projects.

I acknowledge that this thesis has been a learning process for me in my awareness of and engagement with research, theory, and ethics published and led by Aboriginal and Torres Strait Islander academics, including Indigenous methodologies. I initially approached the subject matter of this thesis from a quantitative, medicalised perspective focused on exposures and outcomes bound within a statistical framework. As I engaged more deeply in the theory surrounding this field, I have increasingly recognised the presence of racialisation and racism within almost all forms of interpersonal interaction and become increasingly aware of the systemic influences of racialisation and racism across multiple sectors, including within academia, research methodologies, axiology, and epistemology. (137-140) The shape and direction of this thesis would have differed from its current state if Indigenous methodologies were integrated into each study. As it stands, I plan to incorporate several different practices into future research projects based on these newly gained perspectives. Prior to developing a research project, I plan to identify existing Aboriginal and Torres Strait Islander leadership and community governance in the region/s encompassing the proposed research data sources. I will reach out to relevant Aboriginal Community Controlled Organisations, Elders

Councils, and/or Aboriginal Corporations to determine whether formal or informal groups recognised as representing Aboriginal and Torres Strait Islander leadership in that region have been established and ensure that members from these groups are invited to direct the proposed research via a steering committee or advisory group. I plan to engage more deeply with Indigenous Data Sovereignty by first identifying how the principles of data ownership, data access, control over data ecosystems, and participation in the collection, analysis, interpretation, and dissemination of research data are understood and intended to be enacted by the group directing the proposed research. I would then work with the group to design a research plan incorporating these principles. Ideally, this plan would incorporate Indigenous research methodologies and be led by the needs identified by Aboriginal and Torres Strait Islander communities in the designated region/s.

To ensure that Aboriginal and Torres Strait Islander perspectives and knowledge informed the current project, I set up a community advisory group comprised of Aboriginal and Torres Strait Islander community members from Perth, Western Australia within the first months of this PhD. Named the 'Social Determinants of Aboriginal Health Community Advisory Group' (SDAH CAG), the group was a first step in ensuring research undertaken to understand the links between racial discrimination and children's health was informed by the Aboriginal and Torres Strait Islander community.

4.2.2.2 The Social Determinants of Aboriginal Health Community Advisory Group

Aboriginal adults from across the Perth metropolitan region were recruited to participate as members of a community advisory group. I met individually with interested participants to present the aims and objectives intended for the PhD project, gauge support for these aims and objectives, and begin a discussion with each participant about the potential benefits and barriers to their ongoing participation as advisory group members. Ultimately, group members included Emma Castle, Jayde Conway, Doris Getta, Janet Hansen, Raelene Hayward, Justin Kickett, Lakkiera Miller, Ralph Mogridge, Doreen Nelson, and Fred Penny. These group members were retained for the entire three-year term of the SDAH CAG. Group members were from Noongar Country (Perth metropolitan area) and included Elders and community members from different backgrounds, including those working in government, juvenile justice, education, and community services. While efforts were made to ensure that group membership was diverse and represented the perspectives of Aboriginal community members within the Perth metropolitan region, the SDAH CAG could not represent the views of all Aboriginal and Torres Strait Islander peoples.

The SDAH CAG was chaired by a group member (determined by democratic vote) who performed this role on a 12-month rotational basis. Group members drafted and finalised a Terms of Reference which set out the name of the group, the objectives and purpose of the group, how membership was determined, the roles and responsibilities of group members, confidentiality, meeting frequency, the duration of the group, honorariums, and conflicts of interest. SDAH CAG members were provided with an Honorarium payment in

acknowledgement of members' valuable expertise and input into the PhD project. Meetings were held quarterly and led by the chairperson. As secretary of the SDAH CAG, my role was to provide agenda items with the chairperson and group members and to circulate the finalised agenda with any supporting documents prior to each meeting. Agenda items primarily focused on studies in different stages of development, discussions about research dissemination activities, and the development of policy and practice recommendations. As an advisory group within the Telethon Kids Institute, the SDAH CAG were also occasionally presented with studies undertaken within the Institute more broadly which were relevant to the social determinants of Aboriginal health.

The SDAH CAG was designed to be a forum for members to provide advice, guidance, and endorsement for the research activities to be undertaken throughout this PhD research project. However, the role of SDAH CAG members evolved throughout the course of the project. Initially group members provided guidance to aid the development of proposed studies, identifying whether the studies were perceived of as reflecting the needs of Aboriginal children and families and identifying potential policy and practice initiatives aligned with study aims. As study findings became available, group members were provided with both lay summaries and draft manuscripts communicating these findings and members provided feedback on the study design (e.g., requesting the inclusion of new variables, additional comparisons between variables, additional analyses, etc.) and provided suggestions for the interpretation of findings, particularly for findings which were difficult to interpret (e.g., higher prevalence of racial discrimination in remote communities). As manuscripts were finalised, group members then participated in research dissemination. The most notable of these activities was having two group members (nominated and endorsed by the group) attend and co-present at the Rural Health West Aboriginal Health Conference in Perth and the drafting and editing of a research and policy summary document used to disseminate findings to key stakeholders. Towards the conclusion of the PhD project, group members identified several key stakeholders both at the state-level and nationally who should be engaged with to ensure that any intended translational activities are driven by the appropriate organisations, peak bodies, and departments.

Summary of contributions from SDAH CAG to each thesis chapter. Members of the SDAH CAG were presented with the progress and findings of each chapter within the thesis and provided suggestions and input on each prior to their publication. Chapter 5 was proposed to the SDAH CAG prior to analysis and endorsed by the group as a first step in examining the link between racial discrimination and health in Aboriginal children. Preliminary findings from analysis were later shared with the group in a summary presentation and the group contributed suggestions for future analyses. Key among these was the need to account for structural racism and the impact of racism in social media. The group also contributed to the interpretation of findings, providing input into potential explanations for the increased risk of racial discrimination found for Aboriginal children living in high remoteness areas and for children speaking an Aboriginal language.

The research proposal to examine the link between racial discrimination experienced by Aboriginal children and health outcomes was described to members of the SDAH CAG during initial meetings with group members. This proposal was endorsed by members during initial meetings and continued to be validated as a crucial social determinant of health during quarterly meetings. The specific study described within Chapter 6 was proposed after findings from Chapter 5 were presented and discussed, and dissemination had begun in conference settings. Although racial discrimination and health were already endorsed by the group as a primary research focus, the need to examine the health effects of racial discrimination was strengthened by findings from Chapter 5 and the group felt that the study which now comprises Chapter 6 was an important contribution. Group members provided additional interpretation of findings and suggested additional avenues for analysis in future analysis, including the need to account for families moving from metropolitan to remote regions, and to investigate whether the gender of the primary carer affects the impact of vicarious racism on Aboriginal children. The study described in Chapter 7 was proposed to the SDAH CAG at the same time as Chapter 6—constituting two components of research investigating the link between racial discrimination experienced by Aboriginal and Torres Strait Islander children and health outcomes. The specific focus in Chapter 7 on the effects of age of first exposure to racial discrimination on the mental health of Aboriginal and Torres Strait Islander children was endorsed by the SDAH CAG as a means to determine the age at which anti-racism interventions should be targeted.

The SDAH CAG were presented with an update on the progress of this PhD thesis in May 2019. This update highlighted the research objective to examine the link between racial discrimination and health outcomes in the broader context of Aboriginal and Torres Strait Islander peoples' lives. This objective was endorsed by the group as an appropriate next step after completion of analysis from Chapters 6 and 7. Results from Chapter 9 were subsequently presented to the SDAH CAG and group members provided general input into the interpretation of findings. Group members were presented with the characteristics common to members of each latent class derived in analysis and discussions were held about whether the latent classes represented realistic subgroups within the Aboriginal and Torres Strait Islander population. Final analysis from Chapter 8 was completed in September 2020 after the SDAH CAG had concluded (May 2020).

Results from final analysis were presented at the Australian Society for Medical Research – Western Australia Scientific Symposium (June 2018), the Public Health Association Australia Australian Public Health Conference (September 2018), the Australian Epidemiological Association Annual Scientific Meeting (October 2018), and the Public Health Association of Australia online Australian Public Health Conference (October 2020) as oral presentations, and at the Canadian Paediatric Society 8th International Meeting on Indigenous Child Health (March 2019) and the Lowitja Institute International Indigenous Health and Wellbeing Conference (June 2019) as poster presentations. Results were also integrated into a co-presentation at the Rural Health West Aboriginal Health Conference (July 2019) involving two members from the SDAH CAG (Fred Penny and Janet Hansen). Results from Chapters 5-7 were integrated into a

Research and Policy Summary document designed with the SDAH CAG for dissemination to community service organisations, peak bodies and government departments. Results from Chapters 5-7 and Chapter 9 were integrated into a presentation at the Western Australian Commissioner for Children and Young People in March 2020.

4.3 Datasets

4.3.1 Footprints in Time: The Longitudinal Study of Indigenous Children

Footprints in Time: The Longitudinal Study of Indigenous Children (LSIC) is a prospective national longitudinal cohort survey of Aboriginal and Torres Strait Islander children. It has been conducted annually since 2008 and was designed to capture participants' socioeconomic and cultural background, and track their development across several social and health domains. (141) The LSIC is funded through the Australian Federal Government and is conducted by the Department of Social Services (DSS) each year between February/March and December (June – December in 2020). The sample totalled 1,671 children at baseline and a further 88 children were recruited the following year, leading to a sample of 1,759 children. At the time of writing, the LSIC had conducted 12 waves of data collection and data collection for wave 13 was underway. Ethical approval for the LSIC was provided by Federal and state/territory Human Research Ethics Committees and state/territory education departments and Catholic dioceses. The LSIC used a multi-stage clustered sampling method across 11 sites to recruit a non-representative national sample of Aboriginal and Torres Strait Islander children across two age cohorts. The LSIC aimed to recruit 5-10% of the total Australian population of Aboriginal and Torres Strait Islander children aged 0.5-2 years in the 'younger cohort' and 3.5-5 years in the 'older cohort' at baseline. DSS conducts annual face-to-face interviews with the study child and their primary caregiver, using Aboriginal and Torres Strait Islander interviewers where possible. Full details of the rationale, sampling, recruitment, and data collection have been reported elsewhere. (142) The study sites selected for inclusion in the LSIC are referenced below in Table 4.1 and shown geographically in Figure 4.1.

Table 4.1: LSIC study sites

State	Region	Town/s
New South Wales	Western Sydney	Campbelltown – Riverstone
	NSW South Coast	Kiama – Eden
	Dubbo	Incl. Gilgandra, Wellington, Narromine
Victoria	Greater Shepparton	Incl. Wangaratta, Seymour, Bendigo, Cobram, Barmah
Queensland	South East QLD	Incl. Brisbane, Ipswich, Logan, Inala, Gold Coast, Bundaberg
	Mount Isa & remote Western QLD	Incl. Mornington Island, Doomadgee, Normanton, Cloncurry

	Torres Strait Islands and Northern Peninsula Area	
Western Australia	Kimberley	Incl. Derby, Fitzroy Crossing, Broome, Ardiyaloona (One Arm Point)
South Australia	Adelaide	Incl. Port Augusta
Northern Territory	Alice Springs	
	NT Top End	Incl. Darwin, Katherine, Minyerri, Galiwin'ku

Figure 4.1: LSIC study sites

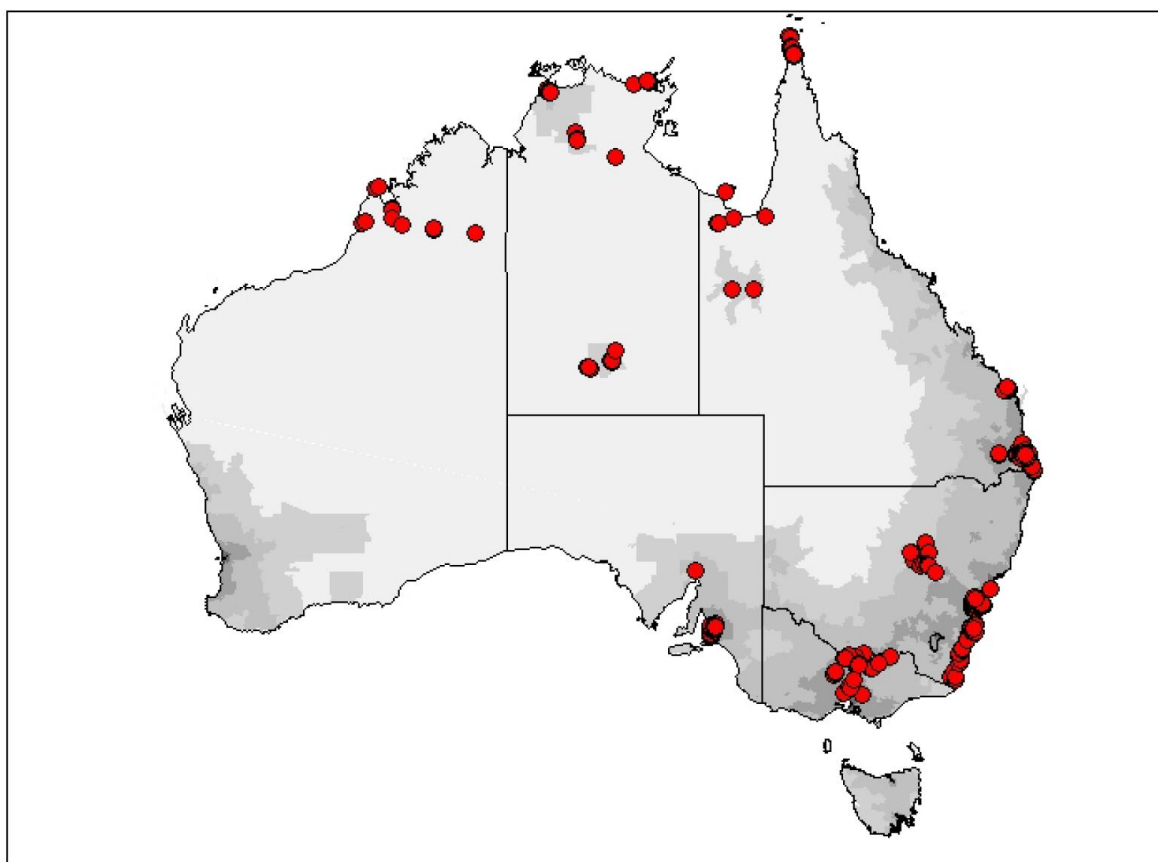


Image retrieved from: Department of Social Services (2019) Footprints in Time: The Longitudinal Study of Indigenous Children—Data User Guide, Release 10.0.

The LSIC was developed and designed with extensive input from Aboriginal and Torres Strait Islander people. The Steering Committee for this study ensured that widespread consultation took place within urban, regional, and remote Aboriginal and Torres Strait Islander communities across Australia during the design phases of the study, with a goal of ensuring that survey findings would provide genuine benefit to Aboriginal and Torres Strait Islander people in those communities. Discussions from those consultation meetings have been documented and disseminated, and they continue to inform survey development as the study progresses.

4.3.2 Australian Aboriginal and Torres Strait Islander Health Survey

The *Australian Aboriginal and Torres Strait Islander Health Survey* (AATSIHS) collected comprehensive health information from the Aboriginal and Torres Strait Islander population and was conducted by the Australian Bureau of Statistics—Australia’s national statistical agency. Data collection in 2012-13 encompassed the *National Aboriginal and Torres Strait Islander Health Survey* (NATSIHS), a *National Aboriginal and Torres Strait Islander Nutrition and Physical Activity Survey* (NATSINPAS) and a *National Aboriginal and Torres Strait Islander Health Measures Survey* (NATSIHMS) for the first time. Collectively, these survey components were designed to obtain national benchmark information on health-related issues, nutrition and physical activity, collect biomarkers of chronic disease, and monitor trends in Aboriginal and Torres Strait Islander health. Full details of the data collection, recruitment, and sampling have been reported elsewhere. (143)

The NATSIHS was conducted from April 2012 to February 2013 in over 5,000 private dwellings in remote and non-remote areas across Australia with approximately 9,300 adults and children (aged 0-17 years). The NATSINPAS was conducted between August 2012 and July 2013 in over 2,800 private dwellings with approximately 4,100 adults and children (aged 2-17 years). Selected adult members of the household (who consented to participate) undertook face-to-face interviews with trained ABS interviewers. No individual could be selected into both the NATSIHS and the NATSINPAS. Adults aged 18 years and over who participated in the NATSIHS or NATSINPAS were invited to participate in the NATSIHMS, where biomedical data from blood and urine tests were collected. Approximately 3,300 participants aged over 18 years volunteered to participate in the NATSIHMS. Participants consenting to blood and urine collection were referred to collection clinics or had this collection take place during a home visit or at a temporary clinic held within an Aboriginal Medical Service.

4.4 Indigenous Data Sovereignty

Indigenous Data Sovereignty is an international movement centred on the right of First Nations peoples to govern all aspects of data pertaining to them. (135) Indigenous Data Sovereignty has been prioritised as an essential – and urgent – issue for many First Nations peoples due in part to past unethical data collection practices from colonial settler states, ongoing statistical misinterpretation, and a reliance on outside sources for data collection, management, and analysis due to associated high financial and resource costs. (144) In Australia, the Indigenous Data Sovereignty movement developed from a workshop in 2015 held to determine an Indigenous Data Sovereignty agenda informed by academics, First Nations organisations, and government representatives from Canada, Australia, Aotearoa/New Zealand, and the United States prompted by the United Nations Declaration on the Rights of Indigenous Peoples. (135) Ultimately, this workshop led to the formation of the Maïam nayri Wingara Indigenous Data Sovereignty Collective in 2017. A communique from the Indigenous Data Sovereignty Summit held in Canberra in 2018 set out the

definition of 'Indigenous Data Sovereignty' in Australia as "[...] the right of Indigenous people to exercise ownership over Indigenous Data. Ownership of data can be expressed through the creation, collection, access, analysis, interpretation, management, dissemination and reuse of Indigenous Data". (145)

Delegates from this summit asserted that Aboriginal and Torres Strait Islander people in Australia have the right to:

- Exercise control of the data ecosystem including creation, development, stewardship, analysis, dissemination and infrastructure.
- Data that is contextual and disaggregated (available and accessible at individual, community and First Nations levels).
- Data that is relevant and empowers sustainable self-determination and effective self-governance.
- Data structures that are accountable to Indigenous peoples and First Nations.
- Data that is protective and respects our individual and collective interests.(145)

The datasets utilised in this thesis were developed prior to the initiation of the Maiam nayri Wingara Indigenous Data Sovereignty Collective and the principles set out above, with design and development for the LSIC beginning in December 2005 and the first National Aboriginal and Torres Strait Islander Health Survey (on which the Australian Aboriginal and Torres Strait Islander Health Survey is based) conducted in 2004-5. As such, the government agencies responsible for these datasets have been required to evolve to respond to the rights of Aboriginal and Torres Strait Islander peoples to enact principles of ownership over data pertaining to them.

The ABS has initiated several strategies to build and strengthen engagement with Aboriginal and Torres Strait Islander communities and organisations, improve the data collection experience for Aboriginal and Torres Strait Islander peoples, collect relevant and culturally appropriate data, and provide support for Aboriginal and Torres Strait Islander peoples to access and use their data. (146) Led by the Centre of Excellence for Aboriginal and Torres Strait Islander Statistics, the ABS is guided by cultural protocols and procedures for engagement with Aboriginal and Torres Strait Islander peoples and communities developed in alignment with Indigenous data sovereignty principals. (146, 147) ABS has attempted to be proactive in maintaining positive relationships with Aboriginal and Torres Strait Islander communities via their Indigenous Community Engagement Strategy (ICES). (146) The ICES is delivered by Indigenous Engagement Managers across Australia who are engaged to advise communities and organisations on the use of Aboriginal and Torres Strait Islander data, while facilitating the return of information pertaining to Aboriginal and Torres Strait Islander peoples back to communities. (146) These activities address some of the principles of data sovereignty laid out by the Maiam nayri Wingara Indigenous Data Sovereignty

Collective but are unable to address all principals comprehensively. Localised data from the ABS is not made available for local governance and decision-making, although outputs from sources including the national Census are increasingly available at a more granular level. The ABS data ecosystem is not designed to facilitate Aboriginal and Torres Strait Islander control over data collection processes, data analysis, dissemination strategies or the overall data infrastructure. The ABS continues to work towards delivering improved data access, analytic support, and responsiveness to community needs, however considerable transformational change is required within this agency to fully engage with Indigenous Data Sovereignty principles.

Several principles of Indigenous Data Sovereignty are reflected in the practices and protocols utilised by the DSS in conducting the LSIC, particularly via the use of a community partnership approach and a study design which privileges and values Aboriginal and Torres Strait Islander perspectives and voices. (148) Extensive consultation was conducted prior to the development of the LSIC, from September 2003 to June 2004 across metropolitan, regional and remote communities across Australia. (149) Aboriginal and Torres Strait Islander participants in these consultations highlighted the need for a sense of ownership over the study processes and the data itself, and of the importance of knowing how the data is used. (150) To address these requests, the LSIC has consistently prioritised working in partnership with Aboriginal and Torres Strait Islander communities and organisations, ensuring that community priorities are responded to, that the study is conducted in a participatory and culturally respectful way (e.g., by adhering to community protocols and employing Aboriginal and Torres Strait Islander interviewers), and incorporating a strengths-based focus into the study design. (148) Study participants have emphasised the importance of the appropriate use of the data collected from them, ensuring that their data will be used in future research to inform policy and practice. (148) It will be critical for the DSS to continuously disseminate findings back to participants and their communities, alongside the broader Aboriginal and Torres Strait Islander population, and to develop strategies to encourage the inclusion of these populations in the translation of findings into policy and practice.

4.5 Study population

Analysis undertaken throughout this thesis draws on individual level data from the LSIC 2008-2017 and AATSIHS 2012-13. Cohorts from each dataset were identified for analysis based on the specific research questions proposed in each chapter and the most recent year of data available within each dataset. For Chapters 5, 6, and 7, the total cohort of children from waves 1-8 (collected 2008-2015) of the LSIC were included in analysis. For Chapter 8, only the older cohort of children from wave 10 (collected 2017) of the LSIC were included in analysis. For Chapter 9, only individuals who consented to participate in the NATSIHMS within the NATSIHS component of the AATSIHS 2012-13 were included in analysis.

4.6 Ethics approval

Ethical approval for the LSIC was provided by the Australian Commonwealth Department of Health Departmental Ethics Committee and from state and territory Ethics Committees. Ethics approval for the NATSIHMS component of AATSIHS was sought and gained from the Australian Government Department of Health and Ageing's Departmental Ethics Committee and from relevant ethics committees at the jurisdictional level for New South Wales, South Australia, Western Australia, Northern Territory and for Queensland Health Service Districts. Analysis conducted for completion of this thesis was approved by the Western Australian Aboriginal Health Ethics Committee (ref: 809) and the University of Western Australia Human Research Ethics Committee (ref: RA/4/20/4069).

4.7 Statistical analysis

A range of statistical analysis techniques have been used throughout the studies in this thesis, dependent on the research questions and focus of each chapter. All studies incorporate descriptive statistics generated during initial data exploration, including count and proportion (with confidence intervals estimated after weighting), means (with standard deviations and/or standard errors), and simple comparisons undertaken using chi-squared tests or Student's T tests. Multivariate associations between exposures, confounders, and health outcomes were examined using generalised linear mixed models with underlying binary, ordinal (logistic), or normal distributions (Chapters 6 and 7), controlled for the clustering by study sites inherent within the LSIC study design. Chapter 6 and 7 both report odds ratios for the association between racial discrimination and health outcomes. Due to the focus of these studies – and the thesis as a whole – on situating racial discrimination within an epidemiological framework, these studies refer to racial discrimination increasing the risk of adverse health outcomes. I acknowledge that odds ratios do not approximate relative risk and that terminology referring to an increased likelihood of adverse health outcomes is standard language. Throughout this thesis, reference to confidence intervals has been privileged over the interpretation of *p*-values and statistical significance when determining differences in effect size or mean estimates. This has been done to reflect the movement in epidemiology and biological science away from null hypothesis significance testing, the misuse of and overreliance on *p*-values, and associated issues with reproducibility, towards the use of estimates and confidence intervals. (151, 152) Confirmatory factor analysis and principal components analysis were used in Chapter 8 to identify item factors and derive continuous scales for inclusion in final analysis.

The Bolck, Croon and Hagenaars (BCH) approach to latent class analysis (LCA) with a distal outcome (153) was used in Chapter 8 to analyse children's mental health and in Chapter 9 to analyse adult allostatic load. The BCH approach first estimates the parameters of the LCA model without the distal outcome (e.g. allostatic load) and then computes a weighting variable based on the posterior probabilities of class membership from the LCA model. (154) The weighting variable is applied to the outcome variable to

calculate the weighted average of that outcome for each class. In both Chapter 8 and 9, BCH adjusted proportional assignment was used to calculate distal outcome estimates. BCH adjustment is used to account for the uncertainty introduced by potentially misclassifying estimates of model parameters. (154) The use of LCA with a distal outcome facilitates both the prediction of outcome estimates across latent classes and the comparison of outcome estimates between latent classes. In both Chapters 8 and 9, this enabled broader contextual factors within people's lives to be examined alongside racial discrimination, rather than controlling for racial discrimination, and for the associated outcomes on mental health and allostatic load to be investigated within this broader context. Use of this specific technique made possible our investigation into whether racial discrimination more adversely affects mental and physical health for individuals with one set of shared characteristics over another. Ultimately, this technique permits us to view racism as situated within—rather than isolated from—the reality of complex intersecting stressors present within individual lives.

Some level of missing data was present in all studies within this thesis. In Chapters 6 and 7, multilevel multivariate normal imputation with joint modelling and auxiliary variables was used as a sensitivity analysis to determine the influence of missing data on parameter estimates. (155) Linear mixed effects models were run on unrounded imputed data and pooled parameter estimates were compared against estimates from complete case analysis prior to main analyses. In Chapter 8, MICE was undertaken first to impute values for the racial discrimination items with missing data before scale variables were derived by weighting items with item factor score regression coefficients. MICE was then undertaken again to impute values for explanatory variables and the health outcome variable (SDQ) in LCA with a distal outcome. Pooled item response probabilities, distal outcome estimates, Wald test estimates, and standard errors were calculated from output generated from imputed datasets. Similarly, in Chapter 9, MICE was run to impute biomarker data for the allostatic load outcome variable and pooled distal outcome estimates, Wald test estimates, and standard errors were calculated from output generated from imputed datasets.

4.8 Software

Data manipulation, management, and analysis was conducted across multiple software platforms, depending on analytic capability and access. Access to the AATISHS was permitted only through the ABS DataLab, a protected research environment designed to allow secure access to micro-level datasets managed by the ABS. (156) Due to this, some limitations were placed on the software and statistical packages available for access within the DataLab. In the DataLab environment, all data manipulation and management was undertaken within SAS Enterprise Guide Version 7.15 (SAS Institute Inc., Cary, NC, USA, 2017) and all statistical analysis was undertaken within Stata Version 16.0 (© 1985-2019) using the LCA Stata Plugin and LCA_Distal_BCH Stata functions. (157, 158)

Outside the DataLab environment, SAS Version 9.4 (SAS Institute Inc., Cary, NC, USA, 2002-12) was the preferred base package for data manipulation and analysis in Chapters 5-9. In Chapters 6 and 7, multiple imputation using mixed effects models was undertaken in R version 3.4.3 (© 2017) for sensitivity analysis using the 'mitml' package (159) because this form of multiple imputation was not available in SAS and was required due to the nested structure of the LSIC. In Chapter 8, multiple imputation by chained equations (MICE) was undertaken in STATA Version 16.0 as the rounding procedures applied to ordinal and binary variables using the 'mitml' package led to unrealistic or biased estimates. While this was resolved using continuous variables in sensitivity analysis, this technique could not be applied where imputed data would be used in analysis. As such, the MICE procedure permitted ordinal and binary variables without the need for later rounding procedures. Also in Chapter 8, item exploration and modelling to identify item factors and derive weights for continuous racism exposure variables was undertaken in SPSS Version 24 (Armonk, NY: IBM Corp, 2016) and LISREL Version 9.3 (SSI Inc., 2007) as these were the preferred packages for confirmatory factor analysis and principal components analysis.

Chapter 5: Prevalence of Racial Discrimination in a Cohort of Aboriginal and Torres Strait Islander Children

5.1 Preface

This chapter identifies the prevalence of interpersonal racial discrimination in Aboriginal and Torres Strait Islander child populations, with a focus on the timing and accumulation of exposure, by:

- Quantifying the proportion of Aboriginal and Torres Strait Islander children with exposure to direct and vicarious racial discrimination using large scale national longitudinal data;
- Deriving exposure variables to identify the age of first exposure and accumulation of exposure to racial discrimination in Aboriginal and Torres Strait Islander children; and
- Examining associations between racial discrimination and key sociodemographic factors over time.

The purpose of this chapter is to provide an accurate assessment of exposure to different forms of racial discrimination experienced by the LSIC cohort of Aboriginal and Torres Strait Islander children from birth to late childhood. Gaining evidence which describes the prevalence of racism in Aboriginal and Torres Strait Islander children is an important first step in examining the link between racism and health as this provides an indication of the scale and the spread of exposure during a critical developmental period. Specifically, this chapter sought to determine when the LSIC cohort of Aboriginal children were first exposed to racism both directly and through vicarious experiences, to examine how exposure to racism accumulated over time, and to identify whether any sociodemographic factors placed those children at a greater risk of exposure.

This chapter was released as a Working Paper as part of the Australian Research Council Centre of Excellence for Children and Families over the Life Course (Life Course Centre) Working Paper Series in October 2018. The chapter which follows is a verbatim copy of the content from that manuscript with the exception of minor modifications for readability. A copy of the typeset manuscript is available in Appendix 1 (Page 210) and supplementary materials are available in Appendix 3 (Page 321).

5.2 Abstract

Background: Racial discrimination is a central social determinant of health in Aboriginal and Torres Strait Islander populations and is associated with health inequities between Aboriginal and Torres Strait Islander and non-Aboriginal Australians. This study sought to estimate the prevalence of racism in a longitudinal study of Aboriginal and Torres Strait Islander children.

Method: This study examined direct and vicarious racism within the *Footprints in Time: The Longitudinal Study of Indigenous Children* (LSIC) dataset, providing descriptive analysis of direct and vicarious forms of racism exposure, including overall prevalence, accumulation of exposure, and age of first exposure, across key sociodemographic factors over time. Participants for this study include 1,759 children from the first 8 waves of LSIC, comprising those aged 6 months to 12 years.

Results: One in five (20.4%) study children had a direct experience of racial discrimination by age 11 years, with the majority of these children (73.5%) experiencing first exposure to direct racism by age 7, while vicarious racism was more commonly experienced (44.5% through the primary carer and 50.5% via family members). Children living in areas of high remoteness, in the most disadvantaged regions, and children who spoke an Aboriginal language were at increased risk of experiencing direct racism by age 11.

Conclusion: Direct and vicarious racism is commonly experienced by Aboriginal and Torres Strait Islander children and exposure often occurs within the first years of life. This study is one of the first studies internationally to characterise the prevalence of both direct and vicarious forms of racism among a cohort of children using longitudinal data.

5.3 Introduction

Racism has been defined as the operation of social inequalities which act to limit or improve access to resources, opportunities, power, and capacity according to racial or ethnic categorisations. (1, 2, 4) Racism acts both directly and indirectly through a range of mechanisms which may occur in negative beliefs about an individual's own racial group, through internalised racism, between individuals, through interpersonal racism, or within the structure of society, through systemic racism. (1). Interpersonal racism, and to a lesser extent, internalised and systemic racism, have now all been shown to have a significantly negative impact on an array of health outcomes, albeit with stronger and more consistent effects for mental than physical health. (3, 4, 6-8, 13, 63, 84) Racism's significantly negative impact on health contributes to the health disparities typically observed between different ethnic and racial groups, (3, 10, 58-62) particularly in First Nations populations worldwide, including Aboriginal and Torres Strait Islander populations in Australia. (121)

Developing an understanding of the prevalence of racial discrimination and the sociodemographic risk factors associated with exposure to racism are important first steps in generating meaningful insights into racial disparities between Aboriginal and Torres Strait Islander and non-Aboriginal peoples across Australia. This is particularly the case for children and young people, where the strength of the relationship between racial discrimination and negative health effects is greater in children than adults. (8, 64) It is also critical to examine vicarious racism exposure in children as significant associations have been observed between parental or caregiver reported racial discrimination and negative socioemotional and mental health outcomes in children and young people. (72) Finally, the timing and duration of exposure both likely play a role in the relationship between racism and health, as persistent exposure to racism potentially leads to the ongoing 'weathering' of bodily systems and hence increased susceptibility to disease over time. (160, 161) However, the majority of available studies examining the prevalence of racial discrimination in Aboriginal and Torres Strait Islander populations are focused on adults and based on cross-sectional datasets, and studies examining critical periods of racism exposure on child health are predominantly based in the United States. To the best of our knowledge, no studies have yet examined the prevalence of direct or vicarious racism in Aboriginal and Torres Strait Islander children over time as they grow and develop.

Life course epidemiology offers a range of theoretical models to facilitate an examination of the causal and/or temporal pathways through which exposures influence health and wellbeing across lifetimes and inter-generationally. (81) These models can inform the development of exposure variables by providing a conceptual framework within which the role of factors including early exposure, age of first exposure, and accumulated exposure may be examined. Research incorporating each of these exposure variables into a longitudinal examination of the duration and timing of exposure to racial discrimination during childhood is generally limited, particularly for Aboriginal and Torres Strait Islander children. A detailed examination of racism prevalence in Aboriginal and Torres Strait Islander children over time using exposure variables informed by life course epidemiology will enhance our understanding of Aboriginal and Torres Strait Islander children's experience of racial discrimination, laying the foundation for further examinations of how racism interacts longitudinally with the health and wellbeing of this at-risk population group.

Based on currently available prevalence estimates of direct and vicarious interpersonal racism in Aboriginal and Torres Strait Islander populations aged below 18 years, (97, 162-165) we anticipate that a substantial proportion of Aboriginal and Torres Strait Islander children will be exposed to direct racism, with slightly higher rates seen for vicarious racism. It is expected that reports of direct racism will increase with age based on previous research undertaken within the *Footprints in Time: Longitudinal Study of Indigenous Children* (LSIC) dataset used in this analysis (97) and due to children's ability to increasingly conceive of and recognise racially discriminatory behaviour as they age. (166) We also expect a range of sociodemographic factors to influence risk for exposure to both direct and vicarious racism, including geographic, socioeconomic, and cultural factors.

Socioeconomic status (SES) and geography have both been found to be consistently associated with racial discrimination in Aboriginal and Torres Strait Islander child populations. (97, 162, 164, 165) Low SES has been found to be associated with direct and vicarious racism, (97, 164, 165) while mixed findings have been reported for the association between racism exposure and remoteness. (97, 162) A study based on the Western Australian Aboriginal Child Health Survey (WAACHS) found that direct racism was reported less frequently in areas of extreme remoteness compared to non-remote areas, while a study based on the LSIC dataset found that Aboriginal and Torres Strait Islander children in regional and remote areas were more likely to experience direct and vicarious racism than those in non-remote areas. (97, 162) Based on these findings, we anticipate that children in regional and remote areas and those living in low SES households will be at increased risk of racism exposure compared to children in metropolitan areas and those living in higher SES households.

Strong cultural identity has been found to be associated with increased incidence of racism in studies focused on adult Aboriginal and Torres Strait Islander populations. (167) As a strong sense of cultural identity has been associated with more perceptions of racial discrimination only in non-remote areas, it may be that this association is influenced by the heightened racial tensions and increased challenge of living 'between cultures' experienced in metropolitan areas. (168) Currently, only one study has examined the association between cultural identity and racism in those aged under 18 years, finding no association in a population of Aboriginal and Torres Strait Islander young people aged 12-26 years. (164) However, this association has not yet been examined during early childhood. Based on findings from adult studies, we anticipate that children speaking an Aboriginal and Torres Strait Islander language will be at increased risk of direct exposure to racism.

A closer examination of the prevalence of direct and vicarious racism in Aboriginal and Torres Strait Islander children will provide valuable evidence which can begin to inform policy and practice responses to this critical health determinant. The longitudinal nature of the LSIC dataset offers a valuable opportunity to identify the risk factors associated with racism exposure in a national cohort of Aboriginal and Torres Strait Islander children and to understand how the prevalence of racism changes as these children age.

5.4 Methods

LSIC is a national longitudinal survey of Aboriginal and Torres Strait Islander children designed to follow the development of these children across a range of domains and to capture the socioeconomic and cultural background of their families. The survey has been described in great detail elsewhere, (141) however in brief, LSIC used a multi-stage clustered sampling method across 11 sites to recruit a non-representative national sample of Aboriginal and Torres Strait Islander children into two cohorts defined by age. LSIC aimed to recruit 5-10% of the total Australian population of Aboriginal and Torres Strait Islander children aged 0.5-2 years for the younger cohort and 3.5-5 years for the older cohort at baseline (2008), recruiting a

total of 1,671 children at that time point and an additional 88 children at wave 2. The survey conducts annual face-to-face interviews with the study child and their primary caregiver. To date, data for 10 waves have been collected with data from 8 waves currently available for analysis.

5.4.1 Participants

Participants for this study include children from the first 8 waves of LSIC, comprising those aged 6 months to 12 years. The sample size over the first 8 waves included up to 1,759 respondents due to participant flow in and out of the full sample over the course of LSIC, with 1,255 (75% retention) remaining by wave 8. Of the full sample, 1,010 were represented in the younger cohort and 749 represented in the older cohort. At wave 1 the mean age was 2.4 years in the full sample (SD = 1.6; age range 0-6 years), 1.1 years in the younger cohort (SD = 0.5; age range 0-2 years) and 4.1 years in the older cohort (SD = 0.5; age range 3-6 years). By wave 8 the mean age was 9.3 years in the full sample (SD = 1.5; age range 7-12 years), 8.1 years in the younger cohort (SD = 0.5; age range 7-9 years) and 11.1 years in the older cohort (SD = 0.5; age range 10-12 years). There were 887 (50.4%) males and 872 (49.6%) females in the full sample. Overall, 1,534 (87.2%) study children were Aboriginal, 117 (6.7%) were Torres Strait Islander and 108 (6.1%) were both Aboriginal and Torres Strait Islander.

5.4.2 Measures

5.4.2.1 Demographic variables

Each study child's primary carer reported the study child's age and gender at each wave. Geographic characteristics in LSIC are captured via the Level of Relative Isolation (LORI) measure, an index for remoteness levels within Australia developed based on an extension of the Accessibility/Remoteness Index of Australia. The extended measure, ARIA++, has an 18-point remoteness scale based on the relative distance of localities from population centres of varying size. LORI uses five categories of isolation based on the ARIA++ scores: none (e.g. metropolitan areas), low, moderate, high and extreme (e.g. isolated remote communities). Within LSIC, respondents in the 'high' and 'extreme' category have been collapsed into one category for 'high/extreme isolation'.

5.4.2.2 Socioeconomic status

The measures of SES used in this analysis include the Index of Relative Indigenous Socioeconomic Outcomes (IRISEO), the highest level of education completed by the primary carer and financial difficulty reported by the primary carer. IRISEO is an area-based composite ranked scale that has been derived using a range of socio-economic outcomes from regions across Australia, based on the employment, education, income, and housing characteristics of Aboriginal and Torres Strait Islander persons only. (169) IRISEO data from wave 1 of LSIC has been categorised into quintiles for this analysis.

LSIC primary carers were asked to indicate the highest qualification they had completed. This measure was coded into a four-item variable in order to capture university-level education (bachelor, graduate and post-graduate degree), certificate or post-school qualifications (Certificate I-IV, diploma and advanced diploma), completion of Year 11 to Year 12 or equivalent, and lower levels of completion (Year 10, those who never attended school or were still at school).

Primary carers were also asked to provide a subjective rating of their family financial situation, using a 5-item scale. This measure was coded into a binary variable for analysis, with families considered to be in financial difficulty if they answered, 'We run out of money before payday', 'We are spending more money than we get', 'We have just enough money to get us through to the next pay day' or 'There's some money left over each week but we just spend it'; a response of 'We can save a bit every now and then' or 'We can save a lot' were coded as not being in financial difficulty. Responses taken at wave 1 are included in this analysis.

5.4.2.3 Speaking an Aboriginal language

The LSIC dataset contains a range of variables tied to Aboriginal and Torres Strait Islander cultural identity and attachment. For simplicity, a variable asking primary carers whether the study child speaks an Aboriginal language ('yes', 'no') has been used as a proxy measure of cultural attachment in this analysis. However, it is important to acknowledge that culture is a complex construct which comprises many elements, particularly across heterogeneous Aboriginal and Torres Strait Islander populations, and analysis utilising any single construct in isolation is necessarily limited. Notwithstanding, language has been chosen here as it is considered one of four central elements of cultural attachment, alongside cultural identification, cultural participation, and traditional activities, and has been shown to have strong positive effects on happiness and mental health in adult Aboriginal and Torres Strait Islander populations. (168)

5.4.2.4 Racial discrimination

LSIC includes three measures of racial discrimination, herein referred to as direct racism, vicarious racism via the primary carer, and vicarious racism via the family. Each of these measures were asked at different waves throughout LSIC and the timing of questions related to direct racism differed between study cohorts. Table 5.1 describes the timing of collection of each racial discrimination measure over the first 8 waves.

Direct racism

Throughout waves 2-7 of LSIC, direct racism was reported by the primary carer in response to a question on whether the study child had been bullied or treated unfairly at preschool or school because they were Aboriginal and Torres Strait Islander. Carers were able to indicate that the study child was bullied by other children, treated unfairly by adults or both. This measure was coded as a binary variable for analysis ('Yes,

bullied [kids being mean to him/her]', 'Yes, treated unfairly [adult being mean to him/her]' or 'Yes, both bullied and treated unfairly' compared with 'No'). In wave 8, the structure of the question was changed slightly so that the primary carer was first asked whether the study child had been bullied or treated unfairly at school and if they responded positively to this question (study child was bullied, treated unfairly or both), they were then prompted to indicate whether this was because the study child is Aboriginal or Torres Strait Islander. Carers could indicate that the bullying or unfair treatment was 'always for this reason', 'sometimes for this reason' or not for this reason. This measure was then coded as a binary variable for analysis ('Yes, always for this reason' or 'Sometimes for this reason' compared with 'No'). Although the structure of this question differs from that asked in previous waves, the content remains consistent. The wording of both questions used for this measure was not time limited and may be used to indicate that the study child was ever exposed to racism at school or preschool.

Accumulation of racism exposure

Using the binary variables created for the measures of direct racism, vicarious racism via the primary carer, and vicarious racism via the family at each study wave, derived variables were generated to capture the number of exposures recorded for each type of racism for each study child. Both vicarious racism via the primary carer and family were asked in 3 waves within LSIC, while direct racism was asked in 4 waves (Table 5.1). The waves in which the direct racism measure was asked differed by cohort, requiring an accumulation variable to be derived in each cohort separately before creating a final derived variable from their combination.

The sample for this measure included only cases where a response to the direct racism measure was recorded in all waves in which it was asked. There were no respondents reporting exposure to direct racism in all 4 waves, likely due to the change in question structure during wave 8. As a result, the accumulation variable for direct racism excluded the wave 8 measure, limiting responses to a maximum of three exposures at three time points. Due to the small number of children with three exposures, children with two and three exposures were combined into the same category.

Age of first exposure

Mean age at each wave for the separate cohorts was used to assign an age for children during each wave in which each racism measure was asked. Exposure to racism was recorded for children whose primary carer provided a positive response to racism measures at any wave exclusive of those who had indicated a positive response in a previous wave. As not all children participated in all waves of LSIC, this allowed children who had either not been exposed to racism in the previous wave, did not respond to the measure in the previous wave, or who did not participate in LSIC during the previous wave to still be included in analysis. Proportions of children with exposure at each successive age were then totalled, allowing

cumulative exposure by mean age 11 to be examined. Proportions represent the number of children with exposure out of the total number of primary carers asked the question at each wave.

This derived variable recorded only first exposures, excluding subsequent exposures for children with more than one exposure. This variable also provided the total number of children who did not report exposure during any recorded response to this question. Although children who were recorded as a missing response to this question in some waves may have reported direct racism had there been a response, this variable provides figures for those reporting no exposure who responded to the question on direct racism at least once.

Due to the accelerated cross-sequential design of LSIC and the patterning of each racism measure, there is little cross-over in age between cohorts for each measure. Where cross-over has occurred, proportions have been totalled across cohorts. For direct racism, exposure was recorded for mean ages 4, 5, 7, 8, 9, and 11 years. Vicarious racism via the primary carer was recorded for exposure at ages 1, 4, 7, 8, and 11 years. Vicarious racism via the family was recorded for exposure at ages 3, 5, 6, 8, and 11 years. This method only accounts for the age at which each racism measure was included in LSIC and cannot account for earlier exposure prior to LSIC.

Vicarious racism via the primary carer

Primary carers were asked to indicate whether they had been treated unfairly or discriminated against because they were Aboriginal or Torres Strait Islander at three time points during the first 8 waves of LSIC (Table 5.1). Primary carers were able to indicate whether they had been unfairly treated or discriminated against a 'little bit', 'fair bit', 'lots of times', or 'not really'. This measure was then coded as a binary variable (ever ['little bit', 'fair bit' or 'lots of times'] compared with 'not really'). This measure, like the direct racism measure, does not specify a time limited period for exposure to racial discrimination and each occasion must be treated as a record of ever experiencing racial discrimination at any time in the past.

Vicarious racism via the family

Primary carers were asked to indicate how often their family experienced racism, discrimination or prejudice at three time points over the 8 waves of LSIC (Table 5.1). Responses were rated on a five-point scale in terms of frequency, including; 'every day', 'every week', 'sometimes', 'only occasionally', and 'never or hardly ever'. This measure was coded as a binary variable comparing 'every day', 'every week', 'sometimes' or 'only occasionally' with 'never or hardly ever'.

5.4.3 Data analysis

Data from the first 8 waves of LSIC were used in this study, with a long dataset created merging data from 8 files (all variables included). Subset datasets were then created for each cohort, allowing separate computation of variables for the birth and child cohorts.

The prevalence of racial discrimination was examined across waves of the study by calculating the proportion of children with exposure over those without exposure in each age group. Bivariate associations were examined between racial discrimination variables and sociodemographic factors using the Pearson chi-squared test.

SAS version 9.4 software (SAS Institute Inc., Cary, NC, USA, 2002-12) was used in all analysis.

5.4.3.1 Missing data

Overall, small proportions of missing values were found for vicarious racism via the primary carer (0.7-3.5%) and vicarious racism via the family (0.8-2.5%) variables across cohorts and waves within LSIC (Tables 5.3 and 5.4). Prior to wave 8, the proportion of missing values for direct racism were also relatively small, ranging from 1.8-11.0% (Table 5.2). However, a higher proportion of missing values (72.6-75.3%) was seen for the direct racism variable in wave 8 as that measure was nested within a pre-requisite question on having experienced any school bullying for the first time during that wave.

Large proportions of missing values were also found when developing the derived variables for accumulation of exposure and age of first exposure. Missing values were high for the accumulation of exposure variables due to applying a conservative algorithm which required all data points to be completed by respondents (Tables 5.5 and 5.6). This variable only included children who had a response to each racism measure in every wave in which they were asked. Of the 1,759 children within LSIC, direct racism had complete data points for 33.8% of children (Table 5.5), while 43.4% and 52.8% of children had complete data points for vicarious racism via the primary carer and vicarious racism via the family, respectively (Table 5.6). The derived racial discrimination variables for age of first exposure included all children who responded to each racism measure at any wave during LSIC while excluding those who did not respond to racism measures in any waves in which they were asked. In total, 228 (13.0%) of children were missing from the direct racism age of first exposure variable, 225 (14.5%) were missing from the variable for vicarious exposure via the primary carer, and 166 (9.4%) were missing from the vicarious exposure via the family variable.

Comparisons between key sociodemographic variables across children with missing and non-missing data were undertaken for each of the racism measures using χ^2 tests (Supplementary Tables 5-10). A brief discussion of significant and negligible differences between these groups follows. Overall, given the small to

moderate relationship seen between some key sociodemographic factors and missing values across the racism variables, data are likely to be missing at random.

Negligible missingness

No major differences in sociodemographic variables were found between children with missing and non-missing data for the accumulation variable for vicarious racism exposure via the primary carer, although the level of missingness was higher within the child cohort compared to the birth cohort (44.7% compared to 39.8%). No notable differences were seen in the majority of sociodemographic factors between children with missing and non-missing data for age of first exposure to vicarious racism via the family, although greater proportions of children with missing data for this variable were living in both moderately remote (30.6% compared to 13.6%) and the most disadvantaged areas (19.6% compared to 12.3%). Minimal differences were seen for children with missing values for the age of first exposure to direct racism variable across gender, Aboriginal and Torres Strait Islander status, and socioeconomic variables (<7% difference), although children with missing values were more likely to be younger, as a larger proportion of these children were in the birth cohort (68.4% compared to 55.8%). Negligible differences were also seen in the distributions of gender, cohort, Aboriginal and Torres Strait Islander status, and financial difficulty between those with and without data for the accumulation of vicarious racism via the family variable and while older children were slightly more likely to have missing values for this variable, the mean age of children with missing and non-missing data differed minimally (missing: 9.5 years; non-missing: 9.3 years). No major differences between children with missing and non-missing values were found for gender, cohort, and age in the variable for age of first exposure to vicarious racism via the primary carer. Finally, minimal differences between those with and without data were seen in gender and Aboriginal and Torres Strait Islander status for the accumulation of direct racism variable.

Significant missingness

Some notable differences were found between children with missing and non-missing data for the accumulation of exposure variables for direct racism and vicarious racism via the family. Specifically, greater proportions of children with missing data in these variables were living in highly remote (direct: 10.5% compared to 7.3%; vicarious family: 12.7% compared to 6.5%) and the most disadvantaged (direct: 15.3% compared to 8.5%; vicarious family: 17.1% compared to 9.4%) areas. Additionally, children with missing data from the direct racism accumulation variable were overrepresented in the birth cohort (61.4% compared to 49.7%) and a greater proportion of their primary carers reported financial difficulty (68.2% compared to 57.6%). Children with missing data from the variable for age of first exposure to vicarious racism via the primary carer were overrepresented in non-remote (46.0% compared to 22.7%) and the most advantaged (25.2% compared to 12.4%) areas, and a greater proportion of these children were living with a primary carer who reported completing university (8.8% compared to 5.3%). Smaller proportions of

children with missing data for the age of first exposure to direct racism variable were living in metropolitan areas (16.4% compared to 27.5%).

5.4.4 Ethics

Ethics approval for the LSIC was provided by the Australian Commonwealth Department of Health Departmental Ethics Committee and from state and territory Ethics Committees. The current analysis was approved by the Western Australian Aboriginal Health Ethics Committee and the University of Western Australia Human Research Ethics Committee.

5.5 Results

The prevalence rates of each form of racism exposure reported at each wave for both cohorts are presented in Tables 5.2-5.4. Data has been subset by cohort with mean age and gender presented for those reporting each racism exposure at each wave.

As expected, rates of racism exposure generally increased with age and, in the oldest children (aged 10-12 years), close to one in five children had been exposed to racial discrimination. In the birth cohort, rates of exposure steadily increased with age from wave 4 to wave 8 (Table 5.2). Although the trajectory was less uniform, proportions also increased with age in the child cohort. Slight differences were seen in the prevalence of direct racism exposure between the birth and child cohorts. The proportion of those at mean age 5 years in the child cohort reporting direct racism exposure was approximately two-fold higher than those of the same age in the birth cohort (10.5% compared with 6.0%), while a larger proportion of those with a mean age of 7 years in the birth cohort reported direct racism exposure compared to those aged 7 years in the child cohort (13.6% compared with 8.9%).

Overall, the prevalence of vicarious racism via the primary carer was considerably higher than those seen for direct racism experienced by the study child in LSIC (Table 5.3). Prevalence rates were slightly lower in the birth cohort overall when compared to the child cohort. The gender balance of those exposed to this form of racial discrimination remained relatively steady over time for both cohorts.

The prevalence of vicarious racism via the family was consistent across the birth and child cohorts, across waves and between those of comparative age (Table 5.4). Rates differed slightly from those of vicarious racism via the primary carer, however it is likely that this simply reflected differences in the structure and content of each question. Although both measures captured frequency, the family racism measure included more explicit timeframes (e.g. every week, every day) compared to the primary carer measure (e.g. fair bit, lots of times). Additionally, the family racism measure was reported by primary carers who may not have been aware of all experiences of racial discrimination in other family members. A relatively even gender

balance was seen across waves and cohorts for those experiencing vicarious racism via the family and no significant differences were seen between genders for either cohort at any wave.

5.5.1 Accumulation of racism exposure

Accumulation of exposure to each racism measure has been presented in Tables 5.5 and 5.6. The majority of children (78.0%) did not have any recorded exposure to direct racism at school, while close to one in five (17.7%) reported only one exposure during the three possible time points (Table 5.5). Few children reported racism exposure at two or more time points, with only 26 children (4.4%) recording this level of exposure across the full sample.

Approximately half of those with complete responses to the measure of vicarious racism via the primary carer reported no exposure across all relevant waves in the full sample, with a slightly higher proportion of those in the birth cohort reporting no exposure compared to the child cohort (50.8% compared to 44.2%) (Table 5.6). The proportion of those reporting exposure decreased successively with each additional exposure level. Rates were very similar between the full sample, birth, and child cohorts for one exposure (26.4%, 26.3% and 26.6% respectively) and two exposures (15.7%, 15.0% and 16.8% respectively) to vicarious racism via the primary carer. Twice the proportion of those in the child cohort reported three exposures compared to the birth cohort (10.2% compared with 5.0%).

The majority of those who responded at all three time points to the measure of vicarious racism via the family indicated some level of exposure to this form of racism. Overall, while the proportion of children with one or two exposures to vicarious racism via the family was similar to that found for vicarious racism via the primary carer, the proportion reporting exposure at three time points is somewhat higher.

5.5.1.1 Accumulation of exposure by sociodemographic factors

Overall, financial difficulty and remoteness were both found to be significantly associated with direct racism. However, all significant associations were found with single exposure and not accumulated exposure.

Remoteness was found to be significantly related to single exposure to direct racism ($\chi^2=9.88$; $df=3$; $p=0.0196$). However, pairwise comparisons of remoteness levels only revealed a significant difference between those living in non-remote areas and areas of high remoteness ($p=0.0093$), with no significant difference found between those living in non-remote areas and areas of low ($p=0.5985$) or moderate ($p=0.8478$) remoteness. Children living in areas of high remoteness had 2.1 (95% CI: 1.2 – 3.5) times the risk of single exposure to direct racism compared to those living in non-remote areas.

Financial difficulty was also found to be significantly associated with single exposure to direct racism ($\chi^2=7.37$; $df=2$; p -value 0.0251). Children whose primary carer reported financial difficulty had 1.7 (95% CI:

1.1 – 2.5) times the risk of single exposure to direct racism compared to those whose primary carer reported no financial difficulty.

5.5.2 Age of first exposure

The count and proportion of children with first exposure to each racism measure at each mean age is presented in Tables 5.7-5.9. The count data at each age is then presented as a proportion of the total number of children who responded to each racism measure during any wave of LSIC for the full sample and each cohort. The proportions in the full sample have been summed at each successive age after the youngest (e.g. mean age 4 years for direct racism) and cumulative totals at each age are presented in Figures 5.1-5.3.

In the full sample, the largest proportions of children with first exposure to direct racism reported this at mean age 7 (10.2%) and age 9 (11.8%), while relatively few children had their first exposure at age 4 (3.9%) (Table 5.7). Slightly different patterns were seen between the birth and child cohorts as higher proportions of those in the child cohort had their first exposure to direct racism at mean age 5 (10.5% compared to 5.5% in the birth cohort), while higher proportions of those in the birth cohort had their first exposure at mean age 7 (12.1% compared to 7.6% in the child cohort). Almost 4% of study children were exposed to direct racism at age 4 years, increasing to one in five by age 11 (20.4%; 95% CI: 18.5-22.6) (Figure 5.1). By age 5, the age at which the majority of children in Australia have begun primary education, 8.5% (95% CI: 7.0-10.2) of study children in LSIC had been exposed to direct racism at school or preschool from either adults or peers. Most children with recorded exposures to direct racism had their first exposure by age 7, with only an additional 5.0% of children experiencing their first exposure between ages 7-11 years.

In the full sample, the largest proportions of primary carers who reported experiencing racial discrimination reported this at the first possible wave (wave 1) when the birth cohort was aged mean 1 year and the child cohort were aged mean 4 years (Table 5.8). A smaller proportion of primary carers indicated experiencing racism for the first time in LSIC at wave 4 (birth cohort aged 4 years, child cohort aged 7 years) and a yet smaller proportion indicated first experiencing racism at wave 8 (birth cohort aged 8 years, child cohort aged 11 years). As this variable was not time limited, it is possible that experiences of racial discrimination occurred prior to wave 1, when the study child was at an earlier age or during gestation. Overall, proportions of children exposed to vicarious racism via the primary carer were similar across both cohorts. Just over four in ten (44.5%; 95% CI: 42.0-47.0) children had been exposed to vicarious racism through their primary carer at some point by age 11 years (Figure 5.2). The largest proportion of children who were exposed had been exposed by ages 1-4 (35.7%; 95% CI: 33.2-38.2) with only a further 8.8% of those with any exposure to vicarious racism via the primary carer reporting a first occurrence between ages 4-11.

Across the full sample, prevalence of exposure to vicarious racism via the family appears to be inconsistent over time (Table 5.9). However, this is due to the timing of the exposure measure and the age of children at each time point. In each cohort, rates of exposure were similar to those of vicarious racism via the primary carer. Three in ten (30.7%) children from the child cohort and one third (33.0%) of children in the birth cohort had their first exposure in the first possible wave (birth cohort: age 3; child cohort: age 6). With slightly higher rates than those seen for vicarious racism via the primary carer, just over half (50.5%; 95% CI: 48.0-53.0) of children had at least one point of exposure for vicarious racism via the family by age 11 (compared to 44.5% exposed to vicarious racism via the primary carer and 20.4% exposed to direct racism) (Figure 5.3). A slight decrease was seen at age 6 as there was an increase in the number of children with a response to this measure that was not matched by the number of children with an additional exposure at that age. However, there was a linear increase with age overall.

5.5.2.1 Age of first exposure by sociodemographic factors

Age of first exposure to direct racism by key sociodemographic factors have been presented in Figures 5.4-5.8. Cumulative proportions at each age have been presented for each level of the categorical and binary variables.

Level of relative isolation

Similar rates of exposure were seen in areas with moderate and no isolation, while consistently lower rates of exposure were seen in areas of low isolation and somewhat higher rates of exposure were found in areas with high isolation (Figure 5.4). Around one in four (27.6%; 95% CI: 20.0-35.2) children living in areas of high isolation were exposed to direct racism by age 11, compared to 17.1% (95% CI: 14.3-19.9) of children living in areas with low isolation. Remoteness was related to exposure to direct racism by age 11 ($\chi^2=9.44$; $df=3$; p -value 0.0240). Although pairwise comparisons did not reach significance for children living in areas of low remoteness compared with moderate ($p=0.1290$) and non-remote areas ($p=0.0787$), a significant risk of exposure to direct racism by age 11 was found between children living in areas of low remoteness and high remoteness ($p=0.0043$). Children living in areas with low remoteness had 1.6 (95% CI 1.2 – 2.2) times the risk of exposure to direct racism by age 11 compared to those living in areas with high levels of remoteness.

Socioeconomic status

Children living in regions classified as the most disadvantaged (quintile 1) were most likely to have been exposed to direct racism by age 11 (Figure 5.5). Although rates for children living in the most advantaged regions (quintile 5) were slightly higher by age 7, rates in this quintile then remain steady and by age 11 children living in quintiles 2, 3, 4 and 5 all had similar rates of exposure to direct racism, encompassing children living across both more disadvantaged and more advantaged regions. Overall, rates of exposure for children living in moderately advantaged regions (quintile 3) remained consistently lower throughout.

IRISEO was related to exposure to direct racism by age 11 ($\chi^2=12.34$; $df=4$; p -value 0.0150). While pairwise comparisons found no significant differences between children classified as living in quintile 1 and quintile 2 ($p=0.1866$) or quintile 5 ($p=0.1126$) regions, significant differences were found between children living in quintile 1 and quintile 3 regions ($p=0.0007$) and between children living in quintile 1 and quintile 4 regions ($p=0.0367$). Children living in areas classified as quintile 1, the most disadvantaged regions, had 1.7 (95% CI 1.3 – 2.3) times the risk of direct racism by age 11 compared to those living in areas classified as quintile 3 and 1.5 (95% CI 1.0 – 2.1) times the risk of exposure compared to those living in areas classified as quintile 4.

Rates of exposure to direct racism were fairly consistent across differing levels of primary carer education (Figure 5.6). Children whose primary carer completed university had slightly lower rates of exposure at ages 7 and 8, however by age 11 these rates were similar to primary carers who had never attended school to Year 10 completion.

By age 11, 21.6% (95% CI: 18.9-24.3) of children whose primary carer reported financial difficulty reported exposure to direct racism compared to 17.3% (95% CI: 14.0-20.7) who reported no financial difficulty (Figure 5.7). These rates remained consistently higher at each age during LSIC.

Cultural attachment

Overall, there was a higher prevalence of exposure to direct racism among children who spoke an Aboriginal language compared with those who did not (Figure 5.8). By age 11, close to one quarter (24.2%; 95% CI: 19.6-29.3) of study children who spoke an Aboriginal language had been exposed to direct racism at least once compared to 18.8% (95% CI: 16.6-21.2) of those who did not speak an Aboriginal language. Whether study children spoke an Aboriginal language was strongly related to exposure to direct racism by age 11 ($\chi^2=4.62$; $df=1$; p -value 0.0317). Study children who spoke an Aboriginal language had 1.4 (95% CI 1.0 – 1.9) times the risk of exposure to direct racism by age 11 compared to those who did not speak an Aboriginal language.

5.6 Discussion

As anticipated, this study confirmed that a substantial proportion of the LSIC cohort of Aboriginal and Torres Strait Islander children experienced direct interpersonal racism during childhood. Around one in five children were observed to have been exposed to direct racism during at least one time point by age 11 years. The prevalence rates for direct racism found in this study reflect those found for Aboriginal and Torres Strait Islander children of a similar age (97, 163) and are somewhat lower than rates found for Aboriginal and Torres Strait Islander adolescents and young people. (162, 164, 170, 171) While children can understand and recognise discriminatory behaviour and actions by ages 5-6, children's ability to discern and contextualise discrimination becomes more consistent with age (166) and Aboriginal and Torres Strait

Islander children aged 8-12 have conceptualised and discussed clear instances of racial discrimination. (124) Increased perceptions of direct racism are likely to occur as children develop from early to late childhood and into adolescence, given that adolescents' increased autonomy likely leads to greater risk of exposure in a wider variety of contexts. (172) As the direct racism measure from this study was specific to the school context, it is critically important that strategies aimed at addressing this form of racism are developed in collaboration with education providers and relevant State/Territory education departments, ensuring that the policies and interventions required are appropriate, responsive, and targeted.

Also as expected, the prevalence of vicarious racism was found to be considerably higher than that seen for direct racism in LSIC children, with close to half of all children exposed to vicarious racism via the primary carer or the family by age 11. These higher rates may reflect the restricted context of the direct racism measure (i.e. school), children's inability to recognise instances of discrimination during early childhood, or their decision not to report these incidences to their parent/carers as well as an increased awareness and incidence of racism in adulthood. Prevalence estimates for vicarious racism found in this study are slightly higher than rates seen for similar measures in Aboriginal and Torres Strait Islander children aged below 7 years in the Northern Territory (NT). (165) This difference may be accounted for by the time-limited nature of the measurement item used in the NT study, which referred to experiences of racial discrimination as a stressor over the last year while the measurement item within LSIC did not specify an exposure timeframe. The considerable proportion of Aboriginal and Torres Strait Islander children exposed to either form of vicarious racial discrimination in this study highlights the compounding effect that racism can have within Aboriginal and Torres Strait Islander families and further reiterates the crucial need for coordinated strategies to be developed to address discriminatory behaviour directed towards Aboriginal and Torres Strait Islander populations in Australia.

This study is the first to describe the age of first exposure to direct and vicarious racial discrimination in a longitudinal study of Aboriginal and Torres Strait Islander children in Australia. We found that one third of all children with at least one exposure to direct racism had first been exposed by age 5 years (33%), the average age of school-entry, while the majority had their first exposure by age 7 years (74%). Proportions were similar for children exposed to vicarious racism via the family, with the majority of all children with at least one experience of this form of racism being first exposed by age 6 (71%). For those with exposure to vicarious racism via the primary carer, these proportions are even starker, with 77% of children with at least one exposure to vicarious racism via the primary carer having first exposure by age 4. It is concerning that the majority of these exposures were observed to occur during the formative years of child development, given that children have been shown to be particularly adversely affected by the negative health outcomes associated with racial discrimination. (8, 64) Early developmental periods should be an integral focus in future research examining the pathways between racism and child health outcomes.

A number of associations were found between sociodemographic factors and the derived racism variables for accumulation of exposure and age of first exposure in this study. In a novel finding, this study found a moderate relationship between speaking an Aboriginal language and exposure to direct racism. Children who spoke an Aboriginal language had 1.4 times the risk of exposure to direct racism by age 11, compared to children who did not speak an Aboriginal language. To the best of our knowledge, this is the first study to include a cultural identifier in the examination of risks for racial discrimination exposure in Aboriginal and Torres Strait Islander children. Western Australian Aboriginal children aged 8-12 have identified Aboriginal language as a valued part of their racial identity, acting to distinguish them from non-Aboriginal children and within their own specific language group. (173) In the school context, where the direct racism measure within LSIC is situated, speaking an Aboriginal language likely highlights the Aboriginal and Torres Strait Islander identity of the child even where language is not spoken on school grounds. As Aboriginal and Torres Strait Islander children have identified bullying within school due to their Aboriginal and Torres Strait Islander identity in qualitative studies, (124) it is possible that any explicit indication of Aboriginal and Torres Strait Islander identity – such as through speaking an Aboriginal language – may lead to increased exposure to incidences of racialised bullying.

Moderate associations were found between racism variables and measures of geographic remoteness. Single exposure to direct racism and direct racism exposure by age 11 were found to be associated with levels of relative isolation, whereby children living in areas of high/extreme remoteness were observed to have the highest proportions of direct racism exposure compared to those living in areas of low or non-remoteness. These results differ from those found in the WAACHS, where racism was reported less often in areas of extreme remoteness, though these results were not statistically significant. (162) Areas of extreme remoteness, as classified by LORI, are generally communities which experience limited contact with non-Aboriginal people. (162) Given that perceptions of racism occurred at school, the increased perceptions of racism in these communities may stem from interactions with non-Aboriginal teaching staff unfamiliar to the community. The categories for high and extreme isolation were collapsed in the LSIC dataset which also may have contributed to the discrepancy. Further examination of the association between remoteness and racism exposure in children is required to fully understand this relationship.

Socioeconomic indicators also revealed an association with direct racism exposure, although associations were not uniform across racism measures. Financial difficulty was found to have a significant association with single exposure to direct racism but no association was found with direct racism exposure by age 11. The IRISEO measure did not appear to be associated with single exposure to direct racism, although children living in the most disadvantaged areas had a greater risk of being exposed at age 11 years than those living in areas classified as moderately advantaged and more advantaged.

5.6.1 Limitations

The limitations of this study centre predominantly around the measures of racial discrimination. Each measure was not time limited, making it difficult to extrapolate data recording multiple exposures. Due to the wording of the direct racism and vicarious racism via the primary carer measures, each record of exposure may refer to either recent or distant past experiences of racial discrimination. While multiple records of exposure can be interpreted as multiple recent exposures, the language utilised in these measures does not explicitly define the exposure as such.

All three measures of racial discrimination were reported by the primary carer, not directly by the study child or other family members, limiting the validity of this measure to the perspective of the primary carer. Measures of racial discrimination were not recorded in all waves, limiting points of exposure to those in which data was recorded.

All measures of racism were single-item measures, potentially underestimating the extent of racism exposure in study children. This study has only undertaken a close examination of interpersonal racism, which only represents a single component of racism. Systemic and internalised racism are both critical components of the experience of racial discrimination although they are outside the scope of the current study.

As notable differences were found between children included and excluded from the derived racism variables across measures of remoteness and SES, and increased risk of exposure to racism was found to be associated with these measures, it may be expected that the prevalence of direct and vicarious racism would differ with the inclusion of certain missing cases. However, overrepresentation of missing cases in areas of low/high remoteness and SES differed according to the racism variable under examination.

Finally, although the LSIC chose study sites to accurately represent the community context of Aboriginal and Torres Strait Islander children across Australia, the study employed a non-random sampling design and the sample is not held as representative of the total population of Aboriginal and Torres Strait Islander children. As a result, findings may not be generalisable to the broader population of Aboriginal and Torres Strait Islander children in Australia.

5.7 **Conclusion**

Direct and vicarious racism was commonly experienced by the LSIC cohort of Aboriginal and Torres Strait Islander children and exposure often occurred within the first years of life. This study is one of the first studies internationally to characterise the prevalence of both direct and vicarious forms of racism among a cohort of children using longitudinal data. Findings contributed to the development of variables investigating the age of first exposure and accumulation of exposure to racial discrimination across the lives

of Aboriginal and Torres Strait Islander children. Understanding the prevalence of racial discrimination and sociodemographic factors associated with increased risk of exposure to racism during childhood are important first steps to developing meaningful insights into racial disparities between Aboriginal and Torres Strait Islander and non-Aboriginal children in Australia.

Table 5.1: Racial discrimination measures in LSIC by wave and cohort¹

	Direct racism (carer-reported)		Direct racism (child-reported)		Vicarious racism (primary carer)		Vicarious racism (family)	
	Cohort							
	Birth	Child	Birth	Child	Birth	Child	Birth	Child
2008								
2009								
2010								
2011								
2012								
2013								
2014								
2015								

¹ Shaded boxes in Table 5.1 denote data collection points across time points separately for each cohort.

Table 5.2: Prevalence of direct racism across waves and cohorts

Birth cohort							
Prevalence					Gender distribution of those who experienced racism		
Wave (age range)	Mean age (SD)	N	n	% (95% CI)	Female n (%)	Male n (%)	Missing ¹ n (%)
4 (3-5 years)	4.1 (0.3)	435	17	3.9 (2.3, 6.2)	8 (47.1)	9 (52.9)	41 (8.6)
5 (4-6 years)	5.2 (0.4)	622	37	6.0 (4.2, 8.1)	23 (62.2)	14 (37.8)	29 (4.5)
7 (6-8 years)	7.2 (0.4)	719	98	13.6 (11.2, 16.4)	53 (54.1)	45 (45.9)	13 (1.8)
8 (7-9 years)	8.1 (0.4)	207	31	15.0 (10.4, 20.6)	13 (41.9)	18 (58.1)	547 (72.6)
Child cohort							
Prevalence					Gender distribution of those who experienced racism		
Wave (age range)	Mean age (SD)	N	n	% (95% CI)	Female n (%)	Male n (%)	Missing n (%)
2 (4-7 years)	5.2 (0.5)	504	53	10.5 (8.0, 13.5)	28 (52.8)	25 (47.2)	62 (11.0)
4 (6-9 years)	7.1 (0.5)	515	46	8.9 (6.6, 11.7)	19 (41.3)	27 (58.7)	18 (3.5)
6 (8-10 years)	9.2 (0.5)	490	79	16.1 (13.0, 19.7)	43 (54.4)	36 (45.6)	16 (3.2)
8 (10-12 years)	11.1 (0.7)	125	22	17.6 (11.4, 25.4)	10 (45.5)	12 (54.6)	381 (75.3)

¹ Missing data as a proportion of the total sample of study children at school in each wave and cohort.

Table 5.3: Prevalence of vicarious racism (primary carer) across waves and cohorts

Birth cohort							
Wave (age range)	Mean age (SD)	Prevalence			Gender distribution of those who experienced racism		
		N	n	% (95% CI)	Female n (%)	Male n (%)	Missing n (%)
1 (0-2 years)	1.1 (0.5)	797	238	29.9 (26.7, 33.2)	126 (52.9)	112 (47.1)	23 (2.8)
4 (3-5 years)	4.1 (0.4)	613	148	24.1 (20.8, 27.7)	72 (48.7)	76 (51.4)	4 (0.7)
8 (7-9 years)	8.1 (0.5)	617	135	21.9 (18.7, 25.4)	73 (54.1)	62 (45.9)	9 (1.4)
Child cohort							
Wave (age range)	Mean age (SD)	Prevalence			Gender distribution of those who experienced racism		
		N	n	% (95% CI)	Female n (%)	Male n (%)	Missing n (%)
1 (3-6 years)	4.1 (0.5)	587	193	32.9 (29.1, 36.8)	102 (52.8)	91 (47.2)	21 (3.5)
4 (6-9 years)	7.1 (0.4)	446	119	26.7 (22.6, 31.0)	53 (44.5)	66 (55.5)	6 (1.3)
8 (10-12 years)	11.2 (0.5)	404	123	30.5 (26.0, 35.2)	66 (53.7)	57 (46.3)	7 (1.7)

Table 5.4: Prevalence of vicarious racism (family) across waves and cohorts

Birth cohort							
Wave (age range)	Mean age (SD)	N	n	Prevalence		Gender distribution of those who experienced racism	
				% (95% CI)	Female n (%)	Male n (%)	Missing n (%)
3 (2-4 years)	3.1 (0.4)	821	271	33.0 (29.8, 36.3)	143 (52.8)	128 (47.2)	13 (1.6)
5 (4-6 years)	5.1 (0.4)	720	244	33.9 (30.4, 37.5)	127 (52.0)	117 (48.0)	15 (2.0)
8 (7-9 years)	8.1 (0.5)	747	224	30.0 (26.7, 33.4)	123 (54.9)	101 (45.1)	12 (1.6)
Child cohort							
Wave (age range)	Mean age (SD)	N	n	Prevalence		Gender distribution of those who experienced racism	
				% (95% CI)	Female n (%)	Male n (%)	Missing n (%)
3 (5-8 years)	6.1 (0.5)	580	178	30.7 (27.0, 34.6)	84 (47.2)	94 (52.8)	15 (2.5)
5 (7-10 years)	8.1 (0.5)	528	181	34.3 (30.2, 38.5)	79 (43.7)	102 (56.4)	4 (0.8)
8 (10-12 years)	11.1 (0.5)	497	167	33.6 (29.5, 37.9)	83 (49.7)	84 (50.3)	9 (1.8)

Table 5.5: Accumulation of exposure to direct racism measure by cohort

	Direct racism							
	No exposure			1 exposure		2+ exposures		Missing
	N	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n (%)
Full sample	594	463	78.0 (74.4, 81.2)	105	17.7 (14.7, 21.0)	26	4.4 (2.9, 6.4)	1,165 (66.2)
Birth cohort	295	239	81.0 (76.1, 85.3)	59	15.6 (11.5, 20.3)	10	3.4 (1.6, 6.2)	715 (70.8)
Child cohort	299	224	74.9 (69.6, 79.7)	46	19.7 (15.4, 24.7)	16	5.4 (3.1, 8.5)	450 (60.1)

Table 5.6: Accumulation of exposure to vicarious racism measures by cohort

	Vicarious racism (primary carer)									
	No exposure			1 exposure		2 exposures		3 exposures		Missing
	N	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n (%)
Full sample	764	388	50.8 (47.2, 54.4)	202	26.4 (23.3, 29.7)	120	15.7 (13.2, 18.5)	54	7.1 (5.4, 9.1)	995 (56.6)
Birth cohort	460	247	53.7 (49.0, 58.3)	121	26.3 (22.3, 30.6)	69	15.0 (11.9, 18.6)	23	5.0 (3.2, 7.4)	550 (54.5)
Child cohort	304	141	46.4 (40.7, 52.2)	81	26.6 (21.8, 32.0)	51	16.8 (12.8, 21.5)	31	10.2 (7.0, 14.2)	445 (59.4)
	Vicarious racism (family)									
	No exposure			1 exposure		2 exposures		3 exposures		Missing
	N	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n (%)
Full sample	928	410	44.2 (41.0, 47.4)	244	26.3 (23.5, 29.3)	159	17.1 (14.8, 19.7)	115	12.4 (10.3, 14.7)	831 (47.2)
Birth cohort	549	242	44.1 (39.9, 48.4)	148	27.0 (23.3, 30.9)	94	17.1 (14.1, 20.5)	65	11.8 (9.3, 14.8)	461 (45.6)
Child cohort	379	168	44.3 (39.3, 49.5)	96	25.3 (21.0, 30.0)	65	17.2 (13.5, 21.3)	50	13.2 (10.0, 17.0)	370 (49.4)

Table 5.7: Age of first exposure to direct racism by cohort

	Age 4			Age 5			Age 7		
	N	n	%	N	n	%	N	n	%
Full sample	435	17	3.9	1,126	87	7.7	1,234	126	10.2
Birth cohort	435	17	3.9	622	34	5.5	719	87	12.1
Child cohort				504	53	10.5	515	39	7.6
	Age 8			Age 9			Age 11		
	N	n	%	N	n	%	N	n	%
Full sample	207	16	7.7	490	58	11.8	125	9	7.2
Birth cohort	207	16	7.7						
Child cohort				490	58	11.8	125	9	7.2

Figure 5.1: Full sample: age of first exposure to direct racism, cumulatively totalled

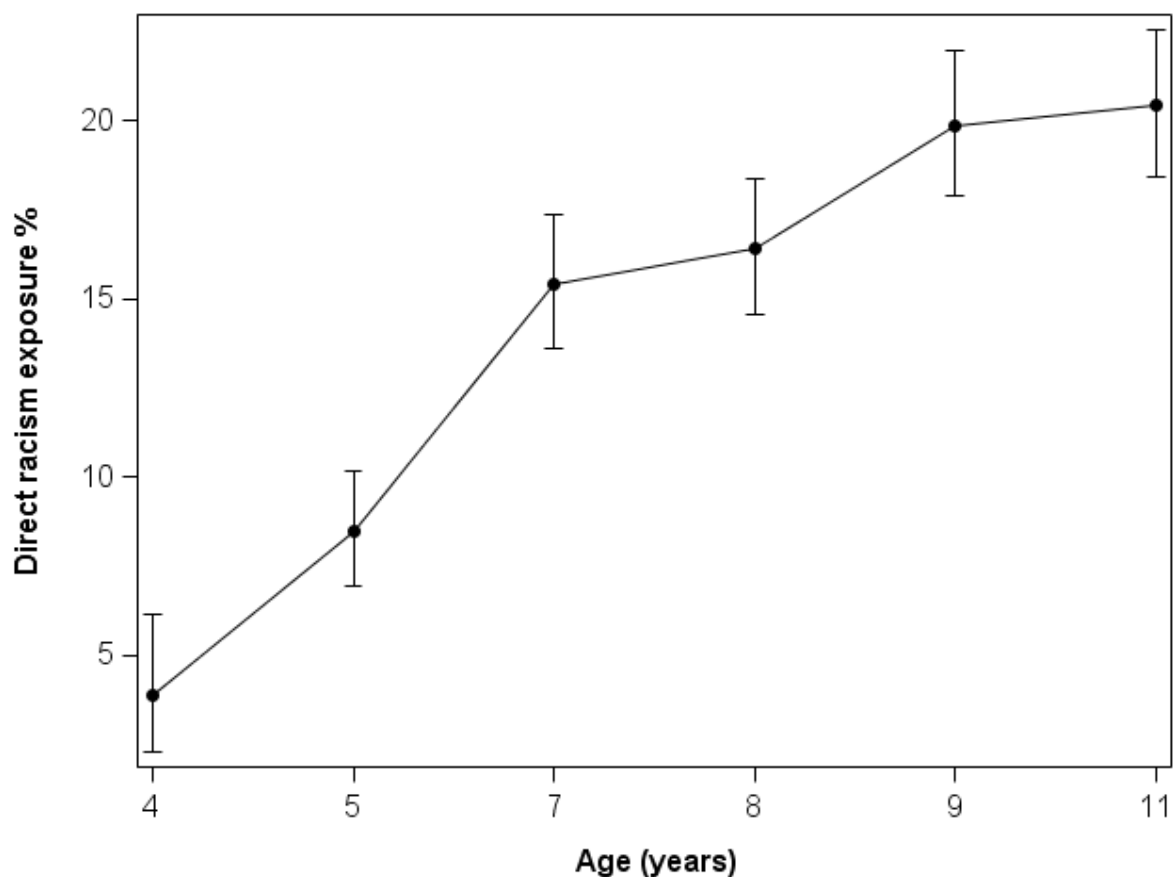


Table 5.8: Age of first exposure to vicarious racism (primary carer) by cohort

	Age 1			Age 4			Age 7		
	N	n	%	N	n	%	N	n	%
Full sample	797	238	29.9	1,200	275	22.9	446	60	13.5
Birth cohort	797	238	29.9	613	82	13.4			
Child cohort				587	193	32.9	446	60	13.5
	Age 8			Age 11					
	N	n	%				N	n	%
Full sample	617	53	8.6				404	43	10.6
Birth cohort	617	53	8.6						
Child cohort							404	43	10.6

Figure 5.2: Full sample: age of first exposure to vicarious racism (primary carer), cumulatively totalled

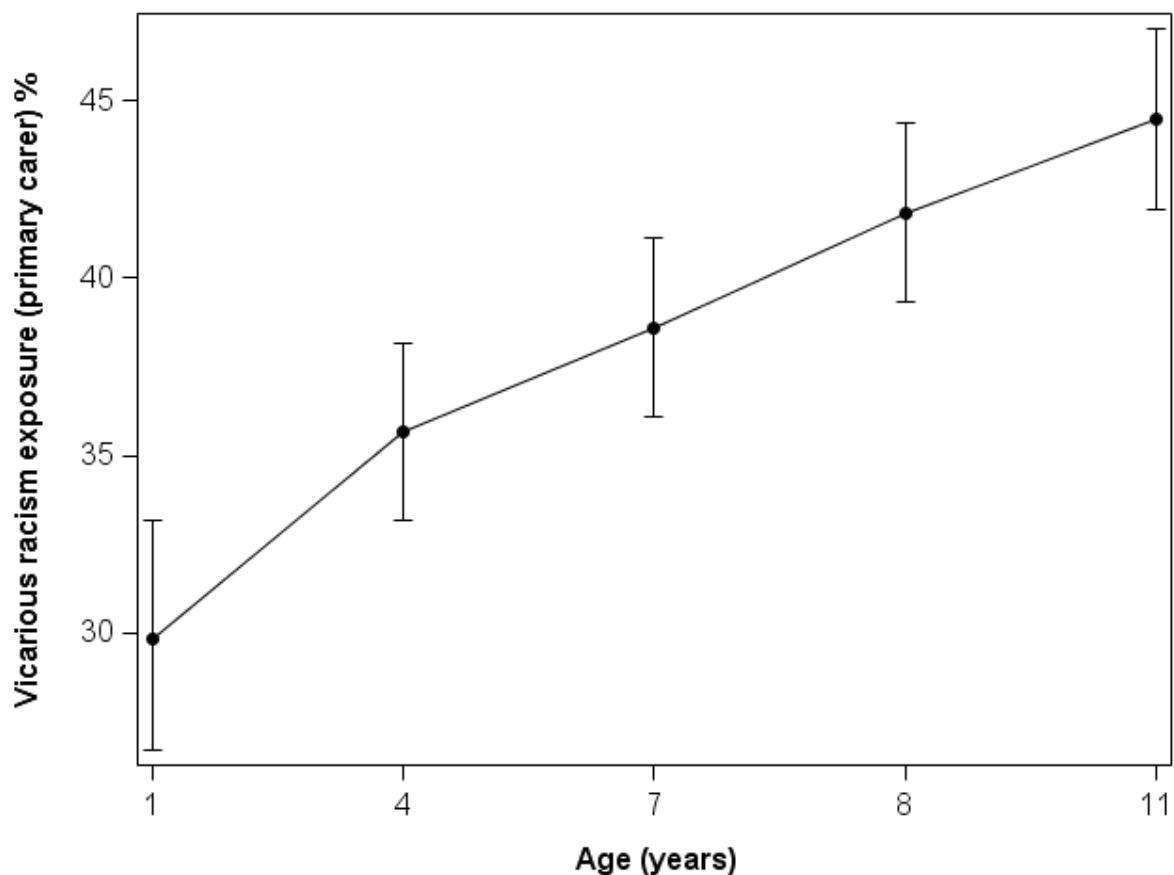


Table 5.9: Age of first exposure to vicarious racism (family) by cohort

	Age 3			Age 5			Age 6		
	N	n	%	N	n	%	N	n	%
Full sample	821	271	33.0	720	121	16.8	580	178	30.7
Birth cohort	821	271	33.0	720	121	16.8			
Child cohort							580	178	30.7
	Age 8			Age 11					
	N	n	%	N	n	%			
Full sample	1,275	176	13.8				497	58	11.7
Birth cohort	747	77	10.3						
Child cohort	528	99	18.8				497	58	11.7

Figure 5.3: Full sample: age of first exposure to vicarious racism (family), cumulatively totalled

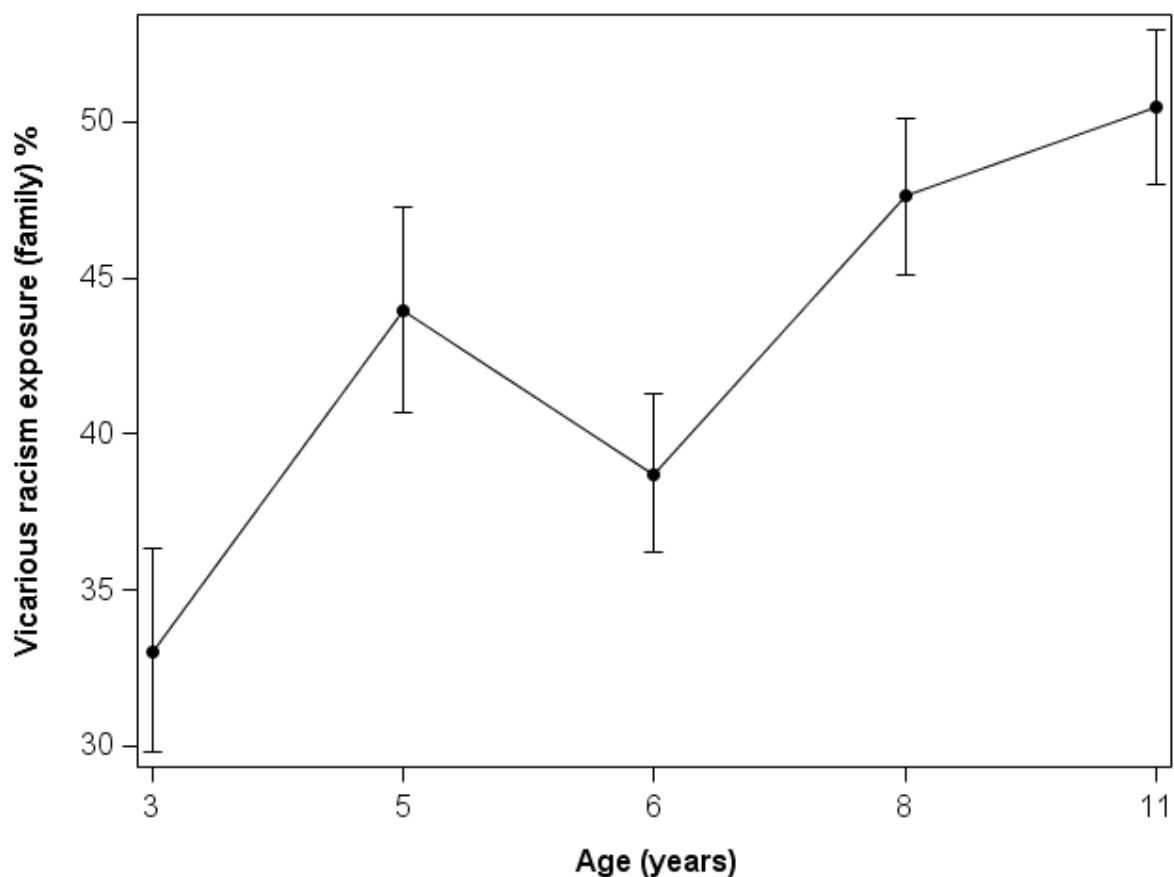


Figure 5.4: Direct racism: full sample by LORI and racism exposure, cumulatively totalled

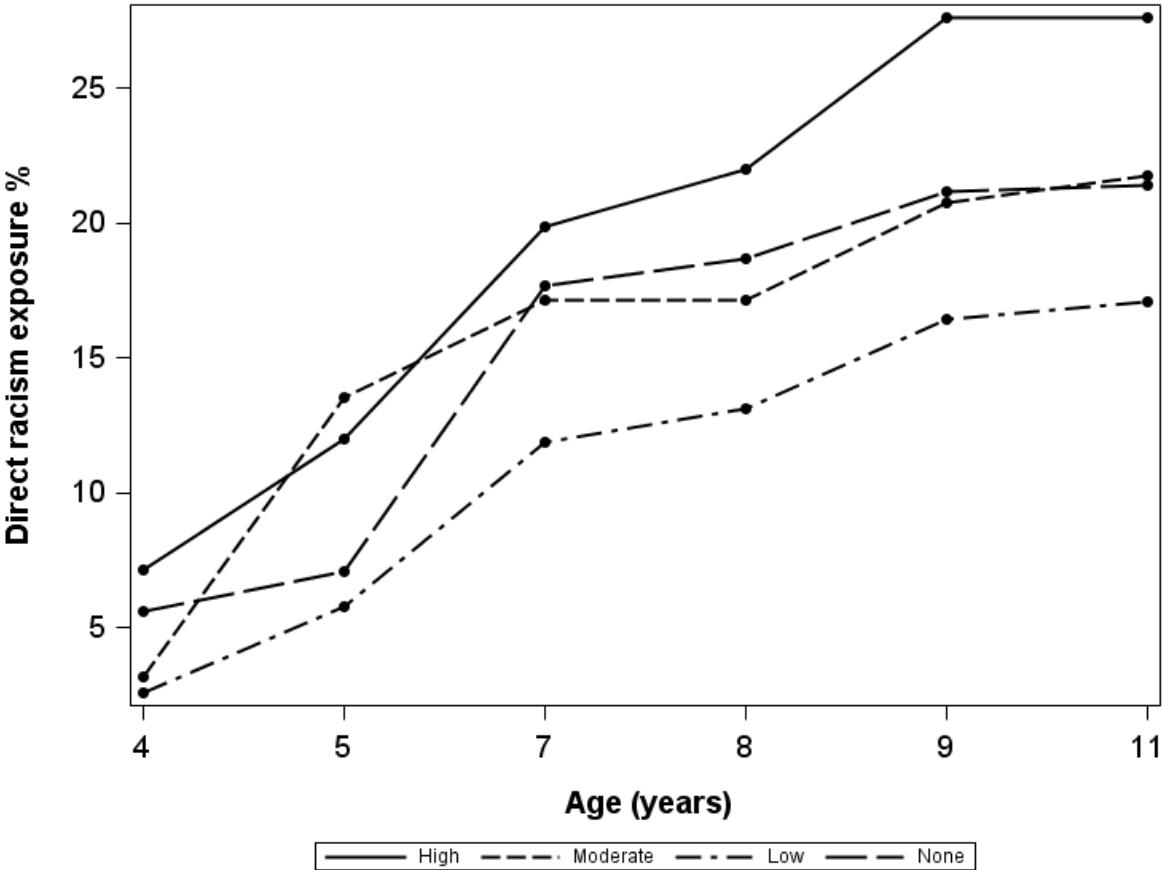


Figure 5.5: Direct racism: full sample by IRISEO and racism exposure, cumulatively totalled

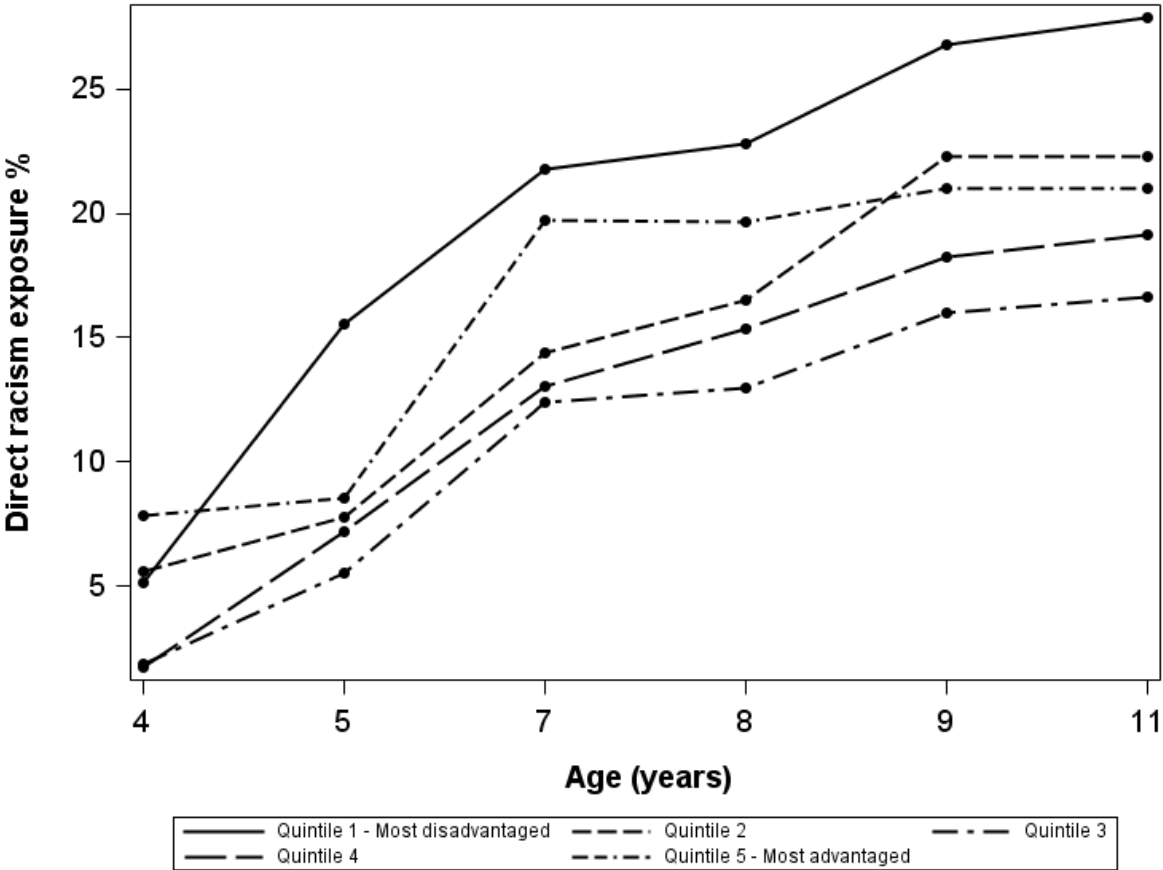


Figure 5.6: Direct racism: full sample by primary carer highest education completed and racism exposure, cumulatively totalled

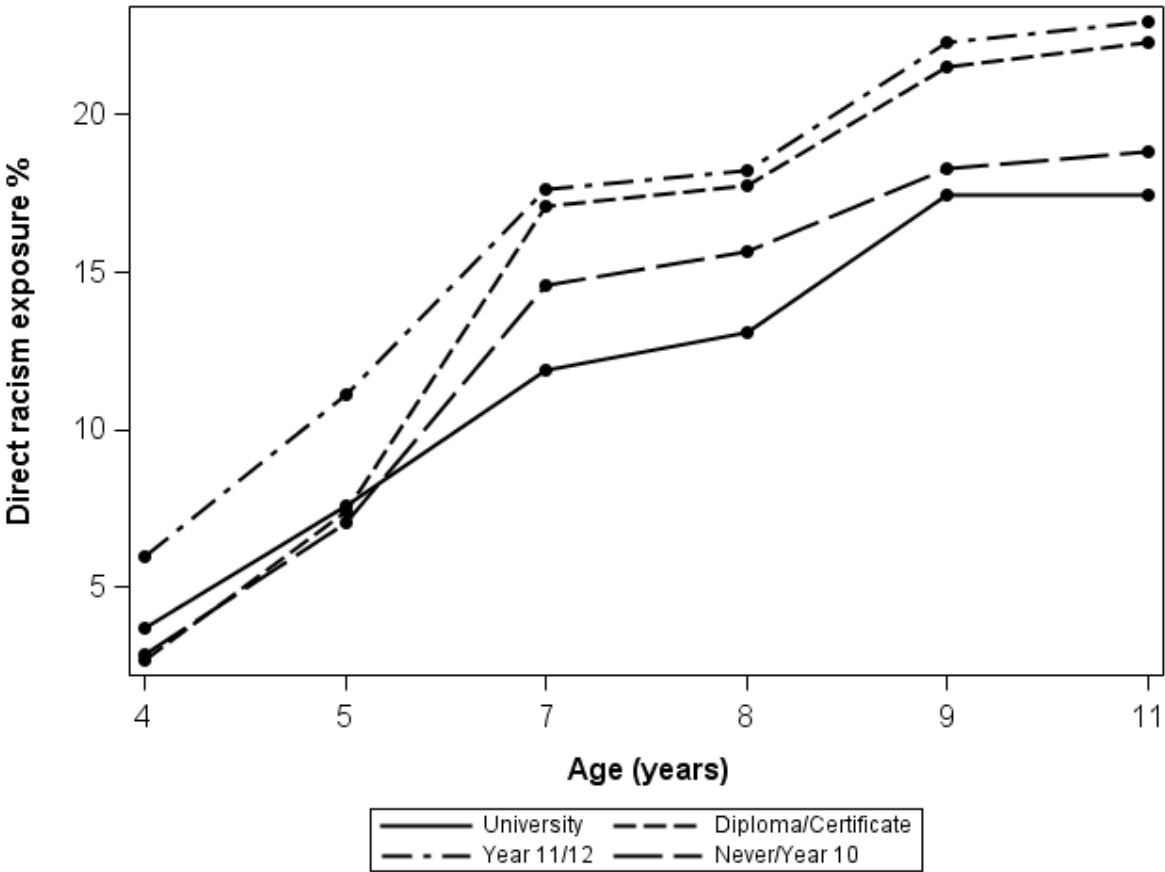


Figure 5.7: Direct racism: full sample by financial difficulty and racism exposure, cumulatively totalled

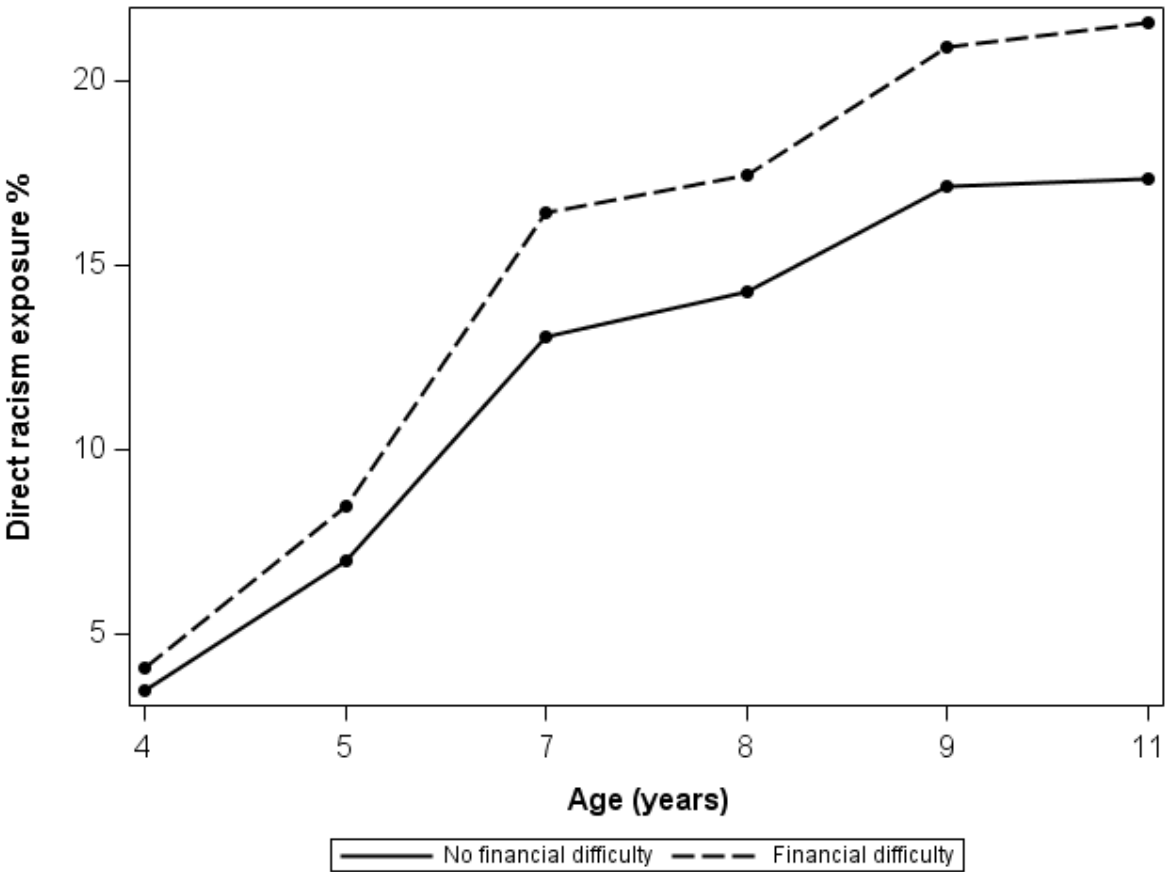
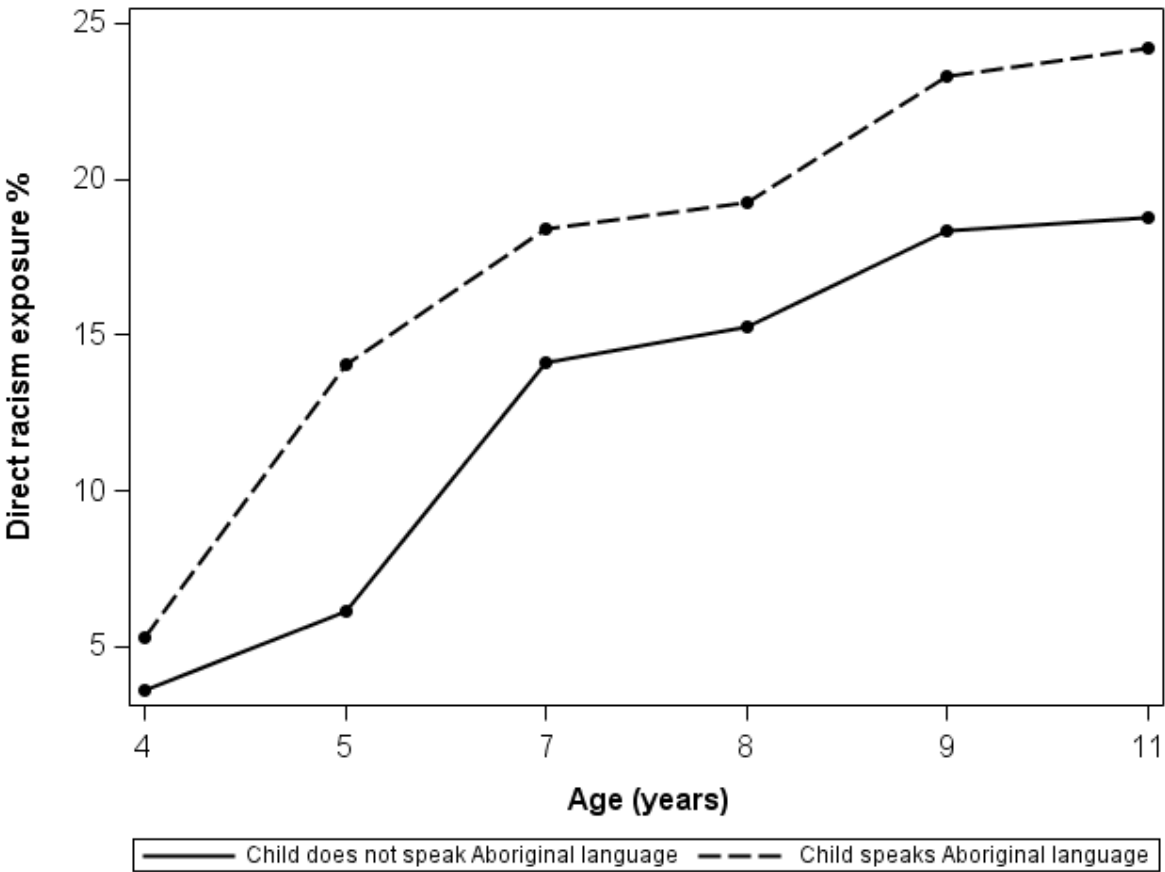


Figure 5.8: Direct racism: full sample by whether child spoke Aboriginal language and racism exposure, cumulatively totalled



Chapter 6: Caregiver-perceived racial discrimination is associated with diverse mental health outcomes in Aboriginal and Torres Strait Islander children aged 7–12 years

6.1 Preface

The previous chapter provided evidence indicating that racial discrimination was commonly experienced by the LSIC cohort of Aboriginal and Torres Strait Islander children, with exposure to direct racial discrimination at school observed as early as age 4 years and prevalence increasing with age. Given the observed frequency of exposure to racism between 4-11 years, this chapter sought to determine the effects of this exposure on mental health and related behavioural and physiological outcomes.

This chapter investigates the association between interpersonal racial discrimination and physical and mental health outcomes in an Aboriginal and Torres Strait Islander child population, with consideration of the timing, duration, and developmental period of exposure. These associations focus specifically on exposure to racial discrimination at ages 4 through 11 years.

This chapter was published in the International Journal for Equity in Health in September 2019. (174) The chapter which follows is a verbatim copy of the content from that published manuscript with the exception of minor modifications for readability. A copy of the typeset manuscript is available in Appendix 1 (Page 248) and online supplementary materials are available in Appendix 4 (Page 327).

6.2 Abstract

Background: Racial discrimination is acknowledged as a central social determinant of Australian Aboriginal and Torres Strait Islander health, although quantitative empirical literature on the impacts of racism on Aboriginal and Torres Strait Islander children remains sparse. We use a novel, longitudinal dataset to explore the relationship between caregiver-perceived racism exposure and a range of mental health and related behavioural and physiological outcomes in childhood.

Method: The study cohort comprised 1,759 Aboriginal and Torres Strait Islander children aged 4-12 years from waves 2-8 (2009-2015) of the *Footprints in Time: The Longitudinal Study of Indigenous Children* (LSIC) dataset. We examined exposure to caregiver-perceived racism between 4-11 years as a predictor for mental health and related outcomes at ages 7-12 and substance use at 10-12 years. Unadjusted models and models adjusted for remoteness, community-level and family-level socioeconomic status, child age and gender were used in analysis. Multilevel logistic regression was used in all analysis.

Results: In fully adjusted models, perceived exposure to racism at ages 4-11 was associated with twice the risk of negative mental health (95% CI: 1.3-3.0), sleep difficulties (95% CI: 1.4-3.0), and behaviour issues at school (95% CI: 1.2-2.9), 1.7 times the risk of obesity (95% CI: 1.1-2.5), and nearly 7 times the risk of trying cigarettes (95% CI: 1.1-43.9) compared to children without exposure. Increased risks were also found for being underweight and trying alcohol though estimates did not reach statistical significance. There was no evidence that racism was associated with poorer general health.

Conclusion: Exposure to racial discrimination in a cohort of Aboriginal and Torres Strait Islander children increased the risk for a spectrum of interrelated psychological, behavioural, and physiological factors linked to negative mental health. Our results further affirm the importance of interventions aimed at reducing the prevalence of racial discrimination for the benefits of population health and health inequalities. The services and institutions which aim to support the mental health and wellbeing of Aboriginal and Torres Strait Islander children should also support interventions to reduce racism and implement accountable policies which prioritise this goal.

6.3 Background

Racism is a central social determinant of health which contributes to the disparities in health observed between different racial and ethnic populations. (3, 10, 58-62) Racism continues to pervade the social systems and institutions which impact on the health and wellbeing of First Nations populations worldwide, including Aboriginal and Torres Strait Islander populations in Australia. (121) More broadly, significant associations have been found between interpersonal racism and negative health and wellbeing outcomes in international studies across both child and adult populations. (3, 4, 6-8, 13, 63, 84) Yet the negative health effects of racism as a pervasive stressor have been shown to be stronger in children and young

people when compared to adults. (8, 64) This is unsurprising given that the early years are understood to present a critical period of health vulnerability to adversity and stress (65, 66). An increasing number of studies have examined the association between racial discrimination and health and wellbeing outcomes in children aged below 12 years in recent years, although relatively few have focused on children from First Nations populations. (7)

For Aboriginal and Torres Strait Islander populations in Australia, racism is a layered, diverse, and – critically – persistent experience which encompasses interpersonal forms of racism encountered through verbal or behavioural gestures (e.g. name calling, abuse) and structural forms of racism prevalent throughout society (e.g. delayed medical attention, media misinformation). (119, 120, 175, 176) While contemporary forms of racism continue to evolve, racism experienced by Aboriginal and Torres Strait Islander Australians is also a historically informed experience tied to the colonisation of Australia by white settlers in the 18th Century and the subsequent social marginalisation, loss of sovereignty, and land dispossession associated with this to the current day. (12, 123) Additionally, the effects of phenomena which exist at the intersection of racism and colonisation, such as intergenerational trauma, are increasingly being recognised and understood to have a profound impact on Aboriginal and Torres Strait Islander health. (12, 27) The common exposure to racism in the everyday life of Aboriginal and Torres Strait Islander children is well documented, both as direct exposure to discrimination or unfair treatment and as vicarious exposure through caregivers or family members. (123) A growing body of literature has also reported associations between racism exposure and health outcomes within this population. (97, 164, 165, 170, 171, 177) Despite this nascent literature, evidence surrounding the specific impact of racism on children's health as they transition into adolescence is currently limited.

Racism likely acts on health and wellbeing through increasing allostatic load and associated physiological dysregulation, initiating maladaptive psychological or behavioural responses, or prompting changes in health behaviour. (4, 7, 63) Each of these processes contribute to the biological embodiment of racism exposure, encompassing the pathogenic pathways induced specifically by interpersonal racism as a psychosocial stressor. (13, 178) Within this context, racial discrimination exposure has been found to be more consistently and strongly associated with mental health than physical health outcomes across the life span, including during childhood and adolescence. (4, 7, 63, 72, 87) The relative strength of this association in children and adolescents may be due in part to an earlier onset of psychological over physiological effects as the psychological harm occasioned by racial discrimination exposure is more immediately apparent than any indicators of physiological harm, including metabolic or hormonal changes. (79, 179) A closer examination of mental health indicators adversely affected by experiences of racism during childhood will assist in understanding this association. This is particularly relevant for Aboriginal and Torres Strait Islander children as broader aspects of mental health and related risk factors such as problem behaviour and substance use have yet to be examined in this population.

This paper aims to address this knowledge gap, with a focus on Aboriginal and Torres Strait Islander children aged 4-12 years using data from the Longitudinal Study of Indigenous Children. We include measures of socioemotional problems, sleep difficulties, school notifications of behaviour issues and substance use within our analysis alongside weight status and general health. We expected that Aboriginal and Torres Strait Islander children exposed to caregiver-perceived racial discrimination would have an increased risk of negative mental health and related risk factors compared to children who have never been exposed.

6.4 Methods

Footprints in Time: The Longitudinal Study of Indigenous Children (LSIC) is a prospective national longitudinal cohort study of Aboriginal and Torres Strait Islander children designed to capture their socioeconomic and cultural background, and track their development across several domains. This study has been described more fully elsewhere, (141) however in brief, LSIC used a multi-stage clustered sampling method across 11 geographic sites to recruit a non-representative national sample of Aboriginal and Torres Strait Islander children across two age cohorts. LSIC aimed to recruit 5-10% of the total Australian population of Aboriginal and Torres Strait Islander children; recruitment targeted two age-based cohorts, children aged 0.5-2 years (younger cohort) and children aged 3.5-5 years (older cohort) at baseline (2008). The survey conducts annual face-to-face interviews with the study child, their primary caregiver, and their teacher. The sample totalled 1,671 children at baseline and a further 88 children were recruited at wave 2, leading to a sample of up to 1,759 children. To date, data for 10 waves have been collected with data from 8 waves currently available for analysis.

6.4.1 Participants

Participants in the current study include children from the first 8 waves of LSIC, comprising 1,759 respondents aged 6 months to 12 years. The younger cohort included 1,010 children aged 6 months to 9 years and the older cohort included 749 children aged 4-12 years. By wave 8, 1,255 participants provided data (75% retention). At wave 1 the mean age was 2.4 years in the full sample (SD = 1.6; age range 0-6 years), 1.1 years in the younger cohort (SD = 0.5; age range 0-2 years), and 4.1 years in the older cohort (SD = 0.5; age range 3-6 years). By wave 8 the mean age was 9.3 years in the full sample (SD = 1.5; age range 7-12 years), 8.1 years in the younger cohort (SD = 0.5; age range 7-9 years), and 11.1 years in the older cohort (SD = 0.5; age range 10-12 years). There were 887 (50.4%) males and 872 (49.6%) females in the full sample, including 510 (50.5%) males and 500 (49.5%) females in the younger cohort and 377 (50.3%) males and 372 (49.7%) females in the older cohort. Overall, 1,534 (87.2%) study children were Aboriginal, 117 (6.7%) were Torres Strait Islander and 108 (6.1%) were both Aboriginal and Torres Strait Islander.

6.4.2 Measures

6.4.2.1 Predictor variable

LSIC includes a carer-reported measure of racial discrimination asked at different waves throughout LSIC which differed by cohort. Exposure to racial discrimination was recorded from 3-8 years (waves 4-7) in the younger cohort and 4-11 years (waves 2-7) in the older cohort. Throughout waves 2-7 of LSIC, racism experienced by study children was reported by the primary carer in response to a question on whether the study child had been bullied or treated unfairly at preschool or school by children or adults because they were Aboriginal and Torres Strait Islander. Carers were able to indicate that the study child was bullied by other children, treated unfairly by adults or both. This measure was coded as a binary variable for analysis ('Yes, bullied [kids being mean to him/her]', 'Yes, treated unfairly [adult being mean to him/her]' or 'Yes, both bullied and treated unfairly' compared with 'No'). In wave 8 the structure of the question was changed slightly so that the primary carer was first asked whether the study child had been bullied or treated unfairly at school and if they responded positively to this question (study child was bullied, treated unfairly or both), they were then prompted to indicate whether this was because the study child is Aboriginal or Torres Strait Islander. For the purposes of this study, carer responses of 'always for this reason' or 'sometimes for this reason' were categorised as a child that had been bullied or unfairly treated due to being Aboriginal or Torres Strait Islander.

6.4.2.2 Outcome variables

Health outcomes have been grouped into mental health and behaviour issues, substance use and physical health. All health outcomes were transcribed as binary variables for analysis. All outcomes were defined solely by data from wave 8, except sleep difficulties which was last asked in wave 7.

Mental health and behavioural issues

Measures of socioemotional problems, sleep difficulties, and behavioural issues at school were the indicators of mental health and behaviour examined within this study. We chose all measures related to mental health available within the LSIC after considering completeness and timing of data collection. The Strengths and Difficulties Questionnaire (SDQ) was used to measure socioemotional problems based on primary carer reports. The SDQ is a behavioural screening questionnaire designed for use with those aged 4-17 years to identify both positive and negative emotional and behavioural attributes. This tool has been found to have adequate construct validity in separate populations of Aboriginal and Torres Strait Islander children aged 4-17 years across Australia. (180, 181) The questionnaire includes 20 items associated with emotional symptoms, conduct problems, hyperactivity, and peer problems which are summed to create a total difficulties score ranging from 0-40. Based on recommended cut-off scores, the raw total difficulties score was categorised into abnormal, (17-40) borderline, (14-46) and normal (0-13). (182) Scores of 14-40 (combining borderline and abnormal) were used to indicate an increased risk of negative mental health in

this study. (183) Study children were determined to be experiencing sleep difficulties if their primary carer indicated that they usually had trouble getting to sleep or staying asleep over the past month. Study children were considered to have behavioural issues at school if their primary carer indicated that they had been contacted by the study child's school due to behaving badly at school in the last twelve months.

Substance use

Primary carers of study children from the child cohort were asked in wave 8 to give permission for interviewers to ask study children directly about whether they had ever tried cigarettes or alcohol. Responses were categorised as having used cigarettes or alcohol if they indicated 'yes, just a few puffs/yes, just a few sips', 'yes, a few times' or 'yes, lots of times' in response to the questions 'Have you ever tried cigarettes?' or 'Have you ever tried alcohol?'.

Physical health

Physical health outcomes included indicators of both general health and weight status. These indicators were chosen as they are implicated with mental health. General health encompasses both physical health and socioemotional wellbeing, while childhood psychosocial factors and mental health disorders have been associated with obesity both during childhood and in later life. (184-186) Study children were determined to have high general health when the primary carer indicated that the study child's health was generally 'excellent', 'very good', or 'good' and low general health when the response was 'fair' or 'poor'. Children's height and weight were translated into Body Mass Index (BMI)-for-age z-scores using the World Health Organisation (WHO) Anthro and WHO Anthro Plus programs. Children were classified as obese or underweight according to WHO and International Obesity Taskforce cut-off points for BMI-for-age z-scores. (142)

6.4.2.3 Covariates

Factors considered to confound the association between racial discrimination and mental health were included as covariates in analytic models. These factors included geographic remoteness, community-level and family-level socioeconomic status, and the study child's age and gender.

Community variables

Geographic characteristics in LSIC are reported using wave 1 data for the Level of Relative Isolation (LORI) measure, an index for remoteness levels within Australia developed based on an extension of the Accessibility/Remoteness Index of Australia. Five categories of isolation based are derived; none (e.g. metropolitan areas), low, moderate, high, and extreme (e.g. remote communities). Within LSIC, respondents in the 'high' and 'extreme' category have been collapsed into one item for 'high/extreme

isolation' due to small sample size. The Index of Relative Indigenous Socioeconomic Outcomes (IRISEO) was used as a proxy measure of community-level socio-economic outcomes. IRISEO is a composite, rank order variable derived from information on the employment, education, income, and housing characteristics of Aboriginal and Torres Strait Islander peoples from Indigenous Areas across Australia. (169) IRISEO data from wave 1 of LSIC has categorised into quintiles for this analysis.

Primary carer variables

All LSIC primary carers in waves 1 and 2, alongside all new primary carers in waves 3 and 4, were asked to indicate their highest completed qualification. This measure was coded into a four-item variable: university-level education, certificate or post-school qualifications, completion of Year 11 to Year 12 or equivalent, and lower levels of completion. A binary 'financial difficulty' variable was defined if they answered, 'We run out of money before payday', 'We are spending more money than we get', 'We have just enough money to get us through to the next pay day', or 'There's some money left over each week but we just spend it'; a response of 'We can save a bit every now and then' or 'We can save a lot' were coded as no financial difficulty. Responses taken at wave 1 are included in this analysis. In wave 3, all primary carers were asked whether in the last five years when they did not have any place to live; 'prior experience of homelessness' was indicated for those that responded 'Yes, many times', 'Yes, a few times', or 'Yes, once'.

Child variables

Each study child's primary carer reported the study child's age and gender at each wave. Child age at wave 8 was collapsed into three categories: 7-8, 9-10, and 11-12 years.

6.4.3 Data analysis

Chi-squared was used to examine bivariate associations and Kendall's Tau was used to assess potential collinearities between perceived racism and the covariates. Following this, two logistic regression models, using the generalised linear mixed modelling (GLMM) framework, were defined and fitted: a model adjusted for child age and gender (model 1) and a fully adjusted model (model 2) including child age and gender, geographic remoteness, area-level socioeconomic status, and family-level socioeconomic status (primary carer reported highest education completed, financial difficulty and prior homelessness). A randomised cluster variable was included within LSIC to identify respondents living in close geographic proximity; (142) this variable was developed to overcome bias introduced by the sampling method and was the grouping variable used in the random effect modelling. Models were fitted using PROC GLIMMIX in SAS (version 9.4, SAS Institute Inc., Cary, NC, USA, 2002-12) with compound symmetry as the covariance structure. Adaptive Gaussian quadrature methods were chosen as they have been shown to perform well with excellent coverage probabilities and minimal bias when estimating the fixed effects of a GLMM for

binary outcome clustered data where there are sufficient numbers of observations per random effect.
(187)

6.4.3.1 Missing data

Non-responses (missing data) were present in the predictor, outcome, and covariate variables. As a sensitivity analysis, multiple imputation was used to determine the influence of missing data on parameter estimates. Two auxiliary variables (cohort and number of major events experienced in the last year) were used to assist with the prediction of missing data. Multilevel multivariate normal imputation with joint modelling was then carried out, generating 100 imputed datasets. Adaptive rounding (188) was pursued on imputed datasets as model variables were binary or categorical, however this did not return realistic data in all cases. Instead, linear mixed effects models were run on unrounded data across all imputed datasets, and combined parameter estimates were compared against the complete cases analysis (Appendix 4) These analyses were conducted using the 'mitml' package (159) in R (Version 1.2.1335 – © 2009-2019).

6.5 Results

One in five (20.4%) study children from LSIC between the ages of 4-11 years experienced at least one exposure to caregiver-perceived racial discrimination at school from either adults or peers. Close to one in six (17%) children in LSIC aged 7-12 were found to be at an increased risk of negative mental health or had behavioural issues at school reported to their primary carer, while 21% were reported to have experienced difficulty sleeping. Around one in twenty (4%) children were found to be underweight by wave 8 and 18% were obese, while 3% were identified as having fair or poor global health. Among responding children aged 10-12 years, 3% reported that they had tried smoking and 11% had tried alcohol.

After adjustment for all study variables, study children living in the most disadvantaged areas (IRISEO; quintile 1) had twice the odds of being exposed to caregiver-perceived racial discrimination at school compared with those living in the most advantaged areas (OR 2.1; 95% CI: 1.0-4.3) (Table 6.1). A similar effect size (OR 2.3; 95% CI: 1.4-3.7) was evident for children whose primary carer had experienced homelessness in the past five years relative to those with no experiences of homelessness. No other sociodemographic factors were associated with caregiver-perceived racial discrimination exposure.

Overall, positive associations were seen between exposure to caregiver-perceived racism and mental health, behavioural issues, and substance use (Table 6.2). In fully adjusted models, children exposed to perceived racial discrimination had around twice the risk for negative mental health, sleep difficulties, behaviour issues at school, and trying alcohol (ORs ranging 1.8 to 2.0) compared to unexposed children, although estimates for trying alcohol were not statistically significant (95% CI: 0.8-4.2). While estimates for children trying cigarettes were imprecise, these children were at seven times increased risk of trying

cigarettes with racism exposure in the fully adjusted model (95% CI: 1.1-45.0) compared to those unexposed to racism.

Positive associations were found between caregiver-perceived racial discrimination and physical health outcomes, with the exception of general health (Table 6.2). After adjustment for child age and gender, study children had 1.8 times the risk of experiencing obesity (95% CI: 1.2-2.5)—with a similar odds ratio in the fully adjusted model (OR: 1.7; 95% CI: 1.1-2.5)—compared with children with no exposure. A moderate effect for being underweight was also observed in the fully adjusted model (OR: 1.6; 95% CI: 0.7-3.9), although the effect estimate was not statistically significant. A negative association was found for general health though this did not reach significance.

Sociodemographic factors were also included in logistic regression models with each health outcome. After adjustment for all covariates, the following covariates and health outcomes were found to be significantly associated. Compared to males, females had lower odds for negative mental health (OR: 0.6; 95% CI: 0.4-0.9), behaviour issues at school (OR: 0.2; 95% CI: 0.1-0.3), and having tried alcohol (OR: 0.2; 95% CI: 0.1-0.4). Children living in the most disadvantaged areas had lower odds of obesity compared to those living in the most advantaged areas (OR: 0.2; 95% CI: 0.1-0.9). Living in areas of moderate remoteness (i.e. regional towns) was associated with lower odds of sleeping difficulties (OR: 0.3; 95% CI: 0.1-0.7) compared to living in the least remote areas (i.e. cities). Children at an older age (11-12 years) were significantly more likely to have negative general health than those aged 7-8 years (OR: 2.4; 95% CI: 1.0-6.0). Children had decreased odds of socioemotional difficulties where primary carers had completed Year 11 or 12 (OR: 0.6; 95% CI: 0.4-0.9) or university (OR: 0.3; 95% CI: 0.1-0.9) compared to primary carers who had completed Year 10 education or less.

Analysis using imputed datasets resulted in pooled estimates for each outcome that were similar to estimates from complete case analysis. Pooled estimates fell within confidence intervals from complete case analysis and confidence intervals from both analyses overlapped considerably. All significant associations between racial discrimination and health outcomes found in complete case analysis were also found in analysis of imputed datasets.

6.6 Discussion

This study sought to broadly assess the effects of racial discrimination exposure on mental health in a cohort of Aboriginal and Torres Strait Islander children. We found that Aboriginal and Torres Strait Islander children exposed to racial discrimination between ages 4-11 in the LSIC were at higher risk of negative mental health and related behavioural and physical outcomes compared to children without racism exposure. Children with caregiver-perceived racism exposure had around twice the risk of negative mental health, sleep difficulties, behavioural issues at school, and obesity.

In a novel finding, we saw that Aboriginal and Torres Strait Islander children exposed to racism had seven times the risk of trying cigarettes at ages 10-12 compared to unexposed children. The strong, albeit imprecise, effect of racial discrimination on trying cigarettes found in our study is reflected in longitudinal studies conducted in both the United States and United Kingdom examining childhood exposure to racism as a predictor of later smoking behaviour, though both studies measured smoking behaviour in adulthood (21-25 years). (189, 190) Studies in child (6-11 years) and adolescent (12-18 years) populations are broadly mixed, with around half of studies finding a significant positive association between racism and smoking. (7) While our study focused on racism exposure during childhood, the positive associations we found between racism and both trying cigarettes and alcohol reflect those seen between trajectories of racial discrimination throughout adolescence and later risk of substance use (encompassing alcohol, tobacco, and marijuana use). (88, 191-193) It is likely that racism exposure, substance use, and mental health disorders are interrelated as the onset of mental health disorders in childhood known to be strongly associated with racial discrimination, such as anxiety and conduct disorder, is predictive of later substance use (194) and substance use disorder. (195) The association between racial discrimination and cigarette smoking in Aboriginal and Torres Strait Islander children warrants further examination, particularly in older cohorts and longitudinally, to fully assess the nature and size of this association by age and over time.

We further confirmed the broad reaching effects of racial discrimination on mental health through the strong and consistent associations found between racism and socioemotional, sleep, and behavioural difficulties in this cohort of Aboriginal and Torres Strait Islander children. Strong associations between racism and negative mental health and behavioural issues during this developmental period are supported in the literature, with positive associations found in children aged 6-11 years (7) and under 13 years. (8) Significant associations have also been found between racial discrimination and sleep difficulties both in cross-sectional (196, 197) and longitudinal studies, (198, 199) although these are predominantly based on adolescent and adult populations. (200) Behavioural problems, negative mental health, and sleep difficulties are known to be associated both concurrently and longitudinally. (201-203) Racial discrimination exposure may contribute to the development of these related factors as a psychosocial stressor by initiating the emotional and psychological responses which characterise negative mental health symptomology. (204) Findings from this study underscore the reality that racial discrimination is a central social determinant of the mental health of Aboriginal and Torres Strait Islander children. Interventions, policies, and practices designed to recognise and address racial discrimination in this population must be considered by the programs, services, and institutions which aim to support the mental health and wellbeing of Aboriginal and Torres Strait Islander children, particularly within the healthcare and education sectors.

Changes in weight status found in Aboriginal and Torres Strait Islander children exposed to racism reflect those seen for socioemotional, behavioural, and substance use outcomes within our analysis. We found

that children exposed to caregiver-perceived racial discrimination had an increased risk of obesity and being underweight, though estimates for being underweight did not reach significance. While the positive association found between perceived racial discrimination and obesity in our study has been observed in a number of studies of child (97) and adolescent (113) populations, the majority of studies in child populations have found no association. (7) This may be due in part to the complexity of processes underlying the association between physiological responses to stress and obesity or metabolic syndrome. (205-207) Yet there is evidence that mental health plays an important role in mediating and modifying the effect of racial discrimination on BMI during adolescence. (113, 208) One longitudinal study reported an indirect association between racial bullying and increased BMI through greater negative emotional symptoms, (113) while another found that high protective emotional support from parents attenuated BMI in adolescents who perceived racism. (208) While our findings confirm a direct association between racism and weight status, this may be complicated by unexamined mediating or moderating pathways. Future studies should consider potential mediating and moderating factors in the association between racial discrimination and weight status in Aboriginal and Torres Strait Islander children to better clarify the function of mental health within this relationship.

Although this study extended previous research on the association between racism and the mental health of Aboriginal and Torres Strait Islander children, our findings should be interpreted in light of several limitations. The instrument used to measure racism exposure in this study was based on the perceptions of primary carers rather than self-reported by study children. Although primary carers reported on the experiences of study children to the best of their knowledge, these reports may not necessarily reflect the perceptions of racism in these children. Additionally, the racism exposure instrument did not specify a timeframe for racism exposure or quantify the frequency or severity of racism exposure. These factors reduce the sensitivity of this instrument as children with many different experiences with racism were unable to be distinguished from one another. Finally, despite the strength of the LSIC as a prospective cohort study with strong community involvement, the sampling design was non-random due to practical and logistic considerations in site selection. (209) As a result, the sample of study children in LSIC is not representative of the population of Aboriginal and Torres Strait Islander children across Australia. However, the sites selected for the study were intended to capture geographic diversity across the population of Aboriginal and Torres Strait Islander children within Australia and the varied environments in which these children live. (142)

6.7 Conclusions

Exposure to racial discrimination in Aboriginal and Torres Strait Islander children increases the risk for a spectrum of interrelated psychological, behavioural, and physiological factors encompassed by mental health. This includes an increased risk of socioemotional and behavioural difficulties, changes in weight

status and, in a novel result, substance use. Findings from this study contribute to the limited body of evidence surrounding the contribution of racial discrimination towards mental health and wellbeing outcomes in Aboriginal and Torres Strait Islander children. Initiatives to reduce the prevalence of racism may act to simultaneously attenuate the risk for a range of factors related to mental health. These initiatives must be driven by the Aboriginal and Torres Strait Islander populations involved (from inception to delivery) to ensure they are culturally relevant and draw from Aboriginal and Torres Strait Islander voices and paradigms. (120) Aboriginal and Torres Strait Islander adults have identified that addressing racism involves both internal and external processes, including distancing oneself from racism and strengthening a sense of identity and pride in being Aboriginal and Torres Strait Islander while emphasising the need for society to acknowledge racism and challenge racist attitudes and behaviours. (119) Given that racial discrimination is an ongoing public health concern for Australian Aboriginal and Torres Strait Islander children, school-based interventions informed by the above parameters would be well placed to address the effects of this critical social determinant and target a reduction in its prevalence.

Table 6.1: Multivariate associations between caregiver-perceived racial discrimination and selected socio-demographic characteristics in Aboriginal children.

Variables	Child ever exposed to being bullied or treated unfairly because they were Aboriginal			
	% (n)	Adjusted OR ¹	95% CI	P-value
Gender of child				
Male	50.4 (887)	Ref		
Female	49.6 (872)	1.09	0.80-1.48	0.61
Age of child (years)				
7-8	46.8 (823)	Ref		
9-10	14.2 (249)	0.91	0.56-1.47	0.73
11-12	39.1 (687)	1.13	0.82-1.56	0.32
Level of relative isolation				
None	26.0 (433)	Ref		
Low	49.4 (822)	0.75	0.50-1.14	0.20
Moderate	15.2 (253)	0.88	0.48-1.59	0.77
High	9.4 (157)	1.21	0.63-2.31	0.58
Index of relative Indigenous socioeconomic outcomes				
Quintile 5 – most advantaged	14.2 (237)	Ref		
Quintile 4	14.7 (245)	1.04	0.60-1.82	0.87
Quintile 3	41.3 (690)	1.09	0.63-1.86	0.80
Quintile 2	16.9 (282)	1.52	0.84-2.75	0.17
Quintile 1 – most disadvantaged	13.0 (217)	2.10	1.03-4.27	0.04
Primary carer highest education completed				
Never attended school to Year 10	42.6 (649)	Ref		
Year 11/12	33.5 (510)	1.26	0.88-1.80	0.18
Diploma or Certificate	18.1 (275)	1.44	0.94-2.19	0.09
University	5.8 (89)	1.26	0.63-2.55	0.45
Financial difficulty				
Save a lot/save a bit every now and then	35.5 (569)	Ref		
Some money left/just enough to get through	46.5 (745)	1.32	0.93-1.86	0.13
Spending more than we get/run out of money	18.1 (290)	1.46	0.85-2.07	0.21
Primary carer experienced homelessness				
No	91.3 (1279)	Ref		
Yes	8.7 (122)	2.30	1.42-3.71	<0.001

¹ Odds ratios are adjusted for all variables that appear in the table.

Table 6.2: Models examining association between caregiver-perceived racial discrimination and mental health related outcomes in Aboriginal children

	Model 1 ¹			Model 2 ²		
	Adjusted OR	95% CI	P-value	Adjusted OR	95% CI	P-value
Negative mental health						
No exposure	Ref			Ref		
Ever exposed	1.66	1.17-2.36	0.01	1.99	1.32-2.99	0.001
Sleep difficulties						
No exposure	Ref			Ref		
Ever exposed	1.85	1.31-2.63	<0.001	2.00	1.35-2.96	<0.001
Behaviour issues at school						
No exposure	Ref			Ref		
Ever exposed	1.68	1.15-2.44	0.01	1.88	1.21-2.91	0.01
Tried cigarettes³						
No exposure	Ref			Ref		
Ever exposed	4.74	1.27-17.69	0.02	7.05	1.10-45.02	0.04
Tried alcohol³						
No exposure	Ref			Ref		
Ever exposed	1.46	0.71-3.02	0.30	1.81	0.78-4.20	0.17
General health						
No exposure	Ref			Ref		
Ever exposed	0.71	0.26-1.94	0.50	0.70	0.23-2.12	0.53
Underweight						
No exposure	Ref			Ref		
Ever exposed	1.76	0.84-3.69	0.14	1.61	0.66-3.93	0.29
Obesity						
No exposure	Ref			Ref		
Ever exposed	1.76	1.23-2.52	0.002	1.68	1.12-2.53	0.01

¹ Model adjusted for child age and gender.

² Model adjusted for child age and gender, geographic remoteness, area-level socioeconomic status and family-level socioeconomic status (primary carer reported highest education completed, financial difficulty and prior homelessness).

³ Child cohort only

Chapter 7: Racial discrimination and the health and wellbeing of Aboriginal and Torres Strait Islander children: Does the timing of first exposure matter?

7.1 Preface

The previous chapter confirmed the association between racial discrimination and adverse psychological, behavioural, and physiological outcomes in the LSIC cohort of Aboriginal and Torres Strait Islander children aged 4-11 years, providing evidence that these adverse effects can be observed after exposure to racial discrimination from early to middle childhood. However, this finding does not indicate whether exposure at more specific developmental periods can have a differential effect on later outcomes.

The current chapter is the second study to investigate the association between interpersonal racial discrimination and physical and mental health outcomes in Aboriginal and Torres Strait Islander child populations, with consideration of the timing, duration, and developmental period of exposure. This study derives a measure for age of first exposure to racism and examines the relative effect of first exposure to racial discrimination at 4-5 and 7 years on mental health and mental health-related outcomes during middle childhood. The purpose of this chapter is to consider whether the developmental period of exposure to racial discrimination can differentially affect the mental health of Aboriginal and Torres Strait Islander children.

This chapter was published in SSM – Population Health in December 2019. (210) The chapter which follows is a verbatim copy of the content from that published manuscript with the exception of minor modifications for readability. A copy of the typeset manuscript is available in Appendix 1 (Page 258) and online supplementary materials are available within this typeset manuscript.

7.2 Abstract

Background: Racial discrimination has been observed to negatively impact on the health of Aboriginal and Torres Strait Islander children, although evidence surrounding periods of greater sensitivity to the stressor of racism have not yet been explored in this population. We compared first exposure to interpersonal racism at either ages 4-5 years or 7 years with no exposure to examine the influence of sensitive periods of racism exposure on mental health and physiological outcomes during middle childhood (7-12 years).

Methods: The study cohort comprised 1,759 Aboriginal and Torres Strait Islander children aged 4-12 years from waves 2-8 (2009-2015) of the *Footprints in Time: The Longitudinal Study of Indigenous Children* (LSIC) dataset. Multilevel logistic regression was used in all analysis.

Results: We observed a larger effect (OR: 2.8; 95% CI: 1.4-5.4) for negative mental health with first exposure at 4-5 years compared to 7 years (OR: 2.1; 95% CI: 1.2-3.6), referenced to children with no exposure. Effect sizes were similar in both exposure groups for the significantly increased risk of sleep difficulties, while a stronger adverse effect on behavioural issues was found at 7 years (OR: 2.2; 95% CI: 1.3-4.0) relative to 4-5 years (OR: 1.7; 95% CI: 0.8-3.7). No significant associations were found with general health, obesity, or being underweight.

Conclusion: This study generates new evidence surrounding sensitive periods of exposure to racism in Aboriginal and Torres Strait Islander children. A pattern of consistently greater adverse effects on mental and physiological health was not observed with first exposure at 4-5 compared to 7 years, although initial evidence indicates that first exposure to racism at these ages increases the likelihood of negative mental health relative to children without racism exposure. Longitudinal data extending from earlier to later developmental periods will allow further investigations into the presence of sensitive periods of exposure to racism in these children.

7.3 Background

Racism is a modifiable and direct determinant of negative health outcomes which contributes to population health disparities, (3, 10, 58-62) including those observed between First Nations and non-First Nations populations worldwide. (121, 211, 212) Despite this, developing effective public health responses to racism remains an ongoing challenge. (213-215) Targeted responses are particularly vital during childhood as the early years are understood to present a critical period of health vulnerability resulting from adversity and stress. (65, 66, 216) The stressor of racial discrimination has been shown to generate greater adverse effects on health during this early developmental period compared with exposure during adolescence or adulthood. (8, 9, 64) While interventions to reduce prejudice in early childhood have shown some promise, effective strategies to address this complex issue remain elusive. (217) Examining developmental trends in

the health risk of racism among First Nations children can potentially inform the content and timing of important public health initiatives to address this critical stressor in highly exposed population groups.

The aetiological pathways between racism and health outcomes have been closely examined, although predominantly in cross-sectional studies of adult populations. (4, 67) Interpersonal racism is known to have a significantly negative impact on myriad health outcomes, with stronger and more consistent effects reported for mental health as opposed to physical health. (3, 4, 6-8, 13, 63, 84) Racism impacts health and wellbeing through initiating physiological dysregulation, maladaptive psychological responses, or changes in health behaviour such as disturbed sleep patterns or substance use. (4, 7, 63) Longitudinal studies have shown weaker associations between racism and negative mental health outcomes compared with cross-sectional studies, suggesting that the impact of racism on negative mental health may attenuate over time. (4, 8) While this provides perspective on the duration of racism's impact, it does not account for the age of study populations or the relative impact of racism exposure during different developmental periods. Studies that examine how this association may differ according to the age of first exposure to racism in a longitudinal cohort of children have not yet taken place.

Children have demonstrated the ability to conceptualise and perpetuate racial prejudice, recognising discriminatory behaviour from age 5 years (218) and enacting prejudice from ages 2-4 years, with a peak in middle childhood (5-7 years). (219) More specifically, in the context of Australian Aboriginal and Torres Strait Islander groups, children aged 8-12 years have demonstrated an awareness of racist acts and described the onward impact of these acts on their health and wellbeing. (124) The occurrence of racism in the lives of Aboriginal and Torres Strait Islander children is well documented (97, 123, 162-165) and evidence has begun to be generated on the negative impact of racism on Aboriginal and Torres Strait Islander child health and wellbeing outcomes. (97) Despite this, no studies have yet examined whether sensitive periods of exposure to racism are present for Aboriginal and Torres Strait Islander children – that is, whether these children are more adversely affected by the negative health effects of racism exposure during certain developmental periods. This is partly due to the paucity of datasets able to examine the timing of exposures and outcomes across childhood, including prospective cohort studies.

This study undertakes one of the first examinations of the impact of timing of exposure to racial discrimination, (11, 101, 105-107) using a prospective national longitudinal cohort study of Aboriginal and Torres Strait Islander children aged 4-12 years. We expected that Aboriginal and Torres Strait Islander children first exposed to direct racial discrimination at an early age (4-5 years) will have an increased risk of negative physical and mental health outcomes relative to both those first exposed during middle childhood (7 years) and those never exposed.

7.4 Methods

Footprints in Time: The Longitudinal Study of Indigenous Children (LSIC) is a prospective national longitudinal cohort survey of Aboriginal and Torres Strait Islander children designed to track their development in the context of their sociodemographic background. (141) LSIC used a multi-stage clustered sampling method across 11 sites to recruit a non-representative national sample of Aboriginal and Torres Strait Islander children across two age cohorts. LSIC aimed to recruit 5-10% of the total Australian population of Aboriginal and Torres Strait Islander children aged 0.5-2 years in the 'younger cohort' and 3.5-5 years in the 'older cohort' at baseline (2008). The survey conducts annual face-to-face interviews with the study child and their primary caregiver. The sample came to 1,671 children at baseline, with a further 88 children recruited at wave 2 culminating in a total sample of up to 1,759 children. Full details of the rationale, sampling, recruitment, and data collection have been reported elsewhere. (142)

7.4.1 Participants

Study participants include children aged 6 months to 12 years from the first 8 waves of LSIC. From a total sample of 1,759, 1,255 children remained by wave 8 (75% retention). The sample is broken into a younger and older cohort, with 1,010 respondents in the younger cohort and 749 in the older cohort.

7.4.2 Measures

7.4.2.1 Predictor variable

Throughout waves 2-7 of LSIC, primary carers were asked whether the study child had been bullied or treated unfairly at preschool or school by children or adults because they are Aboriginal or Torres Strait Islander. This direct racism measure was coded as a binary variable for analysis ('Yes, bullied [kids being mean to him/her]', 'Yes, treated unfairly [adult being mean to him/her]' or 'Yes, both bullied and treated unfairly' compared with 'No'). In wave 8, the structure of the question was changed slightly so that the primary carer was first asked whether the study child had been bullied or treated unfairly at school and if they responded positively to this question (study child was bullied, treated unfairly or both), they were then prompted to indicate whether this was because the study child is Aboriginal or Torres Strait Islander. Carer responses of 'always for this reason' or 'sometimes for this reason' were categorised as a child that had been bullied or unfairly treated due to being Aboriginal or Torres Strait Islander. The mean age of children at each wave in each cohort was then used to assign an age at which the direct racism measure was first responded to. First exposure was recorded at 4, 5 and 7 years; this was then collapsed into two exposure age categories, 4-5 years and 7 years. First exposure was limited to 4-7 years to ensure minimal overlap with the age range at which outcome variables were assessed (7-12 years). First exposure was recorded for children whose primary carer reported direct racism exposure at each age, excluding those who reported racism exposure at any previous age.

7.4.2.2 Outcome variables

Health outcomes included within this analysis were categorised as either mental health and behavioural issues or physical health. All outcomes were categorised into binary variables for analysis. All outcomes were taken from wave 8 except sleep difficulties which was last asked in wave 7.

Mental health and behavioural issues

Mental health and behavioural outcomes included measures of child mental health, sleep difficulties, and behavioural issues at school. Child mental health status was determined by primary carer responses to the Strengths and Difficulties Questionnaire (SDQ), a measure of emotional and behavioural difficulties in children aged 4-17 years which provides a score ranging from 0-40. Total difficulty scores were categorised into abnormal (17-40), borderline (14-16), and normal (0-13) based on cut-off scores derived from community-based samples of children. (182) In this study, scores of 14-40 (combining borderline and abnormal) were used to indicate an increased risk of mental health problems. Study children were considered to be experiencing sleep difficulties when the primary carer reported they usually had trouble getting to sleep or staying asleep over the past month. Study children were deemed to have behavioural issues at school where primary carers reported that the school had contacted them because their child had behaved badly at school in the last twelve months.

Physical health

Physical health outcomes included indicators of general health, obesity, and being underweight. General health was coded as positive if the study child's health was indicated to be 'excellent', 'very good', or 'good' by the primary carer and coded as negative where their health was indicated to be 'fair' or 'poor'. Children's height and weight were translated into Body Mass Index (BMI)-for-age z-scores and then classified as obese or underweight based on WHO guidelines. Underweight was indicated by BMI-for-age z-scores below 2. Obesity was indicated by BMI-for-age z-scores above 2. (142)

7.4.2.3 Covariates

Community variables

The Level of Relative Isolation (LORI) measure was used as an index for remoteness levels within Australia. LORI uses five categories of isolation; none (e.g. metropolitan areas), low, moderate, high, and extreme (e.g. remote communities). Within LSIC, respondents in the 'high' and 'extreme' categories have been collapsed into one item – 'high/extreme isolation' – due to small sample size. The Index of Relative Indigenous Socioeconomic Outcomes (IRISEO) was used as an indicator of community level socio-economic outcomes. IRISEO is a ranked scale based on the employment, education, income, and housing

characteristics of Aboriginal and Torres Strait Islander peoples from Indigenous Areas across Australia. (169) IRISEO data from wave 1 of LSIC has been refined into quintiles for this analysis.

Primary carer variables

LSIC primary carers were asked to indicate the highest qualification they had completed. This measure was coded into a four-item variable including university-level education, certificate or post-school qualifications, completion of Year 11 to Year 12 or equivalent, and Year 10 completion or less. A five-item subjective rating of the family financial situation was coded into a binary variable for analysis, with families considered to be in financial difficulty if they answered, 'We run out of money before payday', 'We are spending more money than we get', 'We have just enough money to get us through to the next pay day', or 'There's some money left over each week but we just spend it'; responses of 'We can save a bit every now and then' or 'We can save a lot' were coded as not being in financial difficulty. Prior experience/s of homelessness were recorded from all primary carers in wave 3 based on whether there had been any times in the last five years when they did not have a place to live; homelessness was indicated for those that responded 'Yes, many times', 'Yes, a few times' or 'Yes, once'.

Child variables

Primary carers reported the study child's age and gender at each wave. Child age at wave 8 was collapsed into three categories: 7-8, 9-10, and 11-12 years.

7.4.3 Data analysis

Ordinal logistic regression was used to determine independent associations between the covariates and age of first exposure to racism. Two logistic regression models were then defined and fitted using the generalised linear mixed modelling (GLMM) framework to determine associations between age of first exposure to racism and health outcomes: the first model adjusted for child age and gender (model 1); the fully adjusted model (model 2) included child age and gender, geographic remoteness, area-level socioeconomic status, and family-level socioeconomic status (primary carer reported highest education completed, financial difficulty and prior homelessness). A randomised cluster variable was developed within LSIC to identify respondents living in close geographic proximity and to overcome bias introduced by the sampling method. (142) This variable was used as the grouping variable in random effects modelling. Models were fitted using PROC GLIMMIX in SAS (version 9.4, SAS Institute Inc., Cary, NC, USA, 2002-12) using compound symmetry as the covariance structure. Adaptive Gaussian quadrature methods were chosen as they have been shown to perform well with minimal bias when estimating the fixed effects of a GLMM for binary outcome clustered data where there are sufficient numbers of observations per random effect. (187)

7.4.4 Missing data

The predictor, outcome, and covariate variables all contained a proportion of non-responses (missing data). Multiple imputation was used as a sensitivity analysis to determine the influence of missing data on parameter estimates. Cohort (younger or older) and number of major events experienced in the last year were used as auxiliary variables to assist with the prediction of missing data. Multilevel multivariate normal imputation with joint modelling was then conducted, generating 100 imputed datasets. Adaptive rounding was pursued on imputed datasets because model variables were either binary or categorical, although this did not return realistic data in all cases. Linear mixed effects models were then run on unrounded imputed data and pooled parameter estimates were then compared against estimates from complete case analysis (see supplementary materials within Appendix 1 of this thesis, Page 263). These analyses were conducted using the 'mitml' package (159) in R studio (Version 1.2.1335 - © 2009-2019).

7.4.5 Ethics

Ethics approval for the LSIC was provided by the Australian Commonwealth Department of Health Departmental Ethics Committee and from state and territory Ethics Committees. The current analysis was approved by the Western Australian Aboriginal Health Ethics Committee and the University of Western Australia Human Research Ethics Committee.

7.5 **Results**

In the full sample the mean age of respondents was 2.4 years (SD: 1.6; age range: 0-6 years) at wave 1 and 9.3 years (SD: 1.5; age range: 7-12 years) by wave 8. Overall, 887 (50.4%) study children were male and 872 (49.6%) were female, 1,534 (87.2%) study children were Aboriginal, 117 (6.7%) were Torres Strait Islander, and 108 (6.1%) were both Aboriginal and Torres Strait Islander. First exposure to racial discrimination at 4-5 years was reported for 6.9% of the in-scope study sample and first exposure at 7 years was reported for 8.3% of children. By 7-12 years, 17% of study children were reported to have negative mental health or behavioural issues at school, 18% of children were obese, 4% were underweight, and 3% of children were identified as having fair or poor general health. At 6-11 years, 21% of children were reported to have experienced difficulty sleeping.

After adjustment for all covariates, having a primary carer experience homelessness in the previous five years increased the odds of being first exposed to racism at age 7 by 1.9 times compared with being first exposed at age 4-5 and never being exposed (OR: 1.9; 95% CI: 1.1-3.2) (Table 7.1). No other sociodemographic factors increased the odds of first exposure to racial discrimination.

Overall, first exposure to racial discrimination at 4-5 years did not consistently increase the risk of mental and physical health outcomes relative to children first exposed to racism at age 7 (Table 7.2). Positive associations were observed between first exposure to direct racial discrimination at 4-5 and 7 years and

each outcome related to mental health. In the fully adjusted model, statistically significant effects for negative mental health and sleep difficulties were seen in study children with first exposure to direct racism at 4-5 years and 7 years compared with those not exposed to racism. Risk for negative mental health was higher for children exposed at 4-5 years (OR: 2.8; 95% CI: 1.4-5.4) compared with those exposed for the first time at 7 years (OR: 2.1; 95% CI: 1.2-3.6). Study children were found to be at similar risk of sleep difficulties at 6-11 years when exposed to racism at 4-5 years (OR: 2.1; 95% CI: 1.1-4.3) and 7 years (OR: 2.2; 95% CI: 1.4-3.7) compared to those not exposed to racism. Study children with first exposure to direct racism at 7 years had 2.2 times the risk of behaviour issues at school (95% CI: 1.3-4.0; fully adjusted model) when compared with those not exposed; while a smaller effect was seen for first exposure at 4-5 years for this outcome (OR: 1.7; 95% CI: 0.8-3.7). A reparameterization of the model (results not otherwise shown) indicated that children with first exposure at 7 years had 1.3 times the risk of behavioural issues relative to those first exposed at 4-5 years (95% CI: 0.5-3.3).

No discernible effects were evident for general health in either the basic or fully adjusted model. We observed significant effects for being underweight (OR: 2.9; 95% CI: 1.1-7.6) and obesity (OR: 2.1; 95% CI: 1.2-3.6) in children with first exposure at age 7 in the model adjusted for child age and gender, although these effects were attenuated in the fully adjusted model. In this model, we continued to observe an increased risk for children being underweight in both those first exposed to racism at 4-5 years (OR: 2.5; 95% CI: 0.7-9.3) and 7 years (OR: 2.2; 95% CI: 0.7-7.2) compared with those not exposed, although these estimates were imprecise. Smaller effects were also observed for obesity, with imprecise estimates seen for those first exposed at 4-5 years (OR: 1.2; 95% CI: 0.6-2.7) and marginally significant effects seen for those first exposed at 7 years (OR: 1.8; 95% CI: 1.0-3.2) compared with those without racism exposure.

Analysis using imputed datasets resulted in pooled estimates for each outcome that were similar to estimates from complete case analysis. Pooled estimates fell within confidence intervals from complete case analysis and confidence intervals from both analyses overlapped considerably. All significant associations between racial discrimination and health outcomes found in complete case analysis were also found in analysis of imputed datasets.

7.6 Discussion

This study investigated whether the effect on health outcomes at 7-12 years differed by the age of first exposure to direct racism at school, thereby offering a novel method to understand how sensitive periods of exposure to racism influence later mental and physical health outcomes. We found limited evidence to support our expectation that first exposure to direct racial discrimination at a younger age (4-5 years) would pose an increased risk of later negative mental and physical health outcomes compared to first exposure at an older age (7 years). An increased risk of negative mental health was observed for first

exposure at 4-5 years relative to 7 years, after adjustment for all covariates, though this relationship was not seen across other outcomes.

Overall, children with a first exposure to racism at either 4-5 or 7 years had a moderately increased likelihood of experiencing the negative mental health and weight-related outcomes under examination relative to children who were not exposed to racism. However, the effect estimates were imprecise for weight-related outcomes and behaviour issues at school with first exposure at 4-5 years in the fully adjusted model. The negative impact of racism on health in both First Nations and Australian Aboriginal and Torres Strait Islander populations is well established. (121, 211, 212) Our study confirms that this impact is apparent early (ages 7-12) when first exposure of racism occurs at 4-5 and 7 years of age. Evidence supporting the heightened physiological and psychological sensitivity to adverse environments during early development is indisputable. (220-223) Similar patterns of increased sensitivity have been found with exposure to interpersonal racism as a stressor, though these are based on broad comparisons between child and adolescent or adult periods of exposure. (8, 9, 64) While the more granular periods of exposure examined within our study allowed closer investigation of the impact of first exposure to racism during childhood, we did not find evidence for differential effects on health from racism exposure earlier in childhood. This may be due in part to the small proportion of children with first exposure at these young ages. While children can recognise and enact discriminatory behaviour based on racial prejudice from age 5, awareness of this discrimination increases as children age, becoming more consistently detected by 8-10 years. (218) Concomitantly, the children in this study were 7 years or less at the time of collecting information on racial discrimination and may have had a lesser capacity or inclination to articulate and/or disclose their experiences. These factors, collectively, may have contributed to the small proportions reporting exposure and the resulting imprecision of estimates observed for some outcomes. Differences in the duration and frequency of racism exposure at each age also likely influence the impact of racism on health, though these aspects of racism exposure were unmeasured in this study. Larger longitudinal datasets incorporating time-limited measures of racism (e.g. exposure within previous 12 months) which capture the duration, frequency, and context of racism exposure throughout childhood will allow for analysis that can more accurately confirm the presence of sensitive periods of exposure to racial discrimination during early development.

We observed an increased risk of negative mental health in children with first exposure to direct racism at 4-5 years compared with those first exposed at 7 years. Our findings align with the strong associations found between racism and negative mental health outcomes in adult and adolescent populations, and provide a unique insight into the impact of racism exposure during childhood. (7-9, 63) Environmental stressors are understood to increase the risk of negative mental health via the disturbance of neurobiological systems implicated in stress responses and emotional regulation. (65, 223) Exposure to stress early in life can reduce neurological adaptability to later difficulties, resulting in patterns of behaviour

that characterise a range of mental health disorders. (223) It is likely that changes in neural plasticity throughout development lead to different mental health responses to external stressors and that the nature and severity of the stressor also influences this response. However, sensitive periods of exposure to racial discrimination as a stressor are currently underexamined, particularly during childhood. Where the strength of this association has been compared across adolescent developmental periods, the positive association between emotional and behavioural difficulties and racial discrimination has been shown to be stronger in early rather than late adolescence. (9) Although our study found a similar pattern during childhood, it is clear that complex intersections between the neurological, environmental, and genetic factors which influence associations between racism and mental health outcomes must still be addressed. It is also important to note that resilience to racism as an early life stressor is among the potential outcomes of exposure. Integrating psychometric and neurobiological outcome data within the context of broader environmental and genetic factors may better identify sensitive periods of exposure to the negative mental health effects of racism.

In contrast to findings for the association between early exposure to racial discrimination and mental health, we saw that children first exposed to direct racism at a later age (7 years) were at an increased risk of behavioural issues at school and that there was minimal difference in the effect size of associations with sleep difficulties by age of first exposure. Emotional and behavioural difficulties are known to co-develop throughout childhood (224) and racial discrimination has been found to have a strong and consistent association with behavioural issues during childhood and adolescence, equal to the association with negative mental health outcomes. (7) Our preliminary evidence for a stronger adverse effect at 7 years adds to these earlier findings, although a lack of statistical precision meant that we did not find a significant difference in the likelihood of behavioural issues for those first exposed at 7 years relative to 4-5 years. The stronger adverse effect at an older age may be due in part to the later expression of behavioural issues at school after an earlier experience of negative mental health, particularly as the measure under investigation captured only behavioural issues severe enough to result in the school contacting a parent or carer. In contrast, children with first exposure to racial discrimination during the earliest years of school were at significantly increased risk of sleep difficulties and there was minimal difference in the effect size of these associations with age. This may be explained in part by the links between sleep difficulties and both emotional and behavioural difficulties in children, (202) leading to strong associations at both younger and older ages. Overall, the contrast between these two observations may reflect different mechanisms underlying the association between racism and behavioural compared to mental health outcomes, particularly given the early developmental period under investigation. This finding strengthens the need to examine the longitudinal association between behavioural and mental health outcomes and racial discrimination in children as they move from early to late childhood and into adolescence.

We provide tacit evidence that first exposure to racism at either 4-5 or 7 years poses an increased likelihood of being underweight or experiencing obesity, although our expectation that first exposure at 4-5 years would increase the risk of later obesity or underweight status compared to first exposure at age 7 was not supported in this cohort of Aboriginal and Torres Strait Islander children. Estimates for obesity in this study reflect those observed between obesity and racial discrimination exposure in Aboriginal and Torres Strait Islander children aged between 5-10 years. (97) Weight-related outcomes may be more consistently influenced by the timing of exposure to racial discrimination during later childhood (8-11 years) or by repeated exposures throughout childhood. In the current study, age of first exposure to racism was limited to 4-7 years to reduce overlap with the ages at which outcome measures were recorded (7-12 years). However, longitudinal data which captures data from respondents across a broader age range (incorporating adolescence) would allow sensitive periods of exposure to racism to be examined more fully.

This study contributes to examinations of the impact of racial discrimination on the health of Aboriginal and Torres Strait Islander children by developing a novel exposure variable – age of first exposure – to explore sensitive periods of exposure to racism. To our knowledge, no other published study has examined age of first exposure to racism in Aboriginal and Torres Strait Islander children or characterised the health impacts of first exposure at different ages. As a prospective cohort study, the LSIC allows for an examination of temporal exposure variables which would not be possible within a cross-sectional study design. Alongside these strengths, a number of limitations should also be considered when interpreting our findings – principally related to the racism exposure variable. The exposure variable for racism in this study was based on the perceptions of primary carers, not the study children themselves. While primary carers were asked to report on the experiences of study children, these reports may not reflect the perceptions of racism in study children. There was a risk of respondent bias where primary carers also provided reports of outcome variables (i.e. mental health [SDQ], sleep difficulties and general health). In these cases, carers' assessments of racism and mental or physical health outcomes in children may have tended towards being uniformly positive or negative, whether consciously or not. The racism exposure variable was not time-limited and did not account for the frequency or severity of racism exposure. These factors reduce the sensitivity of this exposure as children with an array of experiences with racism were unable to be differentiated. Finally, despite the strength of the LSIC as a prospective cohort study, the sampling design was non-random due to practical and logistic considerations in site selection. As a result, the sample of study children in LSIC is not nationally representative of the population of Aboriginal and Torres Strait Islander children across Australia, although the sites selected for the study were intended to reflect the geographic distribution of Aboriginal and Torres Strait Islander children within Australia and the varied environments in which these children live. (142)

7.7 Conclusion

This study generates new evidence surrounding the impact of age of first exposure to racism on mental and physical health outcomes in Aboriginal and Torres Strait Islander children. We provide further evidence that racial discrimination places Aboriginal and Torres Strait Islander children at a moderately increased risk of negative mental and physical health outcomes, with no evidence to suggest that these risks are consistently higher for first exposure at 4-5 years than 7 years across all the health outcomes under investigation. Although we did not observe consistently different health effects of racism with exposure at 4-5 and 7 years, exposure during this period of childhood may still be heightened compared to exposure in older childhood and adolescence. Examining longitudinal data which also captures these later developmental periods will assist in determining the presence and timing of sensitive periods of exposure to racism. Additionally, study designs and analytic models should integrate validated psychometric and biological outcomes alongside psychosocial covariates including cultural identity, social support, and resilience where possible to ensure that the complex intersections between racism, health, and environment are accounted for. Ultimately, this work can inform the timing of important public health initiatives to address the critical stressor of racism in highly exposed population groups.

Table 7.1: Distribution and multivariate associations between age of first exposure to direct racial discrimination and selected socio-demographic characteristics in Aboriginal children

Variables	Age of first exposure to bullying or unfair treatment due to child being Aboriginal			
	4-5 years % (n)	7 years % (n)	No exposure % (n)	Adjusted OR ¹ (95% CI)
Gender of child				
Male	45.2 (47)	48.4 (61)	51.3 (657)	Ref
Female	54.8 (57)	51.6 (65)	48.8 (625)	1.11 (0.79-1.57)
Age of child (years)				
7-8	41.4 (43)	54.8 (69)	37.7 (483)	-
9-10	10.6 (11)	16.7 (21)	13.9 (178)	-
11-12	48.1 (50)	28.6 (36)	48.4 (621)	-
Level of relative isolation				
None	25.6 (23)	38.0 (46)	26.7 (325)	Ref
Low	35.6 (32)	40.5 (49)	50.8 (619)	0.79 (0.50-1.26)
Moderate	25.6 (23)	9.9 (12)	13.5 (165)	1.08 (0.56-2.06)
High	13.3 (12)	11.6 (14)	9.0 (110)	1.04 (0.49-2.18)
Index of relative Indigenous socioeconomic outcomes				
Quintile 5 – most advantaged	16.5 (15)	21.3 (26)	14.3 (175)	Ref
Quintile 4	14.3 (13)	13.1 (16)	16.0 (195)	0.71 (0.39-1.30)
Quintile 3	28.6 (26)	36.9 (45)	42.0 (513)	0.74 (0.41-1.31)
Quintile 2	15.4 (14)	15.6 (19)	16.1 (197)	0.90 (0.47-1.72)
Quintile 1 – most disadvantaged	25.3 (23)	13.1 (16)	11.6 (142)	1.56 (0.74-3.30)
Primary carer highest education completed				
Never attended school to Year 10	33.3 (33)	42.5 (51)	43.5 (504)	Ref
Year 11/12	43.4 (43)	31.7 (38)	32.2 (374)	1.32 (0.89-1.96)
Diploma or Certificate	17.2 (17)	22.5 (27)	18.0 (209)	1.39 (0.87-2.22)
University	6.1 (6)	3.3 (4)	6.3 (73)	0.87 (0.37-2.06)
Financial difficulty				
Save a lot/save a bit every now and then	31.8 (28)	29.7 (35)	36.5 (429)	Ref
Some money left/just enough to get through	39.8 (35)	50.0 (59)	46.1 (541)	1.19 (0.81-1.76)
Spending more than we get/run out of money	28.4 (25)	20.3 (24)	17.4 (204)	1.34 (0.83-2.18)
Primary carer experienced homelessness				
No	86.8 (72)	85.6 (95)	92.6 (1011)	Ref
Yes	13.3 (11)	14.4 (16)	7.4 (81)	1.87 (1.10-3.18)

¹Odds ratios are adjusted for all variables that appear in the table excluding child age.

Table 7.2: Multivariate models examining association between age of first exposure to direct racial discrimination and mental and physical health outcomes in Aboriginal children

	Model 1		Model 2	
	β	Adjusted OR (95% CI)	β	Adjusted OR (95% CI)
Mental health				
No exposure	Ref	...	Ref	...
First exposure age 4-5 years	0.54	1.72 (0.96-3.08)	1.01	2.76 (1.42-5.40)
First exposure age 7 years	0.57	1.77 (1.08-2.89)	0.75	2.11 (1.23-3.62)
Sleep difficulties				
No exposure	Ref	...	Ref	...
First exposure age 4-5 years	0.35	1.43 (0.77-2.65)	0.75	2.13 (1.06-4.25)
First exposure age 7 years	0.74	2.09 (1.31-3.32)	0.79	2.20 (1.33-3.66)
Behaviour issues at school				
No exposure	Ref	...	Ref	...
First exposure age 4-5 years	0.46	1.58 (0.84-2.96)	0.52	1.68 (0.77-3.67)
First exposure age 7 years	0.56	1.74 (1.04-2.92)	0.80	2.22 (1.25-3.95)
General health				
No exposure	Ref	...	Ref	...
First exposure age 4-5 years	0.003	1.00 (0.23-4.36)	0.18	1.20 (0.26-5.59)
First exposure age 7 years	-0.25	0.78 (0.18-3.37)	-0.07	0.94 (0.21-4.17)
Underweight				
No exposure	Ref	...	Ref	...
First exposure age 4-5 years	0.78	2.19 (0.73-6.54)	0.92	2.50 (0.67-9.31)
First exposure age 7 years	1.07	2.91 (1.12-7.57)	0.78	2.18 (0.66-7.22)
Obesity				
No exposure	Ref	...	Ref	...
First exposure age 4-5 years	0.31	1.36 (0.71-2.61)	0.21	1.23 (0.55-2.74)
First exposure age 7 years	0.74	2.10 (1.21-3.63)	0.57	1.76 (0.96-3.22)

Chapter 8: The social determinants of mental health in Aboriginal and Torres Strait Islander children: A latent class analysis

8.1 Preface

The systematic review undertaken in Chapter 2 highlighted that analytic models examining the association between racial discrimination and mental health should integrate broader ecological factors from the individual-level, family-level, and neighbourhood-level to ensure that the complex intersections between racism, health, and environment are accounted for. This chapter responds to this recommendation by conducting a latent class analysis (LCA) using data from *Footprints in Time: The Longitudinal Study of Indigenous Children* (LSIC) 2017.

This chapter presents the first study responding to the thesis objective to examine the contribution of racial discrimination to physical and mental health outcomes in Aboriginal and Torres Strait Islander populations, within the context of broader ecological factors. LSIC data are used to identify subpopulations of Aboriginal and Torres Strait Islander children aged 12-14 years defined by various social determinants at the individual, family, and area-levels, including interpersonal racial discrimination. Mental health status is then predicted based on Aboriginal and Torres Strait Islander children's membership in the identified subpopulations. The purpose of this chapter is to examine how mental health differs among subgroups of Aboriginal and Torres Strait Islander children when racial discrimination is incorporated alongside the various social determinants of health defining these subgroups. Specifically, this chapter sought to determine how racism acts to influence mental health within the complex landscape of a child's social environment, acknowledging the critical role of other life stressors and accounting for social determinants within the family and environment surrounding the child. The supplementary materials intended for submission with this manuscript are available in Appendix 5 (Page 328).

8.2 Abstract

Background: Racial discrimination is a critical social determinant of health which acts alongside other determinants to shape child and adolescent mental health. This chapter employs latent class analysis to examine how racial discrimination accounts for variability in the mental health of Aboriginal and Torres Strait Islander children within the context of several wider determinants of health, identifying and comparing population subgroups characterised by these determinants.

Methods: We conducted latent class analysis (LCA) using a social determinant of health framework that included indicators of racial discrimination, bullying, area-level disadvantage, geographic remoteness, police contact, parental education, and family financial stress from Aboriginal and Torres Strait Islander children aged 12-14 years within *Footprints in Time: The Longitudinal Study of Indigenous Children* (LSIC) 2017 (N=498). We used LCA with distal outcomes to predict mental health status from latent class membership using the child-reported total difficulties score from the Strengths and Difficulties Questionnaire (SDQ).

Results: Our social determinant measures informed a six-class structure: 'Metropolitan, higher SES areas' (24.5%); 'Suburban/regional, mid SES areas' (37.2%); 'Bullying exposure, financial stress' (10.7%); 'Remote, lower SES areas' (16.1%); 'Majority males, multiple stressors' (5.3%); and 'High bullying exposure, multiple stressors' (6.2%). The 'High bullying exposure, multiple stressors' class (17.1; 95% CI: 14.8, 19.4) and the 'Majority males, multiple stressors' class (17.0; 95% CI: 13.9, 20.2) had statistically significant higher mean SDQ total difficulties scores compared with all other classes and both included the highest proportion of Aboriginal and Torres Strait Islander children reporting high exposure to personal racism ('High bullying exposure, multiple stressors': 39.3%; 'Majority males, multiple stressors': 41.7%).

Conclusion: Most Aboriginal and Torres Strait Islander children fall into population subgroups predictive of positive mental health which are characterised by few psychosocial or environmental stressors. However, a minority of Aboriginal and Torres Strait Islander children with high exposure to personal racism were highly represented in subgroups characterised by several overlapping psychosocial stressors and limited family financial resources which are predictive of adverse mental health. Strategies aiming to alleviate mental health risk among Aboriginal and Torres Strait Islander children must recognise and address the interdependence of multiple factors, including interpersonal racial discrimination and other prominent social determinants driven by structural racism.

8.3 Background

Racial discrimination refers to the attitudes and beliefs held towards different racial/ethnic populations within social systems, whereby value, capacity, and power is ascribed according to racial/ethnic background. (1) Manifestations of racial discrimination are as varied as the social conditions, interpersonal

interactions, and ideologies encompassed within the discriminatory systems which perpetuate it. (14) The effects of racial discrimination may be felt at the structural level, where discriminatory practices occur within social, political, and economic systems, at the interpersonal level, where racially discriminatory overt or covert language and behaviour occurs directly between individuals, and internally within individuals, where negative stereotypes or ideologies about racial/ethnic groups are integrated within the psychology of individual members of those groups. (225) The current study will focus on exposure to interpersonal racial discrimination as a psychosocial stressor which has known links to the mental and physical health of ethnic/racial minority populations worldwide. (4) The effects of interpersonal racial discrimination on adverse mental health outcomes can manifest early in life during childhood and adolescence, including in Aboriginal and Torres Strait Islander child and adolescent populations in Australia. (97, 125, 126, 164, 171, 210, 226, 227)

Interpersonal racial discrimination is a critical social determinant of health. (228) As such, interpersonal racial discrimination acts alongside other adverse social determinants, including physical environments, psychosocial factors, and early life stressors, to shape child and adolescent mental health. (229-231) It is important to emphasise that structural racism is a common cause of both interpersonal racial discrimination and adverse social determinants of health such as area-level disadvantage, increased police attention, and limited educational opportunities. Higher levels of exposure to adverse social determinants of health can occur because of structural racism within economic, political, and social systems, just as interpersonal racial discrimination can occur because of ideologies supported and reinforced by structural racism. Both downstream factors can interact with and influence one another to drive the changes in emotional and behavioural symptomology which result in the development of adverse mental health during childhood and adolescence. Examining patterns of exposure to these factors can help identify the social determinants which prompt, facilitate, or constrain the development of social and emotional wellbeing in Aboriginal and Torres Strait Islander children and adolescents. (231) Identifying the social determinants which are present (or absent) for those with strong social and emotional wellbeing and for those at risk can inform child and adolescent mental health advocacy and practice which takes broader ecological and psychosocial factors into account. This is an appropriate approach for Aboriginal and Torres Strait Islander child and adolescents, where the effects of structural racism drive exposure to multiple social determinants of health.

Various analytic approaches can incorporate contextual variables beyond racial discrimination to examine mental health. Variable-centred approaches such as regression and structural equation modelling are suited to quantifying the role of specific variables, (232, 233) while person-centred analyses describe population heterogeneity by identifying similarities and differences across individuals according to a set of characteristics or response patterns. (234) Person-centred analysis generally has greater applicability for social policy and service design than many variable-centred analyses. (234) This analytic approach not only

identifies population groups at increased risk of adverse outcomes which require additional resources, or specific issues within population groups which require tailored support, but it also helps shed light on the circumstances in which population groups are able to succeed and thrive. Models using a person-centred approach have been found to better capture the interplay between population characteristics, enabling researchers to explore how clusters or patterns of shared characteristics predict outcomes of interest. (235) The specific strengths and vulnerabilities of Aboriginal and Torres Strait Islander child and adolescent populations require population-specific analysis which accounts for the varied life circumstances of these individuals. Latent class analysis is one such technique which can be used to identify these shared characteristics or circumstances. (236)

Internationally, latent class analysis and latent profile analysis have been widely used as a method to examine the relationships between subgroups of children and adolescents and various mental health outcomes. (237-239) Studies in Australia have specifically provided unique evidence for the role of intersecting social determinants on outcomes relevant to the mental health of Aboriginal and Torres Strait Islander children and adolescents. (240, 241) Strobel and colleagues (2019) examined neurodevelopmental outcomes as an outcome in latent class analysis focused on population subgroups of Aboriginal and Torres Strait Islander children aged 5 years and below. (240) Area-level socioeconomic status, number of siblings, and maternal mental health contact, hospitalisations, and ED presentations were all observed to be concentrated in groups of Aboriginal and Torres Strait Islander children at risk of developmental vulnerability. (240) Hopkins and colleagues (2014) also used a person-centred approach to define subpopulations of Aboriginal adolescents 12-17 years in Western Australia by cross-classifying psychosocial functioning with exposure to family risks predictive of poor psychosocial functioning, deriving an outcome capturing resilient psychosocial status. (241) Racial discrimination was included as an individual factor and was observed to increase the risk of poor psychosocial functioning even in low family risk contexts. (241) Links between various social determinants and mental health outcomes have also been confirmed in Aboriginal and Torres Strait Islander child populations using variable-centred approaches, including neighbourhood disadvantage, (242) sociodemographic risk factors, (243) life stressors, (244, 245) intergenerational effects of trauma associated with forced removal, (246) peer relationships, and bullying. (175) Evidence gained from each of these studies lends weight to the integration of a social determinants approach and person-centred analysis in investigations of mental health in Aboriginal and Torres Strait Islander child and adolescent populations. However, mental health has not yet been examined as an outcome in latent class analysis for Aboriginal and Torres Strait Islander children or adolescents. Ensuring existing evidence informs the definition of population subgroups can strengthen analyses examining the link between social determinants and mental health.

This study undertakes the first examination of the role of interpersonal racial discrimination in the mental health of Aboriginal and Torres Strait Islander children aged 12-14 years within the context of various social

determinants of mental health—including those at the individual, family, and area-levels. A latent class approach is adopted to examine how mental health differs among these subgroups of Aboriginal and Torres Strait Islander children using a validated measure of emotional and behavioural difficulties.

8.4 Methods

Footprints in Time: The Longitudinal Study of Indigenous Children (LSIC) is a prospective national longitudinal cohort survey of Aboriginal and Torres Strait Islander children designed to track their development in the context of their sociodemographic background. (141) LSIC used a multi-stage clustered sampling method across 11 sites to recruit a non-representative national sample of Aboriginal and Torres Strait Islander children across two age cohorts. LSIC aimed to recruit 5-10% of the total Australian population of Aboriginal and Torres Strait Islander children aged 0.5-2 years in the 'younger cohort' and 3.5-5 years in the 'older cohort' at baseline (2008). The survey consists of annual face-to-face interviews with the study child and their primary caregiver. The sample came to 1,671 children at baseline, with a further 88 children recruited at wave 2 culminating in a total sample of up to 1,759 children. Full details of the rationale, sampling, recruitment, and data collection have been reported elsewhere. (142)

8.4.1 Participants

Study participants included children from the older cohort aged 12 to 14 years from wave 10 of LSIC. From the total sample of 1,759 children, 1,276 remained by wave 10, 514 of which were from the older cohort. There were 15 study children in the older cohort who were recorded as a 'non-responding person' and one child recorded as 'not asked of cohort' who did not provide responses to any survey items; these children were excluded from analysis. A final sample of 498 study children were included in final analysis (M age = 13.1, SD = 0.5; 50.5% female).

8.4.2 Measures

8.4.2.1 Outcome variable

Mental health status was determined by the study children's responses to the Strengths and Difficulties Questionnaire (SDQ), a measure of emotional and behavioural difficulties in children which provides a total difficulties score ranging from 0-40. Higher scores indicate greater emotional and behavioural difficulties. Mean SDQ scores were used in all analysis.

8.4.2.2 Racial discrimination

In wave 10, a series of 14 ordinal scaled items were introduced to the LSIC asking the study child how often they had experienced various discriminatory acts or gestures in the previous twelve months because they are Aboriginal and/or Torres Strait Islander, or how often they had witnessed unfair treatment directed towards other Aboriginal and/or Torres Strait Islander people. These items included how often

racial discrimination was personally experienced or witnessed by the study child (8 items), how often racial discrimination was enacted by teachers at the study child's school (4 items), and how often racial discrimination was observed in the news/media or on social media (2 items). Each item was scaled from 1 (Always) to 6 (Never). All items were examined together, and modelled to identify item factors and derive racism factor scales for inclusion in final analysis. Full details of the model fitting procedure have been provided in Appendix 5 of this thesis (Page 328). However, in brief, after removal of the items measuring racial discrimination in the news/media and social media due to disproportionate levels of "don't know" responses, principal components analysis and confirmatory factor analysis was run on the remaining twelve items. This analysis resulted in good definition for two extracted factors, accounting for 57.2% of the shared item variance. Proportionally adjusted item factor score regression coefficients were used to weight the original items to form a composite score for the two factors. The first factor comprised of the 4 items related to racism enacted by teachers and the second factor comprised of 5 of the items related to personal experiences of racial discrimination by the study child. We chose to proceed with the second factor comprised of items related to personal experiences of racial discrimination; referred to herein as 'personal racism'. Personal racism was dichotomised for analysis so that children whose score fell into the 90th percentile and above were categorised with 'high exposure to personal racism'.

8.4.2.3 Explanatory variables

A total of 12 explanatory variables were selected for inclusion in latent class analysis (LCA). These variables encompassed individual (n=6), family (n=4), and area (n=2) level characteristics (Table 8.1) and were selected to capture various social determinants of mental health informed by a child development approach. (231) All explanatory variables were included in the LCA model.

Individual level characteristics

Individual level characteristics included racial discrimination, substance use, bullying, social skills, and police contact. The racial discrimination measure has been described in detail above. Substance use was characterised by two self-reported measures indicating whether study children had smoked cigarettes or had drunk alcohol in the last twelve months. Study children who indicated that they had smoked or had drunk alcohol in the last twelve months were categorised as 'yes', while those categorised with a 'no' response included both those who had never tried cigarettes or tried alcohol and those who had tried cigarettes or alcohol but not in the previous twelve months. Bullying was derived from a question asked of the study child's primary carer about whether the study child had been bullied or treated unfairly at school (yes/no). If bullying or unfair treatment had occurred, primary carers were prompted to indicate whether this was because the study child is Aboriginal or Torres Strait Islander. Due to the overlap with our racial discrimination measures, we excluded cases where bullying or unfair treatment had occurred because the study child was Aboriginal or Torres Strait Islander. Social skills were characterised by the empathy subscale

of the Social Skills Improvement System Rating Scales (SSIS-RS) questionnaire, comprising six items self-reported by the study child (values 1-4 for a total score of 6-24). The total score was dichotomised, with those in the lowest decile regarded as having low empathy. Police contact was characterised using a categorical variable derived from three child-reported items: being charged with an offence by the police; told to 'move on', warned or cautioned by the police and; quizzed or questioned by the police. Study children were asked how often each of these had occurred in the last twelve month and responses were dichotomised to none/once or more. Children reporting that they had been charged with an offence were designated in the highest category (4), children who did not report being charged but had been told to 'move on', warned or cautioned were designated as '3', children who did not report being charged or told to 'move on' but who had been quizzed or questioned were designated as '2', and children with no police contact were designated as '1'.

Family level characteristics

Family level characteristics included primary carer-reported education and financial stress. Education was characterised by a single item asking primary carers to indicate the highest qualification they had completed. This measure was coded into a four-item variable including university-level education, certificate or post-school qualifications, completion of Year 11 to Year 12 or equivalent, and Year 10 completion or less. Financial stress was characterised using three items asking primary carers to indicate whether they were short of money for food, short of money for school activities, or whether they had received assistance from welfare organisations (yes/no).

Area level characteristics

Area level characteristics included area-level socioeconomic status and remoteness. Area-level socioeconomic status was characterised using the Index of Relative Indigenous Socioeconomic Outcomes (IRISEO). The IRISEO is a ranked scale based on the employment, education, income, and housing characteristics of Aboriginal and Torres Strait Islander peoples from Indigenous Areas across Australia. (169) Indigenous Areas are geographic units comprised of one or more Indigenous Locations, generally representing small urban and rural Aboriginal and Torres Strait Islander communities. (247) The IRISEO was collapsed into quintiles for analysis. Remoteness was characterised using the Level of Relative Isolation (LORI) measure. LORI uses five categories of isolation: none (e.g. metropolitan areas), low, moderate, high, and extreme (e.g. remote communities). Within the LSIC, respondents in the 'high' and 'extreme' categories have been collapsed into 'high/extreme isolation' due to small sample size.

8.4.2.4 Covariates

Child age and gender were included as covariates in latent class analysis models. Age was a continuous measure of the study child's age in single years. Gender was categorised as female/male with male as the reference category.

8.4.3 Data analysis

Initial exploration for item suitability for scaling was undertaken in SPSS (Version 24). Preliminary analysis was run to determine the mean, standard deviation, and confidence intervals for personal racism and SDQ total difficulties scores, and to estimate percentage distributions of explanatory variables. Linear regression models adjusted for age and gender were used to test associations between explanatory variables and SDQ total difficulties scores. All preliminary analysis was carried out using SAS (version 9.4, SAS Institute Inc., Cary, NC, USA, 2002-12).

LCA was used to identify and characterise social risk profiles for study children using 12 explanatory variables, including eight dichotomous and four categorical variables. Statistical model fit was assessed using the Akaike Information Criterion (AIC), sample size adjusted Bayesian Information Criterion (BIC), log-likelihood, and entropy for models with 2-10 classes. Mean estimates of mental health status were compared between classes using the Bolck, Croon and Hageaars (BCH) approach to LCA with a distal outcome. (153, 248) In this analysis, BCH adjusted proportional assignment was used to calculate distal outcome estimates based on the posterior probabilities of class membership from the LCA model (154). All LCA was conducted using the LCA Stata Plugin and LCA_Distal_BCH Stata function in Stata (Version 16.0 - © 1985-2019). (157, 158)

8.4.4 Missing data

The predictor, outcome, and explanatory variables all contained a minimal proportion of non-responses (missing data). Multiple imputation by Chained Equations (MICE) was used to minimise potential bias due to missing data within these variables. The number of respondents with missing data ranged from 2.7-8.6% for personal racism items and from 0.6-5.6% for all explanatory variables. A total of 9 respondents had missing data for the SDQ measure. Descriptive statistics based on complete cases for all variables and proportions of missing data by the reason recorded are included in Appendix 5 of this thesis. Ten imputed datasets were generated for racial discrimination items, SDQ, and all explanatory variables. Multiple imputation was conducted in STATA 16. Analysis was conducted on the final sample of 498 study children after imputation (4980 observations).

8.5 Results

Summary statistics of the 498 participant responses for the 14 explanatory variables are presented in Table 8.1. Overall, the mean SDQ total difficulties score was 11.1 (SD: 6.5; 95% CI: 10.5, 11.7). No significant differences in mean SDQ were observed between males and females ($t=1.12$, $p=0.26$), or with increased age ($\beta=.003$, $p=0.99$). High exposure to personal racism (scores at or above the 90th percentile) was observed in 8.6% of respondents. No significant differences in those with high exposure to personal racism were observed between males and females ($\chi^2=16.96$, $p=.19$). The likelihood of high exposure to personal racism increased with age ($\beta=0.26$, $SE=0.15$, $p=.08$), although this estimate was only marginally significant.

There were statistically significant differences in SDQ scores across many of the explanatory variables included in LCA, after adjustment for age and gender (Table 8.2). Significantly increased SDQ scores were observed for children with high exposure to personal racism, after adjustment for age and gender ($B=6.30$, 95% CI: 4.39, 8.21, $p<.0001$) (Table 8.2).

8.5.1 Latent class analysis

Fit indices were generated for latent class models with 2-10 classes (Table 8.3). Model fit was assessed based on an appropriate balance between the sample adjusted BIC, entropy, and log-likelihood estimates, and a six-class model was chosen. Item response probabilities for explanatory variables are reported at the child-, family-, and area-level in Figures 8.1-8.3. A brief description of the characteristics of the six latent classes identified within both models is provided below:

(1) 'Metropolitan, higher SES areas': characterised by low probabilities of substance use, police contact, bullying, and high exposure to personal racism, but high probabilities for living in metropolitan areas within the highest IRISEO quintile; (2) 'Suburban/regional, mid SES areas': characterised by low probabilities of substance use, police contact, bullying, and high exposure to personal racism, but high probabilities of living in low remoteness suburban areas or regional centres within the middle IRISEO quintile; (3) 'Bullying exposure, financial stress': characterised by low probabilities of substance use, police contact, and high exposure to personal racism but moderate probabilities of bullying or unfair treatment, and relatively high probabilities of living in a family receiving welfare assistance or short of money for food or school activities; (4) 'Remote, lower SES areas': characterised by low probabilities of substance use, police contact, bullying, and high exposure to personal racism, but high probabilities of living in moderate or high remoteness areas within the most disadvantaged IRISEO quintile; (5) 'Majority males, multiple stressors': characterised by a high probability of being male, relatively high probabilities of substance use, high exposure to personal racism, and police contact, while living in metropolitan or suburban/regional areas classified in the middle or second highest IRISEO quintile; (6) 'High bullying exposure, multiple stressors': characterised by a very high probability of reporting being bullied or unfairly treated, relatively high probabilities of drinking

alcohol, high exposure to personal racism, police contact, and living in a family receiving welfare assistance or being short of money for food, while living in suburban/regional areas classified in the middle and second lowest IRISEO quintiles.

8.5.1.1 Latent classes and SDQ scores

Mean SDQ scores for each latent class were estimated after including SDQ as a distal outcome in LCA models adjusted for age and gender (Table 8.4). The 'majority males, multiple stressors' class (17.0; 95% CI: 13.9, 20.2) and the 'high bullying exposure, multiple stressors' class (17.1; 95% CI: 14.8, 19.4) were observed to have the highest mean SDQ total difficulties scores compared to all other classes. According to Australian normative data for the SDQ, a large proportion of both male and female respondents within these two high risk classes would be classified as having SDQ total difficulty scores within the 'abnormal/of concern' range (males 11-13 years: ≤ 16 ; females 11-13 years: ≤ 17) (249). A large proportion of female respondents within the 'bullying exposure, financial stress' class would be classified within the 'borderline/query' range (13.4; 95% CI: 11.3, 15.5). Comparatively, the majority of male respondents within this class and all other respondents in the 'metropolitan, higher SES areas', 'suburban/regional, mid SES areas', and 'remote, lower SES areas' classes would be considered to have 'normal' mental health.

The 'high bullying exposure, multiple stressors' class (17.1; 95% CI: 14.8, 19.4) and the 'majority males, multiple stressors' class (17.0; 95% CI: 13.9, 20.2) had significantly higher mean SDQ total difficulties scores compared with all other classes (Table 8.5). The 'bullying exposure, financial stress' class was observed to have significantly higher mean SDQ total difficulties scores than the 'metropolitan, higher SES areas' ($B=4.2$, 95% CI: 1.7, 6.7), 'suburban/regional, mid SES areas' ($B=3.2$, 95% CI: 0.9, 5.6), and 'remote, lower SES areas' classes ($B=3.0$, 95% CI: 0.6, 5.5).

8.6 Discussion

This study presents a first exploration of how indicators for several social determinants of health interact within subgroups of Aboriginal and Torres Strait Islander children to predict mental health status. We focused on social relationships, area-level disadvantage, police attention, and psychosocial factors including racial discrimination to define latent classes and used a model-based approach to predict emotional and behavioural difficulties as a distal outcome based on latent class membership. Our study found that, on average, Aboriginal and Torres Strait Islander children with few psychosocial risk factors (such as substance use, police attention, experiences with bullying, or high exposure to personal racism) had positive mental health regardless of area-level disadvantage or whether they lived in a metropolitan, suburban/regional, or remote area. Adverse mental health was observed where higher proportions of Aboriginal and Torres Strait Islander children had multiple psychosocial risk factors (as above), in addition to family-level financial difficulties. Finally, a higher proportion of Aboriginal and Torres Strait Islander children had experiences

with bullying and family-level financial difficulties where these children were typically classified in or were approaching the borderline range for adverse mental health.

Aboriginal and Torres Strait Islander children with adverse mental health are exposed to personal racial discrimination in high proportions, alongside several other psychosocial risk factors. Interpersonal racial discrimination and adverse social determinants of health reflect two pathways through which structural racism can affect Aboriginal and Torres Strait Islander child and adolescent mental health. (250) These pathogenic factors are both the downstream products of structural racism and should be understood within the context of the wider forces that comprise structural racism in the lives of Aboriginal and Torres Strait Islander populations. (251) Interrelationships between social environments, psychosocial factors, and mental health during childhood are complex and dynamic, and evidence gained from the cross-sectional analysis undertaken in the current study can only provide a snapshot of these interrelationships. However, the key concern driving the current study was to determine where racial discrimination ‘fit’ within population subgroups defined by several established predictors of Aboriginal and Torres Strait Islander children’s mental health, not to quantify the relative contribution of these determinants to mental health. Almost all Aboriginal and Torres Strait Islander children with positive mental health did not have high exposure to personal racial discrimination. Conversely, children in classes characterised by notably higher proportions of exposure to racial discrimination had SDQ total difficulties scores on or approaching the cut-off score for adverse mental health. While these classes were characterised by notably high proportions of children experiencing challenging circumstances predictive of adverse mental health, the specific set of circumstances in each class differed considerably. This finding may suggest that it is, in part, the high quantity of environmental challenges and psychosocial stressors occurring in the lives of Aboriginal and Torres Strait Islander children experiencing adverse mental health which perpetuate the circumstances that generate emotional and behavioural difficulties. Existing evidence already supports associations between several of the social determinants included in this analysis and adverse mental health. (175, 242, 243, 245) Findings from the current study indicate that the development of adverse mental health in Aboriginal and Torres Strait Islander children may extend from the confluence of multiple challenges across several social determinants, whereas the absence of specific psychosocial factors – including racial discrimination – may be predictive of positive mental health. This evidence also indicates that racial discrimination must be accounted for alongside social determinants represented by psychosocial factors, area-level disadvantage, and family-level financial difficulty when considering the patterns of circumstances with relevance for Aboriginal and Torres Strait Islander children’s mental health.

Latent classes which predicted adverse mental health were characterised by relatively high proportions of children who had experimented with smoking cigarettes and drinking alcohol, had contact with the police, had high exposure to personal racism and, for those in the ‘high bullying exposure, multiple stressors’ class, almost all had experienced bullying or unfair treatment. Some of these factors have been observed to have

independent associations with adverse mental health in Aboriginal and Torres Strait Islander child or adolescent populations, (162, 252-254) although few studies have specifically examined the interactions between racial discrimination and these factors in their effect on mental health.

Levels of comorbidity between substance use and adverse mental health are likely to be significant in Aboriginal and Torres Strait Islander adolescent populations, given the high prevalence of comorbidities within the general Australian population. (255) Adverse mental health has been identified as increasing the likelihood of smoking in First Nations adolescents internationally, (256) while stress has been identified as a likely risk factor for smoking in Aboriginal and Torres Strait Islander adolescents (254) and racism exposure has previously been found to amplify the risk of experimentation with smoking in Aboriginal and Torres Strait Islander children aged 4-11 years. (227) It is likely that racism exposure, substance use and mental health disorders are interrelated. The onset of mental health disorders in childhood such as anxiety and conduct disorder are known to be strongly associated with racial discrimination and are also predictive of later substance use and substance use disorder. (194, 195)

Early initial police contact as a person of interest can also signal a heightened likelihood of adverse mental health, externalising problems, and substance use, while also increasing the likelihood of having further police contact, including as a victim. (257) Adverse mental health is more common among Aboriginal and Torres Strait Islander adolescents (13-17 years) on remand awaiting trial or sentencing than among Aboriginal and Torres Strait Islander adolescents in the community, (253) and high proportions of Aboriginal and Torres Strait Islander children and adolescents (10-17 years) held in custody in juvenile detention indicate psychological distress, (252) signalling the increased incidence of adverse mental health for these populations once within the justice system. Historical and contemporary police interventions within Aboriginal and Torres Strait Islander communities defined by discriminatory, uninformed, or violent conduct have contributed to antipathy and fear in relations with the police. (258) Unwarranted attention or over-surveillance by the police also likely interacts with perceptions of discrimination and anxiety-based vigilance, further increasing exposure to additional social stressors.

Bullying at school has been linked to an increased risk of smoking, increased anger and sadness, behaviour problems, and an increased risk of suicide in both quantitative (162) and qualitative studies (259) involving Aboriginal and Torres Strait Islander adolescents. Low concordance between racial discrimination and bullying has been observed in Aboriginal and Torres Strait Islander children aged 12-13 years, indicating that each exposure generates distinct effects in the lives of these children with different patterns of association with adverse mental health. (163) Increased exposure to both racial discrimination and bullying concurrently has been observed to be independently associated with adverse mental health in Australian children aged 10-11 years. (260) This analysis measured racial discrimination reported by Aboriginal and Torres Strait Islander and non-Aboriginal children (Australian-born, Anglo/European, and visible minorities).

Although analysis was not undertaken separately for Aboriginal children, combined exposure to both racial discrimination and bullying was observed to be higher in Aboriginal and Torres Strait Islander children aged 10-11 years compared to their non-Aboriginal peers, (260) suggesting that the resultant effects may also be heightened in this population.

Overall, evidence from the literature confirms that there is a need to analyse the effects of racial discrimination in the context of wider social forces that direct and maintain patterns of exposure to multiple psychosocial stressors. (3, 261) The simultaneous exposure to several psychosocial stressors observed in profiles of Aboriginal and Torres Strait Islander children predictive of adverse mental health suggests that these factors are interrelated for those experiencing social and emotional difficulties in this population.

Aboriginal and Torres Strait Islander children with positive mental health experienced few psychosocial risk factors, although some children with positive mental health lived in disadvantaged and/or remote areas or had parents who had not attained post-secondary qualifications. It is perhaps unsurprising that children in these subgroups had positive mental health given that family-level financial stress was low, indicating that these families likely had sufficient material resources to protect or buffer children from the stressful environments or conditions associated with socioeconomic disadvantage. Children in the 'remote, lower SES areas' class were almost exclusively living in moderately remote small towns or very remote communities in regions classified among the most disadvantaged in Australia. However, none of these children's parents indicated financial difficulties in the form of welfare receipt or being short of money for food or school activities. While other forms of family-level financial difficulty may have been present, it is likely that factors associated with living in higher remoteness areas such as cultural identity and connection to country acted to support positive mental health regardless of area-level disadvantage. Cultural elements including connection to country, language use, cultural expression, family and kinship, and self-determination appear to enhance the health and wellbeing of Aboriginal and Torres Strait Islander peoples. (262) These cultural elements may be present or absent in the lives of children regardless of remoteness, although connection to kinship and passing on traditional knowledge have been observed to contribute to positive child development outcomes in remote communities where they are present (263). It is critical that the broader health risks present in some remote areas (e.g. environmental health risks from poor water quality, dust, etc.) are not overlooked as a significant issue with strong implications for public health. (264, 265) However, it is important to note that these health risks are not exclusive to remote communities. The absence of psychosocial risk factors in the subgroups of Aboriginal and Torres Strait Islander children with positive mental health identified in the current study may be a more relevant determinant of mental health than the remoteness of the communities in which they live. Protection from adverse social experiences, as shown through the minimal proportion of children experiencing bullying or police attention, and limited exposure to the psychosocial stressor of racial discrimination, can promote ideal conditions for social and

emotional wellbeing. As such, these psychosocial factors may have a more proximal influence on mental health in Aboriginal and Torres Strait Islander children than area-level disadvantage or remoteness.

Although this study has several strengths, there are also some clear limitations. First, the data presented in this analysis was cross-sectional and cannot infer any casual relationships. As such, we were unable to rule out a bidirectional relationship between racial discrimination and mental health, or indeed between any of the psychosocial indicators included in latent class models and mental health. It is possible that prior adverse mental health may have led to an increase in these indicators, or vice versa, and biased results. Second, latent class analysis is considered an exploratory approach to examining population subgroups and estimated latent classes should not be viewed as representing true subgroups within this population of Aboriginal and Torres Strait Islander children. (234) The best fitting model in latent class analysis is dependent on the researcher's judgement, meaning that results may not be replicable. Third, the selection of explanatory variables included in latent class analysis was intended to represent a cross-section of indicators for key social determinants of health, including physical environments, psychosocial factors, and life stressors. However, these indicators are by no means exhaustive. Many other indicators could have been included, although the analytic software used to run latent class analysis limited the number of explanatory variables that could be included in final models. The results from the latent class models run in this study can thereby only reflect the selection of explanatory variables which informed them. Finally, while the empathy subscale of the SSIS-RS has been found to perform well for the older cohort of children from LSIC, qualitative item validation has not yet been conducted to determine the meaning and relevance of items from the empathy subscale in the Aboriginal and Torres Strait Islander context and SSIS-RS data should be interpreted with caution. (266)

8.7 Conclusion

The majority of Aboriginal and Torres Strait Islander children in this study fell into population subgroups predictive of positive mental health and which were characterised by few psychosocial or environmental stressors. Aboriginal and Torres Strait Islander children with high exposure to personal racism were highly represented in subgroups characterised by several overlapping psychosocial stressors and limited family financial resources, indicating that this form of racial discrimination has the potential to undermine Aboriginal and Torres Strait Islander children's social and emotional wellbeing alongside these social determinants of health. These findings provide further nuanced evidence for policy and practice responses which promote the development of positive mental health in Aboriginal and Torres Strait Islander children. Strong advocacy work, mental health promotion, and practice interventions have been aimed at reducing racial discrimination and promoting recognition of the social determinants of Aboriginal and Torres Strait Islander health. These strategies must continue to act cohesively and acknowledge the interdependence of

social determinants, including racial discrimination, in profiles of mental health risk among Aboriginal and Torres Strait Islander children.

Table 8.1: Explanatory variables

Individual-level characteristics	% ¹	95% CI
Male	49.6	45.3, 53.8
Smoked cigarettes in last year	3.3	1.3, 5.3
Drank alcohol in last year	5.6	3.6, 7.7
Police contact		
Charged with an offence	1.9	0.4, 3.4
Told to 'move on', warned, cautioned	9.4	6.2, 12.6
Quizzed or questioned by police	6.3	3.9, 8.7
No police contact	82.5	78.3, 86.6
Low empathy	9.9	6.5, 13.2
Personal racism	10.1	7.0, 13.2
Family-level characteristics	%	95% CI
Primary carer highest education		
Never attended school to Year 10	27.1	22.5, 31.7
Year 11/12	21.8	17.3, 26.2
Diploma or Certificate	42.2	37.4, 47.0
University	8.9	6.0, 12.0
Short of money – Went without meals	4.9	3.0, 6.7
Short of money – Assistance from welfare organisation	14.2	11.0, 17.4
Short of money – Child could not do school activities	5.5	3.1, 7.9
Area-level characteristics	%	95% CI
Level of Relative Isolation		
None	26.9	17.2, 36.5
Low	49.6	36.0, 63.2
Moderate	13.0	3.5, 22.5
High/Extreme	10.5	2.7, 18.3
IRISEO		
1 - Most disadvantaged area	15.1	4.9, 25.3
2	13.8	6.2, 21.4
3	37.3	22.6, 51.9
4	19.9	11.0, 28.8
5 – Least disadvantaged area	13.9	6.8, 21.0

¹ Count data is not provided as this differed across imputed datasets.

Table 8.2: Unadjusted group differences in SDQ total difficulties scores, by explanatory variables

	β^1	95% CI	P-value
Individual-level characteristics			
Smoked cigarettes in last year			
Yes	5.18	1.51, 8.84	.0061
No	Ref	...	...
Drank alcohol in last year			
Yes	3.34	0.91, 5.77	.0071
No	Ref	...	...
Police contact			
Charged with an offence	7.58	3.51, 11.66	.0003
Told to 'move on', warned, cautioned	4.15	2.26, 6.03	<.0001
Quizzed or questioned by police	3.67	1.32, 6.02	.0022
No police contact	Ref	...	...
Low empathy			
Yes	2.29	0.36, 4.21	.0197
No	Ref	...	...
High exposure to personal racism			
Yes	6.30	4.39, 8.21	<.0001
No	Ref	...	...
Family-level characteristics			
Primary carer highest education			
University	-1.89	-4.03, 0.25	.0833
Diploma or Certificate	-0.94	-2.32, 0.43	.1786
Year 11/12	-1.52	-3.13, 0.08	.0632
Never attended school to Year 10	Ref	...	...
Short of money – Went without meals			
Yes	2.59	0.05, 5.12	.0453
No	Ref	...	...
Short of money – Assistance from welfare			
Yes	1.70	0.15, 3.25	.0318
No	Ref	...	...
Short of money – Child could not do school activities			
Yes	2.47	0.08, 4.86	.0424
No	Ref	...	...
Area-level characteristics			
Level of Relative Isolation			
High/Extreme	-1.43	-3.53, 0.66	.1794
Moderate	0.21	-1.84, 2.09	.9041
Low	0.41	-0.95, 1.78	.5537
None	Ref	...	...
IRISEO			
1 - Most disadvantaged area	1.34	-0.80, 3.49	.2198
2	1.72	-0.41, 3.85	.1145
3	1.22	-0.57, 3.02	.1814
4	2.31	0.35, 4.27	.0209
5 – Least disadvantaged area	Ref	...	...

Table 8.3: Fit indices for one to ten latent class models

Number of classes	Log-likelihood	AIC	BIC (sample size adjusted)	Change in BIC	Entropy
1	-3760.03	2100.82	2123.63	-	1.00
2	-3619.45	1865.67	1912.32	-211.31	0.90
3	-3562.48	1797.72	1868.21	-44.11	0.75
4	-3504.39	1727.53	1821.86	-46.35	0.77
5	-3481.92	1728.61	1846.77	+24.91	0.81
6	-3449.31	1709.37	1851.38	+4.61	0.84
7	-3430.66	1718.08	1881.93	+30.55	0.84
8	-3415.80	1734.36	1924.05	+42.12	0.84
9	-3399.69	1748.14	1961.67	+37.62	0.84
10	-3384.49	1763.73	2001.11	+39.44	0.84

Table 8.4: Mean SDQ total difficulties scores, by latent class

	Mean SDQ ¹	95% CI
Metropolitan, higher SES areas	9.21	6.74, 11.68
Suburban/regional, mid SES areas	10.20	8.92, 11.48
Bullying exposure, financial stress	13.42	11.29, 15.54
Remote, lower SES areas	10.40	7.92, 12.88
Majority males, multiple stressors	17.03	13.90, 20.17
High bullying exposure, multiple stressors	17.07	14.77, 19.36

¹ Conditional distribution of distal outcome estimates for mean SDQ total difficulty score were predicted based on posterior probabilities of latent class membership (BCH adjusted proportional assignment).

Table 8.5: Differences in mean SDQ total difficulties score between latent classes

Latent class	Estimate (95% CI)				
Suburban/regional, mid SES areas	0.99 (-0.84, 2.83)				
Bullying exposure, financial stress	4.21 (1.67, 6.74)	3.21 (0.86, 5.56)			
Remote, lower SES areas	1.19 (-1.11, 3.49)	0.19 (-1.87, 2.25)	3.02 (5.47, 0.57)		
Majority males, multiple stressors	7.82 (4.48, 11.17)	6.83 (3.49, 10.17)	2.69 (-0.98, 6.37)	6.64 (3.31, 9.96)	
High bullying exposure, multiple stressors	7.86 (5.29, 10.42)	6.86 (4.30, 9.42)	3.65 (0.51, 6.79)	6.67 (4.10, 9.24)	0.03 (-3.82, 3.88)
	Metropolitan, higher SES areas	Suburban/regional, mid SES areas	Bullying exposure, financial stress	Remote, lower SES areas	Majority males, multiple stressors

Figure 8.1: Item response probabilities by latent class – child-level characteristics

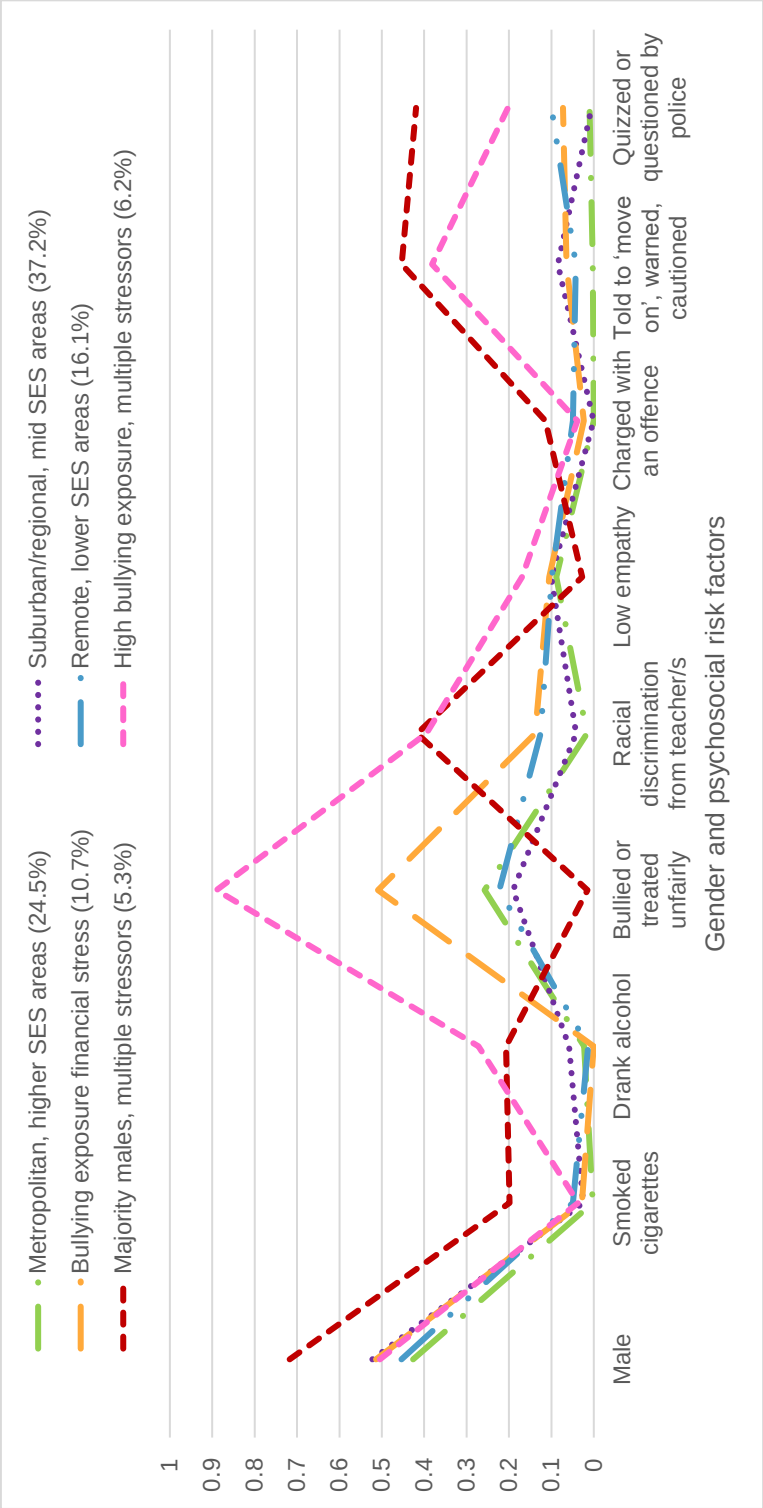


Figure 8.2: Item response probabilities by latent class – family-level characteristics

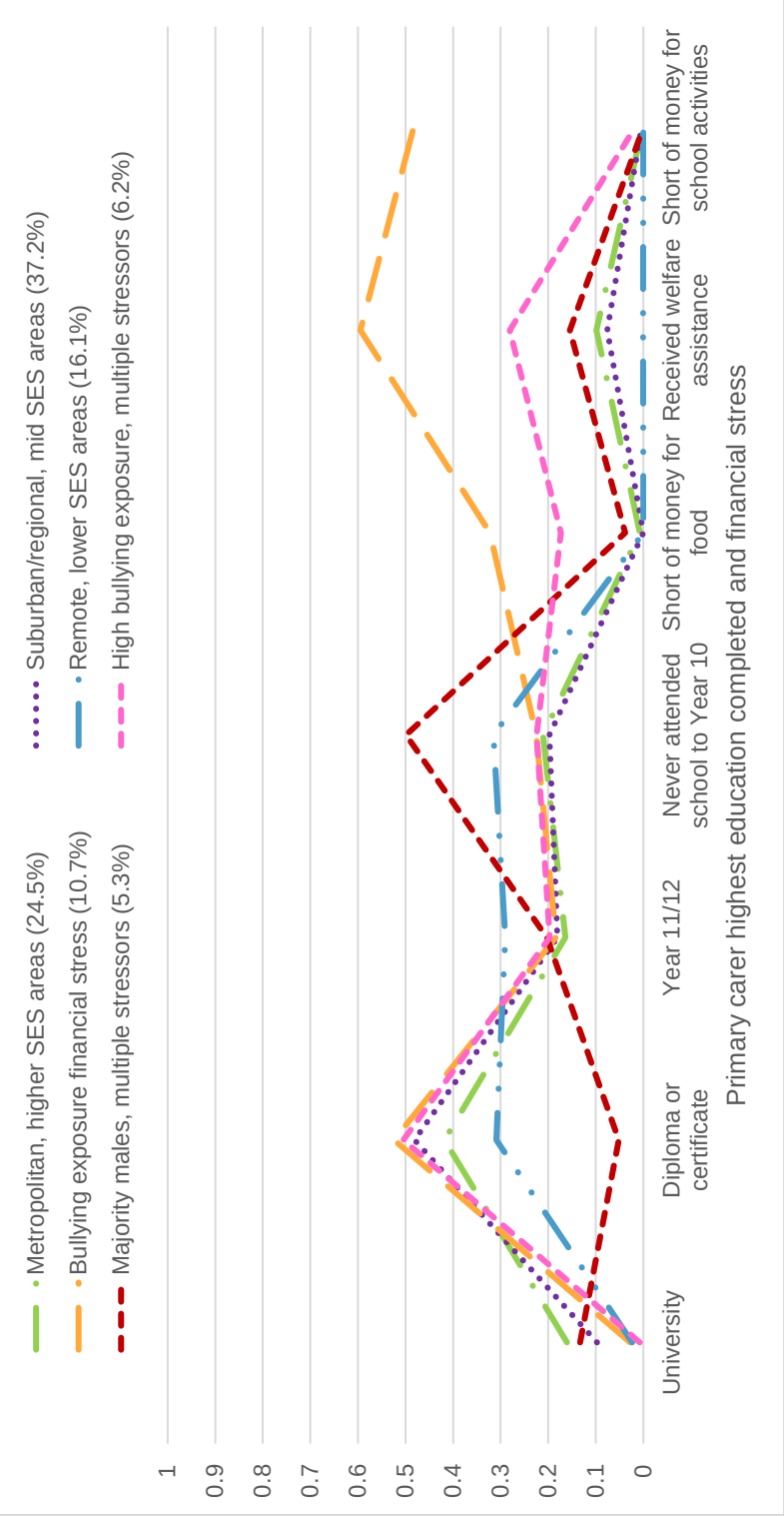
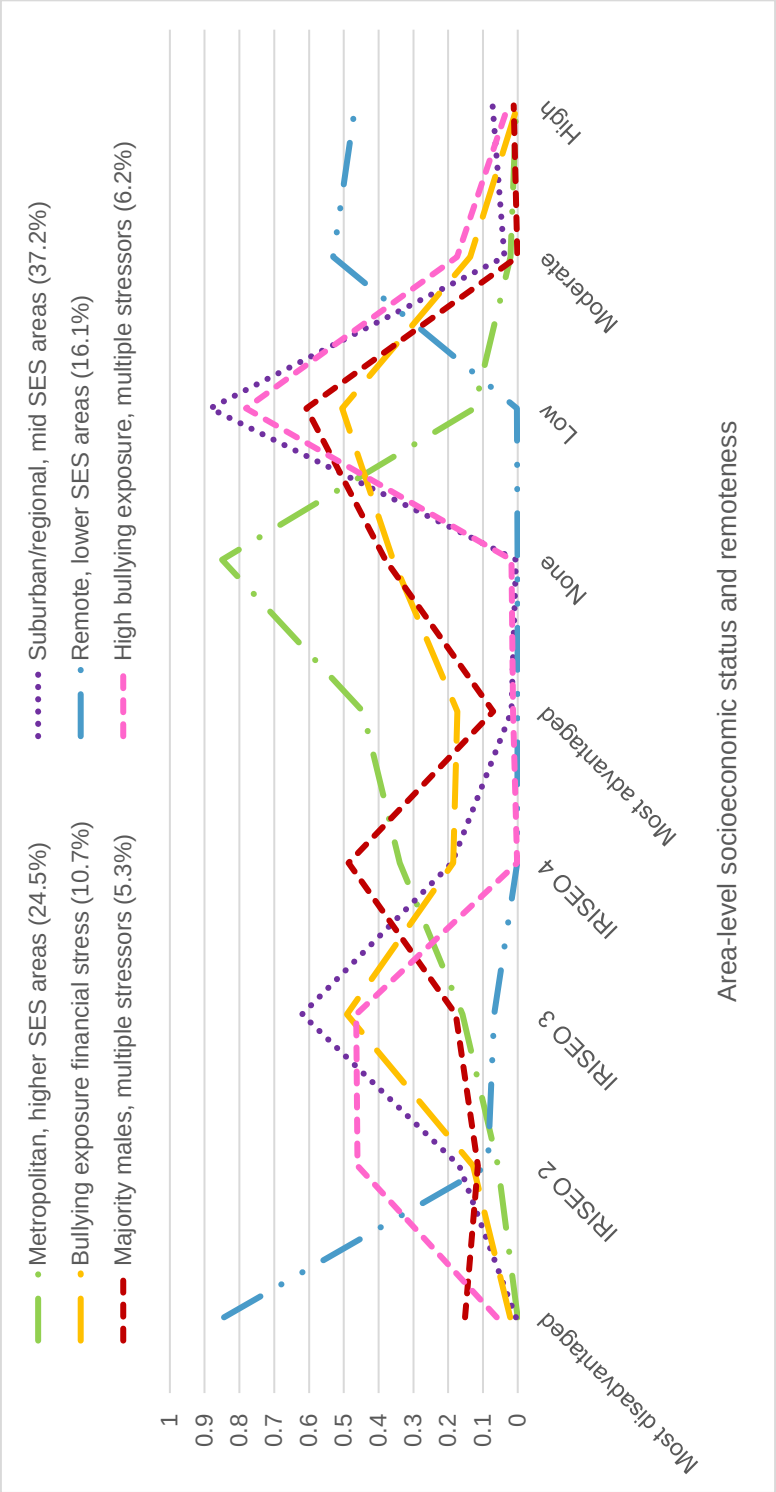


Figure 8.3: Item response probabilities by latent class – area-level characteristics



Chapter 9 Racial discrimination and allostatic load among First Nations Australians: A nationally representative cross-sectional study

9.1 Preface

The preceding chapters within this thesis so far have retained a focus on racial discrimination and its effects in Aboriginal and Torres Strait Islander children. This is primarily due to the increased sensitivity to stress experienced during childhood and adolescence and the need to focus on intervening early in the life course to address stressors occurring during these developmental periods. However, chronic or repeated acute exposure to racial discrimination as a psychosocial stressor also has implications for the regulation of physiological systems later in life. The repeated or permanent dysregulation of these systems, termed allostatic load, is unlikely to be apparent during childhood but is more likely to become measurable as individuals age.

This chapter will focus on Aboriginal and Torres Strait Islander adults aged 18-75 and will identify subpopulations of Aboriginal and Torres Strait Islander adults using measures capturing current and previous health conditions, psychosocial and sociodemographic factors, and life stressors based on data from the Australian Bureau of Statistics *Australian Aboriginal and Torres Strait Islander Health Survey 2012-2013*. A measure of allostatic load capturing physiological dysregulation is compared within and between subpopulations of Aboriginal and Torres Strait Islander adults with and without exposure to racial discrimination over the past year. The purpose of this chapter is to examine how racial discrimination interacts with socioecological, environmental, and health conditions to affect multisystem dysregulation in a population of Aboriginal and Torres Strait Islander adults. Specifically, this chapter uses person-centred analysis to understand how racism is situated within the complex reality of intersecting supports and stressors present within the lives of these adults.

This chapter was published in BMC Public Health in December 2020. (267) The chapter which follows is a verbatim copy of the content from that published manuscript with the exception of minor modifications for readability. A copy of the typeset manuscript is available in Appendix 1 (Page 265) and online supplementary materials are available in Appendix 6 (Page 340).

9.2 Abstract

Background: Increased allostatic load is linked with racial discrimination exposure, providing a mechanism for the biological embedding of racism as a psychosocial stressor. We undertook an examination of how racial discrimination interacts with socioecological, environmental, and health conditions to affect multisystem dysregulation in a First Nations population.

Methods: We conducted latent class analysis (LCA) using indicators of life stress, socioeconomic background, and physical and mental health from a nationally representative sample of Australian Aboriginal and Torres Strait Islander adults (N=2 056). We used LCA with distal outcomes to estimate the effect of the latent class variable on our derived allostatic load index and conducted a stratified analysis to test whether allostatic load varied based on exposure to racial discrimination across latent classes.

Results: Our psychosocial, environmental, and health measures informed a four-class structure; 'Low risk', 'Challenged but healthy', 'Mental health risk' and 'Multiple challenges'. Mean allostatic load was highest in 'Multiple challenges' compared to all other classes, both in those exposed (4.5; 95% CI: 3.9, 5.0) and not exposed (3.9; 95% CI: 3.7, 4.2) to racial discrimination. Allostatic load was significantly higher for those with exposure to racial discrimination in the 'Multiple challenges' class ($t= 1.74$, $p=.04$) and significantly lower in the 'Mental health risk' class ($t=-1.67$, $p=.05$).

Conclusions: Racial discrimination may not always modify physiological susceptibility to disease. Social and economic contexts must be considered when addressing the impact of racism, with a focus on individuals and sub-populations experiencing co-occurring life challenges.

9.3 Background

Racial discrimination is a well-established contributor to adverse physical health outcomes in ethnic/cultural minority populations. (4, 6, 7, 85, 178, 268) Evidence detailing how racial discrimination affects physiology within the context of broader life circumstances is needed to encourage the development of informed strategies to prevent or eradicate racism in the settings where it occurs. This approach is particularly essential for First Nations populations within high-income countries, where racial discrimination is often compounded by ongoing social marginalisation, land dispossession, and loss of sovereignty.(12)

In Australian Aboriginal and Torres Strait Islander populations, where the pervasiveness of racial discrimination is well documented across legal, healthcare, educational and employment settings, (120, 269, 270) assessing the link between the psychosocial stressor of racism and physical health remains a challenge. To date, indicators of physical health most commonly comprise self- or carer-rated general health status, with few significant associations found. (97, 164, 165, 227, 271, 272) Self-reported general

health can be a misleading indicator of physical health, particularly for socially disadvantaged populations who may underreport or understate adverse health outcomes. (273, 274) Clinical biomarkers present a stronger indicator of underlying biological risk factors or early precursors of disease, and are typically unrecognised or not acknowledged by individuals responding to general health self-report measures. Individual biomarkers for allostatic load have been observed to be significantly higher in Aboriginal and Torres Strait Islander compared with non-Aboriginal populations (275) and studies have begun to investigate the association between racism and individual biomarkers in Aboriginal and Torres Strait Islander populations. (171, 276-279) However, single biomarkers are specific to individual physiological systems and cannot capture the interactions and adaptations occurring between systems which lead to dysregulation.

Allostatic load is an indicator of multisystem physiological dysregulation resulting from over- or under-activation of systems designed to adapt to stress (i.e. metabolic, cardiovascular, immune, and neuroendocrine systems). (280) Long periods of repeated exposure to psychosocial stressors such as racial discrimination are proposed to increase allostatic load, (281) promoting pathophysiology and ultimately increasing morbidity and mortality. (282) Increased allostatic load has also been linked to multiple other markers of stress and adversity, including socioeconomic status. (282-286) Associations between racial discrimination and allostatic load indices that comprise multiple biomarkers have been established in international studies. (208, 287-299) Two of these studies were focused on First Nations adults attending university in western Canada. (293, 294) In these Canadian studies, childhood experiences of racial discrimination and past year experiences of racial discrimination were both significantly associated with an allostatic load index comprised of seven biomarkers. The sample was dichotomised into groups with high and low cultural continuity, as defined by engagement in cultural practices and values related to their First Nations cultural heritage at the time of data collection. Both studies observed that cultural continuity buffered the harmful effects of racial discrimination on allostatic load, with the association reduced to non-significance for those with high cultural continuity. (293, 294) Several studies have situated racism within the multiple intersecting stressors known to be implicated in heightened allostatic load but did so using mediation analysis or analysis of effect modification to investigate the role of specific variables measuring single environmental factors, such as emotional support, (208) social support, (297) racial background, (287, 288, 298) and socioeconomic status. (287, 289) Studies utilising this form of variable-centred analysis are less focused on examining the effects of multiple shared characteristics within population groups than on specified pathways between exposure and outcome variables. In contrast, person-centred analysis permits an examination of how racism is situated within—rather than isolated from—the complex reality of intersecting supports and stressors present within individual lives. Latent class analysis (LCA) is a form of person-centred analysis which identifies clusters or patterns of shared characteristics within groups of people and explores how outcomes of interest differ between these groups. (236) In this study, a latent

class approach was used to determine whether exposure to racial discrimination could increase allostatic load for groups of people already experiencing many psychosocial stressors and adverse health, investigating whether racial discrimination can measurably increase allostatic load in the context of competing stressors and challenging circumstances.

This study undertakes the first examination of the role of racial discrimination on allostatic load in the context of broader socioecological, environmental, and health risk factors within a First Nations population. A more nuanced understanding of the role of racism is important in supporting intervention studies and policy approaches that seek to address the persistent impact of racism on population health disparities across the globe. We apply a latent class approach to nationally-representative data to first identify profiles of Aboriginal and Torres Strait Islander Australian adults defined by psychosocial stressors, environmental factors, health conditions, and mental health factors. We then examine the association between these profiles and an index of allostatic load. Finally, we examine the association between identified profiles and allostatic load after dichotomising the population into those with exposure to racial discrimination in the previous 12 months and those unexposed. Our primary objective was to determine the effect of exposure to racial discrimination on allostatic load in profiles of Aboriginal and Torres Strait Islander adults defined by stress-related psychosocial, environmental, and health factors.

9.4 Methods

Data were from the National Aboriginal and Torres Strait Islander Health Survey (NATSIHS) and National Aboriginal and Torres Strait Islander Health Measures Survey (NATSIHMS) components of the Australian Bureau of Statistics' (ABS) Australian Aboriginal and Torres Strait Islander Health Survey (AATSIHS) 2012-13. Full details of the data collection, recruitment, and sampling have been reported elsewhere. (143, 300) However, in brief, the AATSIHS selected a nationally representative sample of Aboriginal and Torres Strait Islander Australians via stratified multistage area sampling of private dwellings across remote, non-remote areas, and discrete Aboriginal and Torres Strait Islander communities nationally. The AATSIHS collected comprehensive health information from the Aboriginal and Torres Strait Islander population to obtain national benchmark information on health-related issues, collect biomarkers of chronic disease, and monitor trends in Aboriginal and Torres Strait Islander health. Selected adult members of the household consenting to participate undertook face-to-face interviews with trained interviewers. The AATSIHS core sample had a response rate of 79.5% fully or adequately responding households, culminating in 12,947 respondents aged 2 years and over. Adults aged 18 years and over (n=8,157) were invited to participate in the NATSIHMS, where biomedical data from blood and urine tests was collected. The current study analysed data from respondents within the NATSIHMS subset of the AATSIHS (n = 3,293). The sample was weighted by the ABS to represent the national Aboriginal and Torres Strait Islander population as at 30 June 2011 (the estimated population benchmark from the 2011 Census of Population and Housing). Within the

NATSIHMS subset, only individuals who also participated in the NATSIHS component of the AATSIHS were retained (n = 2,060) as participant characteristics provided within this survey component informed explanatory variables within LCA. Four respondents were recorded as a 'refusal' in answering the racial discrimination measure and were excluded from further analysis, resulting in a final sample of 2,056 respondents (Figure 9.1).

The ABS has initiated several strategies to build and strengthen engagement with Aboriginal and Torres Strait Islander communities and organisations and to ensure best practice in the collection and dissemination of data from Aboriginal and Torres Strait Islander populations. (146) Led by the Centre of Excellence for Aboriginal and Torres Strait Islander Statistics, the ABS is guided by cultural protocols and procedures for engagement with Aboriginal and Torres Strait Islander peoples and communities developed in alignment with Indigenous data sovereignty principals. (146, 147) The current study received input and guidance on the study design and interpretation of findings from the Telethon Kids Institute Social Determinants of Aboriginal Health Community Advisory Group, an advisory group comprised of Aboriginal community members from the Perth region (Western Australia) established to ensure this research was directed and approved by the local Aboriginal community.

9.4.1 Measures

9.4.1.1 Outcome variable

The outcome was an allostatic load index derived from 10 biomarkers selected based on their relevance in measuring physiological systems implicated in allostatic load and availability within the NATSIHMS (282). Biomarkers frequently used in allostatic load studies represent physiological systems implicated in both the primary and secondary effects of stress exposure, including the neuroendocrine system (e.g. cortisol, epinephrine, dopamine); immune system (e.g. Interleukin-6, tumour necrosis factor-alpha, C-reactive protein); metabolic system (e.g. high density lipoprotein cholesterol, triglycerides, glucose, insulin, albumin, creatinine); cardiovascular/respiratory systems (e.g. systolic/diastolic blood pressure, peak expiratory flow, heart rate); and anthropomorphic measures (e.g. waist-to-hip ratio, body mass index). (282) The physiological systems represented in this allostatic load index reflect secondary outcomes associated with longer-term stress exposure, as biomarkers constituting primary effects were not collected within the NATSIHMS (i.e. stress hormones, cortisol, epinephrine and norepinephrine or pro- and anti-inflammatory cytokines). (282, 301) We have used a multi-systemic composite approach, including biomarkers representing several physiological systems to gain early indications of the secondary effects of stress. (282, 301) The biomarkers included in the current study were (cardiovascular system) systolic and diastolic blood pressure; (metabolic system) high density lipoprotein- (HDL) cholesterol, low density lipoprotein- (LDL) cholesterol, triglycerides, fasting glucose, plasma glycosylated haemoglobin (HbA1c), and albumin-creatinine ratio; (anthropomorphic) body mass index; and (immune system) C-reactive protein. To derive allostatic load, participants were given a value of '1' for each biomarker that fell within the highest quartile

of sample values (or the lowest quartile for HDL cholesterol), with these values then summed to a total score (index range 0-10; biomarkers weighted equally). This method has been applied to numerous studies to predict health outcomes, including later mortality, and to examine the variation produced by stress and related psychosocial factors. (282, 302)

9.4.1.2 Racial discrimination

Respondents were asked whether they had felt they had been treated badly in the last twelve months because they were Aboriginal or Torres Strait Islander (yes/no).

9.4.1.3 Explanatory variables

Respondents within this dataset will have varying allostatic load scores based on their psychosocial, environmental, and physiological circumstances, and history. Factors that capture these circumstances have been included as explanatory variables in LCA as they will account for a portion of the variability in models of allostatic load. We selected a total of 15 explanatory variables for assessment in LCA — these factors were primarily related to stress, mental health, and physical health. Factors related to stress included low socioeconomic status (current unemployment, low education, area level disadvantage), financial difficulties, perceived social support, and death in the family. Factors related to mental health included psychological distress and a sense of control or mastery, while factors related to physical health included past or present health conditions, exercise, and having limited facilities for sanitation in the home. Geographic remoteness was also included as this can have both positive and negative implications for stress, mental health, and physical health due to either environmental and lifestyle stressors within metropolitan areas or challenges accessing services and infrastructure within remote areas. Substance use was initially included, although mean differences in allostatic load were minimal for substance use indicator variables so that stress and physical and mental health factors were ultimately prioritised for analysis.

Included variables spanned individual level (n=10), family level (n=3), and area level (n=2) characteristics (Table 9.1). All explanatory variables were dichotomised with the reference category set to the low risk category, except area-level socioeconomic status which was a five-level categorical variable with the reference category set to the highest socioeconomic quintile.

Individual level characteristics

Individual level characteristics included health conditions, social and emotional wellbeing, exercise, education, and employment.

Health condition variables analysed (n=4) included current or pre-existing kidney, cardiac, diabetes, and respiratory conditions. These condition categories were derived from 10 specific conditions reported by respondents. Respondents reporting kidney disease were classified with a 'current or pre-existing kidney

condition', respondents reporting heart attack, heart failure, hypertensive disease or stroke were classified with a 'current or pre-existing cardiac condition', respondents reporting asthma, bronchitis, chronic sinusitis, or hayfever and allergic rhinitis were classified with a 'current or pre-existing respiratory condition', and respondents reporting diabetes mellitus (Type 1, 2 or unknown) were classified with a 'current or pre-existing diabetes condition'. Each condition was considered present where the condition status was 'ever told has condition, still current and long-term'; 'ever told has condition, still current but not long-term'; 'ever told has condition, not current'; or 'not known or not ever told, but condition current and long-term'.

Social and emotional wellbeing variables analysed (n=3) included the Kessler Psychological Distress Scale (Kessler-5), the Multidimensional Scale of Perceived Social Support (MSPSS) and an adaption of the Pearlin Mastery Scale. The Kessler-5 measure of psychological distress is derived from 5 items in the Kessler Psychological Distress Scale-10, designed to measure levels of negative emotional states in the four weeks prior to interview. (303) Responses were categorised according to the system used by the NATSIHS and dichotomised so that high/very high scores (12-25) indicate high levels of psychological distress while low scores (5-11) indicate low levels of psychological distress. (304) The MSPSS is a measure of perceived social support from family, friends, and significant others (305) and was derived from 6 items in the NATSIHS. A score of 6-18 was then generated so that a higher score indicated reduced social support. This scale was then dichotomised by categorising those in the top decile (at or above the 90th percentile) as having 'low social support'. The Pearlin Mastery Scale measures the extent to which individuals feel in control over their life outcomes (306) and was derived from 7 items in the NATSIHS. A score of 7-21 was then generated so that a higher score indicated a reduced sense of control. This scale was then dichotomised by categorising those in the top decile as having a 'low sense of control'.

Exercise was derived from a single item indicating whether the amount of exercise or physical activity respondents undertook in the previous week reached 150 minutes as per Australian National Physical Activity and Sedentary Behaviour guidelines for adults. Respondents who did not undertake 150 minutes or more were categorised as 'did not meet exercise guidelines'. Education was derived from a single item indicating whether respondents had completed educational attainment up to Year 11 completion. Respondents who indicated they had completed up to Year 11 education or had no educational attainment were categorised as 'Completed Year 11 or below'. Employment was derived from a single item indicating whether respondents were unemployed (looking for part-time or full-time work) or not in the labour force, using a categorisation of labour force status in which the Federal Government Community Development Employment Projects scheme was included in the category of 'unemployed or not in the labour force'. Respondents who were unemployed or not in the labour force were categorised as 'unemployed or not in the labour force'.

Family level characteristics

Family level characteristics included household financial stress, experiencing death as a family stressor, or having limited facilities for sanitation in the home.

Financial stress was derived from a single item indicating whether household members could raise \$2000 in an emergency. Respondents who indicated they could not raise \$2000 were categorised as experiencing 'financial stress'. Death as a family stressor was derived from a single item indicating whether 'death' had occurred in the previous 12 months as a family stressor. Limited facilities for sanitation in the home was derived from a single variable indicating whether respondents' homes had working facilities for washing people, washing clothes or bedding, preparing food, or sewerage facilities. Respondents who indicated that they had no working facilities for any one of these fundamental household tasks were categorised as having 'limited facilities for sanitation at home'.

Area level characteristics

Area level characteristics included area level socioeconomic status and geographic remoteness. Area level socioeconomic status was determined from the Index of Relative Socioeconomic Disadvantage developed by the ABS. (307) This index ranks the relative level of disadvantage of areas using the attributes of all persons (Aboriginal and Torres Strait Islander and non-Aboriginal) in small areas, and includes measures of income, educational attainment, employment status, family composition, and employment categorisation (i.e. low skill occupations). For the purposes of this study, we have categorised the index values into quintiles. Geographic remoteness was determined according to the Australian Statistical Geographic Standard 2011 remoteness areas with non-remote areas encompassing 'major cities of Australia', 'Inner regional Australia' and 'Outer regional Australia', while remote areas encompassed 'Remote Australia' and 'Very Remote Australia'. Respondents living in remote areas were categorised as 'living in a remote area'.

9.4.1.4 Covariates

Age and gender were included as covariates in LCA models. Age was a continuous measure of respondent's age in single years. Gender was categorised as female/male with male as the reference category.

9.4.2 Data analysis

Multiple imputation by Chained Equations was conducted in SAS Enterprise Guide 7.15 to minimise potential bias due to missing biomarker data in the NATSIHMS (Appendix 6). The number of respondents with missing data ranged from 14 to 708 (0.7-34.4%) for each biomarker. Descriptive statistics and sample sizes for all biomarkers are included in Supplementary Table 20. Analysis was conducted on the final sample of 2,056 respondents after imputation.

Preliminary analysis was run to generate the mean, standard error, and confidence intervals for our index of allostatic load. Percentage distributions of explanatory variables were calculated. Linear regression models, adjusted for age and gender, were used to test associations between each explanatory variable and allostatic load. These analyses were run in SAS Enterprise Guide Version 7.15.

LCA was used to identify health and psychosocial stress profiles of Aboriginal and Torres Strait Islander adults within our sample using the 15 explanatory variables. Statistical model fit was assessed using the Akaike Information Criterion (AIC), sample size adjusted Bayesian Information Criterion (BIC), log-likelihood, and entropy for models with 2-10 classes. After the model of best fit was identified, mean estimates of allostatic load were compared between classes using Bolck, Croon and Hagenaars adjusted proportional assignment to calculate distal outcome estimates. (153, 248) Finally, racial discrimination exposure was included as a grouping variable in LCA to dichotomise the sample so that mean estimates of allostatic load could be compared between respondents who reported racial discrimination exposure and respondents with no reported racial discrimination exposure within each latent class. Differences in mean allostatic load with exposure to racial discrimination are reported both within and between latent classes in Supplementary Table 21. All LCA was conducted using the LCA Stata Plugin and LCA_Distal_BCH Stata function (158, 308) in Stata Version 16.0.

All analysis incorporated the ABS-generated person-weights produced for the NATSINPAS dataset. Use of these weights allows us to use sample population data to estimate outcomes for the total in-scope population. (143) All data was accessed and analysis run within the ABS DataLab environment. (156)

9.5 Results

Summary statistics of the 2,056 participants' responses for the 15 explanatory variables are presented in Table 9.1; frequencies ranged from 6.8% (current or pre-existing kidney disease) to 63.7% (living in a remote area). The sample was comprised of 53.6% females, with ages ranging from 18-75 years ($M = 41.5$, $SD = 21.2$). Means, standard errors, and 75th percentile cut-offs for each of the ten biomarkers comprising the allostatic load risk index are presented in Table 9.2. The number of biomarkers per individual observed to fall into the high-risk category ranged from 1 to 10, with a mean of 2.4 ($SD: 2.3$; 95% CI: 2.4, 2.5).

Increased age was significantly associated with increased allostatic load ($B=0.1$, $p<.0001$), while allostatic load did not differ between male and female participants ($B=-0.02$, $p=.81$). There were statistically significant differences in mean allostatic load across many of the explanatory variables included in LCA, after adjustment for age and gender (Table 9.3). The estimated prevalence of racial discrimination exposure within the previous 12 months was 14.6% (95% CI: 12.4,16.8). A statistically significant increase in mean allostatic load was observed in participants who reported racial discrimination, after adjustment for age and gender ($B=0.38$, $p=.02$) (Table 9.3).

9.5.1 Latent class analysis

Fit indices for latent class models with 2 to 10 classes were generated (Table 9.4). The four-class model was chosen to represent the optimal number of classes based on an appropriate balance between the sample adjusted BIC, entropy, and log-likelihood estimates. (236) Item response probabilities for explanatory variables from the four-class model are presented alongside the probability of latent class membership both for respondents with and without exposure to racial discrimination in Table 9.5. The four-class model included (1) 'Low risk': characterised by low probabilities of current or pre-existing health conditions, mental health risk indicators, and low probabilities of socioeconomic risk factors; (2) 'Challenged but healthy': characterised by low probabilities of current or pre-existing health conditions, mental health risk indicators, but with moderate probability of experiencing death as a family stressor, and high probabilities of almost all socioeconomic risk factors including financial stress, living in a disadvantaged area, living in a remote area, unemployment, and low education; (3) 'Mental health risk': characterised by a high probability of psychological distress, moderate-high probability of financial stress and unemployment, high probability of a current or pre-existing respiratory condition and low probabilities of all other current or pre-existing health conditions; (4) 'Multiple challenges': characterised by high probabilities of current or pre-existing cardiac, respiratory, and diabetes or related conditions and a relatively high probability of a current or pre-existing kidney condition, moderate probabilities of psychological distress and experiencing death as a family stressor, and moderate-high probabilities of financial stress, low education, unemployment, and living in a disadvantaged area.

9.5.1.1 Latent classes and allostatic load

Mean allostatic load for each latent class was estimated after including the allostatic load risk index as a distal outcome in LCA in a model adjusted for age and gender (Table 9.5). Mean allostatic load was observed to vary significantly by latent class ($Z=301.7$, $p<.001$) (Table 9.6). The 'Multiple challenges' class was observed to have the highest mean allostatic load (4.05; 95% CI: 3.84, 4.26). This estimate was significantly higher than mean estimates for all other classes, while the estimate for the 'Challenged but healthy' class was significantly higher than the 'Low risk' ($B=0.44$, $SE=0.07$, $p<.0001$) and 'Mental health risk' ($B=0.39$, $SE=0.09$, $p<.0001$) classes. No significant difference in allostatic load was observed between the 'Low risk' and 'Mental health risk' classes.

9.5.1.2 Latent classes, allostatic load and racial discrimination

Mean allostatic load for each latent class was again estimated in an extended latent class model that dichotomised respondents into those exposed and unexposed to racial discrimination in the previous 12 months before including the allostatic load index as a distal outcome (Table 9.5). This permitted mean allostatic load to be estimated in each latent class both for individuals with and without exposure to racial discrimination in the previous 12 months. Mean allostatic load varied significantly between latent classes

both for those with ($Z=67.5$, $p<.001$) and those without exposure to racial discrimination ($Z=235.5$, $p<.001$) (Table 9.6).

Mean estimated allostatic load was significantly higher for those in the 'Multiple challenges' class with exposure to racial discrimination compared to those unexposed ($t= 1.74$, $p=.04$), while allostatic load was significantly lower for those in the 'Mental health risk' class with exposure to racial discrimination compared to those unexposed ($t=-1.67$, $p=.05$) (Table 9.7). The 'Multiple challenges' class was observed to have the highest mean allostatic load compared with all other classes both for those with exposure to racial discrimination in the previous 12 months (4.48; 95% CI: 3.95, 5.00) and for those unexposed (3.95; 95% CI: 3.73, 4.18).

9.6 Discussion

This study presents a first exploration of how patterns of psychosocial stressors, environmental and mental health factors, and health conditions within latent classes affect multisystem dysregulation in a First Nations population. We used LCA with distal outcomes to identify profiles of Aboriginal and Torres Strait Islander Australian adults defined by these factors, examine the association between these profiles and an index of allostatic load, and determine whether the association between latent classes and allostatic load differed for those exposed and unexposed to racial discrimination.

Our study observed that allostatic load was significantly increased for individuals with exposure to racial discrimination in the 'Multiple challenges' class compared to those unexposed to racial discrimination in this class. By contrast, allostatic load was significantly lower for those exposed to racial discrimination in the 'Mental health risk' class compared to those unexposed. No significant difference in allostatic load was observed between those exposed and unexposed to racial discrimination in other latent classes. The 'Multiple challenges' class was characterised by high proportions of individuals who reported experiencing death as a family stressor, financial stress, unemployment, and low education, alongside current or pre-existing diabetes and cardiac conditions. Overall, our results indicate that racial discrimination can measurably increase allostatic load for groups of Aboriginal and Torres Strait Islander adults with this profile of psychosocial stress and adverse health, suggesting that these individuals were still physiologically susceptible to the additional psychosocial stressor of racism.

This study confirms that while exposure to racial discrimination has an effect on the physiological dysregulation linked with allostatic load, this effect is significant only in select contexts. Allostatic load was significantly increased between those exposed and unexposed to racial discrimination within the 'Multiple challenges' class, significantly decreased between those exposed and unexposed to racial discrimination within the 'Mental health risk' class, and no significant differences were observed between those exposed and unexposed in the remaining classes. Multiple individual stressors were significantly associated with

increased allostatic load after adjustment for age and gender, providing an indication of the variety of psychosocial stressors that can affect allostatic load. Overall, results from these analyses suggest that not all circumstances in which Aboriginal and Torres Strait Islander people live lend themselves to an increased susceptibility to the adverse physiological effects of racism. These findings underscore that we cannot easily summarise the broader circumstances of Aboriginal and Torres Strait Islander peoples' lives or the continuing adaption of those lives to the adversities often present within them. Racial discrimination is frequently numbered among these adversities, yet when examining the impact of racism on physiological health it is worth broadening the scope of analysis to include, rather than adjust for, socioecological, environmental, and health factors. This is especially the case where these factors have the potential to moderate the body's physiological response to stress.

Findings from this study show that Aboriginal and Torres Strait Islander adults living in high stress environments with low socioeconomic resources have a higher allostatic load than those living in a low stress environment with high socioeconomic resources. This is the case even in the absence of reported health conditions and psychological distress. Respondents in the 'Challenged but healthy' class were observed to have a significantly higher allostatic load than respondents in the 'Low risk' class in the total sample, both before and after grouping for racial discrimination exposure. Both class profiles indicated low proportions of those with pre-existing health conditions or psychological distress, although the 'Challenged but healthy' class had considerably higher proportions of respondents indicating financial stress, unemployment, low education, and area-level disadvantage compared to the 'Low risk' class. Our findings suggest that the financial stress and resource deprivation related to low socioeconomic status (SES) contributes to a higher allostatic load burden in Aboriginal and Torres Strait Islander adults with otherwise positive physical and mental health profiles. Strong and consistent associations between lower SES and allostatic load have been empirically established (284, 309) and various mediators of the association between SES and allostatic load have been identified. (287) Economic difficulties encountered during adulthood have also been observed to amplify allostatic load in those exposed to stressors during childhood and adolescence, suggesting that SES can have an additive effect where maladaptive physiologic patterns have already been established. (310) Mechanisms like this illustrate how allostatic load can be indicative of past stress, providing a marker of the cumulative physiological toll exacted on the body over time. These observations suggest that allostatic load provides both an indication of past challenges and a risk factor for future physiological response patterns. (284) Where individuals have faced many stressors or challenging environments in the past, these patterns are more likely to be physiologically damaging and disease-promoting. (311) Based on results from this study, it appears that SES-related determinants can contribute to increases in physiological dysregulation for Aboriginal and Torres Strait Islander adults and that measures of SES must be accounted for when examining allostatic load in this population.

Levels of allostatic load were significantly lower for respondents characterised by indicators of psychological distress ('Mental health risk') compared to respondents characterised by low SES ('Challenged but healthy'). In fact, levels of allostatic load for those in the 'Mental health risk' class were comparable to those observed in the 'Low risk' class. Additionally, those in the 'Mental health risk' class with exposure to racial discrimination were observed to have significantly lower allostatic load compared to those who were unexposed. These findings suggest that the components of adverse mental health incorporated into LCA models did not completely explain an observable increase in allostatic load and that exposure to racial discrimination interacts with mental health to measurably reduce allostatic load. Strong evidence for a link between allostatic load and adverse mental health has been observed in international studies and allostatic load has been proposed as a likely predictor of adverse mental health in Aboriginal and Torres Strait Islander populations. (275, 312, 313) Currently, further research is required to fully determine the association between increased allostatic load and adverse mental health in Aboriginal and Torres Strait Islander Australian populations. Cortisol and cortisone levels measured from hair samples of Aboriginal and Torres Strait Islander young adults were not significantly associated with psychological distress in the Aboriginal Birth Cohort Study, (314) while no significant association was observed between an allostatic load index comprised of multiple biomarkers and depressive symptoms in recent research undertaken with Aboriginal and Torres Strait Islander adolescents and adults in Queensland, Australia. (315) However, the Queensland study observed that anhedonia and insomnia sub-scores were significantly associated with increased allostatic load in one of the study sites, suggesting that depression symptomology can influence allostatic load. (315) Our observation that psychological distress and low sense of control are not significantly associated with allostatic load in regression analysis adjusted for age and gender suggests a less marked association with these mental health symptoms. However, the implications of our observation that allostatic load is lower for those with a high mental health risk profile who report exposure to racial discrimination are less clear. Emerging evidence from Aboriginal and Torres Strait Islander populations indicates that chronic exposure to psychosocial stressors can lead to suppression of the hypothalamic-pituitary-adrenal (HPA) axis measured via lower cortisol, cortisone, and a blunted cortisol awakening response. (279, 314, 316) Although a broader set of biomarkers were incorporated into our allostatic load index, the combination of stressors present within our mental health risk profile in addition to racial discrimination exposure may be indicative of this type of physiological response.

The strengths of this study include the novel investigation of allostatic load, racial discrimination and psychosocial, environmental and health factors in a large nationally representative sample of Australian Aboriginal and Torres Strait Islander adults. As allostatic load is conceptualised as an indicator of the cumulative effects of stress and adversity, our study design ensured that a broad range of factors were accounted for when examining the link between racial discrimination and this measure of physiological dysregulation. Alongside these strengths, our study encountered some limitations. First, our study was

cross-sectional and could not account for interactions between racial discrimination, psychosocial, environmental and health factors, and allostatic load over time. We are unable to determine whether exposure to racial discrimination had occurred prior to the previous 12 months, or the frequency and duration of this exposure. Neither are we able to determine the temporal sequence of many explanatory variables included in LCA, racial discrimination exposure, and the development of physiological dysregulation captured by the index of allostatic load. Second, a critical component within the literature on life and environmental stress concerns perceptions of stress. (317) Respondents in this study were unable to indicate the presence or degree of stress they perceived in response to individual measures included as explanatory factors in LCA. Third, the measure of racial discrimination utilised in this study was a single-item measure that has not been methodologically validated. Racism is a complex phenomenon and multi-item measures have been shown to be more reliable and able to capture this complexity. (121) Validated, multi-item racial discrimination measures have been developed for Aboriginal and Torres Strait Islander populations (e.g. the Measure of Indigenous Racism Experiences) (318) and would more accurately reflect the experience of racism for these populations. Fourth, although the biomedical data collected in this study over 2012-13 represents the most recent and comprehensive available in a nationally representative Aboriginal and Torres Strait Islander population dataset, these data are now several years old. Despite this, there have been few significant changes in the social, economic, and health circumstances of Aboriginal and Torres Strait Islander children and families across Australia since the AATSIHS data were collected. Accordingly, we strongly believe the data continue to be a relevant and useful resource for examination of the circumstances of Aboriginal and Torres Strait Islander peoples. Finally, many individual biomarkers included in the allostatic load index used within this study are predictive of the current or previous health conditions reported by respondents that were used in latent class formation. For those in the 'Multiple challenges' class, levels of allostatic load are likely primarily driven by the high proportion of respondents reporting the presence of these conditions.

9.7 Conclusions

This chapter has shown that allostatic load was significantly increased for those exposed to the psychosocial stressor of racism in a profile of Aboriginal and Torres Strait Islander adults already experiencing multiple challenges and adverse health. Our findings also indirectly imply that Aboriginal and Torres Strait Islander individuals with fewer challenges, greater resources, or differing life circumstances (e.g. living in a remote area) were more physiologically resilient to the additional stressor of racial discrimination. This finding does nothing to diminish the importance of responding to racial discrimination as a social determinant of health, rather it highlights that the specific conditions of Aboriginal and Torres Strait Islander people's lives must be accounted for when attempting to understand the link between racism and physiological health. The harmful effects of racism on Aboriginal and Torres Strait Islander health are modifiable and a stronger understanding of the circumstances in which they occur can

encourage the development of evidence-based prevention strategies to mitigate their onset and continuation. Prevention strategies may take the form of intervention programs with linked evaluations or policy approaches which cut across multiple systems (e.g. healthcare, education, housing) to address the impact of racism on national health disparities.

Table 9.1: Explanatory variables and racial discrimination exposure

Individual level characteristics	n	%	95% CI	N ¹
Current or pre-existing kidney condition	138	6.8	5.2-8.4	2056
Current or pre -existing cardiac condition	836	40.2	37.2-43.2	2056
Current or pre -existing diabetes or related condition	693	31.7	28.9-34.4	2056
Current or pre -existing respiratory condition	857	45.6	42.5-48.6	2056
Psychological distress	617	30.5	27.7-33.4	2045
Low social support	129	12.7	9.9-15.4	947
Low sense of control	115	10.5	8.0-13.1	947
Did not meet exercise guidelines	507	53.2	49.0-57.5	949
Completed Year 11 or below	1087	51.1	47.9-54.2	1989
Unemployed or not in the labour force	1166	54.5	51.4-57.5	2056
Family level characteristics	n	%		N
Household financial stress	1122	54.8	51.7-58.0	1944
Family stressor - Death	798	50.0	46.5-53.5	1517
Limited facilities for sanitation at home	502	21.0	18.6-23.3	2054
Area level characteristics	n	%		N
1 – Most disadvantaged area	1233	54.5	51.4-57.6	2056
2	360	20.5	17.9-23.2	2056
3	205	10.9	9.0-12.8	2056
4	187	10.6	8.7-12.5	2056
5 – Least disadvantaged area	71	3.4	2.3-4.5	2056
Living in a remote area	1106	63.8	61.2-66.5	2056
Racial discrimination				
Exposure previous 12 months	292	14.6	12.4-16.8	2056

¹ Explanatory variables include missing data.

Table 9.2: Allostatic load outcome variables

Biomarkers	Mean	SD	95% CI	P ₇₅	N
Systolic blood pressure	121.6	18.1	120.7-122.4	130.7	2056
Diastolic blood pressure	78.8	13.6	78.2-79.3	86.0	2056
Body mass index	29.6	9.1	29.3-29.9	33.9	2056
HDL cholesterol	1.2	0.3	1.2-1.2	0.9 ²	2056
LDL cholesterol	2.9	1.4	2.9-3.0	3.5	2056
Triglycerides	1.7	0.9	1.6-1.7	2.1	2056
Fasting plasma glucose ¹	1.7	0.3	1.7-1.7	1.8	2056
HbA1c	5.8	1.4	5.8-5.9	5.9	2056
Albumin creatinine ratio ¹	0.2	1.4	0.1-0.2	0.9	2056
C-reactive protein ¹	1.1	1.4	1.1-1.2	2.0	2056
Allostatic load	Mean	SD	95% CI		N
Allostatic load risk index	2.4	2.3	2.3-2.5		2056

¹ Log transformed.

² HDL cholesterol results within the lowest 25th percentile used to indicate risk (results from 0-0.9).

Table 9.3: Mean allostatic load by explanatory variables

Explanatory variables	Mean	SE	β^1	95% CI	P-value
Current or pre-existing kidney condition					
Yes	3.3	0.2	0.39	0.03-0.74	0.03
No	2.4	0.1	Ref	...	...
Current or pre-existing cardiac condition					
Yes	3.1	0.1	0.53	0.48-0.59	<.0001
No	2.0	0.1	Ref	...	...
Current or pre-existing diabetes or related condition					
Yes	3.6	0.1	1.19	0.99-1.39	<.0001
No	1.9	0.1	Ref	...	...
Current or pre-existing respiratory condition					
Yes	2.5	0.1	-0.09	-0.27-0.09	0.31
No	2.4	0.1	Ref	...	...
Psychological distress					
Yes	2.4	0.1	-0.02	-0.21-0.17	0.84
No	2.5	0.1	Ref	...	...
Low social support					
Yes	2.4	0.2	0.09	-0.36-0.54	0.68
No	2.1	0.1	Ref	...	...
Low sense of control					
Yes	2.6	0.2	0.32	-0.07-0.71	0.10
No	2.1	0.1	Ref	...	...
Did not meet exercise guidelines					
Yes	2.3	0.1	0.16	-0.09-0.41	0.20
No	2.0	0.1	Ref	...	...
Completed Year 11 or below					
Yes	2.8	0.1	0.45	0.26-0.63	<.0001
No	2.1	0.1	Ref	...	...
Unemployed or not in the labour force					
Yes	2.7	0.1	0.43	0.24-0.61	<.0001
No	2.1	0.1	Ref	...	...
Financial stress					
Yes	2.7	0.1	0.77	0.60-0.94	<.0001
No	2.1	0.1	Ref	...	...
Family stressor – Death					
Yes	2.7	0.1	0.62	0.41-0.82	<.0001
No	2.0	0.1	Ref	...	...
Limited facilities for sanitation at home					
Yes	2.8	0.1	0.61	0.40-0.82	<.0001
No	2.3	0.1	Ref	...	...
Index of Relative Socioeconomic Advantage and Disadvantage					
1 – Most disadvantaged	2.6	0.1	1.27	0.79-1.75	<.0001
2	2.6	0.1	1.07	0.59-1.56	<.0001
3	2.3	0.2	0.87	0.35-1.39	0.001
4	2.2	0.2	0.78	0.25-1.30	0.004

5 – Least disadvantaged	1.3	0.2	Ref	...	...
Living in a remote area					
Yes	2.9	0.1	0.90	0.72-1.07	<.0001
No	2.2	0.1	Ref	...	...
Racial discrimination exposure previous 12 months					
Yes	2.7	0.1	0.28	0.04-0.51	0.02
No	2.4	0.1	Ref	...	...

¹ Beta estimates indicate group differences in mean allostatic load.

Table 9.4: Fit indices for one to ten latent class models

Number of classes	Log-likelihood	AIC	BIC (sample size adjusted)	Change in BIC	Entropy
1	-17394	7715	7759		-2.06
2	-16537	6039	6130	-1629	0.73
3	-16259	5522	5659	-471	0.70
4	-16141	5324	5508	-151	0.70
5	-16079	5237	5468	-40	0.70
6	-16031	5179	5456	-12	0.68
7	-15985	5126	5449	-7	0.68
8	-15950	5093	5464	+15	0.70
9	-15930	5091	5508	+44	0.71
10	-15912	5092	5556	+48	0.71

Table 9.5: Latent class membership, item response probabilities, and mean allostatic load estimates by latent class and racial discrimination exposure

Latent class membership probabilities	Low risk	Challenged but healthy	Mental health risk	Multiple challenges
Racial discrimination exposure	0.220	0.188	0.231	0.362
No racial discrimination exposure	0.308	0.278	0.174	0.240
Item response probabilities				
Current or pre-existing diabetes or related condition	0.189	0.138	0.142	0.770
Current or pre-existing cardiac condition	0.258	0.179	0.311	0.861
Current or pre-existing respiratory	0.459	0.159	0.686	0.594
Current or pre-existing kidney condition	0.020	0.027	0.033	0.188
Psychological distress	0.096	0.248	0.655	0.357
Low social support	0.005	0.199	0.210	0.211
Low sense of control	0.000	0.000	0.237	0.147
Did not meet exercise guidelines	0.448	0.560	0.388	0.594
Family stressor – Death	0.459	0.674	0.519	0.630
Financial stress	0.157	0.875	0.678	0.586
Limited facilities for sanitation at home	0.020	0.464	0.152	0.208
Completed Year 11 or below	0.265	0.697	0.485	0.624
Unemployed or not in the labour force	0.109	0.711	0.733	0.740
Living in area of relative disadvantage	0.279	0.918	0.443	0.539
Living in a remote area	0.121	0.900	0.052	0.303
Mean allostatic load	Estimate (95% Confidence Intervals)			
Full sample (n=2,056)	1.67 (1.49, 1.85)	2.58 (2.41, 2.74)	1.75 (1.45, 2.04)	4.05 (3.84, 4.26)
Racial discrimination exposure (n=292)	1.88 (1.35, 2.41)	2.85 (1.83, 2.74)	1.20 (0.61, 1.79)	4.48 (3.95, 5.00)
No racial discrimination exposure (n=1,764)	1.64 (1.45, 1.83)	2.67 (2.49, 2.85)	1.78 (1.46, 2.11)	3.95 (3.73, 4.18)

Table 9.6: Wald chi-squared tests, allostatic load risk index

Full Sample		Estimate	SE	Wald statistic	P-value
Low risk	Challenged but healthy	-0.436	0.065	44.939	<.001
Low risk	Mental health risk	-0.048	0.109	0.192	ns
Low risk	Multiple challenges	-0.888	0.062	206.248	<.001
Challenged but healthy	Mental health risk	0.388	0.094	16.913	<.001
Challenged but healthy	Multiple challenges	-0.453	0.0439	106.449	<.001
Mental health risk	Multiple challenges	-0.841	0.093	82.170	<.001
Omnibus test				301.737	<.001
Racial discrimination exposure					
Low risk	Challenged but healthy	-0.196	0.181	1.176	ns
Low risk	Mental health risk	0.447	0.306	2.136	ns
Low risk	Multiple challenges	-0.869	0.161	29.121	<.001
Challenged but healthy	Mental health risk	0.644	0.281	5.246	<.025
Challenged but healthy	Multiple challenges	-0.673	0.124	29.442	<.001
Mental health risk	Multiple challenges	-1.317	0.266	24.518	<.001
Omnibus test				67.507	<.001
No racial discrimination exposure					
Low risk	Challenged but healthy	-0.488	0.069	50.119	<.001
Low risk	Mental health risk	-0.085	0.119	0.515	ns
Low risk	Multiple challenges	-0.881	0.067	173.425	<.001
Challenged but healthy	Mental health risk	0.402	0.103	15.315	<.001
Challenged but healthy	Multiple challenges	-0.393	0.0469	70.174	<.001
Mental health risk	Multiple challenges	-0.795	0.102	61.179	<.001
Omnibus test				235.537	<.001

Table 9.7: Mean difference between those exposed and unexposed to racial discrimination, within latent classes

	Mean difference – exposed compared with unexposed	SE of difference between means	T statistic	P-value
Low risk	0.239	0.293	0.82	0.206
Challenged but healthy	-0.383	0.240	-1.47	0.072
Mental health risk	-0.585	0.350	-1.67	0.048
Multiple challenges	0.524	0.300	1.74	0.041

Chapter 10 Discussion

10.1 Preface

The overall aim of this thesis was to examine the contribution of the timing and context of interpersonal racial discrimination to adverse physical and mental health outcomes in Aboriginal and Torres Strait Islander populations, with a focus on children aged 0-17 years. This aim was substantiated following a systematic review (Chapter 2) examining the evidence for a longitudinal association between racial discrimination exposure during childhood and adolescence, and later mental and physical health outcomes. This review highlighted two central observations underlying the contribution of interpersonal racial discrimination to adverse health:

- 1) The association between interpersonal racial discrimination and health acts across the dimensions of frequency, duration, and developmental period of exposure, necessitating investigations into the timing of exposure to understand these causal processes; and
- 2) Interpersonal racial discrimination interacts with multiple ecological factors in and around individuals (e.g. genetics, physiology, psychology, living conditions, social relationships, environmental exposures, implementation of national policies/legislation, etc.) to affect mental and physical health, requiring investigations of multiple factors to understand how these interact.

These observations provided the organising framework for three central objectives around which this thesis is framed:

- Identify the prevalence of interpersonal racial discrimination in Aboriginal and Torres Strait Islander child populations, with a focus on understanding the timing and accumulation of exposure;
- Investigate the association between interpersonal racial discrimination and physical and mental health outcomes in Aboriginal and Torres Strait Islander child populations, with consideration of the timing, duration, and developmental period of exposure; and
- Examine the contribution of racial discrimination to physical and mental health outcomes in Aboriginal and Torres Strait Islander populations, within the context of broader ecological factors.

Addressing these observations entailed five distinct studies (Chapters 5-9), organised according to the three central objectives. Few previous studies had examined these observations in Aboriginal and Torres Strait Islander populations, particularly Aboriginal and Torres Strait Islander child populations, and some of the

theoretical mechanisms inherent in these observations – such as the effect of age of first exposure – had not been examined in studies of any population.

The first study in this thesis (Chapter 5) addressed the objective to identify the prevalence of interpersonal racial discrimination in Aboriginal and Torres Strait Islander child populations, with a focus on the timing and accumulation of exposure. The second and third studies in this thesis (Chapters 6 and 7) addressed the objective to investigate the association between interpersonal racial discrimination and physical and mental health outcomes in Aboriginal and Torres Strait Islander child populations, detailing the timing, duration, and developmental period of exposure. These studies focused on the ‘isolated’ contribution of racial discrimination to Aboriginal and Torres Strait Islander children’s physical and mental health, using accumulation of exposure and age of first exposure models to examine these factors. The fourth and fifth studies in this thesis (Chapters 8 and 9) addressed the objective to examine the contribution of racial discrimination to physical and mental health outcomes in Aboriginal and Torres Strait Islander populations, within the context of broader ecological factors. These studies used latent class analysis to identify population groups with shared characteristics, including broader ecological factors that may operate alongside racial discrimination, to determine the contribution of both racism and these contextual factors to physical and mental health. Overall, findings from all five of these studies confirmed the relevance of the hypotheses underlying racism’s contribution to adverse health for Aboriginal and Torres Strait Islander populations in Australia. Each study generated unique evidence and, collectively, provided robust new insights into the complexity of the relationships between racial discrimination and health.

This chapter will first summarise the main findings from each study, highlighting the relevance of these findings with reference to contemporary literature, before describing the key strengths and limitations of this thesis overall. The chapter will then outline future research directions and state the overall conclusions of this thesis.

10.2 Summary of findings

The overall aim of this thesis was initially supported through undertaking a systematic review of quantitative longitudinal studies examining the association between racial discrimination and health outcomes within child and adolescent populations aged below 18 years (Chapter 2). This review found that statistically significant adverse outcomes were most frequently observed for the association between racial discrimination and behaviour issues (74%). Following this, statistically significant adverse outcomes were observed in 63% of associations with health-harming behaviours, including substance use, and for 61% of associations with mental health outcomes, including depression and anxiety. Significant indirect effects in the association between racism and health outcomes were found for mental health, behavioural issues, parent behaviour, peer affiliations, and racial identity. Mediators ranged from individual-level factors such as depressive symptoms to family-level and school-level factors such as parenting practices and school

engagement. Although few studies featured analyses which focused on the duration and timing of exposure to racial discrimination, those that did consistently reported significant associations between accumulated racism and later health outcomes, and, critically, the health effects of racism were observed to vary by developmental period. These findings confirmed the need to account for the timing of racism exposure and the effects of multiple ecological factors influencing individuals along the pathway from racism exposure to adverse health in quantitative empirical examinations on the subject.

The first objective supporting the overall aim of this thesis was to identify the prevalence of interpersonal racial discrimination in Aboriginal and Torres Strait Islander child populations, with a focus on the timing and accumulation of exposure.

This objective was met using data from *Footprints in Time: The Longitudinal Study of Indigenous Children* (LSIC; Chapter 5). The prevalence of racial discrimination experienced directly by Aboriginal and Torres Strait Islander children increased considerably between the ages of 4-11 years, rising from 3.9% at age 4 years to 20.4% by age 11 years. Critically, most of these children (73.5%) experienced their first exposure to direct racial discrimination by age 7 years. Aboriginal and Torres Strait Islander children were also exposed to vicarious racism at high rates, with 44.5% of children exposed to vicarious racism through their primary carer and 50.5% exposed to vicarious racism through other family members by age 11 years. Living in an area of high/extreme remoteness, living in a socioeconomically disadvantaged region, and speaking an Aboriginal language were each associated with an increased risk of exposure to direct racial discrimination by age 11 years.

The second objective supporting the overall aim of this thesis was to investigate the association between interpersonal racial discrimination and physical and mental health outcomes in Aboriginal and Torres Strait Islander children, with consideration of the timing, duration, and developmental period of exposure.

This objective was met through two studies based on data from LSIC (Chapters 6 and 7). The first study (Chapter 6) examined exposure to racial discrimination in Aboriginal and Torres Strait Islander children aged 4-11 years (inclusive), observing that children with one or more exposures between those ages were at twice the risk of an adverse mental health outcome (OR: 2.0; 95% CI: 1.3–3.0), sleep difficulties (OR: 2.0; 95% CI: 1.4–3.0), and behaviour issues at school (OR: 1.9; 95% CI: 1.2–2.9) by 7-12 years compared with Aboriginal and Torres Strait Islander children with no exposure to racism. Children exposed between 4-11 years were also found to be at strong risk of trying cigarettes by 10-12 years, although this estimate was imprecise as it was based on a smaller sub-sample of children (OR: 7.0; 95% CI: 1.1–43.9). In addition to these mental health and health behaviour outcomes, children with exposure between 4-11 years were observed to be at moderate risk of obesity (OR: 1.7; 95% CI: 1.1–2.5) by 7-12 years compared to those without exposure. Racial discrimination was also found to pose a risk to being underweight and trying

alcohol, although effect estimates did not reach statistical significance. No significant associations were observed between racial discrimination and general health.

The second study (Chapter 7) examined whether age of first exposure to racism had a differential impact on later health outcomes in Aboriginal and Torres Strait Islander children. Greater adverse effects on mental health were observed where Aboriginal and Torres Strait Islander children were first exposed to racial discrimination at 4-5 years (OR: 2.8; 95% CI: 1.4–5.4) compared to 7 years (OR: 2.1; 95% CI: 1.2–3.6), when referenced to children with no exposure. Similar effect sizes were observed in both exposure groups for sleep difficulties, although these children were still at a significantly increased risk relative to children with no exposure. Stronger adverse effects on behavioural issues were found with first exposure at 7 years (OR: 2.2; 95% CI: 1.3–4.0) relative to 4–5 years (OR: 1.7; 95% CI: 0.8–3.7). No significant associations were found with the physical health outcomes under investigation (general health, obesity or being underweight).

The third objective supporting the overall aim of this thesis was to examine the contribution of racial discrimination to physical and mental health outcomes in Aboriginal and Torres Strait Islander populations, within the context of broader ecological factors.

This objective was met across two studies (Chapters 8 and 9). The first study (Chapter 8) was based on an Aboriginal and Torres Strait Islander child population (with regard to mental health) using data from LSIC, while the second study (Chapter 9) was based on an Aboriginal and Torres Strait Islander adult population (with regard to physical health) using data from the *Australian Aboriginal and Torres Strait Islander Health Survey* (AATSIHS). Mental health was assessed in a child population as the health outcome hypothesised to express an adverse stress response during early life. Physical health responses were assessed in an adult population because the hypothesised physiological dysregulation from repeated or long-term exposure to racial discrimination is likely to only be expressed in later life.”.

Chapter 8 first used latent class analysis to identify subgroups of Aboriginal and Torres Strait Islander children defined by social determinants of health across the individual, family, and neighbourhood levels – including racial discrimination as a psychosocial stressor. Mental health outcomes were then compared between latent classes using a distal outcomes model. Mean SDQ total difficulties scores were estimated to fall into the ‘abnormal/of concern’ range for a ‘very high bullying risk, multiple challenges’ class (17.07; 95% CI: 14.77, 19.36) and a ‘high risk males’ class (17.03; 95% CI: 13.90, 20.17) characterised by multiple psychosocial risk factors, including substance use, police attention, experiences with bullying, and exposure to racial discrimination, in addition to family-level financial difficulties. SDQ total difficulties scores in the ‘normal’ range were observed for classes characterised by minimal psychosocial risk factors, moderate to high area-level disadvantage and moderate to high levels of remoteness.

The examination of this objective among adults focused on 2,056 participants aged 18 to 75 years from the AATSIHS data (Chapter 9), using an index of allostatic load as the physical health outcome of interest given its recognised role in the physiological response to stress. Mean allostatic load was observed to be highest in a 'Multiple challenges' class compared to all other identified latent classes, both for those exposed (4.5; 95% CI: 3.9, 5.0) and not exposed (3.9; 95% CI: 3.7, 4.2) to racial discrimination. Mean allostatic load was found to be significantly elevated only for Aboriginal and Torres Strait Islander adults with exposure to racial discrimination in the 'Multiple challenges' class, characterised by individuals experiencing financial and personal stress, low socioeconomic resources, and multiple health conditions, relative to those without exposure to racial discrimination ($t=1.74$, $p=.04$). Allostatic load was observed to be significantly lower for those with exposure to racial discrimination in a 'Mental health risk' class, characterised by individuals experiencing high psychological distress, financial stress, and unemployment, relative to those without exposure to racial discrimination ($t=-1.67$, $p=.05$).

10.3 Thesis contributions in context

This thesis breaks new ground in the examination of the timing, duration, and developmental period of exposure to racial discrimination in First Nations children, and in the examination of the effect of racism on health in the context of multiple socioecological factors in First Nations populations. Findings observed throughout these studies make a strong contribution to the international literature examining the association between racial discrimination and health. Six key findings have been distilled from this thesis:

1. Aboriginal and Torres Strait Islander children are commonly exposed to racial discrimination, beginning from the first years of life (Chapters 5-8).
2. Exposure to racism increases the risk of adverse mental health and behavioural outcomes in Aboriginal and Torres Strait Islander children (Chapter 6).
3. Earlier exposure to racial discrimination has a more adverse effect on mental health outcomes in Aboriginal and Torres Strait Islander children (Chapter 7).
4. Racial discrimination exposure acts with psychosocial stressors and limited financial resources to increase adverse mental health outcomes in Aboriginal and Torres Strait Islander children (Chapter 8).
5. Racial discrimination can increase allostatic load in Aboriginal and Torres Strait Islander adults with a profile of psychosocial stress and adverse health (Chapter 9).

6. There is a need to account for the duration and timing of exposure to racial discrimination and the role of ecological factors when examining the health effects of racism in longitudinal studies (Chapter 2).

These findings will form the basis of discussion within the following section, which will situate the contribution of these findings in the context of contemporary literature.

10.3.1 Aboriginal and Torres Strait Islander children are commonly exposed to racial discrimination, beginning from the first years of life

Prevalence of interpersonal racism in populations of Aboriginal and Torres Strait Islander children and adolescents aged 18 years or below have been reported from several datasets, including the national *Longitudinal Study of Australian Children* (LSAC), the national *Footprints in Time: The Longitudinal Study of Indigenous Children* (LSIC), the New South Wales and Victorian *Speak Out Against Racism* (SOAR) student survey, the Northern Territory *Aboriginal Birth Cohort* (ABC), the Victorian Aboriginal Health Service's (VAHS) *Young People's Project* (YPP), the *Western Australia Aboriginal Child Health Survey* (WAACHS), the Northern Territory *Housing Improvement and Child Health* (HICH) study, and a population-based study of women giving birth to Aboriginal infants in South Australia. Prevalence estimates have predominantly been derived from datasets of Aboriginal and Torres Strait Islander adolescents aged 12 years or above using self-report measures. Datasets including respondents aged 12 years and below have relied predominantly on carer-reported measures.

Findings from Chapter 5 illustrated that 20.4% of Aboriginal and Torres Strait Islander children aged 3.5-12 years had experienced racial discrimination at school, with the majority of these children (73.5%) experiencing their first exposure to racial discrimination by age 7. This estimate was based on primary carer-reported racial discrimination experienced by the study child at school or preschool between Waves 2-8 of the LSIC (birth cohort: 3.5-9; child cohort: 4.5-12 years). Overall, this estimate is comparable with those found for Aboriginal and Torres Strait Islander children of a similar age (97, 123, 125, 126, 163) and is lower than estimates found for Aboriginal and Torres Strait Islander adolescents and young people from 12-26 years of age. (162, 164, 170, 171) An increased prevalence of racial discrimination with age is likely due to several factors. Predominant among these is an increased awareness of racial discrimination as children develop a more sophisticated social consciousness throughout childhood into adolescence, and an increased risk of exposure in a wider variety of contexts due to the relatively greater autonomy of adolescents compared to children. (172)

Despite its comparability, the estimate from Chapter 5 covers a wider age range than previous prevalence estimates taken from the LSIC and is thereby higher than those reported in the four prior studies reporting racial discrimination exposure in Aboriginal and Torres Strait Islander children aged 12 years and below in

this dataset. (97, 123, 125, 126) Each of these studies were based on the same measure of primary carer-reported racial discrimination. Two of these studies were based on unique sub-samples developed for multivariate analysis and observed that 14-15% of Aboriginal and Torres Strait Islander children from Waves 6 and 7 (6.5-8 years in the birth cohort and 8.5-10 years in the child cohort) experienced racial discrimination at school. (125, 126) Two further studies included the full sample during the time points under investigation, with the first observing that 11.9% of Aboriginal and Torres Strait Islander children at Wave 5 (5.5-9 years) experienced racial discrimination (123) and the second observing that 14% of Aboriginal and Torres Strait Islander children between Waves 2-6 (5-10 years) experienced racial discrimination. (97) However, the estimate from LSIC children 3.5-12 years (Chapter 5) was lower than those observed in Aboriginal and Torres Strait Islander children and adolescents 10-15 years from the SOAR survey. (319) These self-reported measures indicated higher exposure to racial discrimination from peers at school (42.7%), school personnel (20.7%), and others in society (37.0%). (319) This discrepancy may be due in part to prevalence estimates from the LSIC being based on primary carer reports which have likely under-reported children's experiences with racism at school. Children are unlikely to have discussed all incidents of racial discrimination with their primary carer and primary carers are unlikely to have witnessed all incidents directed at their children or to be made aware of these incidents by other witnesses. As such, we may interpret these estimates as being the minimum likely prevalence of direct racism experienced by Aboriginal and Torres Strait Islander children below 12 years.

Results from Chapter 5 reported that 44.5% of Aboriginal and Torres Strait Islander children aged 6 months-12 years were exposed to vicarious racism through their primary carer and 50.5% were exposed through family members. This estimate was based on primary carer-reported racial discrimination which was either personally experienced or experienced by family members between Waves 1-8 of the LSIC (birth cohort: 0.5-9; child cohort: 3-12 years). This estimate was again higher than previous prevalence estimates, although this was to be expected given that study children were older and exposure was over a longer duration than that of previous studies. (97, 123, 165, 278) Earlier studies provided prevalence rates for vicarious racism based on national samples of Aboriginal and Torres Strait Islander children and samples based in the Northern Territory and South Australia. Estimates ranged from 26% to 51% in these studies depending on the scope of exposure (i.e. community setting, healthcare setting), study location, measurement tool, year reported, and whether the carer, mother or family member reported racism.

The earliest study identifying vicarious racism was based on the HICH study conducted across ten remote Aboriginal communities in the Northern Territory in 2003-04, observing that 34% of carers and 38% of households of Aboriginal children aged 1-7 years reported worrying about racial discrimination in the 12 months prior to the survey—based on an item from the Negative Life Events Scale (NLES). (165) More recently, a population-based study of women giving birth to an Aboriginal baby in South Australia between 2011-13 reported that 51% of women had experienced discrimination or unfair treatment by hospitals or

health services providing care during pregnancy and soon after childbirth. (278) Two studies reported the prevalence of racial discrimination in primary carers from the LSIC in addition to Chapter 5. (97, 123) Bodkin-Andrews, et al. (2017) reported the prevalence of primary carer-reported racism experienced by the study child's family (study children aged 3-9 years) and the prevalence of self-reported racism for the primary carer (study children aged 4-10 years). (123) This study observed that 34.8% of families and 25.7% of primary carers were experiencing racial discrimination at the point in time under investigation. (123) Shepherd, et al. (2017) reported any primary carer-reported exposure to racial discrimination either to their family or themselves (study children aged 1-10 years). (97) This study observed that 40% of primary carers and 45% of families experienced racial discrimination at any point in time. (97)

Prevalence rates for vicarious racism experienced by a parent, carer or family member were generally higher than rates of racism directly experienced by Aboriginal and Torres Strait Islander children aged 12-18 years. Vicarious racism experienced by parents or family members was self-reported by someone who was likely older than 18 years, with greater awareness of more subtle or nuanced forms of racism, greater exposure to a wider variety of settings in which racism could occur (e.g. employment settings, tertiary education, government services, healthcare, etc.), and who has simply lived longer with the attendant risk of exposure to racism over a longer duration of time. Higher estimates of vicarious racism (71.7%) were also self-reported by Aboriginal and Torres Strait Islander adolescents in relation to other students at their school, although these estimates concerned students from varying racial/ethnic/cultural backgrounds beyond other Aboriginal and Torres Strait Islander students. (319)

In a novel contribution to the literature, findings from Chapter 5 highlighted that Aboriginal and Torres Strait Islander children were first exposed to vicarious racism at the earliest possible time point in the LSIC (Wave 1) when children were aged 6 months to 4 years. The largest proportion of children were exposed at this point (29.9%), with decreasing proportions exposed at each subsequent age. As the vicarious racism measure was not time limited, it is possible that experiences of racial discrimination occurred prior to wave 1, when the children were at an earlier age or during gestation. In a further novel contribution, findings illustrated that Aboriginal and Torres Strait Islander children were first directly exposed to racial discrimination in their first years of formal schooling – when children were aged 3.5-5 years. Although relatively few children had their first exposure to racism at this time (3.9%), this remains a concerning statistic when we consider that these Aboriginal and Torres Strait Islander children would have an experience of racism among their first impressions of school.

Overall, acknowledging the variation expected by differing study locations, study years and measurement tools, the prevalence of both direct and vicarious racism generally increased with age in Aboriginal and Torres Strait Islander children and adolescents 3.5-20 years in the literature as a whole. The highest prevalence estimates were reported for racism experienced by mothers, carers, and family members of

Aboriginal and Torres Strait Islander children, suggesting that vicarious racism exposures are the most frequent. These patterns indicate a cycle of racial discrimination exposure, beginning via maternal exposure during gestation, increasing throughout preschool and school contact, and with increased cognition and awareness of discriminatory behaviour across developmental stages into adulthood. Critically, these findings also highlight that many Aboriginal and Torres Strait Islander children experience racism in multiple forms as they grow and develop and that this exposure can begin in their earliest years of life.

10.3.2 Exposure to racism increases the risk of adverse mental health and behavioural outcomes in Aboriginal and Torres Strait Islander children

Within the last five years, five studies have investigated the associations between direct racial discrimination and Australian Aboriginal and Torres Strait Islander children's health in populations aged below 12 years, including Chapters 6 and 7. (97, 125, 126) All studies relied on data from the LSIC based on a question asking the child's primary carer whether the study child had been bullied or treated unfairly at school because he/she is Aboriginal and/or Torres Strait Islander.

A comprehensive assessment of mental health and related outcomes was undertaken in Chapter 6, examining their association with racial discrimination and reporting that exposure to racial discrimination at 4-11 years was associated with twice the risk of adverse mental health, sleep difficulties, and behaviour issues at school in Aboriginal and Torres Strait Islander children. This finding confirmed the strength of the association between cumulative racial discrimination exposure from middle to late childhood and adverse mental health outcomes in Aboriginal and Torres Strait Islander children, expanding on an earlier study by Shepherd, et al. (2017) which examined both vicarious and direct racial discrimination exposure in Aboriginal and Torres Strait Islander children aged 5-10 years. (97) This earlier study observed a significant association between both vicarious and direct racism and mental health, sleep difficulties, obesity, and asthma. (97) Notably, this study integrated an assessment of accumulation of vicarious racism exposure, or whether differences were observed in the effects of vicarious racism (primary carer experienced racism) between time-limited (exposure at a single time point) and persistent exposure (exposure across multiple time points). (97) An increased risk of sleep difficulties and asthma was found for children with persistent vicarious racial discrimination compared to those with time-limited exposure. (97) Accumulation of exposure to direct racism was not examined in this study due to the limited sample size of children with exposure at multiple time points.

The observation of a specifically heightened risk for adverse mental health and related outcomes (sleep difficulties, behaviour issues at school) found in Chapter 6 was reflected in a generally heightened risk for socioemotional difficulties observed in a study published concurrently by Macedo, et al. (2019a). (3) Macedo, et al (2019a) focused exclusively on socioemotional wellbeing as the health outcome at 7.5-12 years, based on the total difficulties score and subdomain scores for emotional symptoms, conduct

problems, hyperactivity, and peer problems from the Strengths and Difficulties Questionnaire (SDQ). The SDQ was utilised to identify adverse mental health in Chapter 6, although this outcome was examined alongside behavioural outcomes, weight-related outcomes, and global physical health. SDQ total difficulties score estimates reported in Macedo, et al (2019a) and Chapter 6 differed according to the different analytic methods selected in each study and the exposure period for racial discrimination under investigation. Macedo, et al. (2019a) pooled effect estimates from separate analyses of the birth and child cohorts, presenting an average measure of the effect of racial discrimination at either Wave 6 or 7 on SDQ total difficulties and subdomain scores at Wave 8. Conversely, estimates from Chapter 6 were generated by combining the birth and child cohorts and examining the effect of racial discrimination from Waves 2-7 on SDQ total difficulties scores at Wave 8. Increased risks were observed in Macedo, et al (2019a) across the total difficulties score and each of the subdomain scores with racial discrimination exposure for the full sample, however these estimates were imprecise. Stronger effects on SDQ total difficulties and subdomain scores were observed in a second study by Macedo, et al. (2019b) which investigated the effect-modification of ethnic-racial identity (ERI) on the association between racism and emotional wellbeing. (126) This study focused on respondents in the child cohort (n=408), using the racism measure collected at Wave 6 (7-10 years) and the ERI and social and emotional wellbeing (SEWB) measures from Wave 8 (9-12 years). In this study, Macedo, et al. (2019b) observed that children exposed to racism with low ERI affirmation were at an increased risk of hyperactivity, conduct problems, and total difficulties, while children exposed to racism with high ERI affirmation were at an increased risk of peer problems. (126)

10.3.3 Earlier exposure to racial discrimination has a more adverse effect on mental health in Aboriginal and Torres Strait Islander children

Results from Chapter 7 were suggestive of a greater adverse effect on mental health in Aboriginal and Torres Strait Islander children with first exposure to racial discrimination at 4-5 years compared to those first exposed at 7 years, referenced to children with no exposure. This finding suggests that earlier exposure to racial discrimination has a more adverse effect on the mental health of Aboriginal and Torres Strait Islander children, with important implications for anti-racism interventions. This evidence extends on that observed in Chapter 6 by undertaking a close examination of the role of age of first exposure and continuing to focus on mental health using the SDQ measure alongside sleep and behavioural difficulties. Although findings from Chapter 7 illustrated that earlier exposure had a more adverse effect on mental health, the effects on mental health-related outcomes differed with exposure period. For instance, greater adverse effects on behaviour issues at school were observed with later exposure to racial discrimination. Although emotional and behavioural difficulties co-develop throughout childhood, behavioural issues severe enough to result in the school contacting a parent or carer are likely to be expressed later than the emotional difficulties captured by the SDQ. Alternatively, this effect may be an artefact of the temporal

overlap between exposure and outcome for study children aged 7 years, when both racial discrimination exposure and behavioural issues were recorded.

The results from Chapter 7 present the first examination of the effects of age of first exposure to racial discrimination in Aboriginal and Torres Strait Islander children. In fact, this age of first exposure to racial discrimination measure had not previously been applied in any population. Sensitive periods of exposure to racial discrimination are generally underexamined, particularly during childhood. Where the strength of this association has been compared across adolescent developmental periods in a meta-analytic review, the positive association between emotional and behavioural difficulties and racial discrimination has been shown to be stronger in early rather than late adolescence. (9) To the best of my knowledge, only one study has examined age of first exposure to racial discrimination below 12 years of age and associated health outcomes, although this study used a retrospective measure reliant on respondents' recollections. (11) Cuevas et al. (2019) examined first exposure to racial discrimination using a self-report measure which asked respondents to retrospectively identify the age they first experienced racial discrimination. (11) This study found an increased odds of cardiovascular-related health conditions for those with first exposure during early childhood (0-7 years) and an increased incidence of cardiovascular disease for those first exposed during both early childhood and adolescence (13-19 years), when compared with those not exposed. Findings from both the meta-analytic review and the individual study by Cuevas et al. suggest that earlier exposure to racial discrimination increases a child's sensitivity to adverse physical and mental health outcomes in subsequent developmental periods.

10.3.4 Racial discrimination exposure acts with psychosocial stressors and limited financial resources to increase adverse mental health outcomes in Aboriginal and Torres Strait Islander children

Findings from Chapter 8 highlight that adverse mental health was observed in groups of Aboriginal and Torres Strait Islander children who reported multiple psychosocial risk factors, including high exposure to personal racism, substance use, police attention, experiences with bullying, and family-level financial difficulties in high proportions. On the other hand, Aboriginal and Torres Strait Islander children with few psychosocial risk factors, including minimal substance use, police attention, experiences with bullying or high exposure to personal racism had positive mental health regardless of area-level disadvantage or whether they lived in a metropolitan, suburban/regional or remote area. These findings were based on a person-centred approach using latent class analysis which identified subgroups of Aboriginal and Torres Strait Islander children and included racial discrimination as an explanatory variable alongside other social determinants of health, including individual-level psychosocial factors, family-level socioeconomic status, neighbourhood-level advantage, and geographic remoteness. Due to this approach, these findings extend on existing studies which use variable-centred approaches to quantify the role of specific contextual variables beyond racial discrimination to account for adverse mental health during childhood and

adolescence. Studies using a variable-centred approach have observed singular associations between adverse mental health and experimentation with substance use, contact with the police and justice system, and bullying. (162, 252, 253, 256, 257) Racial discrimination was observed to amplify the risk of experimentation with smoking in Aboriginal and Torres Strait Islander children aged 4-11 years (Chapter 6). This finding may suggest links between racial discrimination, substance use, and adverse mental health, given that the onset of mental health disorders in childhood such as anxiety and conduct disorder are known to be strongly associated with racial discrimination and are also predictive of later substance use and substance use disorder. (194, 195) Conversely, racial discrimination and bullying have been observed to have low concordance with one another in Aboriginal and Torres Strait Islander children aged 12-13 years, indicating that each exposure generates distinct effects in the lives of these children. (163) Although variable-centred approaches are not able to capture the interplay between population characteristics, evidence from these studies confirms the need to analyse the effects of racial discrimination in the context of wider social forces that direct and maintain patterns of exposure to multiple psychosocial stressors.

The study presented in Chapter 8 is the first to have integrated racial discrimination into a latent class analysis which predicts mental health as a distal outcome in Aboriginal and Torres Strait Islander children. However, two other studies have used person-centred approaches to examine mental health and developmental outcomes in Aboriginal and Torres Strait Islander children and adolescents. A study undertaken by Strobel, et al. (2019) used latent class analysis to predict neurodevelopmental outcomes taken from the Australian Early Development Census in Aboriginal and Torres Strait Islander children aged 5 years and below. However, this study was focused on a separate outcome in Aboriginal and Torres Strait Islander children at an earlier stage of development and defined latent classes using indicators of health and human service contact and factors associated with neurodevelopmental outcomes rather than taking a social determinants approach which incorporated racial discrimination exposure. (240) An earlier study by Hopkins, et al. (2014) used a person-centred approach to define subgroups of Aboriginal and Torres Strait Islander adolescents aged 12-17 years by cross-classifying psychosocial functioning with exposure to family risks predictive of poor psychosocial functioning and generating four subgroups: low family risk, good psychosocial functioning; low family risk, poor psychosocial functioning; high family risk, good psychosocial functioning; and high family risk, poor psychosocial functioning. (241) The influence of several individual, family, cultural, and community factors, including racial discrimination, were then modelled separately for these subgroups using regression analysis. (241) Racial discrimination was observed to increase the risk of poor psychosocial functioning even in low family risk contexts. (241) Although this study used a person-centred approach which focused on the interplay between the characteristics of Aboriginal and Torres Strait Islander adolescents, the latent class analysis with distal outcomes applied in Chapter 8 offers a more nuanced form of analysis to explore how clusters or patterns of shared characteristics predict mental health outcomes in Aboriginal and Torres Strait Islander children.

Overall, studies investigating the association between racial discrimination and health outcomes in Aboriginal and Torres Strait Islander children ≤ 12 years align with and support the findings in this thesis. Each of the studies demonstrate the contribution of racial discrimination to adverse mental health outcomes as a psychosocial stressor. These studies also confirm the temporality of the association between earlier exposure to racial discrimination and later adverse health outcomes, focusing on outcomes identified within international literature as occurring along the aetiological pathway that implicates the stress response (65). Physical health outcomes have been investigated less frequently, with inconsistent evidence for adverse effects on these outcomes. This may reflect the developmental stage of respondents, as the biological mechanism linking racial discrimination exposure and adverse physical health may not yet be apparent during childhood. Initial evidence from the findings in this thesis suggests that the effect of racism exposure differs with the age of first exposure and that socioecological factors contribute to the effects of racism exposure, at least with regard to mental health and behavioural outcomes. Direct comparisons between the effects of racism exposure on mental health and physical health outcomes (ideally based on biological data) can potentially verify the relative strength of adverse mental health in this age group and advocate for interventions which address racial discrimination.

10.3.5 Racial discrimination can increase allostatic load in Aboriginal and Torres Strait Islander adults with a profile of psychosocial stress and adverse health

The study undertaken in Chapter 9 observed that allostatic load was significantly increased for individuals with exposure to racial discrimination who were already experiencing many psychosocial stressors and adverse health (the 'Multiple challenges' class) compared to those unexposed to racial discrimination. The 'Multiple challenges' class was characterised by high proportions of individuals who reported experiencing death as a family stressor, financial stress, unemployment, and low education, alongside current or pre-existing diabetes and cardiac conditions. This finding indicates that racial discrimination can increase allostatic load even for groups of Aboriginal and Torres Strait Islander adults with this profile of psychosocial stress and adverse health, suggesting that these individuals were still physiologically susceptible to the additional psychosocial stressor of racism. This novel evidence contextualised the effects of racism on allostatic load within broader health and socioecological factors in Aboriginal and Torres Strait Islander people's lives. Like the findings generated in Chapter 8, these findings were facilitated by a latent class analysis with distal outcomes approach. This analysis investigated the role of racism on physiological dysregulation while also accounting for the health and socioecological factors known to be implicated with stress and increased allostatic load. Prior to the analysis conducted in Chapter 9, no studies had utilised an index of allostatic load in an Australian Aboriginal and Torres Strait Islander population (using multiple biomarkers) to investigate an association with racial discrimination.

Overall, 13 studies published prior to the completion of Chapter 9 examined the association between racial discrimination and an index of allostatic load comprised of multiple biomarkers in international

populations. (208, 287-298) Two of these studies were focused on First Nations adults attending university in western Canada, (293, 294) while the remainder were focused on African American, Puerto Rican, and Chinese American populations. Many studies situated racism within the complex intersecting stressors also known to be implicated in heightened allostatic load but did so using mediation analysis or analysis of effect modification which investigated the role of single contributing factors. Currie, et al. (2019, 2020) focused on a First Nations adult population using an index of allostatic load comprised of seven biomarkers. (293, 294) These studies examined the association between allostatic load and self-reported experiences of racial discrimination in childhood and during the past year, and the degree to which cultural continuity modified the effect of racism on allostatic load for First Nations Canadians. (293, 294) Both studies observed that both racial discrimination experienced during childhood and racial discrimination experienced during the past year were associated with a linear, dose-response increase in allostatic load. (293, 294) Notably, both studies also observed that high cultural continuity acted as a form of resilience, buffering against the adverse effects of racism, regardless of whether racism was experienced during childhood or over the past year. (293, 294)

A further four studies integrated individual mediating and moderating variables into models to account for specific hypothesised pathways between racial discrimination and allostatic load, including emotional support, (208) social support, (297) racial background, (298) and the 'superwoman schema' ("a multidimensional culture-specific framework characterising psychosocial responses to stress among African American women"). (291) Three studies also investigated discrimination as a mediating variable in models examining the association between racial background, (287, 288) socioeconomic status, (287, 289) and allostatic load, although these studies used measures of discrimination which were not exclusive to racial discrimination (e.g. the Everyday Discrimination Scale). (287-289) Findings from studies investigating the link between racism and allostatic load provide strong evidence for the hypothesised role of racism as a psychosocial stressor, given the established link between multiple confirmed stressors or adversities and allostatic load in the broader literature. These studies and my own findings confirm that ecological factors interact with racial discrimination to increase or decrease allostatic load and must continue to be investigated in future analyses.

10.3.6 There is a need to account for the duration and timing of exposure to racial discrimination and the role of ecological factors when examining the health effects of racism in longitudinal studies

The systematic review of longitudinal studies undertaken for this thesis indicated that the duration and timing of exposure to racial discrimination during childhood and adolescence matters for later health outcomes (Chapter 2). This systematic review specifically explored emerging evidence surrounding sensitive/critical periods of exposure to racism during childhood and adolescence. Studies examining critical/sensitive periods in the review reported inconsistent results and were focused on adolescent stages

of development. However, aggregated findings from included studies suggested that earlier exposure to racial discrimination was associated with more adverse mental health. More specifically, study findings pointed to a considerably higher proportion of behaviour problems and health-harming behaviours with exposure to racism from 5-10 years compared to 11-18 years, and a moderately higher proportion of adverse mental health problems among those with exposure at 0-4 years and 5-10 years compared with 11-18 years. This initial evidence was reflected in findings from a recent systematic review and meta-analysis focused on associations between racial/ethnic discrimination and socioemotional distress and risky health behaviours as health outcomes. (9) Meta-analysis from this earlier review observed that the adverse effects of racial/ethnic discrimination on socioemotional distress were stronger during early adolescence (10-13 years) compared with late adolescence (17-20 years), (9) although it included both cross-sectional and longitudinal studies and did not focus on studies including children aged below 10 years. Overall, findings both from the systematic review included in this thesis and recent meta-analytic review provide strong confirmation of the strength of associations between self-reported exposure to racial discrimination and adverse mental health and health-harming behaviours during childhood and adolescence.

The majority of empirical studies have established at least one mediating variable in the association between racial discrimination to subsequent health outcomes. Mediating variables primarily related to mental health and behaviour (including behavioural issues such as anger) and health-harming behaviours (such as substance use and sleep duration). This finding was reflected in an earlier systematic review by Priest, et al. (2013), which included both cross-sectional and longitudinal studies and was among the first reviews to confirm that the consistently observed associations between racial discrimination and health outcomes found in adult populations were also a feature of child and adolescent populations. (7) Priest, et al. (2013) observed significant indirect effects from behavioural issues, including anger, in studies examining the association between racial discrimination and substance use – although significant indirect effects were also observed for peer relationships, parenting, and post-traumatic stress. (7) Variables related to racial and cultural identity were noted as significant mediators of the association between racial discrimination and self-esteem. (7) Variables related to ethnicity and ethnic/cultural identity were also noted as significant interaction terms in moderation analysis, a finding reflected in the systematic review within this thesis where most significant moderating variables related to racial/cultural identity or nativity status and ethnicity. However, considerable variation in the subject and domain of significant moderating and mediating variables was observed in both reviews. Similarities in the findings of both reviews is unsurprising, given the overlap in scope between the systematic review included in this thesis and Priest, et al.'s review (at least to November 2011).

The principal way that the systematic review within this thesis extended on the review conducted by Priest, et al. (2013) was by specifically examining the association between racial discrimination and health outcomes in longitudinal studies in which exposure to racial discrimination occurred during childhood or

adolescence. Both systematic reviews further strengthen the observation that racial discrimination predominantly affects health as a psychosocial stressor. Through this aetiological pathway, the most consistent health effects in children from direct exposure to racism are observed in adverse mental health outcomes, behaviour problems, and health-harming behaviours, while adverse physical health outcomes appear to be more consistently impacted via vicarious exposure to racism. Broadly, findings from the systematic review included within this thesis highlighted that few studies made full use of the potential strengths available in longitudinal datasets, particularly their use in age cohort studies. There are promising avenues for further research to apply models from life course epidemiology (e.g. accumulation of exposure, critical/sensitive periods) in investigations of the duration and timing of exposure to racism, and to examine the underlying mechanisms between racism and health in the context of broader ecological factors.

10.4 Limitations

The limitations of studies within this thesis primarily relate to the measurement of racial discrimination. The single-item racial discrimination measure incorporated within the AATSIHS conforms relatively well to measures used internationally and includes a 12-month exposure timeframe. However, as a single-item it has limited scope for capturing the variety of contexts and experiences which encompass racial discrimination exposure and does not describe the individual's response to racism or capture the frequency or duration of racism exposure across the 12-month period—all of which determine the extent to which racism acts on health as a psychosocial stressor. Multi-item measures have been shown to be more reliable and better able to capture the multi-dimensionality of racial discrimination experiences compared to single-item measures. (121) Validated, multi-item racial discrimination measures have been developed for adult Aboriginal and Torres Strait Islander populations (e.g. the Measure of Indigenous Racism Experiences) (318) and could allow greater consistency between studies focused on these populations if adopted more broadly.

Some measures within the LSIC were not completed in every Wave even by respondents who were retained across all Waves. The inconsistent completion of measures across Waves meant that measures sensitive to age and repeated measures were difficult to derive. In Chapter 6, the measure of racial discrimination included all exposures between 4-11 years, essentially developing a cumulative measure of racial discrimination during childhood. However, due to the limited sample of children with a single exposure at any single Wave (and thereby age), this chapter was unable to compare cumulative exposure to a single exposure to determine whether a dose-response type effect was present. Similarly, the accelerated cross-sequential design provided some practical limitations in constructing the age of first exposure measure in Chapter 7. To ensure the racial discrimination measure preceded the outcome measures under investigation, this chapter was limited to comparing differences in exposure between 4-5 and 7 years which may not allow enough variability in age and developmental stage to capture a

measurable difference in the effect of age of first exposure to racism. This is not a comment on the design of the LSIC but on the limitations imposed on the type of racism exposure variables able to be derived within this environment.

Within the LSIC, the racial discrimination measure incorporated into Chapters 6 and 7 was based on perceptions of the primary carer regarding the study child's experiences. While this was an appropriate way to collect a measure of racial discrimination from children who may not yet be able to articulate racial discrimination or at least to do so in the context of a formal survey, this inevitably leads to bias as the perception of racial discrimination experiences is limited to the primary carer. It is likely that racial discrimination is under-reported in this measure due to gaps in the awareness of primary carers regarding their child's experiences. It is also possible that children could conflate other forms of bullying with racialised bullying when reporting their experience to primary carers, compromising the specificity of this measure. The introduction of a module of racial discrimination items in Wave 10 of the LSIC, used in Chapter 8, provides a model for racial discrimination measures specific to Aboriginal and Torres Strait Islander children to be integrated into future study designs.

The current thesis is limited to interpersonal forms of racial discrimination and does not include studies integrating measures of structural racism. This thesis has focused solely on analysis integrating exposure to racial discrimination perceived to occur between people, although interpersonal racism is only one way of expressing racism. Structural racism is a concept which encompasses all ways in which racial discrimination is supported and reinforced throughout social systems, including through encouraging the discriminatory beliefs which underlie and often prompt acts of interpersonal racism. In this way, structural racism may be thought of as a precondition of interpersonal racism. However, structural racism is notoriously difficult to measure (320) and therefore to incorporate into quantitative analysis because structural racism encompasses such widely differing components of racism—from macrolevel systems (e.g. legal, health care, financial) to cultural, political, and social ideologies, as well as the interactions inevitably occurring between both. Due to these difficulties, investigations into the effects of structural racism on child and adolescent health will ideally be the focus of a later research project with a longer timeframe than the current thesis.

Measuring allostatic load is a difficult undertaking and has been derived in several ways within the literature. The risk index derived for allostatic load in Chapter 9 weighted all biomarkers equally by allocating respondents with a '1' for all biomarkers for which they fell into the 75th percentile or above (or 25th percentile and below in the case of high density lipoprotein cholesterol). However, not all biomarkers included in our allostatic load risk index would necessarily be as sensitive to racism or have comparably strong implications for later health (e.g. C-reactive protein compared to HbA1c). Considerations of the

specific weight of unique biomarkers on the physical health of sample populations should inform future allostatic load indices.

10.5 Strengths

With these limitations in mind, this thesis has several strengths. The central strength of the studies that form this thesis is the novelty of the study design and analytic approach, and their application to a First Nations population (predominantly children). At the time this thesis was conceived and initial studies undertaken, only one existing study had examined the link between direct racism and health in an Australian Aboriginal and Torres Strait Islander child population. (97) Investigations into the timing of racism exposure, examinations of the role of ecological factors in the association between racism and health, and an index of allostatic load had not yet been applied to any Aboriginal and Torres Strait Islander Australian population. Specific components of each of these investigations, most notably the focus on age of first exposure and use of latent class analysis, had not been a feature of any empirical study.

This thesis has drawn on population-representative data, providing a basis for the generalisability of study findings. The AATSIHS was based on a nationally representative sample of Aboriginal and Torres Strait Islander adults and the use of the person-weights generated by the Australian Bureau of Statistics ensured that estimates were applicable for the national Australian population of Aboriginal and Torres Strait Islander adults. The LSIC, while using a non-random purposive sampling design, ensured that study sites reflected the geographic spread and socioeconomic and community environments of Aboriginal and Torres Strait Islander children across Australia. This robust data enabled sophisticated modelling to take place. Analytic models within this thesis were led by the theoretical underpinnings of life course epidemiology. This theory informed the development of measures of the accumulation of exposure (Chapter 5) and age of first exposure (Chapter 7) to racial discrimination. Insights gained from this theory informed the development, structure, and content of the systematic review and contributed to the organising framework for the central objectives driving this thesis. Situating this thesis in a life course epidemiology framework also maintained the focus of analysis and study design on considerations of age and developmental stage, duration, and frequency of exposure, and the interrelationships of variables over time. This focus ensured that studies investigating novel exposure variables during the especially dynamic period of early and middle childhood were sensitive to age and timing, particularly given that these analyses occurred within a longitudinal dataset.

This thesis consistently sought to consider causality when building analytic models and developing study designs. While casual assumptions could not be met in all cases due to the timing of data collection for some exposure and outcome measures, choices were made where possible to ensure that analytic models did not violate basic causal assumptions. These choices included ensuring that exposure variables preceded outcome variables, that confounding variables could not be considered causally antecedent to outcome

variables (where controlling for these confounders would obscure the ‘actual cause’ of the outcome), and that either the exposure or outcome variable could be considered causally antecedent to confounding variables.

The formation of the Social Determinants of Aboriginal Health Community Advisory Group (SDAH CAG) ensured that each study was informed by the experience and expertise of Aboriginal community members from the Perth metropolitan region. The SDAH CAG had good representation from both males and females and across different age groups, and members had professional and personal experience spanning government, juvenile justice, education, and community service sectors. Each sub-study was initially proposed to the group to determine the relevance of the research question to Aboriginal communities and was reviewed based on comments and suggestions from the group before being undertaken. Findings from each study were then presented to the group, with group discussions typically focusing on the interpretation of data—often in considerable detail. Finally, and most crucially, SDAH CAG members contributed to robust discussions concerning the policy and practice implications of study findings. As these implications had direct relevance for the SDAH CAG, members quickly identified key policy and practice recommendations and actively contributed to the research and policy summary document developed for dissemination (Appendix 7).

10.6 Development of policy and practice recommendations

Empirical findings from this thesis have the potential to inform advocacy efforts and practice interventions intended to highlight and address the presence of interpersonal racial discrimination in Aboriginal children’s lives and the resultant adverse effects on their health. Several policy and practice recommendations were developed towards the conclusion of this thesis with members of the SDAH CAG. These recommendations were primarily directed by research findings from Chapters 5, 6 and 7, concerning the prevalence of racial discrimination among Aboriginal children, the adverse effects observed on these children’s mental health and behaviour, and – critically – the observation that children first exposed to racism at a younger age experienced more adverse effects on their mental health. These findings highlight that targeted responses to racism are particularly vital during childhood as the early years present a critical period of health vulnerability to adversity and stress. As such, schools were identified as an ideal universal platform to implement change during this developmental period.

Most recommendations focused on advocating that schools and school communities adopt various proposals designed to ensure that racism and prejudice towards Aboriginal children is prevented from occurring. These recommendations centred on increasing education and awareness, and on improving consistency and accountability. The focus on increased education and awareness centred around ensuring that children and parents are well informed about Aboriginal histories and cultures as a component of Australia’s shared national identity, and about Australia’s history of colonisation and the implications of its

aftermath for Aboriginal communities. The call for improved consistency and accountability focused on ensuring that all schools are a safe place for all children and that the culture and learning environment of schools specifically support Aboriginal children's security and wellbeing. Specific recommendations for mechanisms to achieve these aims have been outlined in the research and policy summary document co-designed with the SDAH CAG (Appendix 7).

10.7 Future research directions

Several opportunities for extending and enhancing the (predominantly quantitative) analysis carried out in this thesis became apparent throughout the process of conducting the theses studies. While this thesis attempted to fill gaps in our understanding of how racial discrimination's impact on health is affected by the timing, frequency, and duration of exposure, gaps still remain in our understanding of the extent to which racism impacts on physiology and how racism interacts with other stressors in life to impact on health more broadly. Several means of extending on this field of research have been identified and are detailed below.

10.7.1 Consistency in racial discrimination measurement

The data sources used in this thesis include differing measures of racial discrimination. This inconsistency is a common feature of racial discrimination measures across the literature, making it difficult to compare experiences of racism between populations and over time while ultimately making meta-analysis of the association between racial discrimination and health challenging or untenable. Although measures used internationally may not be appropriate for Aboriginal and Torres Strait Islander populations, the Measure of Indigenous Racism Experiences was developed specifically for Aboriginal and Torres Strait Islander adult populations and is not consistently utilised in data collection. (318) Racial discrimination measures have not yet been validated in an Aboriginal and Torres Strait Islander child population, however, the comprehensive module of items related to racial discrimination in the LSIC Wave 10 offers a promising series of racial discrimination indicators for study children during both late childhood and adolescence. Ideally, this module should be retained within the LSIC in future years without major changes, to facilitate comparability and longitudinal analysis. This consistency should ideally extend to all current LSIC items, including the way these items are derived for analysis. Consistency in LSIC items will provide opportunities for studies to investigate how both granular (e.g. ages during early childhood) and broad (e.g. developmental periods) sensitive periods of exposure to racial discrimination differentially affect health. This is particularly relevant as study children in the LSIC reach late adolescence and early adulthood where the prevalence of mental health disorders begins to peak and the onset of chronic physical health conditions may commence. Given this reality and that earlier exposure to racial discrimination is likely to be associated with subsequent adverse health outcomes, the strength of the effects of racial discrimination on health overall are likely to increase with age.

10.7.2 Intersections between racial discrimination and biology

As Chapter 9 highlighted, racial discrimination plays a role in changing the physiology of Aboriginal and Torres Strait Islander adults with specific life circumstances. The role of racism in affecting physiology as a psychosocial stressor has been clearly demonstrated in international studies across different population groups. However, this thesis was unable to investigate how racism may impact on physiology during early life as biological data were not available in the nationally representative population datasets from Aboriginal and Torres Strait Islander respondents aged below 18 years. The ethics of collecting biological data from Aboriginal and Torres Strait Islander children must be carefully considered and the benefits of generating greater insights into the biological mechanisms of health weighed against the costs to individuals and concerns surrounding data sharing and ownership rights. Collection of biomedical data from Aboriginal and Torres Strait Islander children could allow for a more enriched examination of the link between racial discrimination and health. However, it is critical that appropriate steps are taken to ensure communities, families, and children are engaged in decision-making processes, are central to research governance, and have full ownership (i.e. custodianship) over the data once collected. (321, 322) There is currently no specific legislative framework in Australia to guide the inclusion of Aboriginal and Torres Strait Islander populations in biomedical research. (323) However, the National Centre for Indigenous Genomics at the Australian National University is developing a model to involve Aboriginal and Torres Strait Islander populations in national biobanks and biomedical research which will provide an ethical research framework centred on culturally competent engagement. (323) Central to this is a dynamic consent process which allows participants to choose to only contribute their biomedical data to specific research projects which benefit their community while maintaining ownership of their (or their relatives) samples which are simply under the stewardship of researchers. (321, 323) This ethical framework is a strong step in the right direction but will need to be re-evaluated with each community from which biomedical data is sourced and continually re-developed as new research questions and ethical issues are raised.

The LSIC is a potential candidate for integration of biomedical data from respondents aged below 18 years. The LSIC has ongoing relationships with communities and is well positioned to engage closely with those communities about the prospect of integrating biomedical data in future survey Waves. Study children in both cohorts are nearing an age where dynamic consent processes would be feasible, if age-appropriate information is provided. Collection of biological data from consenting respondents would permit retrospective analysis not only of the association between racial discrimination and physiological indicators of stress but also that of related life stressors. Recent studies conducted with Aboriginal and Torres Strait Islander adolescents and young people have demonstrated the feasibility of collecting hair and fingernail samples to detect cortisol levels as a biomarker of stress. (314, 316) Minimally invasive, well-tolerated methods such as these may form a viable alternative to more invasive blood, saliva, and urine sample collections where stress biomarkers are the outcome of interest.

Associations between early environmental stress and both broad arrays of epigenetic marks and changes in the expression of specific genes later in life have been found in human studies. (324-326) Studies have also identified links between exposure to racial discrimination and DNA methylation and epigenetic aging. (327, 328) Long-term and dynamic short-term regulation of gene expression during episodes of stress are believed to be driven by epigenetic mechanisms including DNA methylation and histone modification. (329) Gene sequences are unaltered throughout life. However, gene expression can be regulated through epigenetic modifications to the histone proteins within nucleosomes around which stretches of DNA are wrapped. (330) Histone proteins can be chemically modified in multitudinous ways, including through methylation of the amino acids on histones' tail-like extensions, and through variations in histone proteins themselves. (330) These epigenetic modifications work to essentially turn genes 'on' and 'off', allowing changes in protein production to occur which can, in turn, change the functionality of cells and the functionality of the tissues or organs comprised of these cells. (329, 330) These mechanisms are thought to provide a means by which the environment can influence gene expression across the life span. These mechanisms can translate early environmental stress exposures into physiological challenges and changes in health status, affecting many varied domains (e.g. endocrine, metabolic and neuroregulatory pathways, which in turn can induce changes to behaviour, metabolism, immune responsiveness and cognitive processes into adulthood). (329)

Longitudinal studies collecting data on exposure to racial discrimination during gestation, infancy, and early life alongside socioecological factors likely to promote stress and maternal perceptions of stress are well placed to provide data to further explore potential links between these factors. Our current understanding of the links between epigenetic modifications, cell function, and systemic physiological change is constantly evolving. Single cell sequencing techniques have been developed to investigate methylation in different cell types. (331) Combining genomic, epigenomic, and transcriptomic studies can generate novel insights into how stress-related phenotypes are shaped by delving into how genetic and epigenetic mechanisms impact on specific cells and tissues. (332) The use of a systems biology approach can integrate data beyond the genome and epigenome to shed light on known interactions occurring between biological processes. (332) The use of these novel technologies and techniques can reduce bias and deepen our understanding of the molecular and biological processes underlying the relationship between stress exposure, epigenetic modifications, and physiological change. (332)

10.7.3 Structural racism and health

Structural racism encompasses all ways in which racial discrimination is supported and reinforced throughout social systems, including through encouraging the discriminatory beliefs which underlie and often prompt acts of interpersonal racism. Studies examining the link between structural racism and adverse health attempt to explain the onset of adverse health using an analytic framework broader than

the stress pathway often implicit within examinations of the association between interpersonal racism and health. (13) This also includes an assessment of the social and historical conditions which have directed structural racism towards ethnic/racial minority populations, such as the influence of colonisation on Aboriginal and Torres Strait Islander populations in Australia. Understanding the link between structural racism and health presents clear analytic challenges due to the complexity of factors involved and the difficulty in quantifying components of structural racism. However, understanding structural racism also necessarily includes understanding the social policies, systems, and institutions which must be targeted in interventions addressing any form of racial discrimination. Because of this, studies which aim to better understand structural racism are uniquely able to generate evidence which can directly inform these interventions. Despite their analytic complexity, several approaches to investigating the relationship between specific components of structural racism and health outcomes have been proposed and should be pursued – particularly where these components are identified as easily modifiable through policy change and/or practice interventions. (14, 16)

10.7.3.1 Linked population, health and administrative datasets

Data linkage offers several opportunities to source information relevant to components of structural racism, whether through existing data available within administrative datasets, the linkage of administrative data with other population-level datasets, or through the selection of case-control samples within administrative datasets for conducting natural experiments. The use of administrative datasets linked at the individual level is an established technique for investigating complex public health and social issues. (333) Data linkage systems in Australian states and territories store routinely collect data from health and social services systems which can be linked at the family-level, allowing investigations across generations. This data can cover birth registrations, hospital and mortality data, mental health services, justice system contact, family services, and child protection, amongst other sources. In Western Australia, for example, the Western Australia Data Linkage System (WADLS) offers a comprehensive whole-population data linkage system which uses computerised probabilistic matching to create unit-level linkages between datasets. (334) The WADLS can also be used to link population datasets to health and administrative data after appropriate permissions have been sought and granted.

Components of structural racism which may be specifically amenable to investigations using linked data include discriminatory policies or legislation; residential segregation; and racial disparities in factors associated with socioeconomic status (e.g. education, employment), sentencing and incarceration, political representation and participation, housing and infrastructure, environmental health, and healthcare. Although a full description of the potential approaches to investigating each of these components is outside the scope of this chapter, a brief outline for the use of causal approaches have been provided below.

Various techniques have been developed to allow causal relationships between variables to be examined. As classic randomised control trials are inappropriate and unethical when examining the effects of structural racism on health, natural experiments offer a means to compare outcomes between groups defined through conditions already occurring in people's lives. (335) Several methods are available and include difference-in-difference, interrupted time series, instrumental variables, propensity score matching, regression discontinuity, and synthetic controls. (336) Although each have their strengths and limitations, instrumental variables and difference-in-difference are well-established and widely used methods which balance the strength of their causal assumptions with the simplicity of their approach. These methods are also well suited to studies utilising linked datasets and can be easily tailored to pursue investigations into links between structural racism and health.

10.8 Conclusions

Racial discrimination is a critical social determinant of health and the incidence of racism can begin during the earliest years of life for Aboriginal and Torres Strait Islander children, posing a considerable burden on their mental health and wellbeing. This thesis has provided new insights into the timing, duration, and developmental period of racism exposure and the role of ecological factors in the association between racism and health, has broadened existing knowledge of racism's contribution to Aboriginal and Torres Strait Islander children's physical and mental health as a psychosocial stressor, and has initiated the first application of several analytic approaches to increasing our understanding of the impact of racial discrimination on Aboriginal and Torres Strait Islander child populations in Australia and First nations populations internationally. Evidence gained from this thesis can inform advocacy efforts and practice interventions designed to lessen or eradicate interpersonal racial discrimination from Aboriginal and Torres Strait Islander children's lives and the resultant adverse effects on their health. Various means of extending on the studies completed in this thesis were considered for research that can further deepen our understanding of the links between racial discrimination and health, and help inform targeted, community-led policy and practice responses.

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Appendices

As detailed in the Introduction (Chapter 1), Chapters 2, 6, 7, and 9 within this thesis are published in peer-reviewed journals and Chapter 5 is published as a working paper. Appendix 1 contains a copy of the typeset version of each chapter (as published). Appendices 2 to 6 contain the supplementary material available on the journal websites or, in the case of Chapters 5 and 8, on file. Appendix 7 contains the research and policy summary document co-designed with the Social Determinants of Aboriginal Health Community Advisory Group. Appendix 8 describes ethical considerations for conducting research with Aboriginal and Torres Strait Islander peoples and decolonising methodologies for integration into future research.

Racial discrimination and child and adolescent health in longitudinal studies: A systematic review (Chapter 2)

The typeset version of Chapter 2 is available between pages 200 and 209.

The supplementary material for this manuscript is available in Appendix 2.

Prevalence of Racial Discrimination in a Cohort of Aboriginal and Torres Strait Islander Children (Chapter 5)

The typeset version of Chapter 5 is available between pages 210 and 247.

The supplementary material for this manuscript is available in Appendix 3.

Caregiver-perceived racial discrimination is associated with diverse mental health outcomes in Aboriginal and Torres Strait Islander children aged 7–12 years (Chapter 6)

The typeset version of Chapter 6 is available between pages 248 and 257.

The supplementary material for this manuscript is available in Appendix 4.

Racial discrimination and the health and wellbeing of Aboriginal and Torres Strait Islander children: Does the timing of first exposure matter? (Chapter 7)

The typeset version of Chapter 7 is available between pages 258 and 264.

The supplementary material for this manuscript is available within this typeset manuscript.

The social determinants of mental health in Aboriginal and Torres Strait Islander children: A latent class analysis (Chapter 8)

The supplementary material for this manuscript is available in Appendix 5.

Racial discrimination and allostatic load among First Nations Australians: A nationally representative cross-sectional study (Chapter 9)

The typeset version of Chapter 9 is available between pages 265 and 278.

The supplementary material for this manuscript is available in Appendix 6.



Review article

Racial discrimination and child and adolescent health in longitudinal studies: A systematic review

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ABSTRACT

Rationale: The association between racial discrimination and adverse health outcomes has been documented across an increasing body of evidence in recent years, although a close examination of longitudinal studies has not yet taken place. This review applied a life course lens in examining the evidence for a longitudinal association between racial discrimination exposure during childhood and adolescence, and later mental and physical health outcomes.

Method: Medline, PsycINFO, Global Health, ERIC, CINAHL Plus, Academic Search Premier and SocINDEX were searched from earliest records to October 2017 for eligible articles. Results were described through a narrative synthesis of the evidence.

Results: Findings from 46 studies reported in 88 empirical articles published between 2003 and 2017 were identified. Studies were primarily based on cohorts from the United States, comprised of young people aged 11–18 years, and were published since 2010. Data were most frequently collected over two to three timepoints at intervals exceeding 12 months. Statistically significant associations with racial discrimination were most commonly reported for behaviour problems including delinquency and risk-taking behaviour, with significant adverse effects found in 74% of these associations. Statistically significant adverse effects were also reported in 63% of associations with health-harming behaviours including substance use, and 61% found associations with mental health outcomes. Consistently significant associations were reported between accumulated racism and later health outcomes, and the health effects of racism were reported to vary with developmental periods, although few studies featured these analyses.

Conclusions: Evidence from this review highlights that the duration and timing of exposure to racial discrimination matters. This review emphasises the need to gain evidence for the mechanisms linking early racism exposure to adverse health outcomes in later life. Future longitudinal research can address this need by capitalising on prospective cohort studies and ensuring that proposed analysis informs variable selection and timing of data collection.

1. Introduction

Racial discrimination is known to contribute to disparities in health between and within populations worldwide by restricting access to social resources and prompting acts of interpersonal racism (Braveman et al., 2011, 2017; Brondolo et al., 2009; Gee et al., 2012; Krieger et al., 2017; Sanders-Phillips et al., 2009; Williams and Mohammed, 2009). Interpersonal racism negatively affects health through either direct adverse physical effects from racial violence or indirect effects as a

chronic or an acute stressor (Paradies, 2006; Paradies et al., 2015; Priest et al., 2013). When acting as a stressor, racism influences health by initiating physiological dysregulation, maladaptive psychological processes or changes in health behaviour (Paradies, 2006; Paradies et al., 2015; Priest et al., 2013), yet susceptibility to these processes is dependent on age.

Children have been found to be more vulnerable to the negative health effects of racism (Benner et al., 2018; Lee and Ahn, 2013; Schmitt et al., 2014). The early years are also known to present a

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sensitive period for the biological embedding of adversity and stress more generally (McEwen and Gianaros, 2010; Shonkoff et al., 2009). Despite this, knowledge surrounding the aetiological pathways between racism and health outcomes is based predominantly on cross-sectional studies of adult populations (Ben et al., 2017; Paradies et al., 2015). Longitudinal studies of child populations allow an investigation of the association between racism exposure during childhood and later health outcomes, generating evidence surrounding the role of age and development in this association.

The aetiological pathway between racism and negative health outcomes is also influenced by the timing of racism exposure (Gee et al., 2019). The effect size of the association between racial discrimination and negative mental health outcomes has been observed to be weaker in longitudinal compared with cross-sectional studies, suggesting that this association may attenuate over time (Paradies et al., 2015; Schmitt et al., 2014). In studies of children and adolescents, negative mental health outcomes and behaviour problems have exhibited stronger and more consistent associations with racial discrimination compared with physical health outcomes (Priest et al., 2013). This may reflect an earlier onset of mental health and behavioural effects from racism exposure than the physical effects of physiological dysregulation (Gee and Walsemann, 2009; Gee et al., 2012). Alternatively, this may suggest that negative mental health contributes to nascent health conditions through changes in health behaviour (Gee and Walsemann, 2009; Gibbons et al., 2014; Paradies, 2006). A recent longitudinal study examining the effect of a broad measure of perceived discrimination on health found that respondents experiencing discrimination during adolescence (age 16–22) engaged in more substance during early adulthood, compromising overall physical and psychological health by mid-adulthood (age 47–53) (Yang et al., 2019). These results suggest that engagement in substance use may occur as a coping mechanism for perceived discrimination and that these behaviour changes ultimately contribute to adverse health, although the forms of discrimination incorporated in this study's measure were broader than ethnic/racial discrimination alone (i.e. nationality, age, sex and language discrimination). Conversely, consistent physical health effects have been observed in children at birth and during childhood via vicarious exposures (Heard-Garris et al., 2017). These significant effects have primarily been observed through maternal exposure to racial discrimination in association with low birth weight and preterm birth (Alhusen et al., 2016; Kramer and Hogue, 2009). More recently, studies have observed associations between maternal exposure and inflammation biomarkers in both longitudinal (Slopen et al., 2019) and cross-sectional (Condon et al., 2019) analysis during childhood. These findings illustrate the need to better understand the causal and temporal mechanisms underlying the association between racism and health. This is particularly the case in early childhood and pre-adolescence where evidence is especially limited (Paradies et al., 2016).

Investigations into the role of age and development in disease aetiology and the causal processes through which adverse exposures influence health can be integrated through a life course perspective. This perspective is especially useful when considering the complexity of aetiological pathways through which racial discrimination contributes to negative health outcomes (Gee et al., 2012) and the broad-reaching, long-term and often intergenerational nature of racial disparities in health. Life course epidemiology examines both biological and social risk processes to understand how exposures across different life stages can account for health disparities between and within populations (Ben-Shlomo et al., 2016; Ben-Shlomo and Kuh, 2002; Lynch and Smith, 2005). A range of theoretical models have been developed within life course epidemiology to examine the causal and temporal pathways through which exposures influence health and wellbeing across lifetimes and between generations (Kuh et al., 2003). Central among these are the critical periods and accumulation of risk models.

Critical and sensitive periods account for the differential strength of exposures during certain developmental periods over the life course.

Critical periods occur during stages of development when an individual is especially vulnerable or reactive to specific risk factors, with minimal effects at other times (Halfon and Hochstein, 2002). Sensitive periods suggest a similar impact within a discrete period of time, although this impact may be reversed or modified at a later time (Kuh et al., 2003). Accumulation of risk extends on these concepts by acknowledging the effect of modifiers in later life and accounting for the additive risk of physical and psychosocial environments to health (Hertzman et al., 2001; Kuh et al., 2003; Lynch and Smith, 2005). Although accumulation of risk was initially conceptualised as successive and potentially interrelated exposure to different factors with age, this model has more often been operationalised as a standard 'dose-response' effect from a single factor over time (Ben-Shlomo et al., 2016). Operationalising critical period and accumulation of risk models within analysis can integrate examinations into both the socio-biological and causal pathways of health and disease.

2. Rationale

This present review aims to assess the existing evidence on the longitudinal relationship between racial discrimination exposure during childhood and adolescence, and later physical and mental health outcomes. We undertook a systematic review of available literature, applying a life course approach and investigating studies referencing critical periods and accumulation of risk models. We provide a narrative synthesis of review findings as the heterogeneity of racial discrimination exposure measures, covariates, outcomes, and study designs precluded the application of formal meta-analytic techniques.

Systematic and meta-analytic reviews of the literature have now confirmed the association between racial discrimination and adverse physical and mental health outcomes in both child and adult populations (Benner et al., 2018; Carter et al., 2019; Pachter and Coll, 2009; Paradies, 2006; Paradies et al., 2015; Pascoe and Richman, 2009; Priest et al., 2013; Schmitt et al., 2014; Williams et al., 2019; Williams and Mohammed, 2009; Yip et al., 2019). Despite this, close examination of longitudinal studies exclusive to child and adolescent populations has not yet taken place. While few studies internationally have applied a longitudinal design or drawn on panel data, there appears to be an emerging literature focused on younger age groups utilising these techniques. Recent studies have begun to elucidate the causal processes linking racism and health – including in early life – although there is a need for further application of appropriate methods to fully realise this goal. This review will investigate these findings and consider methods for future research, using a life course approach. We focus on studies referencing critical periods and accumulation of risk models in their hypothesis, research questions or analytic framework, and examine results gained from operationalising these models methodologically. The critical periods model was identified where comparisons between developmental periods were explicitly referenced. The accumulation of risk model was identified where a cumulative measure of racism was used in analysis. We investigate study characteristics, health outcomes, and the application – and role – of mediating and moderating variables in the association between racial discrimination exposure and health. Finally, we offer a summary and critique of methods utilised in these longitudinal studies.

3. Methods

3.1. Eligibility criteria

This systematic review was limited to longitudinal studies examining the impact of racial discrimination on health outcomes in children and adolescents aged less than 18 years at baseline. As such, all cross-sectional studies were ineligible for inclusion. Case-control and intervention studies were also ineligible as the interest of this review was on determining the impact of racism exposure on health,

independent of designed interventions.

Eligible longitudinal studies were required to include at least two data collection points at or prior to age 18, with health outcome data recorded at any age after exposure to racial discrimination. The racial discrimination measure used in each study was required to have been asked of participants during at least one timepoint. We limited to measures of racially or ethnically motivated discrimination and excluded studies incorporating measures which encompassed multiple forms of discrimination (e.g. sexual, gender-based or socioeconomic). All studies which included at least one discrete question about racially or ethnically motivated discrimination were eligible for inclusion.

Decisions about which health outcomes to include in this systematic review were informed by both previous systematic reviews conducted in this field (Paradies, 2006; Paradies et al., 2015; Priest et al., 2013; Schmitt et al., 2014) and research published since these reviews. Health outcomes were broadly defined and included measures of physical and mental health alongside behavioural problems (delinquent behaviour, aggression, risk-taking behaviour, violent and problem behaviour) and health-harming behaviours (alcohol use, drug/substance use, cigarette smoking, sleep difficulties). Behaviour problems were considered eligible as they are known to have as strong an association with racial discrimination as adverse mental health outcomes in studies of child and adolescent populations (Priest et al., 2013). Health-harming behaviours were also eligible for inclusion in this review as these behaviours are implicated in the aetiological pathway between racism and the onset of later health outcomes.

In this review, racial discrimination could take the form of interpersonal racism (e.g. unfair treatment or abuse) or systemic racism (e.g. institutional racism in a hospital). Racial discrimination exposure included both direct experiences by the child or adolescent, and vicarious experiences through the parent, caregiver or family members. Studies were eligible regardless of respondent (self-report or parent/carer). Studies using measures of vicarious racism were eligible for inclusion regardless of whether this measure was used alone or in combination with racism directed at the child. The few studies which examined the impact of intergenerational racial discrimination exposure were also eligible if the focus of the study was on the health outcomes in a child. One study referencing unpublished data was eligible for inclusion (Gibbons et al., 2016).

3.2. Search strategy

Literature searches were conducted in the following databases and electronic journal collections from the earliest possible date to October 2017: Medline (1946-, OVID Interface), PsycINFO (1806-, OVID Interface), Global Health (1973-, OVID Interface), ERIC (1966-, ProQuest Interface), CINAHL Plus (1937-, EBSCO Interface), Academic Search Premier (1984-, EBSCO Interface) and SocINDEX (2005-, EBSCO). All searches were conducted in English. The full electronic search strategy for Medline has been included in Appendix 1. Keywords and subject headings were adapted for each database.

Results from all searches were stored in Endnote X8 where titles, abstracts and full-text articles were managed and screened. Some articles with titles and abstracts in English returned full text articles in languages other than English. English translations of these articles were sourced where available. Data from studies which met the inclusion criteria was entered into Microsoft Excel.

3.3. Analysis

Results from all studies, mediation analysis, analysis of effect modification, and from studies utilising critical periods and accumulation of risk models are presented in tables and include all statistically significant and non-significant associations. Associations between racism exposure and health outcomes are organised by outcome into mental health, behaviour problems, physical health and health-harming

Table 1

Characteristics of included articles (k = 88).

	Number of articles	% of total
Publication year		
2000–2004	4	5
2005–2009	14	16
2010–2014	37	42
2015–	33	38
Study country ^a		
Argentina	2	2
Australia	4	5
Israel	3	3
UK	3	3
Canada	1	1
US	76	86
Age at baseline (Time 1)		
0–4 years	3	3
5–10 years	18	20
11–18 years	67	76
Cultural/ethnic background ^b		
African American/Black ^c	48	55
Asian ^d	18	21
Indigenous ^d	8	9
Latino/Hispanic	32	36
European/White	13	15
Other ^e	4	5
Number of timepoints		
2–3	58	66
4–5	21	24
6–7	4	5
8+	5	6
Intervals between timepoints		
< 12 months	12	14
≥ 12 months	76	86
Type of discrimination ^a		
Direct	81	92
Vicarious	13	15
Group	3	3
Respondent ^a		
Child or adolescent self-report	81	92
Parent or carer self-report	11	13
Exposure timeframe		
Not reported	50	57
< 12 months	2	2
12 months	25	28
Lifetime	11	13
Number of items in measure		
≥ 9 items	56	64
2–8 items	27	31
Single item	5	6

Percentages may not add to 100% due to rounding.

^a Categories are not mutually exclusive (e.g. studies could include participants from multiple cultural/ethnic backgrounds or examine more than one type of discrimination).

^b Black African, Black Caribbean.

^c Asian American, Chinese American, Filipino American, Indian, Pakistani, Bangladeshi.

^d Native American, Canadian First Nations, Cherokee, Navajo, Indigenous Australian, Indigenous Argentinean.

^e Studies listing 'other' or 'mixed race' as an additional cultural/ethnic group.

behaviours (Table 2). The direction of association is classified as either leading to an adverse effect (e.g. racial discrimination associated with increased depressive symptoms) or a reverse effect (e.g. racial discrimination associated with increased wellbeing). Associations between racism exposure and health outcomes are then compared by age groups (Table 3). Results from the critical periods and accumulation of risk models are presented with the health outcomes under examination and whether the association aligned with each relevant study hypothesis or research question was found (Tables 4 and 5). The accumulation of risk model also includes the type of racism exposure, while the critical periods model includes the different ages of exposure to racism from each study. Mediating variables tested for indirect effects and

Table 2Findings from 88 articles examining the longitudinal association between racial discrimination and health outcomes ($p < 0.05$)^a.

	Adverse effects	Reverse effects ^b	No association	Total
Mental health	82 (61%)	2 (2%)	50 (37%)	134
Anxiety	4		2	
Body image	1			
Conduct disorder	1		4	
Depression	35	1	13	
Emotional difficulties	8		4	
Happiness	1		1	
Loneliness	3		1	
Positive affect	1		1	
Prosocial behaviour	5	1	2	
Psychological adjustment	2		4	
Resilience	2			
Self-control	1			
Self-efficacy	1		1	
Self-esteem	12		8	
Self-reported stress	3		1	
Social competence			4	
Somatic symptoms			1	
Wellbeing	3		3	
Behaviour problems	20 (74%)	0 (0%)	7 (26%)	27
Anger	3		2	
Behaviour problems	6		1	
Delinquent behaviour	7		4	
Risk-taking behaviour	4			
Physical health	11 (41%)	0 (0%)	16 (59%)	27
Allostatic load	1			
Asthma	2		1	
Blood pressure			2	
Body mass index	1		1	
Cortisol	3		1	
Epigenetic aging	1		1	
Injury			3	
Obesity	1		2	
Physical health	1			
Self-rated health	1		5	
Health-harming behaviours	30 (63%)	0 (0%)	18 (38%)	48
Alcohol use	5		3	
Cigarette smoking	5		2	
Drug/substance use	16		10	
Exercise			1	
Sleep difficulties	3		2	
Unhealthy diet	1			
Total	143 (61%)	2 (1%)	91 (39%)	236

^a P -value refers to individual findings within each study.^b Indicates effects contrary to expected direction of association (e.g. racial discrimination associated with decreased depression).

moderating variables tested for effect modification are presented by health outcomes (Supplementary Tables 1 and 2). Direct associations between racial discrimination and health outcomes from included studies are summarised in Supplementary Table 3 with effect sizes, confidence intervals and p -values.

4. Results

After duplicates were removed, the initial search returned a total of 3322 records across all databases. Following the initial (title/abstract) screening process, 218 full-text articles were sourced and further assessed for eligibility. Of these, 88 papers representing 46 studies met the inclusion criteria and were included in the systematic review (Fig. 1). The main reasons for exclusion were the absence of a health outcome in the study and racial discrimination not being the exposure variable or being incorporated within a broader measure. Titles and the full list of reasons for exclusion of publications at this final stage are provided in Supplementary Table 4.

Table 3Findings from 88 articles examining the longitudinal association between racial discrimination and health outcomes by age group ($p < 0.05$).

	Adverse effects	Reverse effects	No association	Total
Mental health	82 (61%)	2 (2%)	50 (37%)	134
0–4 years	4 (67%)		2 (33%)	6
5–10 years	13 (65%)	2 (10%)	5 (25%)	20
11–18 years	65 (60%)		43 (40%)	108
Behaviour problems	20 (74%)	0 (0%)	7 (26%)	27
0–4 years				0
5–10 years	8 (100%)			8
11–18 years	12 (63%)		7 (37%)	19
Physical health	11 (41%)	0 (0%)	16 (59%)	27
0–4 years	1 (100%)			1
5–10 years	3 (19%)		13 (81%)	16
11–18 years	7 (70%)		3 (30%)	10
Health-harming behaviours	30 (63%)	0 (0%)	18 (38%)	48
0–4 years				0
5–10 years	6 (86%)		1 (14%)	7
11–18 years	24 (59%)		17 (41%)	41

4.1. Study characteristics

Selected characteristics of all studies meeting final inclusion criteria are presented in Table 1. The earliest articles were published in 2003 (Simons et al., 2003; Wong et al., 2003), while the majority (80%, $k = 70$) of articles were published more recently (after 2009). Overall, a limited number of countries were represented in this review, with the vast majority of articles based on studies conducted in the US (86%, $k = 76$) with young people aged 11–18 years (76%, $k = 67$). A further 18 articles (20%) were based on studies conducted with children aged 5–10 years and three articles (3%) reported outcomes for infants and young children from birth to 4 years. The majority of articles focused on African American/Black participants (55%, $k = 48$), followed by participants from Latino/Hispanic (36%, $k = 32$) and Asian cultural and ethnic groups (21%, $k = 18$). Two articles used country of birth as a proxy for cultural/ethnic background (Correa-Velez et al., 2010, 2015) and one article used English or non-English speaking background (Priest et al., 2017). Most articles were based on studies which collected outcomes over 2–3 (66%, $k = 58$) or 4–5 (24%, $k = 21$) timepoints, with intervals exceeding 12 months (86%, $k = 76$).

4.2. Exposure measures

Across the 88 articles included in this review, 53 different instruments measured exposure to racial discrimination. The Schedule of Racist Events was the most frequently used instrument (26.1% of articles), followed by the Racism and Life Experience Scales (11.4%) and the Experiences of Discrimination Scale (5.7%). Many studies revised these instruments by selecting a reduced number of items for inclusion. Exposure instruments developed specifically for individual studies were used in 36.4% of articles, including instruments combining items from multiple scales.

All articles included instruments measuring interpersonal racism, while three also included instruments measuring perceived systemic racism (Bécares et al., 2015; Rios-Salas and Larson, 2015; Wheeler et al., 2015). Almost all articles (92.1%) included instruments measuring direct racism. All direct racism measures were self-reported by the child or adolescent excluding one reported by the primary carer (Shepherd et al., 2017). Several articles (14.8%) included instruments measuring vicarious racism. These articles primarily operationalised vicarious racism as a function of racism experienced by the parent/carer or family, with 12.5% of articles including vicarious racism instruments self-reported by the parent or carer. One article used an instrument assessing vicarious racism through adolescents' self-reported

Table 4
Summary of results from studies examining accumulation of racial discrimination exposure.

Study	Racism exposure	Health outcome	Association
Mental health			
Shepherd et al. (2017)	Primary carer experienced racism	High risk of emotional or behavioural difficulties	No
	Family experienced racism	High risk of emotional or behavioural difficulties	No
Behaviour problems			
Stock et al. (2013)	Perceived racism	Greater HIV-risk behaviours	Yes
Physical health			
Adam et al. (2015)	Perceived racism	Lower waking cortisol	Yes (African-American adults)
	Perceived racism	Lower cortisol awakening response	Yes
	Perceived racism	Flatter diurnal cortisol slope	Yes
	Perceived racism	Lower average cortisol across the day	No
Shepherd et al. (2017)	Primary carer experienced racism	Positive general health	No
	Family experienced racism	Positive general health	No
	Primary carer experienced racism	Obesity	No
	Family experienced racism	Obesity	No
	Primary carer experienced racism	Ever experienced injury	No
	Family experienced racism	Ever experienced injury	No
	Primary carer experienced racism	Ever experienced asthma	Yes
	Family experienced racism	Ever experienced asthma	No
Health-harming behaviours			
Brodish et al. (2011)	Perceived racism	Less healthy diet	Yes
	Perceived racism	More hours of exercise	No
	Perceived racism	More substance use	Yes (men)
Gerrard et al. (2012)	Perceived racism	Increases in substance use	Yes (endorse substance use-as-coping)
Shepherd et al. (2017)	Primary carer experienced racism	Sleep difficulties	Yes
	Family experienced racism	Sleep difficulties	No

perceptions of racism directed towards parents or other family members (Park et al., 2017). Another article used items assessing vicarious racism through adolescents' self-reported perceptions of racism directed towards other students at their school (Priest et al., 2017). Three articles included instruments with items explicitly referencing racism directed at members of respondents' cultural/ethnic group more broadly (Juang and Cookston, 2009; Le and Stockdale, 2011; Rios-Salas and Larson, 2015).

Most articles (56.8%) used instruments which did not specify an exposure timeframe. Close to three in ten articles (28.4%) used instruments specifying exposure in the previous 12 months, 12.5% used instruments referencing lifetime exposure (including being 'ever' exposed or exposed 'in the past'), and 2.3% used instruments specifying an exposure timeframe of less than 12 months. Instruments with nine or more items were used in 63.6% of articles, 2–8 item instruments were used in 30.7% of articles, and 5.7% of articles included single item

instruments.

4.3. Health outcomes

Table 2 shows the associations between the racial discrimination exposure variable and health outcomes in all studies included in this review. In total, 236 associations between racial discrimination and health outcomes were reported across the 88 articles included in this review. A significant adverse effect from racial discrimination was revealed for six in ten (61%) of the outcomes examined. The proportion of significant associations between racial discrimination and health outcomes varied by exposure characteristics. Longitudinal studies with an interval between exposure and outcome of 12 months or greater reported a higher proportion of significant associations (63%) than studies with an interval of less than 12 months (53%). Studies with 4–5 timepoints had the highest proportion of significant associations (85%)

Table 5
Summary of results from studies examining critical or sensitive periods.

Study	Health outcome	Age exposed to racial discrimination	Association
Mental health			
Hou et al. (2015)	More depressive symptoms	12–15 years	Yes
		16–19 years	Yes
		20–23 years	Yes
Ford et al. (2013)	More depressive symptoms	13 years	Yes (high caregiver reported racism)
		17 years	Yes (high caregiver reported racism/low income families)
	Higher levels of wellbeing	13 years	Yes (high caregiver reported racism)
		17 years	Yes (high caregiver reported racism/low income families)
	More perceived stress	13 years	Yes (low income families)
		17 years	Yes (high caregiver reported racism/low income families)
Benner & Kim (2009)	Increased depressive symptoms and alienation	Mean 13.0 years	No
		Mean 17.1 years	Yes
Physical health			
Adam et al. (2015)	Lower waking cortisol	14–17 years	Yes (African-American respondents)
		19–30 years	No
	Lower cortisol awakening response	14–17 years	No
		19–30 years	Yes (African-American respondents)
	Flatter diurnal cortisol slope	14–17 years	Yes
		19–30 years	No
	Lower daily average cortisol	14–17 years	Yes (African-American respondents)
		19–30 years	No

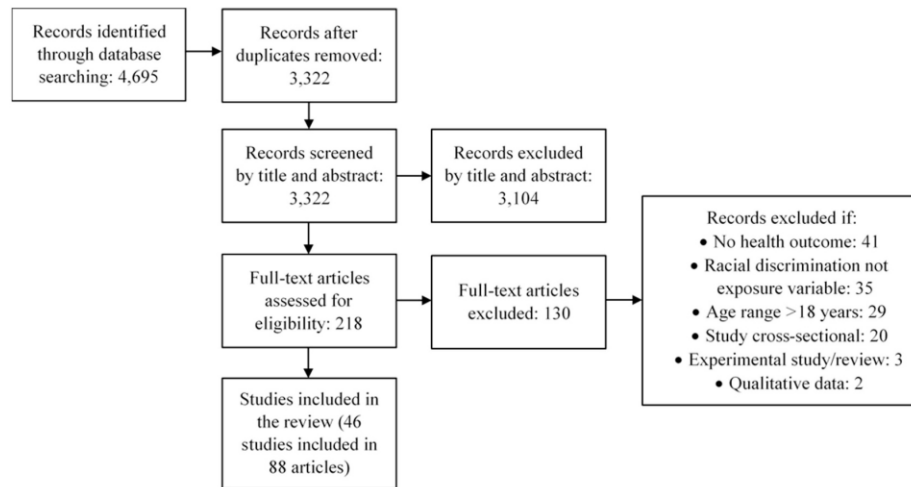


Fig. 1. PRISMA screening process, flow diagram.

compared to studies with 2–3 timepoints (57%), 6–7 timepoints (54%), and 8 or more timepoints (50%). Studies investigating exposure to racial discrimination in children 0–4 years reported 75% adverse effects, while 59% and 61% were reported in studies with children exposed at 5–10 years and 11–18 years respectively. A higher proportion of significant associations with behaviour problems and health-harming behaviours was reported for children exposed to racism at 5–10 years compared to 11–18 years (Table 3). For physical health outcomes, children exposed at 0–4 years and 11–18 years had a higher proportion of significant associations compared to those exposed at 5–10 years. However, individual physical health outcomes differed between age groups. Outcomes for those aged 11–18 included biomarkers such as allostatic load, epigenetic aging and cortisol, whereas outcomes for those aged 5–10 included asthma, blood pressure, BMI, injury and obesity. Relatively consistent proportions of significant associations were reported across age groups for mental health outcomes.

Overall, 25 articles included analysis of mediating variables along the pathway from racial discrimination to subsequent health outcomes. The vast majority (84%) of articles found significant indirect effects for at least one of the mediating variables under investigation (Supplementary Table 1). Of these, mediating variables primarily related to mental health and behaviour, including behavioural issues such as anger and health-harming behaviours such as substance use and sleep duration. In total, 44 articles examined moderation – or effect modification – of the association between racial discrimination and health. Of these, 33 articles found at least one statistically significant interaction term (Supplementary Table 2). There was considerable variation in the subject and domain of significant moderating variables; most related to racial identity, encompassing both cultural and racial identification, orientation and affiliation alongside nativity status and ethnicity.

4.3.1. Mental health outcomes

Mental health outcomes were the outcomes most commonly included in longitudinal studies examining the associations between racial discrimination and health. Overall, 57% of associations related to mental health outcomes. Studies consistently found statistically significant adverse effects from racial discrimination on subsequent mental health outcomes, with 61% of mental health outcomes being adversely affected. Reverse effects were observed for 2% of mental health outcomes, where racial discrimination exposure was associated with decreased depressive symptoms or increased prosocial behaviour.

Non-significant associations between racial discrimination and mental health were found in 37% of cases. Overall, a higher proportion of significant associations was found for ‘negative’ mental health outcomes, compared to the proportion found for ‘positive’ mental health outcomes such as psychological adjustment, social competence, and wellbeing.

4.3.2. Health-harming behaviours

One in five (20%) associations related to health-harming behaviours – of these, 63% indicated that health-harming behaviours were worsened by racial discrimination while no associations were found in 37.5% of cases. The majority of health-harming behaviours were focused on drug/substance use, with 62% of associations with these outcomes exhibiting an adverse and statistically significant effect.

4.3.3. Behaviour problems

Behavioural problems, including conduct disorder, aggression, and risk-taking behaviour, made up 11% of all associations under review. Significant adverse effects from racial discrimination were found for 74% of these associations, while no significant associations were found in the remainder.

4.3.4. Physical health outcomes

Around one in ten (11%) associations related to physical health and general health outcomes, although no significant association with racial discrimination was found in the majority (59%) of cases. In total, 41% of associations between racial discrimination and physical health outcomes were found to result in statistically significant adverse effects, indicating that racial discrimination exposure was related to worse physical health outcomes.

4.4. Accumulation of exposure

Five studies included examination of the association between accumulated racial discrimination and health (Adam et al., 2015; Brodish et al., 2011; Gerrard et al., 2012; Shepherd et al., 2017; Stock et al., 2013). Four of these studies developed an accumulation exposure variable by averaging responses to single exposure measures across multiple timepoints (Adam et al., 2015; Brodish et al., 2011; Gerrard et al., 2012; Stock et al., 2013). These studies included racism measures taken from respondents across a range of ages, with a minimum of two timepoints included in the accumulated racism variable. While studies

that utilised this method accounted for previous exposure/s to racism, comparisons were not made between the effects of the accumulated racism variable and a single point of exposure on health outcomes. However, one study developed a variable for persistent racial discrimination which accounted for exposure in multiple waves (Shepherd et al., 2017). This variable was then compared to a single exposure at any one timepoint. Only two studies (Gerrard et al., 2012; Stock et al., 2013) used a time-limited measure of racism (previous 12 months), while the remaining three studies used measures which captured frequency of perceived racial discrimination or exposures that were otherwise not time-limited (Adam et al., 2015; Brodish et al., 2011; Shepherd et al., 2017).

All studies examining the accumulation of exposure found at least one significant association between accumulated racial discrimination and health. Three studies found associations with health-harming behaviours (Brodish et al., 2011; Gerrard et al., 2012; Shepherd et al., 2017), two studies found evidence of significant associations between physical health outcomes and accumulated racism (Adam et al., 2015; Shepherd et al., 2017), and one study found an association with behaviour problems (Stock et al., 2013). Controlling for diet, exercise, and substance use at age 12, one US study found that greater accumulated racism experienced during adolescence was associated with less healthy eating at age 30 for all participants, while for women accumulated racism was associated with more exercise and for men accumulated racism was associated with more substance use (Brodish et al., 2011). Another US study found that, after controlling for previous substance use, accumulated racism predicted an increase in substance use in adolescents who indicated that they used substances as a coping mechanism (Gerrard et al., 2012). Controlling for risky sex and substance use at age 15 within the same study population, accumulated racism was found to predict increases in substance use between ages 18 and 21 years, while risky sex behaviours at 21 were predicted through substance use and risky sex at age 18 (Stock et al., 2013). Accumulated racism was found to act on cortisol levels in a similar way to chronic and traumatic stress by flattening diurnal cortisol slopes and reducing the cortisol awakening response in both Black and White American adults, and lowering waking cortisol in Black adults only. However, cortisol across the day did not show an association with accumulated racism (Adam et al., 2015).

Vicarious racism via the primary carer was found to be associated with sleep difficulties and asthma, while vicarious racism via the family was not associated with any child health outcomes after adjustment for covariates in one Australian study (Shepherd et al., 2017). Where associations were found, the effect size for accumulated racism exposure was approximately twice that of the effect size for a single exposure to racism (Shepherd et al., 2017).

4.5. Critical or sensitive periods

Four studies examined critical/sensitive periods in their analysis of the relationship between racial discrimination and health outcomes (Adam et al., 2015; Benner and Kim, 2009; Ford et al., 2013; Hou et al., 2015). Three of the four studies found that associations between racial discrimination and health outcomes varied by developmental period (Adam et al., 2015; Benner and Kim, 2009; Ford et al., 2013), while one found no difference in the strength of this association with age (Hou et al., 2015). All studies examined critical/sensitive periods during adolescence, comparing early and middle adolescence, middle adolescence and emerging adulthood, or all three developmental periods. Studies were mixed in identifying the developmental periods in which health outcomes were more vulnerable to the effects of racial discrimination. One study identified early adolescence as being more sensitive than middle adolescence (Ford et al., 2013), while another found that exposure during middle adolescence had a greater effect than exposure in early adolescence (Benner and Kim, 2009). A third study found that compared to young adulthood, exposure during

adolescence more broadly was more detrimental to health (Adam et al., 2015).

Overall, two US studies based on African American and Chinese American adolescents found associations between racial discrimination and mental health outcomes (Benner and Kim, 2009; Ford et al., 2013), while a further US study found an association between racial discrimination and physical health, via cortisol profiles (Adam et al., 2015). This study compared the effects of racial discrimination experienced during adolescence and young adulthood on cortisol profiles taken at age approximately 32 years and found that only when racial discrimination was experienced during adolescence were significant associations found with flatter diurnal cortisol slopes, lower waking cortisol and lower average cortisol (Adam et al., 2015). However, this study also found that exposure during young adulthood was a stronger predictor of cortisol awakening and concluded that adolescence was a more sensitive developmental period compared to young adulthood when considering the effect of racial discrimination on adult cortisol profiles (Adam et al., 2015).

The timing of caregiver experiences of racial discrimination was found to interact with family income in determining African American adolescents' depressive symptoms (Ford et al., 2013). In high income families, frequent caregiver experiences of racism during early adolescence (mean age 13 years) exerted a negative influence on adolescent depressive symptoms and wellbeing which attenuated by middle adolescence (mean age 17 years) but which remained for those in low income families. However, frequency of racial discrimination did not differentially impact perceived stress over these developmental periods (Ford et al., 2013).

Socioemotional adjustment was found to differ by age among Chinese American adolescents, with impacts observed for discrimination experienced during middle adolescence but not early adolescence (Benner and Kim, 2009). However, this result may have been confounded by the contemporaneous experience of discrimination and socioemotional adjustment during middle adolescence, as both measures were collected at the same timepoint. One study found no differences in the strength of longitudinal relationships between racial discrimination and depressive symptoms when comparing racial discrimination exposure during early adolescence (12–15 years), middle adolescence (16–19 years), and emerging adulthood (20–23 years) in Chinese American adolescents (Hou et al., 2015). Although subjects reporting depressive symptoms in early adolescence did not go on to report more racial discrimination in middle adolescence, it was found that adolescents reporting depressive symptoms in middle adolescence went on to report more racial discrimination in emerging adulthood.

5. Discussion

Findings throughout this review were based on an increasing number of studies undertaken in recent years which sought to examine the relationship between racial discrimination exposure prior to age 18 and subsequent health outcomes, with around eight in ten articles included within this review published since 2010 (Table 1). A considerable majority of studies were undertaken in the United States with a focus on exposures occurring during the adolescent stage of development. All studies included instruments measuring perceived interpersonal racial discrimination, with perceived systemic racism additionally measured in a limited number of studies. Most studies focused on direct racism exposure self-reported by children or adolescents, while several studies included a focus on vicarious racism exposure directed at and self-reported by parents or carers. The majority of studies collected data at 2–3 timepoints over intervals of 12 months or more. Evidence from these studies confirms a strong longitudinal association between racial discrimination exposure during childhood and adolescence and later health outcomes (Table 2). This review further confirms the finding that associations between racial discrimination and mental health outcomes are stronger and more consistent than

those seen for physical health outcomes in longitudinal studies (Priest et al., 2013; Schmitt et al., 2014). Behaviour issues such as conduct disorder, aggression and risk-taking and health-harming behaviours such as substance use were also found to have strong and consistent longitudinal associations with racial discrimination.

Evidence from this review suggests that the association between early racism exposure and later health is complicated by the duration and timing of exposure. Studies integrating the accumulation of risk model into analysis found consistent associations between accumulated racial discrimination and both physical health outcomes and health-harming behaviours, although this model was featured in a limited number of studies (Table 4). While this provides preliminary evidence of the additive risks to child health from greater exposure to racism, it is supported by consistent findings in adult studies of a longitudinal association between cumulative racial discrimination and health (Dugan et al., 2017; Friedman et al., 2009; Gee and Walsemann, 2009; Lewis et al., 2006, 2011; Wallace et al., 2016). One study testing accumulated racism as a dose-response relationship found that multiple exposures to vicarious racism through the primary carer had a stronger effect on child outcomes than a single exposure (Shepherd et al., 2017). However, the study undertaking this analysis did not find significant effects for racism experienced by the family and accumulated direct racism was not examined. The methodological limitations in the few studies using this model restrict our ability to make strong assertions about the impact of accumulated exposures to racial discrimination during childhood on later health. Further longitudinal studies including an examination of dose-response relationships will test the generalisability of results from this review and assist in confirming the future utility of this model.

Three of the four studies examining critical/sensitive periods found that associations between racial discrimination and health outcomes varied by developmental period (Table 5). Due to the limited number of studies, it is difficult to draw conclusions on developmental stages during childhood and adolescence that may be more vulnerable to the health effects of racial discrimination. A recent meta-analytic review found that the positive association between racial discrimination and socioemotional distress was stronger during early adolescence (age 10–13) than late adolescence (age 17 and over) (Benner et al., 2018). However, cross-sectional and longitudinal studies were not differentiated in this review and studies were limited to those aged mean 10–20 years. A separate study examining the age of initial exposure to racial discrimination found an increased odds of a cardiovascular-related health condition for those initially exposed during early childhood (age 0–7) and an increased incidence of cardiovascular disease with initial exposure during both early childhood and adolescence (age 13–19) compared to those with no exposure (Cuevas et al., 2019). While this study was based on the recollected age of initial exposure to racial discrimination, self-reported during adulthood, both this study and Benner et al.'s meta-analytic review suggest that greater vulnerability to the negative health effects of racism occurs during early childhood or adolescence. Overall, studies in the current review examining children exposed to racial discrimination at 5–10 years reported higher proportions of significant adverse effects on behaviour problems and health-harming behaviours compared to studies examining exposure at 11–18 years (Table 3). Our review also observed a higher proportion of adverse effects from racial discrimination where children were exposed at 0–4 years compared to both 5–10 and 11–18 years. While crude, this finding repeats the pattern for heightened health vulnerability from earlier racism exposure with a broader set of outcomes. Despite this, studies comparing critical/sensitive periods in our review reported inconsistent results and were focused on adolescent stages of development. No study compared the effects of exposure to racial discrimination during different developmental periods in children aged less than 12 years. This presents a critical knowledge gap as these years present an especially vulnerable period for the negative health effects of environmental stressors. To accurately determine the

salience of critical and sensitive periods in examining the relationship between racial discrimination and health, future studies should aim to undertake analysis across a broad range of developmental stages. Birth cohort studies are well placed for applications of the critical/sensitive periods model where analysis is hypothesis driven and informed by developmental theory.

Findings from this review provide consistent evidence that the pathway between racial discrimination and the health of children and young people is mediated by a range of factors, either partially or fully (Supplementary Table 1). Significant indirect effects were found for mental health, behavioural issues, parent behaviour, peer affiliations, and racial identity. Mediators ranged from individual-level factors such as depressive symptoms to family-level and school-level factors such as parenting practices and school engagement. However, most mediators were related to individual mental health, particularly negative mental health symptomatology such as depression and anger. Notably, the single study which examined physical health outcome variables in mediation analysis found that racial discrimination had a significant effect on physical health via mental health (Rosenthal et al., 2015). Emotional symptoms were found to mediate the association between racial discrimination, blood pressure, body mass index, and self-rated health (Rosenthal et al., 2015). This result may indicate that psychological processes play a regulatory role in the expression of later physiological outcomes or may simply reflect the comparative strength of the association between racial discrimination and mental health outcomes more broadly. It has been proposed elsewhere that the psychological and emotional effects of racism precede adverse physical outcomes (Gee et al., 2012). Initial evidence for the mediating role of substance use on overall physical and psychological health in adulthood has been demonstrated for those exposed to a broad measure of perceived discrimination in late adolescence (Yang et al., 2019) and the lagged effect of racial discrimination on physical health has been illustrated in studies of adult populations (Dugan et al., 2017; Gee and Walsemann, 2009; Pavalco et al., 2003). Confirming whether psychological processes may contribute to the onset of later physiological outcomes requires further investigation from longitudinal studies across the life course, including during childhood and adolescence. Overall, few longitudinal studies within this review investigated associations with physical health outcomes and studies predominantly focused on exposures during the adolescent stage of development. Prospective birth cohort studies are well placed to address this limitation, particularly where exposures and outcomes are collected at timepoints consistent with proposed analytic plans.

One third of studies undertaking mediation models also ran analysis of cross-lagged effects to complement this analysis. Analysing these effects permits an investigation into the causal direction of the association between racial discrimination exposure and the health outcome of interest (e.g. whether more racism at wave 1 was associated with worse health outcomes at wave 2 and not the reverse). Racial discrimination exposure was found to be associated with subsequent negative mental health, behavioural problems, and substance use without the reverse association for all outcomes except externalising symptoms (Berkel et al., 2010). This finding suggests that temporal ordering does lead from racial discrimination exposure to adverse mental health and behavioural outcomes in adolescent populations. However, the number of studies reporting these effects was relatively small and this finding should be treated as preliminary. The incorporation of cross-lagged analysis into study designs will further substantiate hypotheses with underlying assumptions of causality or temporal ordering.

Despite the longitudinal design of studies within this review, around half of the studies analysed a mediation model in which the exposure, mediator and outcome were not temporally antecedent to one another. This violates a fundamental assumption of causal inference analysis and limits the validity of findings from these studies (Hayes, 2013; Hayes and Rockwood, 2017). In this assumption, mediating variables are temporally located between the exposure and outcome variables and

the exposure variable temporally precedes both the mediating and outcome variables (Hayes, 2013; Hayes and Rockwood, 2017; Valeri and Vanderweele, 2013). However, the design of some studies did not allow for longitudinal tests of mediation due to the spacing of these variables over data collection points. Temporal spacing in mediation models should be accounted for in longitudinal study design where possible, particularly where analytic plans are known at the outset and where causal inferences are being sought.

Mixed results were revealed through moderation analysis, with a significant interaction term between racial discrimination and health outcomes observed in just over half of the studies utilising this analytic approach (Supplementary Table 2). The majority of significant moderators related to ethnic/racial identity, including racial orientation and affiliation, nativity status and ethnicity. This reflects findings from a recent meta-analysis which observed that ethnic/racial identity significantly moderated the association between ethnic/racial discrimination and adjustment outcomes (i.e. mental health, academics and cognition, risky behaviours, and physical health) (Yip et al., 2019). Overall ethnic/racial identity buffered the effects of ethnic/racial discrimination on physical health, while ethnic/racial identity exploration (e.g. 'I have spent time trying to find out about my ethnic group, such as its history, traditions, and customs') was found to exacerbate the effects of ethnic/racial discrimination on both negative mental health and risky health behaviours (Yip et al., 2019). Similarly, ethnicity has been found to significantly moderate the association between racial discrimination and both physical and mental health outcomes in previous systematic reviews and meta-analysis (Paradies et al., 2015; Priest et al., 2013). The apparent consistency of findings across these reviews suggests that ethnic/racial identity may be an appropriate candidate for future moderation analysis in this field. Overall, however, results from moderation analysis in the current review were predominantly inconsistent, reflecting, in part, the wide range of moderators included across analyses and the varying measures used in moderating and health outcome variables. In any case, moderation analysis may not make the most of the available data in longitudinal studies as moderation analysis is typically agnostic to the temporality of variables within the model. Few studies incorporated mediated moderation analysis to determine the conditions of the causal mechanism in which racism was associated with health outcomes. However, the possibility of conducting this analysis was dependent on the availability of appropriate variables and their relevance to the proposed hypotheses in many cases.

6. Conclusions

Evidence throughout this review confirms the strong association between racial discrimination and child and adolescent health and wellbeing outcomes. This review contributes to that evidence base by providing an in-depth examination of longitudinal studies which are equipped to examine how age, timing of exposure, and temporal pathways influence the association between racism and health in children and adolescents. Evidence from this review suggests that the association between racism and health is complicated by the duration and timing of exposure, and by mediators and moderators along the pathway between racism exposure and health outcomes. However, the heterogeneity of populations, study designs and outcomes included in review studies precludes a simple summation of how age and timing influence the relationship between racism and health. Hypothesis driven analysis based on prospective cohort studies with data from birth or early childhood will be best placed to test longitudinal associations between racial discrimination and subsequent health outcomes. Studies which integrate key exposure and outcome measures at time-points consistent with proposed analytic plans can also facilitate more rigorous investigations into these longitudinal associations. This work will provide much needed insights into the temporal and causal mechanisms underlying the association between racism and health, and inform evidence-based policies and practices aimed at addressing this

critical public health issue.

Declaration of competing interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.socscimed.2020.112869>.

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Prevalence of Racial Discrimination in a Cohort of Aboriginal and Torres Strait Islander Children

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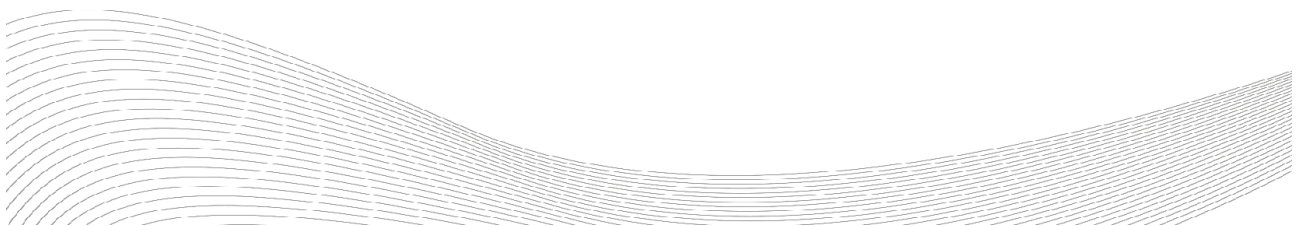


NON-TECHNICAL SUMMARY

Racism has been shown to impact on the health of minority populations worldwide, acting through both direct experiences of interpersonal racism and unequal access to social resources. This is particularly the case for Indigenous populations internationally, including Aboriginal and Torres Strait Islander populations in Australia.

Currently, most research looking at the relationship between racism and health has been focused on adults, even though children have been found to be more vulnerable to the negative effects of racism. Very few studies have examined the impact of racism on children's health across time, limiting our understanding of how experiences of racism change health outcomes as children age.

This study looked at the frequency of racism experiences over time in a population of Aboriginal and Torres Strait Islander children and checked to see which factors might increase the risk of a child experiencing racism in Australia today. We found that direct and vicarious racism is commonly experienced by Aboriginal and Torres Strait Islander children and that these experiences often occur in the first years of life. Children were more at risk of experiencing racism by age 11 if they lived in remote or more disadvantaged areas and if they spoke an Aboriginal language.



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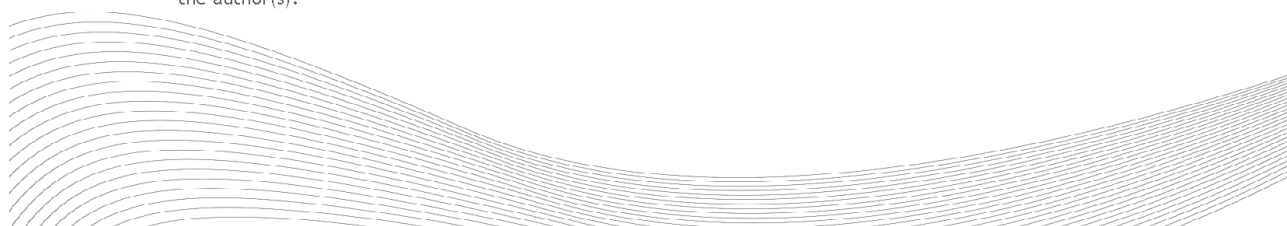
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ABSTRACT

Background. Racial discrimination is a central social determinant of health in Aboriginal and Torres Strait Islander (hereafter referred to as Aboriginal) populations, and is associated with health inequities between Aboriginal and non-Aboriginal Australians. This study sought to estimate the prevalence of racism in a longitudinal study of Aboriginal children.

Method. This study examined direct and vicarious racism within the Footprints in Time: The Longitudinal Study of Indigenous Children (LSIC) dataset, providing descriptive analysis of direct and vicarious forms of racism exposure, including overall prevalence, accumulation of exposure and age of first exposure, across key socio-demographic factors over time. Participants for this study include 1,759 children from the first 8 waves of LSIC, comprising those aged 6 months to 12 years.

Results. One in five (20.4%) study children had direct experience of racial discrimination by age 11 years, with the majority of these children (73.5%) experiencing first exposure to direct racism by age 7, while vicarious racism was more commonly experienced (44.5% through the primary carer and 50.5% via family members). Children living in areas of high remoteness, in the most disadvantaged regions and children who spoke an Aboriginal language were at increased risk of experiencing direct racism by age 11.

Conclusion. Direct and vicarious racism is commonly experienced by Aboriginal children and exposure often occurs within the first years of life. This study is one of the first studies internationally to characterise the prevalence of both direct and vicarious forms of racism among a cohort of children using longitudinal data.

Keywords: racism; Aboriginal; Indigenous; prevalence; Australia

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Introduction

Racism has been defined as the operation of social inequalities which act to limit or improve access to resources, opportunities, power and capacity according to racial or ethnic categorisations (1-3). Racism acts both directly and indirectly through a range of mechanisms which may occur in negative beliefs about an individual's own racial group, through internalised racism, between individuals, through interpersonal racism, or within the structure of society, through systemic racism (1). Interpersonal racism, and to a lesser extent, internalised and systemic racism, have now all been shown to have a significantly negative impact on an array of health outcomes, albeit with stronger and more consistent effects for mental than physical health (2, 4-10). Racism's significantly negative impact on health contributes to the health disparities typically observed between different ethnic and racial groups (9, 11-16), particularly in Indigenous populations worldwide, including Aboriginal and Torres Strait Islander (hereafter referred to as 'Aboriginal') populations in Australia (17).

Developing an understanding of the prevalence of racial discrimination and the socio-demographic risk factors associated with exposure to racism are important first steps in generating meaningful insights into racial disparities between Aboriginal and non-Aboriginal peoples across Australia. This is particularly the case for children and young people, where the strength of the relationship between racial discrimination and negative health effects is greater in children than adults (4, 18). It is also critical to examine vicarious racism exposure in children as significant associations have been observed between parental or caregiver reported racial discrimination and negative socioemotional and mental health outcomes in children and young people (19). Finally, the timing and duration of exposure both likely play a role in the relationship between racism and health, as persistent exposure to racism potentially leads to the ongoing 'weathering' of bodily systems and hence increased vulnerability to disease over time (20, 21). However, the majority of available studies examining the prevalence of racial discrimination in Aboriginal populations are focused on adults and based on cross-sectional datasets, and studies examining critical periods of racism exposure on child health are predominantly based in the United States. To the best of our knowledge, no studies have yet examined the prevalence of direct or vicarious racism in Aboriginal children over time as they grow and develop.

Life course epidemiology offers a range of theoretical models to facilitate an examination of the causal and/or temporal pathways through which exposures influence health and wellbeing across lifetimes and inter-generationally (22). These models can inform the development of exposure variables by providing a conceptual framework within which the role of factors including early exposure, age of first exposure and accumulated exposure may be examined. Research incorporating each of these exposure variables into a longitudinal examination of the duration and timing of exposure to racial discrimination during childhood is generally limited, particularly for Aboriginal children. A detailed examination of racism prevalence rates in Aboriginal children over time using exposure variables informed by life course epidemiology will enhance our understanding of Aboriginal children's experience of racial discrimination, laying the foundation for further examinations of how racism interacts longitudinally with the health and wellbeing of this at-risk population group.

Based on currently available prevalence estimates of direct and vicarious interpersonal racism in Aboriginal populations aged below 18 years (23-27), we anticipate that a substantial proportion of Aboriginal children will be exposed to direct racism, with slightly higher rates seen for vicarious racism. It is expected that reports of direct racism will increase with age based on previous research undertaken within the Footprints in Time: Longitudinal Study of Indigenous Children (LSIC) dataset used in this analysis (23) and due to children's ability to increasingly conceive of and recognise racially discriminatory behaviour as they age (28). We also expect a range of socio-demographic factors to influence risk for exposure to both direct and vicarious racism, including geographic, socio-economic and cultural factors.

Socio-economic status (SES) and geography have both been found to be consistently associated with racial discrimination in Aboriginal child populations (23, 24, 26, 27). Low SES has been found to be associated with direct and vicarious racism (23, 26, 27), while mixed findings have been reported for the association between racism exposure and remoteness (23, 24). A study based on the Western Australian Aboriginal Child Health Survey (WAACHS) found that direct racism was reported less frequently in areas of extreme remoteness compared to non-remote areas, while a study based on the LSIC dataset found that Aboriginal children in regional and remote areas were more likely to experience direct and

vicarious racism than those in non-remote areas (23, 24). Based on these findings, we anticipate that children in regional and remote areas and those living in low SES households will be at increased risk of racism exposure.

Strong cultural identity has been found to be associated with increased incidence of racism in studies focused on adult Aboriginal populations (29). As a strong sense of cultural identity has been associated with more perceptions of racial discrimination only in non-remote areas, it may be that this association is influenced by the heightened racial tensions and increased challenge of living 'between cultures' experienced in metropolitan areas (30). Currently only one study has examined the association between cultural identity and racism in those aged under 18 years, finding no association in a population of Aboriginal young people aged 12-26 years (26). However, this association has not yet been examined during early childhood. Based on findings from adult studies, we anticipate that children speaking an Aboriginal language will be at increased risk of direct exposure to racism.

A closer examination of the prevalence of direct and vicarious racism in Aboriginal children will provide valuable evidence which can begin to inform policy and practice responses to this critical health determinant. The longitudinal nature of the LSIC dataset offers a valuable opportunity to identify the risk factors associated with racism exposure in a national cohort of Aboriginal children and to understand how the prevalence of racism changes as these children age.

Methods

LSIC is a national longitudinal survey of Aboriginal and Torres Strait Islander children designed to follow the development of these children across a range of domains and to capture the socioeconomic and cultural background of their families. The survey has been described in great detail elsewhere (31), however in brief, LSIC used a multi-stage clustered sampling method across 11 sites to recruit a non-representative national sample of Aboriginal children into two cohorts defined by age. LSIC aimed to recruit 5-10% of the total Australian population of Aboriginal children aged 0.5-2 years for the younger cohort and 3.5-5 years for the older cohort at baseline (2008), recruiting a total of 1,671 children at that time point and an additional 88 children at wave 2. The survey conducts annual face-to-face

interviews with the study child and their primary caregiver. To date, data for 10 waves have been collected with data from 8 waves currently available for analysis.

Participants

Participants for this study include children from the first 8 waves of LSIC, comprising those aged 6 months to 12 years. The sample size over the first 8 waves included up to 1,759 respondents due to participant flow in and out of the full sample over the course of LSIC, with 1,255 (75% retention) remaining by wave 8. Of the full sample, 1,010 were represented in the younger cohort and 749 represented in the older cohort. At wave 1 the mean age was 2.4 years in the full sample (SD = 1.6; age range 0-6 years), 1.1 years in the younger cohort (SD = 0.5; age range 0-2 years) and 4.1 years in the older cohort (SD = 0.5; age range 3-6 years). By wave 8 the mean age was 9.3 years in the full sample (SD = 1.5; age range 7-12 years), 8.1 years in the younger cohort (SD = 0.5; age range 7-9 years) and 11.1 years in the older cohort (SD = 0.5; age range 10-12 years). There were 887 (50.4%) males and 872 (49.6%) females in the full sample. Overall, 1,534 (87.2%) study children were Aboriginal, 117 (6.7%) were Torres Strait Islander and 108 (6.1%) were both Aboriginal and Torres Strait Islander.

Measures

Demographic variables

Each study child's primary carer reported the study child's age and gender at each wave. Geographic characteristics in LSIC are captured via the Level of Relative Isolation (LORI) measure, an index for remoteness levels within Australia developed based on an extension of the Accessibility/Remoteness Index of Australia. The extended measure, ARIA++, has an 18-point remoteness scale based on the relative distance of localities from population centres of varying size. LORI uses five categories of isolation based on the ARIA++ scores: none (e.g. metropolitan areas), low, moderate, high and extreme (e.g. isolated remote communities). Within LSIC, respondents in the 'high' and 'extreme' category have been collapsed into one category for 'high/extreme isolation'.

Socioeconomic status

The measures of socioeconomic status used in this analysis include the Index of Relative Indigenous Socioeconomic Outcomes (IRISEO), the highest level of education completed by

the primary carer and financial difficulty reported by the primary carer. IRISEO is an area-based composite ranked scale that has been derived using a range of socio-economic outcomes from regions across Australia, based on the employment, education, income and housing characteristics of Aboriginal persons only (32). IRISEO data from wave 1 of LSIC has been categorised into quintiles for this analysis.

LSIC primary carers were asked to indicate the highest qualification they had completed. This measure was coded into a four-item variable in order to capture university-level education (bachelor, graduate and post-graduate degree), certificate or post-school qualifications (Certificate I-IV, diploma and advanced diploma), completion of Year 11 to Year 12 or equivalent, and lower levels of completion (Year 10, those who never attended school or were still at school).

Primary carers were also asked to provide a subjective rating of their family financial situation, using a 5-part question. This measure was coded into a binary variable for analysis, with families considered to be in financial difficulty if they answered, 'We run out of money before payday', 'We are spending more money than we get', 'We have just enough money to get us through to the next pay day' or 'There's some money left over each week but we just spend it'; a response of 'We can save a bit every now and then' or 'We can save a lot' were coded as not being in financial difficulty. Responses taken at wave 1 are included in this analysis.

Speaking an Aboriginal language

The LSIC dataset contains a range of variables tied to Aboriginal cultural identity and attachment. For simplicity, a variable asking primary carers whether the study child speaks an Aboriginal language ('yes', 'no') has been used as a proxy measure of cultural attachment in this analysis. However, it is important to acknowledge that culture is a complex construct which comprises many elements, particularly across heterogeneous Aboriginal populations, and analysis utilising any single construct in isolation is necessarily limited. Notwithstanding, language has been chosen here as it is considered one of four central elements of cultural attachment, alongside cultural identification, cultural participation and traditional activities, and has been shown to have strong positive effects on happiness and mental health in adult Aboriginal populations (30).

Racial discrimination

LSIC includes three measures of racial discrimination, herein referred to as direct racism, vicarious racism via the primary carer and vicarious racism via the family. Each of these measures were asked at different waves throughout LSIC and the timing of questions related to direct racism differed between study cohorts. Table 1 below describes the timing of collection of each racial discrimination measure over the first 8 waves.

Table 1: Racial discrimination measures in LSIC by wave and cohort¹

		Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 8
Direct racism	Birth cohort								
	Child cohort								
Vicarious racism (primary carer)	Birth cohort								
	Child cohort								
Vicarious racism (family)	Birth cohort								
	Child cohort								

Direct racism

Throughout waves 2-7 of LSIC, direct racism was reported by the primary carer in response to a question on whether the study child had been bullied or treated unfairly at preschool or school because they were Aboriginal. Carers were able to indicate that the study child was bullied by other children, treated unfairly by adults or both. This measure was coded as a binary variable for analysis ('Yes, bullied [kids being mean to him/her]', 'Yes, treated unfairly [adult being mean to him/her]' or 'Yes, both bullied and treated unfairly' compared with 'No'). In wave 8 the structure of the question was changed slightly so that the primary carer was first asked whether the study child had been bullied or treated unfairly at school and if they responded positively to this question (study child was bullied, treated unfairly or both), they were then prompted to indicate whether this was because the study child is Aboriginal or Torres Strait Islander. Carers could indicate that the bullying or unfair treatment was 'always for this reason', 'sometimes for this reason' or not for this reason. This measure was

¹ Shaded boxes in Table 1 denote data collection points across waves separately for each cohort.

then coded as a binary variable for analysis ('Yes, always for this reason' or 'Sometimes for this reason' compared with 'No'). Although the structure of this question differs from that asked in previous waves, the content remains consistent. The wording of both questions used for this measure was not time limited and may be used to indicate that the study child was ever exposed to racism at school or preschool.

Accumulation of racism exposure

Using the binary variables created for the measures of direct racism, vicarious racism via the primary carer and vicarious racism via the family at each study wave, derived variables were generated to capture the number of exposures recorded for each type of racism for each study child. Both vicarious racism via the primary carer and family were asked in 3 waves within LSIC, while direct racism was asked in 4 waves (Table 1). The waves in which the direct racism measure was asked differed by cohort, requiring an accumulation variable to be derived in each cohort separately before creating a final derived variable from their combination.

The sample for this measure included only cases where a response to the direct racism measure was recorded in all waves in which it was asked. There were no respondents reporting exposure to direct racism in all 4 waves, likely due to the change in question structure during wave 8. As a result, the accumulation variable for direct racism excluded the wave 8 measure, limiting responses to a maximum of three exposures at three time points. Due to the small number of children with three exposures, children with two and three exposures were combined into the same category.

Age of first exposure

Mean age at each wave for the separate cohorts was used to assign an age for children during each wave in which each racism measure was asked. Exposure to racism was recorded for children whose primary carer provided a positive response to racism measures at any wave exclusive of those who had indicated a positive response in a previous wave. As not all children participated in all waves of LSIC, this allowed children who had either not been exposed to racism in the previous wave, did not respond to the measure in the previous wave or who did not participate in LSIC during the previous wave to still be included in analysis. Proportions of children with exposure at each successive age were then

totalled, allowing cumulative exposure by mean age 11 to be examined. Proportions represent the number of children with exposure out of the total number of primary carers asked the question at each wave.

This derived variable recorded only first exposures, excluding subsequent exposures for children with more than one exposure. This variable also provided the total number of children who did not report exposure during any recorded response to this question. Although children who were recorded as a missing response to this question in some waves may have reported direct racism had there been a response, this variable provides figures for those reporting no exposure who responded to the question on direct racism at least once.

Due to the accelerated cross-sequential design of LSIC and the patterning of each racism measure, there is little cross-over in age between cohorts for each measure. Where cross-over has occurred, proportions have been totalled across cohorts. For direct racism, exposure was recorded for mean ages 4, 5, 7, 8, 9 and 11 years. Vicarious racism via the primary carer was recorded for exposure at ages 1, 4, 7, 8 and 11 years. Vicarious racism via the family was recorded for exposure at ages 3, 5, 6, 8 and 11 years. This method only accounts for the age at which each racism measure was included in LSIC and cannot account for earlier exposure prior to LSIC.

Vicarious racism via the primary carer

Primary carers were asked to indicate whether they had been treated unfairly or discriminated against because they were Aboriginal or Torres Strait Islander at three time points during the first 8 waves of LSIC (Table 1). Primary carers were able to indicate whether they had been unfairly treated or discriminated against a 'little bit', 'fair bit', 'lots of times' or 'not really'. This measure was then coded as a binary variable (ever ['little bit', 'fair bit' or 'lots of times'] compared with 'not really'). This measure, like the direct racism measure, does not specify a time limited period for exposure to racial discrimination and each occasion must be treated as a record of ever experiencing racial discrimination at any time in the past.

Vicarious racism via the family

Primary carers were asked to indicate how often their family experienced racism, discrimination or prejudice at three time points over the 8 waves of LSIC (Table 1). Responses were rated on a five-point scale in terms of frequency, including; 'every day', 'every week', 'sometimes', 'only occasionally' and 'never or hardly ever'. This measure was coded as a binary variable comparing 'every day', 'every week', 'sometimes' or 'only occasionally' with 'never or hardly ever'.

Data analysis

Data from the first 8 waves of LSIC were used in this study, with a long dataset created merging data from 8 files (all variables included). Subset datasets were then created for each cohort, allowing separate computation of variables for the birth and child cohorts.

The prevalence of racial discrimination was examined across waves of the study by calculating the proportion of children with exposure over those without exposure in each age group. Bivariate associations were examined between racial discrimination variables and sociodemographic factors using the Pearson chi-squared test.

SAS version 9.4 software (SAS Institute Inc., Cary, NC, USA, 2002-12) was used in all analysis.

Missing data

Overall, small proportions of missing values were found for vicarious racism via the primary carer (0.7-3.5%) and vicarious racism via the family (0.8-2.5%) variables across cohorts and waves within LSIC (Tables 3 & 4). Prior to wave 8, the proportion of missing values for direct racism were also relatively small, ranging from 1.8-11.0% (Table 2). However, a higher proportion of missing values (72.6-75.3%) was seen for the direct racism variable in wave 8 as that measure was nested within a pre-requisite question on having experienced any school bullying for the first time during that wave.

Large proportions of missing values were also found when developing the derived variables for accumulation of exposure and age of first exposure. Missing values were high for the accumulation of exposure variables due to applying a conservative algorithm which required all data points to be completed by respondents (Tables 5 & 6). This variable only included children who had a response to each racism measure in every wave in which they were

asked. Of the 1,759 children within LSIC, direct racism had complete data points for 33.8% of children (Table 5), while 43.4% and 52.8% of children had complete data points for vicarious racism via the primary carer and vicarious racism via the family, respectively (Table 6). The derived racial discrimination variables for age of first exposure included all children who responded to each racism measure at any wave during LSIC while excluding those who did not respond to racism measures in any waves in which they were asked. In total, 228 (13.0%) of children were missing from the direct racism age of first exposure variable, 225 (14.5%) were missing from the variable for vicarious exposure via the primary carer and 166 (9.4%) were missing from the vicarious exposure via the family variable.

Comparisons between key sociodemographic variables across children with missing and non-missing data were undertaken for each of the racism measures using χ^2 tests (Appendix 1 and 2). A brief discussion of significant and negligible differences between these groups follows. Overall, given the small to moderate relationship seen between some key sociodemographic factors and missing values across the racism variables, data are likely to be missing at random.

Negligible missingness

No major differences in sociodemographic variables were found between children with missing and non-missing data for the accumulation variable for vicarious racism exposure via the primary carer, although the level of missingness was higher within the child cohort compared to the birth cohort (44.7% compared to 39.8%). No notable differences were seen in the majority of sociodemographic factors between children with missing and non-missing data for age of first exposure to vicarious racism via the family, although greater proportions of children with missing data for this variable were living in both moderately remote (30.6% compared to 13.6%) and the most disadvantaged areas (19.6% compared to 12.3%).

Minimal differences were seen for children with missing values for the age of first exposure to direct racism variable across gender, Indigenous status and socioeconomic variables (<7% difference), although children with missing values were more likely to be younger, as a larger proportion of these children were in the birth cohort (68.4% compared to 55.8%).

Negligible differences were also seen in the distributions of gender, cohort, Indigenous status and financial difficulty between those with and without data for the accumulation of vicarious racism via the family variable and while older children were slightly more likely to

have missing values for this variable, the mean age of children with missing and non-missing data differed minimally (missing: 9.5 years; non-missing: 9.3 years). No major differences between children with missing and non-missing values were found for gender, cohort and age in the variable for age of first exposure to vicarious racism via the primary carer. Finally, minimal differences between those with and without data were seen in gender and Indigenous status for the accumulation of direct racism variable.

Significant missingness

Some notable differences were found between children with missing and non-missing data for the accumulation of exposure variables for direct racism and vicarious racism via the family. Specifically, greater proportions of children with missing data in these variables were living in highly remote (direct: 10.5% compared to 7.3%; vicarious family: 12.7% compared to 6.5%) and the most disadvantaged (direct: 15.3% compared to 8.5%; vicarious family: 17.1% compared to 9.4%) areas. Additionally, children with missing data from the direct racism accumulation variable were overrepresented in the birth cohort (61.4% compared to 49.7%) and a greater proportion of their primary carers reported financial difficulty (68.2% compared to 57.6%). Children with missing data from the variable for age of first exposure to vicarious racism via the primary carer were overrepresented in non-remote (46.0% compared to 22.7%) and the most advantaged (25.2% compared to 12.4%) areas, and a greater proportion of these children were living with a primary carer who reported completing university (8.8% compared to 5.3%). Smaller proportions of children with missing data for the age of first exposure to direct racism variable were living in metropolitan areas (16.4% compared to 27.5%).

Ethics

Ethics approval for the LSIC was provided by the Australian Commonwealth Department of Health Departmental Ethics Committee and from state and territory Ethics Committees. The current analysis was approved by the Western Australian Aboriginal Health Ethics Committee and the University of Western Australia Human Research Ethics Committee.

Results

The prevalence rates of each form of racism exposure reported at each wave for both cohorts are presented in Tables 2-4. Data has been subset by cohort with mean age and gender presented for those reporting each racism exposure at each wave.

Table 2: Prevalence of direct racism across waves and cohorts

Birth cohort							
		Prevalence			Gender distribution of those who experienced racism		
Wave (age range)	Mean age (SD)	N	n	% (95% CI)	Female n (%)	Male n (%)	Missing ² n (%)
4 (3-5 years)	4.1 (0.3)	435	17	3.9 (2.3, 6.2)	8 (47.1)	9 (52.9)	41 (8.6)
5 (4-6 years)	5.2 (0.4)	622	37	6.0 (4.2, 8.1)	23 (62.2)	14 (37.8)	29 (4.5)
7 (6-8 years)	7.2 (0.4)	719	98	13.6 (11.2, 16.4)	53 (54.1)	45 (45.9)	13 (1.8)
8 (7-9 years)	8.1 (0.4)	207	31	15.0 (10.4, 20.6)	13 (41.9)	18 (58.1)	547 (72.6)
Child cohort							
		Prevalence			Gender distribution of those who experienced racism		
Wave (age range)	Mean age (SD)	N	n	% (95% CI)	Female n (%)	Male n (%)	Missing n (%)
2 (4-7 years)	5.2 (0.5)	504	53	10.5 (8.0, 13.5)	28 (52.8)	25 (47.2)	62 (11.0)
4 (6-9 years)	7.1 (0.5)	515	46	8.9 (6.6, 11.7)	19 (41.3)	27 (58.7)	18 (3.5)
6 (8-10 years)	9.2 (0.5)	490	79	16.1 (13.0, 19.7)	43 (54.4)	36 (45.6)	16 (3.2)
8 (10-12 years)	11.1 (0.7)	125	22	17.6 (11.4, 25.4)	10 (45.5)	12 (54.6)	381 (75.3)

As expected, rates of racism exposure generally increased with age and in the oldest children (aged 10-12 years) close to one in five children had been exposed to racial discrimination. In the birth cohort, rates of exposure steadily increased with age from wave 4 to wave 8. Although the trajectory was less uniform, proportions also increased with age

² Missing data as a proportion of the total sample of study children at school in each wave and cohort.

in the child cohort. Slight differences were seen in the prevalence of direct racism exposure between the birth and child cohorts. The proportion of those at mean age 5 years in the child cohort reporting direct racism exposure was approximately two-fold higher than those of the same age in the birth cohort (10.5% compared with 6.0%), while a larger proportion of those with a mean age of 7 years in the birth cohort reported direct racism exposure compared to those aged 7 years in the child cohort (13.6% compared with 8.9%).

Table 3: Prevalence of vicarious racism (primary carer) across waves and cohorts

Birth cohort							
		Prevalence			Gender distribution of those who experienced racism		
Wave (age range)	Mean age (SD)	N	n	% (95% CI)	Female n (%)	Male n (%)	Missing ³ n (%)
1 (0-2 years)	1.1 (0.5)	797	238	29.9 (26.7, 33.2)	126 (52.9)	112 (47.1)	23 (2.8)
4 (3-5 years)	4.1 (0.4)	613	148	24.1 (20.8, 27.7)	72 (48.7)	76 (51.4)	4 (0.7)
8 (7-9 years)	8.1 (0.5)	617	135	21.9 (18.7, 25.4)	73 (54.1)	62 (45.9)	9 (1.4)
Child cohort							
		Prevalence			Gender distribution of those who experienced racism		
Wave (age range)	Mean age (SD)	N	n	% (95% CI)	Female n (%)	Male n (%)	Missing n (%)
1 (3-6 years)	4.1 (0.5)	587	193	32.9 (29.1, 36.8)	102 (52.8)	91 (47.2)	21 (3.5)
4 (6-9 years)	7.1 (0.4)	446	119	26.7 (22.6, 31.0)	53 (44.5)	66 (55.5)	6 (1.3)
8 (10-12 years)	11.2 (0.5)	404	123	30.5 (26.0, 35.2)	66 (53.7)	57 (46.3)	7 (1.7)

Overall, rates in the prevalence of vicarious racism via the primary carer were considerably higher than those seen for direct racism experienced by the study child in LSIC. Prevalence rates were slightly lower in the birth cohort overall when compared to the child cohort. The gender balance of those exposed to this form of racial discrimination remained relatively steady over time for both cohorts.

³ Missing data as a proportion of the total sample of study children in each wave and cohort.

Table 4: Prevalence of vicarious racism (family) across waves and cohorts

Birth cohort							
		Prevalence			Gender distribution of those who experienced racism		
Wave (age range)	Mean age (SD)	N	n	% (95% CI)	Female n (%)	Male n (%)	Missing n (%)
3 (2-4 years)	3.1 (0.4)	82 1	27 1	33.0 (29.8, 36.3)	143 (52.8)	128 (47.2)	13 (1.6)
5 (4-6 years)	5.1 (0.4)	72 0	24 4	33.9 (30.4, 37.5)	127 (52.0)	117 (48.0)	15 (2.0)
8 (7-9 years)	8.1 (0.5)	74 7	22 4	30.0 (26.7, 33.4)	123 (54.9)	101 (45.1)	12 (1.6)
Child cohort							
		Prevalence			Gender distribution of those who experienced racism		
Wave (age range)	Mean age (SD)	N	n	% (95% CI)	Female n (%)	Male n (%)	Missing n (%)
3 (5-8 years)	6.1 (0.5)	58 0	17 8	30.7 (27.0, 34.6)	84 (47.2)	94 (52.8)	15 (2.5)
5 (7-10 years)	8.1 (0.5)	52 8	18 1	34.3 (30.2, 38.5)	79 (43.7)	102 (56.4)	4 (0.8)
8 (10-12 years)	11.1 (0.5)	49 7	16 7	33.6 (29.5, 37.9)	83 (49.7)	84 (50.3)	9 (1.8)

Prevalence rates for vicarious racism via the family were consistent across the birth and child cohorts, across waves and between those of comparative age. Rates differed slightly from those of vicarious racism via the primary carer, however it is likely that this simply reflected differences in the structure and content of each question. Although both measures captured frequency, the family racism measure included more explicit timeframes (e.g. every week, every day) compared to the primary carer measure (e.g. fair bit, lots of times). Additionally, the family racism measure was reported by primary carers who may not have been aware of all experiences of racial discrimination in other family members.

A relatively even gender balance was seen across waves and cohorts for those experiencing vicarious racism via the family and no significant differences were seen between genders for either cohort at any wave.

Accumulation of racism exposure

Accumulation of exposure to each racism measure has been presented in Tables 5 and 6.

Table 5: Accumulation of exposure to direct racism measure by cohort

Direct racism								
		No exposure		1 exposure		2+ exposures		Missing ⁴
	N	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n (%)
Full sample	594	463	78.0 (74.4, 81.2)	105	17.7 (14.7, 21.0)	26	4.4 (2.9, 6.4)	1,165 (66.2)
Birth cohort	295	239	81.0 (76.1, 85.3)	59	15.6 (11.5, 20.3)	10	3.4 (1.6, 6.2)	715 (70.8)
Child cohort	299	224	74.9 (69.6, 79.7)	46	19.7 (15.4, 24.7)	16	5.4 (3.1, 8.5)	450 (60.1)

The majority of children (78.0%) did not have any recorded exposure to direct racism at school, while close to one in five (17.7%) reported only one exposure during the three possible time points. Few children reported racism exposure at two or more time points, with only 26 children (4.4%) recording this level of exposure across the full sample.

⁴ Missing data as a proportion of the total sample of study children and of those in each cohort.

Table 6: Accumulation of exposure to vicarious racism measures by cohort

Vicarious racism (primary carer)										
	No exposure			1 exposure		2 exposures		3 exposures		Missing
	N	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n (%)
Full sample	764	388	50.8 (47.2, 54.4)	202	26.4 (23.3, 29.7)	120	15.7 (13.2, 18.5)	54	7.1 (5.4, 9.1)	995 (56.6)
Birth cohort	460	247	53.7 (49.0, 58.3)	121	26.3 (22.3, 30.6)	69	15.0 (11.9, 18.6)	23	5.0 (3.2, 7.4)	550 (54.5)
Child cohort	304	141	46.4 (40.7, 52.2)	81	26.6 (21.8, 32.0)	51	16.8 (12.8, 21.5)	31	10.2 (7.0, 14.2)	445 (59.4)
Vicarious racism (family)										
	No exposure			1 exposure		2 exposures		3 exposures		Missing
	N	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n (%)
Full sample	928	410	44.2 (41.0, 47.4)	244	26.3 (23.5, 29.3)	159	17.1 (14.8, 19.7)	115	12.4 (10.3, 14.7)	831 (47.2)
Birth cohort	549	242	44.1 (39.9, 48.4)	148	27.0 (23.3, 30.9)	94	17.1 (14.1, 20.5)	65	11.8 (9.3, 14.8)	461 (45.6)
Child cohort	379	168	44.3 (39.3, 49.5)	96	25.3 (21.0, 30.0)	65	17.2 (13.5, 21.3)	50	13.2 (10.0, 17.0)	370 (49.4)

Approximately half of those with complete responses to the measure of vicarious racism via the primary carer reported no exposure across all relevant waves in the full sample, with a slightly higher proportion of those in the birth cohort reporting no exposure compared to the child cohort (50.8% compared to 44.2%). The proportion of those reporting exposure decreased successively with each additional exposure level. Rates were very similar between the full sample, birth and child cohorts for one exposure (26.4%, 26.3% and 26.6% respectively) and two exposures (15.7%, 15.0% and 16.8% respectively) to vicarious racism via the primary carer. Twice the proportion of those in the child cohort reported three exposures compared to the birth cohort (10.2% compared with 5.0%).

The majority of those who responded at all three time points to the measure of vicarious racism via the family indicated some level of exposure to this form of racism. Overall, while

the proportion of children with one or two exposures to vicarious racism via the family was similar to that found for vicarious racism via the primary carer, the proportion reporting exposure at three time points is somewhat higher.

Accumulation of exposure by sociodemographic factors

Overall, financial difficulty and remoteness were both found to be significantly associated with direct racism. However, all significant associations were found with single exposure and not accumulated exposure.

Remoteness was found to be significantly related to single exposure to direct racism ($\chi^2=9.88$; $df=3$; $p=0.0196$). However, pairwise comparisons of remoteness levels only revealed a significant difference between those living in non-remote areas and areas of high remoteness ($p=0.0093$), with no significant difference found between those living in non-remote areas and areas of low ($p=0.5985$) or moderate ($p=0.8478$) remoteness. Children living in areas of high remoteness had 2.1 (95% CI: 1.2 – 3.5) times the risk of single exposure to direct racism compared to those living in non-remote areas.

Financial difficulty was also found to be significantly associated with single exposure to direct racism ($\chi^2=7.37$; $df=2$; $p\text{-value } 0.0251$). Children whose primary carer reported financial difficulty had 1.7 (95% CI: 1.1 – 2.5) times the risk of single exposure to direct racism compared to those whose primary carer reported no financial difficulty.

Age of first exposure

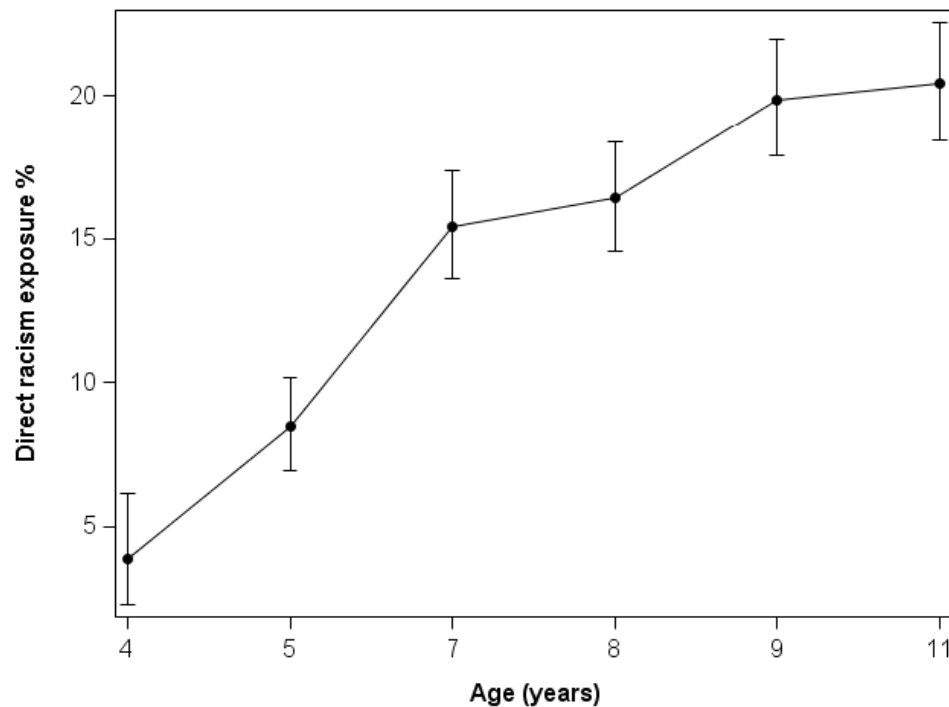
The count and proportion of children with first exposure to each racism measure at each mean age is presented in Tables 7-9 below. The count data at each age is then presented as a proportion of the total number of children who responded to each racism measure during any wave of LSIC for the full sample and each cohort. The proportions in the full sample have been summed at each successive age after the youngest (e.g. mean age 4 years for direct racism) and cumulative totals at each age are presented in Figures 1-3.

Table 7: Age of first exposure to direct racism by cohort

	Age 4			Age 5			Age 7		
	N	n	%	N	n	%	N	n	%
Full sample	435	17	3.9	1,126	87	7.7	1,234	126	10.2
Birth cohort	435	17	3.9	622	34	5.5	719	87	12.1
Child cohort				504	53	10.5	515	39	7.6
	Age 8			Age 9			Age 11		
	N	n	%	N	n	%	N	n	%
Full sample	207	16	7.7	490	58	11.8	125	9	7.2
Birth cohort	207	16	7.7						
Child cohort				490	58	11.8	125	9	7.2

In the full sample, the largest proportions of children with first exposure to direct racism reported this at mean age 7 (10.2%) and age 9 (11.8%) while relatively few children had their first exposure at age 4 (3.9%). Slightly different patterns were seen between the birth and child cohorts as higher proportions of those in the child cohort had their first exposure to direct racism at mean age 5 (10.5% compared to 5.5% in the birth cohort) while higher proportions of those in the birth cohort had their first exposure at mean age 7 (12.1% compared to 7.6% in the child cohort).

Figure 1: Full sample: age of first exposure to direct racism, cumulatively totalled



Almost 4% of study children were exposed to direct racism at age 4 years, increasing to one in five by age 11 (20.4%; 95% CI: 18.5-22.6). By age 5, the age at which the majority of children in Australia have begun primary education, 8.5% (95% CI: 7.0-10.2) of study children in LSIC had been exposed to direct racism at school or preschool from either adults or peers. Most children with recorded exposures to direct racism had their first exposure by age 7, with only an additional 5.0% of children experiencing their first exposure between ages 7-11 years.

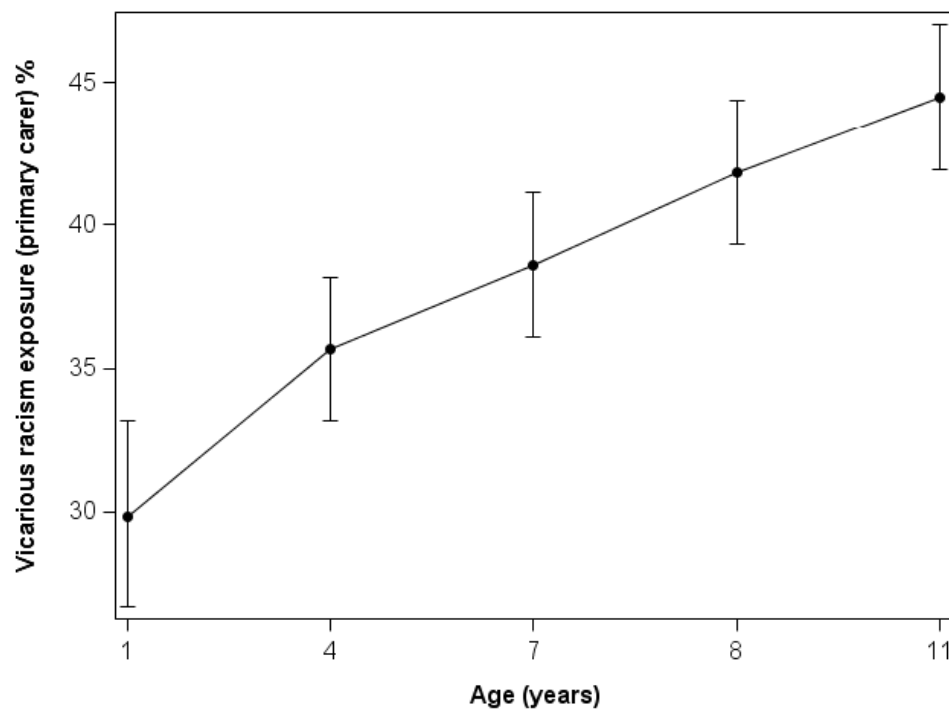
Table 8: Age of first exposure to vicarious racism (primary carer) by cohort

	Age 1			Age 4			Age 7		
	N	n	%	N	n	%	N	n	%
Full sample	797	238	29.9	1,200	275	22.9	446	60	13.5
Birth cohort	797	238	29.9	613	82	13.4			
Child cohort				587	193	32.9	446	60	13.5
	Age 8						Age 11		
	N	n	%				N	n	%
Full sample	617	53	8.6				404	43	10.6
Birth cohort	617	53	8.6						
Child cohort							404	43	10.6

In the full sample, the largest proportions of primary carers who reported experiencing racial discrimination reported this at the first possible wave (wave 1) when the birth cohort was aged mean 1 year and the child cohort were aged mean 4 years. A smaller proportion of primary carers indicated experiencing racism for the first time in LSIC at wave 4 (birth cohort aged 4 years, child cohort aged 7 years) and a yet smaller proportion indicated first experiencing racism at wave 8 (birth cohort aged 8 years, child cohort aged 11 years).

As this variable was not time limited it is possible that experiences of racial discrimination occurred prior to wave 1, when the study child was at an earlier age or during gestation. Overall, proportions of children exposed to vicarious racism via the primary carer were similar across both cohorts.

Figure 2: Full sample: age of first exposure to vicarious racism (primary carer), cumulatively totalled



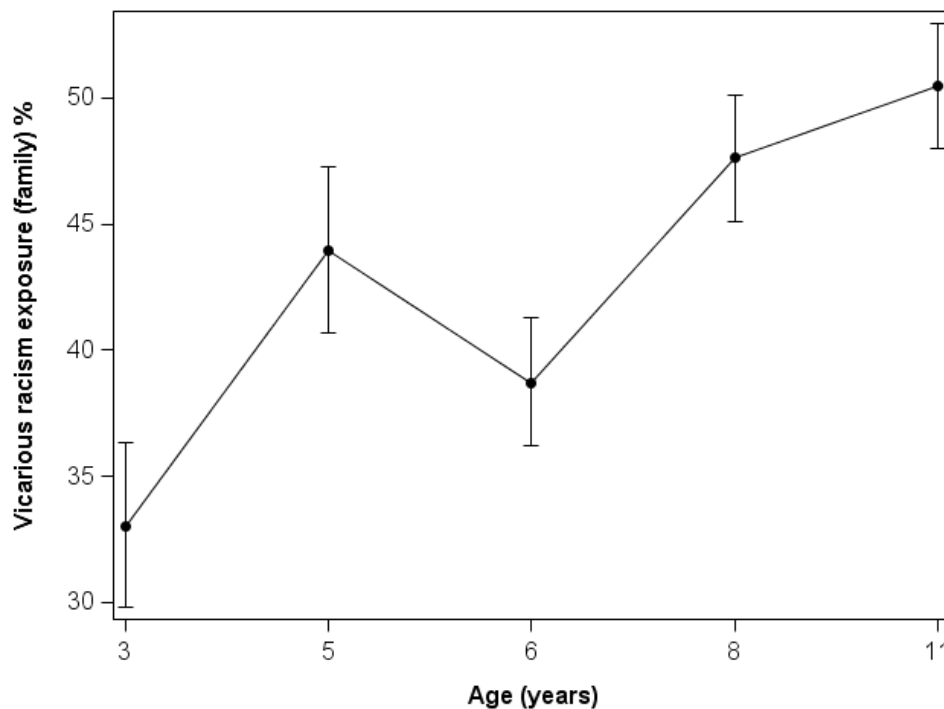
As seen in Figure 2, just over four in ten (44.5%; 95% CI: 42.0-47.0) children had been exposed to vicarious racism through their primary carer at some point by age 11 years. The largest proportion of children who were exposed had been exposed by ages 1-4 (35.7%; 95% CI: 33.2-38.2) with only a further 8.8% of those with any exposure to vicarious racism via the primary carer reporting a first occurrence between ages 4-11.

Table 9: Age of first exposure to vicarious racism (family) by cohort

	Age 3			Age 5			Age 6		
	N	n	%	N	n	%	N	n	%
Full sample	821	271	33.0	720	121	16.8	580	178	30.7
Birth cohort	821	271	33.0	720	121	16.8			
Child cohort							580	178	30.7
	Age 8						Age 11		
	N	n	%				N	n	%
Full sample	1,275	176	13.8				497	58	11.7
Birth cohort	747	77	10.3						
Child cohort	528	99	18.8				497	58	11.7

Across the full sample, prevalence rates of exposure to vicarious racism via the family appear to be inconsistent over time. However, this is due to the timing of the exposure measure and the age of children at each time point. In each cohort rates of exposure were similar to those of vicarious racism via the primary carer. Three in ten (30.7%) children from the child cohort and one third (33.0%) of children in the birth cohort had their first exposure in the first possible wave (birth cohort: age 3; child cohort: age 6).

Figure 3: Full sample: age of first exposure to vicarious racism (family), cumulatively totalled



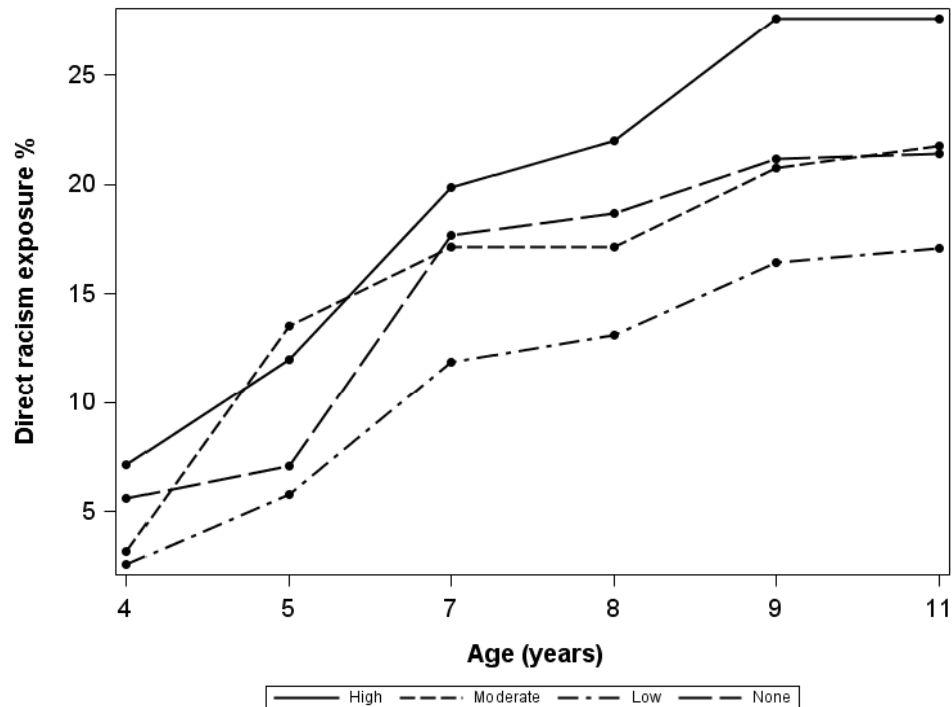
With slightly higher rates than those seen for vicarious racism via the primary carer, just over half (50.5%; 95% CI: 48.0-53.0) of children had at least one point of exposure for vicarious racism via the family by age 11 (compared to 44.5% exposed to vicarious racism via the primary carer and 20.4% exposed to direct racism). A slight decrease was seen at age 6 as there was an increase in the number of children with a response to this measure that was not matched by the number of children with an additional exposure at that age. However, there was a linear increase with age overall.

Age of first exposure by sociodemographic factors

Age of first exposure to direct racism by key sociodemographic factors have been presented in Figures 4-8. Cumulative proportions at each age have been presented for each level of the categorical and binary variables.

Level of relative isolation

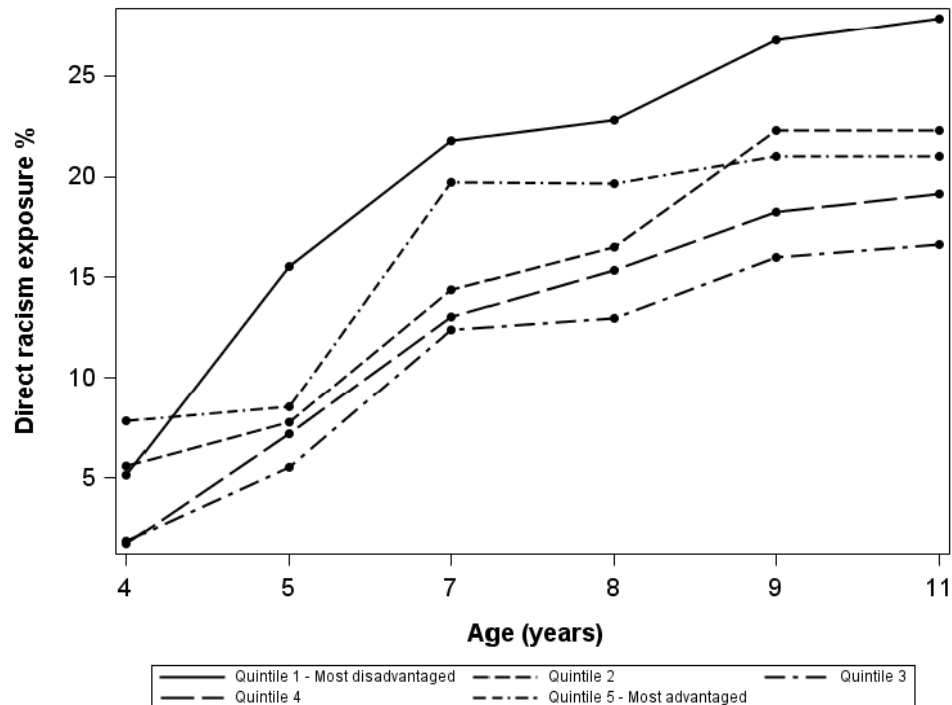
Figure 4: Direct racism: full sample by LORI and racism exposure, cumulatively totalled



As seen in Figure 4, similar rates of exposure were seen in areas with moderate and no isolation, while consistently lower rates of exposure were seen in areas of low isolation and somewhat higher rates of exposure were found in areas with high isolation. Around one in four (27.6%; 95% CI: 20.0-35.2) children living in areas of high isolation were exposed to direct racism by age 11, compared to 17.1% (95% CI: 14.3-19.9) of children living in areas with low isolation.

Remoteness was related to exposure to direct racism by age 11 ($\chi^2=9.44$; $df=3$; p -value 0.0240). Although pairwise comparisons did not reach significance for children living in areas of low remoteness compared with moderate ($p=0.1290$) and non-remote areas ($p=0.0787$), a significant risk of exposure to direct racism by age 11 was found between children living in areas of low remoteness and high remoteness ($p=0.0043$). Children living in areas with low remoteness had 1.6 (95% CI 1.2 – 2.2) times the risk of exposure to direct racism by age 11 compared to those living in areas with high levels of remoteness.

Figure 5: Direct racism: full sample by IRISEO and racism exposure, cumulatively totalled



Children living in regions classified as the most disadvantaged (quintile 1) were most likely to have been exposed to direct racism by age 11, as seen in Figure 5. Although rates for children living in the most advantaged regions (quintile 5) were slightly higher by age 7, rates in this quintile then remain steady and by age 11 children living in quintiles 2, 3, 4 and 5 all had similar rates of exposure to direct racism, encompassing children living across both more disadvantaged and more advantaged regions. Overall, rates of exposure for children living in moderately advantaged regions (quintile 3) remained consistently lower throughout.

IRISEO was related to exposure to direct racism by age 11 ($\chi^2=12.34$; $df=4$; p -value 0.0150). While pairwise comparisons found no significant differences between children classified as living in quintile 1 and quintile 2 ($p=0.1866$) or quintile 5 ($p=0.1126$) regions, significant differences were found between children living in quintile 1 and quintile 3 regions ($p=0.0007$) and between children living in quintile 1 and quintile 4 regions ($p=0.0367$). Children living in areas classified as quintile 1, the most disadvantaged regions, had 1.7 (95%

CI 1.3 – 2.3) times the risk of direct racism by age 11 compared to those living in areas classified as quintile 3 and 1.5 (95% CI 1.0 – 2.1) times the risk of exposure compared to those living in areas classified as quintile 4.

Figure 6: Direct racism: full sample by primary carer highest education completed and racism exposure, cumulatively totalled

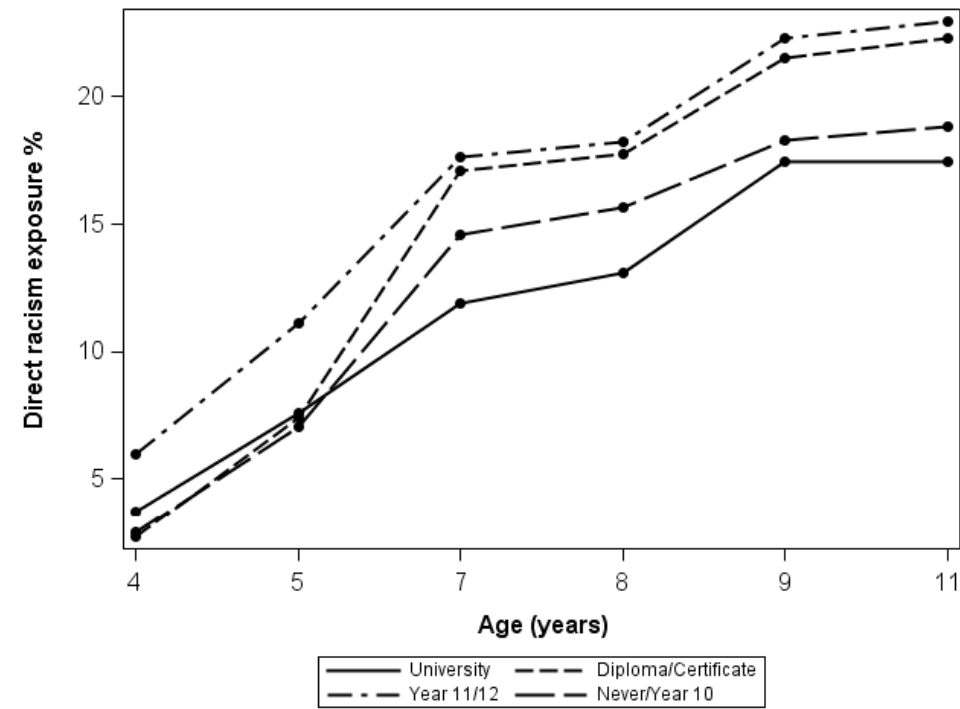
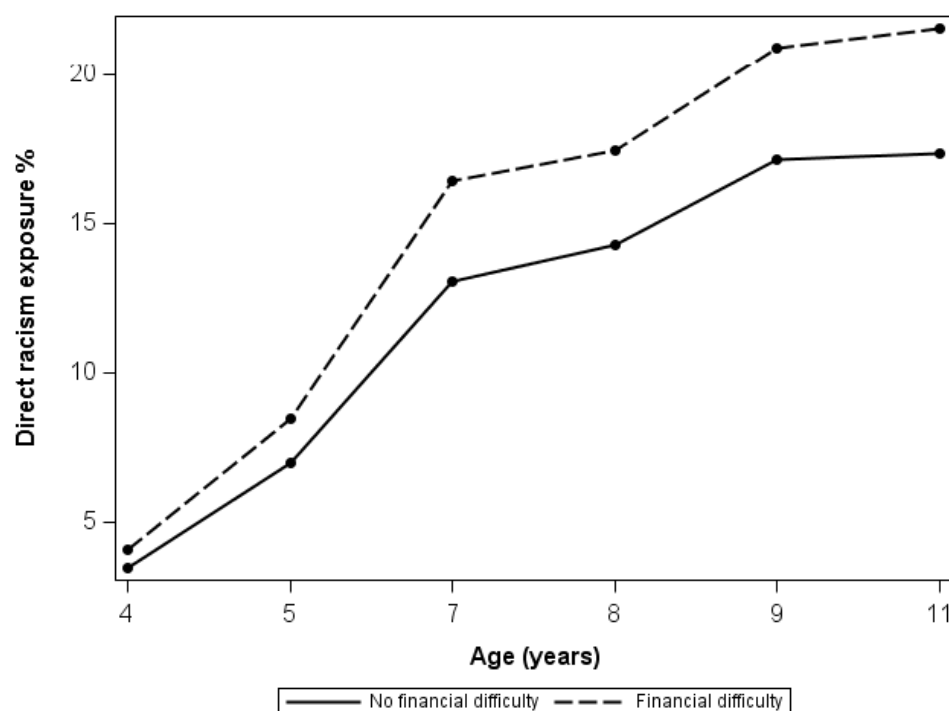


Figure 6 shows that rates of exposure to direct racism were fairly consistent across differing levels of primary carer education. Children whose primary carer completed university had slightly lower rates of exposure at ages 7 and 8, however by age 11 these rates were similar to primary carers who had never attended school to Year 10 completion.

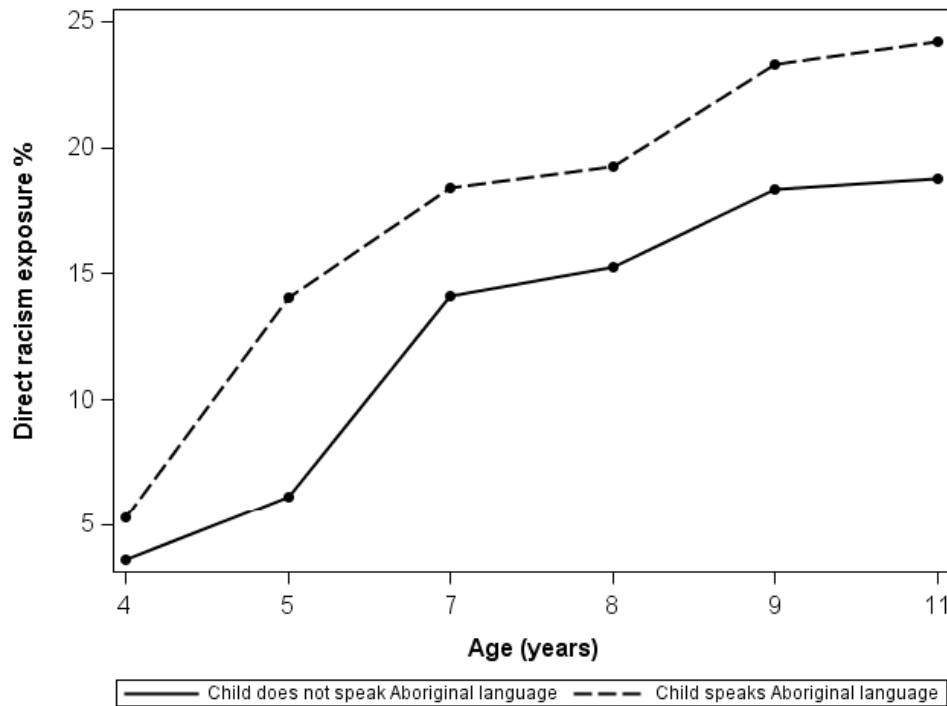
Figure 7: Direct racism: full sample by financial difficulty and racism exposure, cumulatively totalled



By age 11, 21.6% (95% CI: 18.9-24.3) of children whose primary carer reported financial difficulty reported exposure to direct racism compared to 17.3% (95% CI: 14.0-20.7) who reported no financial difficulty. These rates remained consistently higher at each age during LSIC.

Cultural attachment

Figure 8: Direct racism: full sample by whether child spoke Aboriginal language and racism exposure, cumulatively totalled



Overall, there was a higher prevalence of exposure to direct racism among children who spoke an Aboriginal language compared with those who did not. By age 11, close to one quarter (24.2%; 95% CI: 19.6-29.3) of study children who spoke an Aboriginal language had been exposed to direct racism at least once compared to 18.8% (95% CI: 16.6-21.2) of those who did not speak an Aboriginal language.

Whether study children spoke an Aboriginal language was strongly related to exposure to direct racism by age 11 ($\chi^2=4.62$; $df=1$; p -value 0.0317). Study children who spoke an Aboriginal language had 1.4 (95% CI 1.0 – 1.9) times the risk of exposure to direct racism by age 11 compared to those who did not speak an Aboriginal language.

Discussion

As anticipated, this study further confirmed that a substantial proportion of Aboriginal children experience direct interpersonal racism during childhood. Around one in five

children were observed to have been exposed to direct racism during at least one time point by age 11 years. The prevalence rates for direct racism found in this study reflect those found for Aboriginal children of a similar age (23, 25) and are somewhat lower than rates found for Aboriginal adolescents and young people (24, 26, 33, 34). While children can understand and recognise discriminatory behaviour and actions by ages 5-6, as children age their ability to discern and contextualise discrimination becomes more consistent (28) and Aboriginal children aged 8-12 have conceptualised and discussed clear instances of racial discrimination (35). Increased perceptions of direct racism are likely to occur as children develop from early to late childhood and into adolescence, given that adolescent's increased autonomy likely leads to greater risk of exposure in a wider variety of contexts (36). As the direct racism measure from this study was specific to the school context, it is critically important that strategies aimed at addressing this form of racism are developed in collaboration with education providers and relevant State/Territory education departments, ensuring that the policies and interventions required are appropriate, responsive and targeted.

Also as expected, prevalence rates for vicarious racism were found to be considerably higher than those seen for direct racism in LSIC children, with close to half of all children exposed to vicarious racism via the primary carer or the family by age 11. These higher rates may reflect the restricted context of the direct racism measure (i.e. school), children's inability to recognise instances of discrimination during early childhood or their decision not to report these incidences to their parent/carer as well as an increased awareness and incidence of racism in adulthood. Prevalence rates for vicarious racism found in this study are slightly higher than rates seen for similar measures in Aboriginal children aged below 7 years in the Northern Territory (NT) (27). This difference may be accounted for by the time-limited nature of the measurement item used in the NT study, which referred to experiences of racial discrimination as a stressor over the last year while the measurement item within LSIC did not specify an exposure timeframe. The considerable proportion of Aboriginal children exposed to either form of vicarious racial discrimination in this study highlights the compounding effect that racism can have within Aboriginal families and further reiterates the crucial need for coordinated strategies to be developed to address discriminatory behaviour directed towards Aboriginal populations in Australia.

This study is the first to describe the age of first exposure to direct and vicarious racial discrimination in a longitudinal study of Aboriginal children in Australia. We found that one third of all children with at least one exposure to direct racism had first been exposed by age 5 years (33%), the average age of school-entry, while the majority had their first exposure by age 7 years (74%). Proportions were similar for children exposed to vicarious racism via the family, with the majority of all children with at least one experience of this form of racism being first exposed by age 6 (71%). For those with exposure to vicarious racism via the primary carer, these proportions are even starker, with 77% of children with at least one exposure to vicarious racism via the primary carer having first exposure by age 4. It is concerning that the majority of these exposures were observed to occur during the formative years of child development, given that children have been shown to be particularly vulnerable to the negative health outcomes associated with racial discrimination (4, 18). Early developmental periods should be an integral focus in future research examining the pathways between racism and child health outcomes.

A number of associations were found between socio-demographic factors and the derived racism variables for accumulation of exposure and age of first exposure in this study. In a novel finding, this study found a moderate relationship between speaking an Aboriginal language and exposure to direct racism. Children who spoke an Aboriginal language had 1.4 times the risk of exposure to direct racism by age 11, compared to children who did not speak an Aboriginal language. To the best of our knowledge, this is the first study to include a cultural identifier in the examination of risks for racial discrimination exposure in Aboriginal children. Western Australian Aboriginal children aged 8-12 have identified Aboriginal language as a valued part of their racial identity, acting to distinguish them from non-Aboriginal children and within their own specific language group (37). In the school context, where the direct racism measure within LSIC is situated, speaking an Aboriginal language likely highlights the Aboriginal identity of the child even where language is not spoken on school grounds. As Aboriginal children have identified bullying within school due to their Aboriginal identity in qualitative studies (35), it is possible that any explicit indication of Aboriginal identity – such as through speaking an Aboriginal language – may lead to increased exposure to incidences of racialised bullying.

Moderate associations were found between racism variables and measures of geographic remoteness. Single exposure to direct racism and direct racism exposure by age 11 were found to be associated with levels of relative isolation, whereby children living in areas of high/extreme remoteness were observed to have the highest proportions of direct racism exposure compared to those living in areas of low or non-remoteness. These results differ from those found in the WAACHS where racism was reported less often in areas of extreme remoteness, though these results were not statistically significant(24). Areas of extreme remoteness, as classified by LORI, are generally communities which experience limited contact with non-Aboriginal people (24), which may have influenced the prevalence of racism in these communities. The categories for high and extreme isolation were collapsed in the LSIC dataset which may have contributed to the discrepancy. Further examination of the association between remoteness and racism exposure in children is required to fully understand this relationship.

Socioeconomic indicators also revealed an association with direct racism exposure although associations were not uniform across racism measures. Financial difficulty was found to have a significant association with single exposure to direct racism but no association was found with direct racism exposure by age 11. The IRISEO measure did not appear to be associated with single exposure to direct racism, although children living in the most disadvantaged areas had a greater risk of being exposed at age 11 years than those living in areas classified as moderately advantaged and more advantaged.

Limitations

The limitations of this study centre predominantly around the measures of racial discrimination. Each measure was not time limited, making it difficult to extrapolate data recording multiple exposures. Due to the wording of the direct racism and vicarious racism via the primary carer measures, each record of exposure may refer to either recent or distant past experiences of racial discrimination. While multiple records of exposure can be interpreted as multiple recent exposures, the language utilised in these measures does not explicitly define the exposure as such.

All three measures of racial discrimination were reported by the primary carer, not directly by the study child or other family members, limiting the validity of this measure to the

perspective of the primary carer. Measures of racial discrimination were not recorded in all waves, limiting points of exposure to those in which data was recorded.

All measures of racism were single-item measures, potentially underestimating the extent of racism exposure in study children. This study has only undertaken a close examination of interpersonal racism, which only represents a single component of racism. Systemic and internalised racism are both critical components of the experience of racial discrimination although they are outside the scope of the current study.

As notable differences were found between children included and excluded from the derived racism variables across measures of remoteness and SES and increased risk of exposure to racism was found to be associated with these measures, it may be expected that the prevalence of direct and vicarious racism would differ with the inclusion of certain missing cases. However, overrepresentation of missing cases in areas of low/high remoteness and SES differed according to the racism variable under examination.

Finally, although the LSIC chose study sites to accurately represent the community context of Aboriginal children across Australia, the study employed a non-random sampling design and the sample is not held as representative of the total population of Aboriginal children. As a result, findings may not be generalisable to the broader population of Aboriginal children in Australia.

Conclusion

Direct and vicarious racism is commonly experienced by Aboriginal children and exposure often occurs within the first years of life. This study is one of the first studies internationally to characterise the prevalence of both direct and vicarious forms of racism among a cohort of children using longitudinal data. Findings contributed to the development of variables investigating the age of first exposure and accumulation of exposure to racial discrimination across the lives of Aboriginal children. Understanding the prevalence of racial discrimination and sociodemographic factors associated with increased risk of exposure to racism during childhood are important first steps to developing meaningful insights into racial disparities between Aboriginal and non-Aboriginal children in Australia.

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RESEARCH

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Caregiver-perceived racial discrimination is associated with diverse mental health outcomes in Aboriginal and Torres Strait Islander children aged 7–12 years



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Abstract

Background: Racial discrimination is acknowledged as a central social determinant of Australian Aboriginal and Torres Strait Islander (hereafter referred to as Aboriginal) health, although quantitative empirical literature on the impacts of racism on Aboriginal children remains sparse. We use a novel, longitudinal dataset to explore the relationship between caregiver-perceived racism exposure and a range of mental health and related behavioural and physiological outcomes in childhood.

Method: The study cohort comprised 1759 Aboriginal children aged 4–12 years from waves 2–8 (2009–2015) of the Footprints in Time: The Longitudinal Study of Indigenous Children (LSIC) dataset. We examined exposure to caregiver-perceived racism between 4 and 11 years as a predictor for mental health and related outcomes at ages 7–12 and substance use at 10–12 years. Unadjusted models and models adjusted for remoteness, community-level and family-level socio-economic status, child age and gender were used in analysis. Multilevel logistic regression was used in all analysis.

Results: In fully adjusted models, perceived exposure to racism at ages 4–11 was associated with twice the risk of negative mental health (95% CI: 1.3–3.0), sleep difficulties (95% CI: 1.4–3.0), and behaviour issues at school (95% CI: 1.2–2.9), 1.7 times the risk of obesity (95% CI: 1.1–2.5), and nearly 7 times the risk of trying cigarettes (95% CI: 1.1–43.9). Increased risks were also found for being underweight and trying alcohol though estimates did not reach statistical significance. There was no evidence that racism was associated with poorer general health.

Conclusion: Exposure to racial discrimination in Aboriginal children increased the risk for a spectrum of interrelated psychological, behavioural and physiological factors linked to negative mental health. Our results further affirm the importance of interventions aimed at reducing the prevalence of racial discrimination for the benefits of population health and health inequalities. The services and institutions which aim to support the mental health and wellbeing of Aboriginal children should also support interventions to reduce racism and implement accountable policies which prioritise this goal.

Keywords: Racism, Aboriginal, Mental health, Social determinants of health, Australia

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Background

Racism is a central social determinant of health which contributes to the disparities in health observed between different racial and ethnic populations [1–7]. Racism continues to pervade the social systems and institutions which impact on the health and wellbeing of Indigenous populations worldwide, including Aboriginal and Torres Strait Islander (hereafter referred to as ‘Aboriginal’) populations in Australia [8]. More broadly, significant associations have been found between interpersonal racism and negative health and wellbeing outcomes in international studies across both child and adult populations [4, 9–15]. Yet the negative health effects of racism as a pervasive stressor have been shown to be stronger in children and young people when compared to adults [10, 16]. This is unsurprising given that the early years are understood to present a critical period of health vulnerability to adversity and stress [17, 18]. An increasing number of studies have examined the association between racial discrimination and health and wellbeing outcomes in children aged below 12 years in recent years, although relatively few have focused on children from Indigenous populations [12].

For Aboriginal populations in Australia, racism is a layered, diverse and – critically – persistent experience which encompasses interpersonal forms of racism encountered through verbal or behavioural gestures (e.g. name calling, abuse) and structural forms of racism prevalent throughout society (e.g. delayed medical attention, media misinformation) [19–22]. While contemporary forms of racism continue to evolve, racism experienced by Aboriginal Australians is also a historically informed experience tied to the colonisation of Australia by white settlers in the eighteenth Century and the subsequent social marginalisation, loss of sovereignty and land dispossession associated with this to the current day [23, 24]. Additionally, the effects of phenomena which exist at the intersection of racism and colonisation, such as intergenerational trauma, are increasingly being recognised and understood to have a profound impact on Aboriginal health [23, 25]. The common exposure to racism in the everyday life of Aboriginal children is well documented, both as direct exposure to discrimination or unfair treatment and as vicarious exposure through caregivers or family members [24]. A growing body of literature has also reported associations between racism exposure and health outcomes within this population [26–31]. Despite this nascent literature, evidence surrounding the specific impact of racism on children’s health as they transition into adolescence is currently limited.

Racism likely acts on health and wellbeing through increasing allostatic load and associated physiological dysregulation, initiating maladaptive psychological or

behavioural responses or prompting changes in health behaviour [9, 12, 15]. Each of these processes contribute to the biological embodiment of racism exposure, encompassing the pathogenic pathways induced specifically by interpersonal racism as a psychosocial stressor [11, 32]. Within this context, racial discrimination exposure has been found to be more consistently and strongly associated with mental health than physical health outcomes across the life span, including during childhood and adolescence [9, 12, 15, 33, 34]. The relative strength of this association in children and adolescents may be due in part to an earlier onset of psychological over physiological effects as the psychological harm occasioned by racial discrimination exposure is more immediately apparent than any indicators of physiological harm, including metabolic or hormonal changes [35, 36]. A closer examination of mental health indicators adversely affected by experiences of racism during childhood will assist in understanding this association. This is particularly relevant for Aboriginal children as broader aspects of mental health and related risk factors such as problem behaviour and substance use have yet to be examined in this population.

This paper aims to address this knowledge gap, with a focus on Aboriginal children aged 4–12 years using data from the Longitudinal Study of Indigenous Children. We include measures of socioemotional problems, sleep difficulties, school notifications of behaviour issues and substance use within our analysis alongside weight status and general health. We expected that Aboriginal children exposed to caregiver-perceived racial discrimination would have an increased risk of negative mental health and related risk factors compared to children who have never been exposed.

Methods

Footprints in Time: The Longitudinal Study of Indigenous Children (LSIC) is a prospective national longitudinal cohort study of Aboriginal and Torres Strait Islander children designed to capture their socioeconomic and cultural background and track their development across several domains. This study has been described more fully elsewhere [37], however in brief, LSIC used a multi-stage clustered sampling method across 11 geographic sites to recruit a non-representative national sample of Aboriginal children across two age cohorts. LSIC aimed to recruit 5–10% of the total Australian population of Aboriginal children; recruitment targeted two age-based cohorts, children aged 0.5–2 years (younger cohort) and children aged 3.5–5 years (older cohort) at baseline (2008). The survey conducts annual face-to-face interviews with the study child, their primary caregiver and their teacher. The sample totalled 1671 children at baseline and a further 88 children were recruited at wave 2, leading to a sample of

up to 1759 children. To date, data for 10 waves have been collected with data from 8 waves currently available for analysis.

Participants

Participants in the current study include children from the first 8 waves of LSIC, comprising 1759 respondents aged 6 months to 12 years. The younger cohort included 1010 children aged 6 months to 9 years and the older cohort included 749 children aged 4–12 years. By wave 8, 1255 participants provided data (75% retention). At wave 1 the mean age was 2.4 years in the full sample ($SD = 1.6$; age range 0–6 years), 1.1 years in the younger cohort ($SD = 0.5$; age range 0–2 years) and 4.1 years in the older cohort ($SD = 0.5$; age range 3–6 years). By wave 8 the mean age was 9.3 years in the full sample ($SD = 1.5$; age range 7–12 years), 8.1 years in the younger cohort ($SD = 0.5$; age range 7–9 years) and 11.1 years in the older cohort ($SD = 0.5$; age range 10–12 years). There were 887 (50.4%) males and 872 (49.6%) females in the full sample, including 510 (50.5%) males and 500 (49.5%) females in the younger cohort and 377 (50.3%) males and 372 (49.7%) females in the older cohort. Overall, 1534 (87.2%) study children were Aboriginal, 117 (6.7%) were Torres Strait Islander and 108 (6.1%) were both Aboriginal and Torres Strait Islander.

Measures

Predictor variable

LSIC includes a carer-reported measure of racial discrimination asked at different waves throughout LSIC which differed by cohort. Exposure to racial discrimination was recorded from 3 to 8 years (waves 4–7) in the younger cohort and 4–11 years (waves 2–7) in the older cohort. Throughout waves 2–7 of LSIC, racism experienced by study children was reported by the primary carer in response to a question on whether the study child had been bullied or treated unfairly at preschool or school by children or adults because they were Aboriginal. Carers were able to indicate that the study child was bullied by other children, treated unfairly by adults or both. This measure was coded as a binary variable for analysis ('Yes, bullied [kids being mean to him/her]', 'Yes, treated unfairly [adult being mean to him/her]' or 'Yes, both bullied and treated unfairly' compared with 'No'). In wave 8 the structure of the question was changed slightly so that the primary carer was first asked whether the study child had been bullied or treated unfairly at school and if they responded positively to this question (study child was bullied, treated unfairly or both), they were then prompted to indicate whether this was because the study child is Aboriginal or Torres Strait Islander. For the purposes of this study, carer responses of 'always for this reason' or 'sometimes for

this reason' were categorised as a child that had been bullied or unfairly treated due to being Aboriginal or Torres Strait Islander.

Outcome variables

Health outcomes have been grouped into mental health and behaviour issues, substance use and physical health. All health outcomes were transcribed as binary variables for analysis. All outcomes were defined solely by data from wave 8, except sleep difficulties which was last asked in wave 7.

Mental health and behavioural issues Measures of socioemotional problems, sleep difficulties and behavioural issues at school were the indicators of mental health and behaviour examined within this study. We chose all measures related to mental health available within the LSIC after considering completeness and timing of data collection. The Strengths and Difficulties Questionnaire (SDQ) was used to measure socioemotional problems based on primary carer reports. The SDQ is a behavioural screening questionnaire designed for use with those aged 4–17 years to identify both positive and negative emotional and behavioural attributes. This tool has been found to have adequate construct validity in separate populations of Aboriginal children aged 4–17 years across Australia [38, 39]. The questionnaire includes 20 items associated with emotional symptoms, conduct problems, hyperactivity and peer problems which are summed to create a total difficulties score ranging from 0 to 40. Based on recommended cut-off scores, the raw total difficulties score was categorised into abnormal (17–40), borderline (14–46) and normal (0–13) [40]. Scores of 14–40 (combining borderline and abnormal) were used to indicate an increased risk of negative mental health in this study [41]. Study children were determined to be experiencing sleep difficulties if their primary carer indicated that they usually had trouble getting to sleep or staying asleep over the past month. Study children were considered to have behavioural issues at school if their primary carer indicated that they had been contacted by the study child's school due to behaving badly at school in the last twelve months.

Substance use Primary carers of study children from the child cohort were asked in wave 8 to give permission for interviewers to ask study children directly about whether they had ever tried cigarettes or alcohol. Responses were categorised as having used cigarettes or alcohol if they indicated 'yes, just a few puffs/yes, just a few sips', 'yes, a few times' or 'yes, lots of times' in response to the questions 'Have you ever tried cigarettes?' or 'Have you ever tried alcohol?'

Physical health Physical health outcomes included indicators of both general health and weight status. These indicators were chosen as they are implicated with mental health. General health encompasses both physical health and socioemotional wellbeing, while childhood psychosocial factors and mental health disorders have been associated with obesity both during childhood and in later life [42–44]. Study children were determined to have high general health when the primary carer indicated that the study child's health was generally 'excellent', 'very good' or 'good' and low general health when the response was 'fair' or 'poor'. Children's height and weight were translated into Body Mass Index (BMI)-for-age z-scores using the World Health Organisation (WHO) Anthro and WHO Anthro Plus programs. Children were classified as obese or underweight according to WHO and International Obesity Taskforce cut-off points for BMI-for-age z-scores [45].

Covariates

Factors considered to confound the association between racial discrimination and mental health were included as covariates in analytic models. These factors included geographic remoteness, community-level and family-level socioeconomic status, and the study child's age and gender.

Community variables Geographic characteristics in LSIC are reported using wave 1 data for the Level of Relative Isolation (LORI) measure, an index for remoteness levels within Australia developed based on an extension of the Accessibility/Remoteness Index of Australia. Five categories of isolation are derived; none (e.g. metropolitan areas), low, moderate, high and extreme (e.g. remote communities). Within LSIC, respondents in the 'high' and 'extreme' category have been collapsed into one item for 'high/extreme isolation' due to small sample size. The Index of Relative Indigenous Socioeconomic Outcomes (IRISEO) was used as a proxy measure of community-level socio-economic outcomes. IRISEO is a composite, rank order variable derived from information on the employment, education, income and housing characteristics of Aboriginal peoples from Indigenous Areas across Australia [46]. IRISEO data from wave 1 of LSIC has been categorised into quintiles for this analysis.

Primary carer variables All LSIC primary carers in waves 1 and 2, alongside all new primary carers in waves 3 and 4, were asked to indicate their highest completed qualification. This measure was coded into a four-item variable: university-level education, certificate or post-school qualifications, completion of Year 11 to Year 12 or equivalent, and lower levels of completion. A binary

'financial difficulty' variable was defined if they answered, 'We run out of money before payday', 'We are spending more money than we get', 'We have just enough money to get us through to the next pay day' or 'There's some money left over each week but we just spend it'; a response of 'We can save a bit every now and then' or 'We can save a lot' were coded as no financial difficulty. Responses taken at wave 1 are included in this analysis. In wave 3, all primary carers were asked whether there had been times in the last five years when they did not have any place to live; 'prior experience of homelessness' was indicated for those that responded 'Yes, many times', 'Yes, a few times' or 'Yes, once'.

Child variables Each study child's primary carer reported the study child's age and gender at each wave. Child age at wave 8 was collapsed into three categories: 7–8, 9–10 and 11–12 years.

Data analysis

Chi-squared was used to examine bivariate associations and Kendall's Tau was used to assess potential collinearities between perceived racism and the covariates. Following this, two logistic regression models, using the generalised linear mixed modelling (GLMM) framework, were defined and fitted: a model adjusted for child age and gender (model 1) and a fully adjusted model (model 2) including child age and gender, geographic remoteness, area-level socioeconomic status and family-level socioeconomic status (primary carer reported highest education completed, financial difficulty and prior homelessness). A randomised cluster variable was included within LSIC to identify respondents living in close geographic proximity [45], this variable was developed to overcome bias introduced by the sampling method; this was the grouping variable used in the random effect modelling. Models were fitted using PROC GLIMMIX in SAS (version 9.4, SAS Institute Inc., Cary, NC, USA, 2002–12) with compound symmetry as the covariance structure. Adaptive Gaussian quadrature methods were chosen as they have been shown to perform well with excellent coverage probabilities and minimal bias when estimating the fixed effects of a GLMM for binary outcome clustered data where there are sufficient numbers of observations per random effect [47].

Missing data

Non-responses (missing data) were present in the predictor, outcome and covariate variables. As a sensitivity analysis, multiple imputation was used to determine the influence of missing data on parameter estimates. Two auxiliary variables (cohort and number of major events experienced in the last year) were used to assist with the prediction of missing data. Multilevel multivariate normal

imputation with joint modelling was then carried out, generating 100 imputed datasets. Adaptive rounding [48] was pursued on imputed datasets as model variables were binary or categorical, however this did not return realistic data in all cases. Instead, linear mixed effects models were run on unrounded data across all imputed datasets, and combined parameter estimates were compared against the complete cases analysis (see Additional file 1). These analyses were conducted using the 'mitml' package [49] in R (Version 1.2.1335 –© 2009–2019).

Results

One in five (20.4%) study children from LSIC between the ages of 4–11 years experienced at least one exposure to caregiver-perceived racial discrimination at school from either adults or peers. Close to one in six (17%) children in LSIC aged 7–12 were found to be at an increased risk of negative mental health or had behavioural issues at school reported to their primary carer, while 21% were reported to have experienced difficulty sleeping. Around one in twenty (4%) children were found to be underweight by wave 8 and 18% were obese, while 3% were identified as having fair or poor global health. Among responding children aged 10–12 years, 3% reported that they had tried smoking and 11% had tried alcohol.

After adjustment for all study variables, study children living in the most disadvantaged areas (IRISEO; quintile 1) had twice the odds of being exposed to caregiver-perceived racial discrimination at school compared with those living in the most advantaged areas (OR 2.1; 95% CI: 1.0–4.3) (Table 1). A similar effect size (OR 2.3; 95% CI: 1.4–3.7) was evident for children whose primary carer had experienced homelessness in the past five years relative to those with no experiences of homelessness. No other socio-demographic factors were associated with caregiver-perceived racial discrimination exposure.

Overall, positive associations were seen between exposure to caregiver-perceived racism and mental health, behavioural issues and substance use (Table 2). In fully adjusted models, children exposed to perceived racial discrimination had around twice the risk for negative mental health, sleep difficulties, behaviour issues at school and trying alcohol (ORs ranging 1.8 to 2.0), although estimates for trying alcohol were not statistically significant (95% CI: 0.8–4.2). While estimates for children trying cigarettes were imprecise, these children were at seven times increased risk of trying cigarettes with racism exposure in the fully adjusted model (95% CI: 1.1–45.0).

Positive associations were found between caregiver-perceived racial discrimination and physical health outcomes, with the exception of general health (Table 2). After adjustment for child age and gender, study children had 1.8

times the risk of experiencing obesity (95% CI: 1.2–2.5)—with a similar odds ratio in the fully adjusted model (OR: 1.7; 95% CI: 1.1–2.5)—compared with children with no exposure. A moderate effect for being underweight was also observed in the fully adjusted model (OR: 1.6; 95% CI: 0.7–3.9), although the effect estimate was not statistically significant. A negative association was found for general health though this did not reach significance.

Socio-demographic factors were also included in logistic regression models with each health outcome. After adjustment for all covariates, the following covariates and health outcomes were found to be significantly associated. Compared to males, females had lower odds for negative mental health (OR: 0.6; 95% CI: 0.4–0.9), behaviour issues at school (OR: 0.2; 95% CI: 0.1–0.3) and having tried alcohol (OR: 0.2; 95% CI: 0.1–0.4). Children living in the most disadvantaged areas had lower odds of obesity compared to those living in the most advantaged areas (OR: 0.2; 95% CI: 0.1–0.9). Living in areas of moderate remoteness (i.e. regional towns) was associated with lower odds of sleeping difficulties (OR: 0.3; 95% CI: 0.1–0.7) compared to living in the least remote areas (i.e. cities). Children at an older age (11–12 years) were significantly more likely to have negative general health than those aged 7–8 years (OR: 2.4; 95% CI: 1.0–6.0). Children had decreased odds of socioemotional difficulties where primary carers had completed Year 11 or 12 (OR: 0.6; 95% CI: 0.4–0.9) or university (OR: 0.3; 95% CI: 0.1–0.9) compared to primary carers who had completed Year 10 education or less.

Analysis using imputed datasets resulted in pooled estimates for each outcome that were similar to estimates from complete case analysis. Pooled estimates fell within confidence intervals from complete case analysis and confidence intervals from both analyses overlapped considerably. All significant associations between racial discrimination and health outcomes found in complete case analysis were also found in analysis of imputed datasets.

Discussion

This study sought to broadly assess the effects of racial discrimination exposure on mental health in Aboriginal children. We found that Aboriginal children exposed to racial discrimination between ages 4–11 were at higher risk of negative mental health and related behavioural and physical outcomes compared to children without racism exposure. Children with caregiver-perceived racism exposure had around twice the risk of negative mental health, sleep difficulties, behavioural issues at school and obesity.

In a novel finding, we saw that Aboriginal children exposed to racism had seven times the risk of trying cigarettes at ages 10–12 compared to unexposed children.

Table 1 Multivariate associations between caregiver-perceived racial discrimination and selected socio-demographic characteristics in Aboriginal children

Variables	% (n)	Child ever exposed to being bullied or treated unfairly because they were Indigenous		
		Adjusted OR ^a	95% CI	P-value
Gender of child				
Male	50.4 (887)	Ref		
Female	49.6 (872)	1.09	0.80–1.48	0.61
Age of child (years)				
7–8	46.8 (823)	Ref		
9–10	14.2 (249)	0.91	0.56–1.47	0.73
11–12	39.1 (687)	1.13	0.82–1.56	0.32
Level of relative isolation				
None	26.0 (433)	Ref		
Low	49.4 (822)	0.75	0.50–1.14	0.20
Moderate	15.2 (253)	0.88	0.48–1.59	0.77
High	9.4 (157)	1.21	0.63–2.31	0.58
Index of relative Indigenous socioeconomic outcomes				
Quintile 5 – most advantaged	14.2 (237)	Ref		
Quintile 4	14.7 (245)	1.04	0.60–1.82	0.87
Quintile 3	41.3 (690)	1.09	0.63–1.86	0.80
Quintile 2	16.9 (282)	1.52	0.84–2.75	0.17
Quintile 1 – most disadvantaged	13.0 (217)	2.10	1.03–4.27	0.04
Primary carer highest education completed				
Never attended school to Year 10	42.6 (649)	Ref		
Year 11/12	33.5 (510)	1.26	0.88–1.80	0.18
Diploma or Certificate	18.1 (275)	1.44	0.94–2.19	0.09
University	5.8 (89)	1.26	0.63–2.55	0.45
Financial difficulty				
Save a lot/save a bit every now and then	35.5 (569)	Ref		
Some money left/just enough to get through	46.5 (745)	1.32	0.93–1.86	0.13
Spending more than we get/run out of money	18.1 (290)	1.46	0.85–2.07	0.21
Primary carer experienced homelessness				
No	91.3 (1279)	Ref		
Yes	8.7 (122)	2.30	1.42–3.71	< 0.001

^aOdds ratios are adjusted for all variables that appear in the table

The strong, albeit imprecise, effect of racial discrimination on trying cigarettes found in our study is reflected in longitudinal studies conducted in both the United States and United Kingdom examining childhood exposure to racism as a predictor of later smoking behaviour, though both studies measured smoking behaviour in adulthood (21–25 years) [50, 51]. Studies in child (6–11 years) and adolescent (12–18 years) populations are broadly mixed, with around half of studies finding a significant positive association between racism and smoking [12]. While our study focused on racism exposure during childhood, the positive associations we found between racism and both trying cigarettes and alcohol

reflect those seen between trajectories of racial discrimination throughout adolescence and later risk of substance use (encompassing alcohol, tobacco and marijuana use) [52–55]. It is likely that racism exposure, substance use and mental health disorders are interrelated as the onset of mental health disorders in childhood known to be strongly associated with racial discrimination, such as anxiety and conduct disorder, is predictive of later substance use [56] and substance use disorder [57]. The association between racial discrimination and cigarette smoking in Aboriginal children warrants further examination, particularly in older cohorts and longitudinally, to fully assess the nature and size of this association by age and over time.

Table 2 Models examining association between caregiver-perceived racial discrimination and mental health related outcomes in Aboriginal children

	Model 1 ^b			Model 2 ^c		
	Adjusted OR	95% CI	P-value	Adjusted OR	95% CI	P-value
Negative mental health						
No exposure	Ref			Ref		
Ever exposed	1.66	1.17–2.36	0.01	1.99	1.32–2.99	0.001
Sleep difficulties						
No exposure	Ref			Ref		
Ever exposed	1.85	1.31–2.63	< 0.001	2.00	1.35–2.96	< 0.001
Behaviour issues at school						
No exposure	Ref			Ref		
Ever exposed	1.68	1.15–2.44	0.01	1.88	1.21–2.91	0.01
Tried cigarettes ^a						
No exposure	Ref			Ref		
Ever exposed	4.74	1.27–17.69	0.02	7.05	1.10–45.02	0.04
Tried alcohol ^a						
No exposure	Ref			Ref		
Ever exposed	1.46	0.71–3.02	0.30	1.81	0.78–4.20	0.17
General health						
No exposure	Ref			Ref		
Ever exposed	0.71	0.26–1.94	0.50	0.70	0.23–2.12	0.53
Underweight						
No exposure	Ref			Ref		
Ever exposed	1.76	0.84–3.69	0.14	1.61	0.66–3.93	0.29
Obesity						
No exposure	Ref			Ref		
Ever exposed	1.76	1.23–2.52	0.002	1.68	1.12–2.53	0.01

^aChild cohort only^bModel adjusted for child age and gender^cModel adjusted for child age and gender, geographic remoteness, area-level socioeconomic status and family-level socioeconomic status (primary carer reported highest education completed, financial difficulty and prior homelessness)

We further confirmed the broad reaching effects of racial discrimination on mental health through the strong and consistent associations found between racism and socioemotional, sleep and behavioural difficulties in this cohort of Aboriginal children. Strong associations between racism and negative mental health and behavioural issues during this developmental period are supported in the literature, with positive associations found in children aged 6–11 years [12] and under 13 years [10]. Significant associations have also been found between racial discrimination and sleep difficulties both in cross-sectional [58, 59] and longitudinal studies [60, 61], although these are predominantly based on adolescent and adult populations [62]. Behavioural problems, negative mental health and sleep difficulties are known to be associated both concurrently and longitudinally [63–65]. Racial discrimination exposure may contribute to the development of these related factors as a psychosocial

stressor by initiating the emotional and psychological responses which characterise negative mental health symptomatology [66]. Findings from this study underscore the reality that racial discrimination is a central social determinant of the mental health of Aboriginal children. Interventions, policies and practices designed to recognise and address racial discrimination in this population must be considered by the programs, services and institutions which aim to support the mental health and wellbeing of Aboriginal children, particularly within the healthcare and education sectors.

Changes in weight status found in Aboriginal children exposed to racism reflect those seen for socioemotional, behavioural and substance use outcomes within our analysis. We found that children exposed to caregiver-perceived racial discrimination had an increased risk of obesity and being underweight, though estimates for being underweight did not reach significance. The positive

association found between perceived racial discrimination and obesity in our study is supported by findings from both child [27] and adolescent [67] populations, though the majority of studies in child populations have found no association [12]. This may be due in part to the complexity of processes underlying the association between physiological responses to stress and obesity or metabolic syndrome [68–70]. Yet there is evidence that mental health plays an important role in mediating and modifying the effect of racial discrimination on BMI during adolescence [67, 71]. One longitudinal study reported an indirect association between racial bullying and increased BMI through greater negative emotional symptoms [67] while another found that high protective emotional support from parents attenuated BMI in adolescents who perceived racism [71]. While our findings confirm a direct association between racism and weight status, this may be complicated by unexamined mediating or moderating pathways. Future studies should consider potential mediating and moderating factors in the association between racial discrimination and weight status in Aboriginal children to better clarify the function of mental health within this relationship.

Although this study extended previous research on the association between racism and the mental health of Aboriginal children, our findings should be interpreted in light of several limitations. The instrument used to measure racism exposure in this study was based on the perceptions of primary carers rather than self-reported by study children. Although primary carers reported on the experiences of study children to the best of their knowledge, these reports may not necessarily reflect the perceptions of racism in these children. Additionally, the racism exposure instrument did not specify a timeframe for racism exposure or quantify the frequency or severity of racism exposure. These factors reduce the sensitivity of this instrument as children with many different experiences with racism were unable to be distinguished from one another. Finally, despite the strength of the LSIC as a prospective cohort study with strong community involvement, the sampling design was non-random due to practical and logistic considerations in site selection [72]. As a result, the sample of study children in LSIC is not representative of the population of Aboriginal children across Australia. However, the sites selected for the study were intended to reflect the geographic distribution of Aboriginal children within Australia and the varied environments in which these children live [45].

Conclusions

Exposure to racial discrimination in Aboriginal children increases the risk for a spectrum of interrelated psychological, behavioural and physiological factors encompassed by mental health. This includes an increased risk

of socioemotional and behavioural difficulties, changes in weight status and, in a novel result, substance use. Findings from this study contribute to the limited body of evidence surrounding the contribution of racial discrimination towards mental health and wellbeing outcomes in Aboriginal children. Initiatives to reduce the prevalence of racism may act to simultaneously attenuate the risk for a range of factors related to mental health. These initiatives must be driven by the Aboriginal populations involved (from inception to delivery) to ensure they are culturally relevant and draw from Aboriginal voices and paradigms [21]. Aboriginal adults have identified that addressing racism involves both internal and external processes, including distancing oneself from racism and strengthening a sense of identity and pride in being Aboriginal while emphasising the need for society to acknowledge racism and challenge racist attitudes and behaviours [20]. Given that racial discrimination is an ongoing public health concern for Australian Aboriginal children, school-based interventions informed by the above parameters would be well placed to address the effects of this critical social determinant and target a reduction in its prevalence.

Supplementary information

Supplementary information accompanies this paper at (<https://doi.org/10.1186/s12939-019-1045-8>).

Additional file 1: Comparison of estimates from imputation and complete case analysis. (DOCX 16 kb)

Abbreviations

BMI: Body Mass Index; CI: Confidence Interval; GLMM: Generalised Linear Mixed Model; IRISEO: Index of Relative Indigenous Socioeconomic Outcomes; LORI: Level of Relative Isolation; LSIC: Longitudinal Study of Indigenous Children; OR: Odds Ratio; SD: Standard Deviation; SDQ: Strengths and Difficulties Questionnaire; SEIFA: Socioeconomic Index for Areas; SES: Socioeconomic Status; WHO: World Health Organisation

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Authors' contributions

LC and CCJS conceived of and designed the study. LC conducted the primary statistical analysis and imputation analysis. MNC, CCJS and SZ advised on interpretation of data. LC wrote the initial drafts of the manuscript. All authors read, revised and approved the final manuscript.

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Availability of data and materials

The dataset analysed in this study is available, on request, from the Australian Government Department of Social Services via the Australian Data Archive Dataverse platform: <https://dataverse.ada.edu.au/dataverse/ncld>.

Ethics approval and consent to participate

Ethics approval for the LSIC was provided by the Australian Commonwealth Department of Health Departmental Ethics Committee and from state and territory Ethics Committees. The current analysis was approved by the Western Australian Aboriginal Health Ethics Committee and the University of Western Australia Human Research Ethics Committee.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Article

Racial discrimination and the health and wellbeing of Aboriginal and Torres Strait Islander children: Does the timing of first exposure matter?

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ABSTRACT

Racial discrimination has been observed to negatively impact on the health of Aboriginal and Torres Strait Islander children, although evidence surrounding periods of greater vulnerability to the stressor of racism have not yet been explored in this population. We compared first exposure to interpersonal racism at either ages 4–5 years or 7 years with no exposure to examine the influence of sensitive periods of racism exposure on mental health and physiological outcomes during middle childhood (7–12 years).

The study cohort comprised 1,759 Aboriginal and Torres Strait Islander children aged 4–12 years from waves 2–8 (2009–2015) of the Footprints in Time: The Longitudinal Study of Indigenous Children (LSIC) dataset. Multilevel logistic regression was used in all analysis.

We observed a larger effect (OR: 2.8; 95% CI: 1.4–5.4) for negative mental health with first exposure at 4–5 years compared to 7 years (OR: 2.1; 95% CI: 1.2–3.6), referenced to children with no exposure. Effect sizes were similar in both exposure groups for the significantly increased risk of sleep difficulties, while a stronger adverse effect on behavioural issues was found at 7 years (OR: 2.2; 95% CI: 1.3–4.0) relative to 4–5 years (OR: 1.7; 95% CI: 0.8–3.7). No significant associations were found with general health, obesity or being underweight.

This study generates new evidence surrounding sensitive periods of exposure to racism in Aboriginal and Torres Strait Islander children. A pattern of consistently greater adverse effects on mental and physiological health was not observed with first exposure at 4–5 compared to 7 years, although initial evidence indicates that first exposure to racism at these ages increases the likelihood of negative mental health relative to children without racism exposure. Longitudinal data extending from earlier to later developmental periods will allow further investigations into the presence of sensitive periods of exposure to racism in these children.

Introduction

Racism is a modifiable and direct determinant of negative health outcomes which contributes to population health disparities (Braveman, Egerter, & Williams, 2011; Braveman et al., 2017; Brondolo, Gallo, & Myers, 2009; Gee, Walsemann, & Brondolo, 2012; Krieger, Jahn, & Waterman, 2017; Sanders-Phillips, Settles-Reaves, Walker, & Brownlow, 2009; Williams & Mohammed, 2009), including those observed between Indigenous and non-Indigenous populations worldwide (King, Smith, & Gracey, 2009; Paradies, 2018; Paradies, Harris, & Anderson, 2008). Despite this, developing effective public health responses to racism remains an ongoing challenge (Came & Griffith, 2018; Ford &

Airhihenbuwa, 2010; Thomas, Quinn, Butler, Fryer, & Garza, 2011). Targeted responses are particularly vital during childhood as the early years are understood to present a critical period of health vulnerability resulting from adversity and stress (Maggi, Irwin, Siddiqi, & Hertzman, 2010; McEwen & Gianaros, 2010; Shonkoff, Boyce, & McEwen, 2009). The stressor of racial discrimination has been shown to generate greater adverse effects on health during this early developmental period compared with exposure during adolescence or adulthood (Benner et al., 2018; Lee & Ahn, 2013; Schmitt, Branscombe, Postmes, & Garcia, 2014). While interventions to reduce prejudice in early childhood have shown some promise, effective strategies to address this complex issue remain elusive (Aboud et al., 2012). Examining developmental trends in the

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health risk of racism among Indigenous children can potentially inform the content and timing of important public health initiatives to address this critical stressor in vulnerable population groups.

The aetiological pathways between racism and health outcomes have been closely examined, although predominantly in cross-sectional studies of adult populations (Ben, Cormack, Harris, & Paradies, 2017; Paradies et al., 2015). Interpersonal racism is known to have a significantly negative impact on myriad health outcomes, with stronger and more consistent effects reported for mental health as opposed to physical health (Krieger, 2014; Pachter & Coll, 2009; Paradies, 2006; Paradies et al., 2015; Pascoe & Richman, 2009; Priest et al., 2013; Schmitt et al., 2014; Williams & Mohammed, 2009). Racism impacts health and wellbeing through initiating physiological dysregulation, maladaptive psychological responses or changes in health behaviour such as disturbed sleep patterns or substance use (Paradies, 2006; Paradies et al., 2015; Priest et al., 2013). Longitudinal studies have shown weaker associations between racism and negative mental health outcomes compared with cross-sectional studies, suggesting that the impact of racism on negative mental health may attenuate over time (Paradies et al., 2015; Schmitt et al., 2014). While this provides perspective on the duration of racism's impact, it does not account for the age of study populations or the relative impact of racism exposure during different developmental periods. Studies that examine how this association may differ according to the age of first exposure to racism in a longitudinal cohort of children have not yet taken place.

Children have demonstrated the ability to conceptualise and perpetuate racial prejudice, recognising discriminatory behaviour from age 5 years (Brown & Bigler, 2005) and enacting prejudice from ages 2–4 years, with a peak in middle childhood (5–7 years) (Raabe & Beelmann, 2011). More specifically, in the context of Australian Aboriginal and Torres Strait Islander (hereafter after referred to as 'Aboriginal') groups, children aged 8–12 years have demonstrated an awareness of racist acts and described the onward impact of these acts on their health and wellbeing (Priest, Thompson, Mackean, Baker, & Waters, 2016). The occurrence of racism in the lives of Aboriginal children is well documented (Bodkin-Andrews et al., 2017; Priest, King, Becares, & Kavanagh, 2016; Priest, Paradies, Stevens, & Bailie, 2010; Priest, Paradies, Stewart, & Luke, 2011; Shepherd, Li, Cooper, Hopkins, & Farrant, 2017; Zubrick et al., 2005) and evidence has begun to be generated on the negative impact of racism on Aboriginal child health and wellbeing outcomes (Shepherd et al., 2017). Despite this, no studies have yet examined whether sensitive periods of exposure to racism are present for Aboriginal children – that is, whether these children are more vulnerable to the adverse health effects of racism exposure during certain developmental periods. This is partly due to the paucity of datasets able to examine the timing of exposures and outcomes across childhood, including prospective cohort studies.

This study undertakes one of the first examinations of the impact of timing of exposure to racial discrimination (Adam et al., 2015; Benner & Kim, 2009; Cuevas et al., 2019; Ford, Hurd, Jagers, & Sellers, 2013; Hou, Kim, Wang, Shen, & Orozco-Lapray, 2015), using a prospective national longitudinal cohort study of Aboriginal children aged 4–12 years. We expected that Aboriginal children first exposed to direct racial discrimination at an early age (4–5 years) would have an increased risk of negative physical and mental health outcomes relative to both those first exposed during middle childhood (7 years) and those never exposed.

Methods

Footprints in Time: The Longitudinal Study of Indigenous Children (LSIC) is a prospective national longitudinal cohort survey of Aboriginal and Torres Strait Islander children designed to track their development in the context of their sociodemographic background (Thurber, Banks, & Banwell, 2015). LSIC used a multi-stage clustered sampling method across 11 sites to recruit a non-representative national sample of

Aboriginal children across two age cohorts. LSIC aimed to recruit 5–10% of the total Australian population of Aboriginal children aged 0.5–2 years in the 'younger cohort' and 3.5–5 years in the 'older cohort' at baseline (2008). The survey conducts annual face-to-face interviews with the study child and their primary caregiver. The sample came to 1671 children at baseline, with a further 88 children recruited at wave 2 culminating in a total sample of up to 1759 children. Full details of the rationale, sampling, recruitment, and data collection have been reported elsewhere (Australian Government Department of Social Services, 2018).

Participants

Study participants include children aged 6 months to 12 years from the first 8 waves of LSIC. From a total sample of 1,759, 1255 children remained by wave 8 (75% retention). The sample is broken into a younger and older cohort, with 1010 respondents in the younger cohort and 749 in the older cohort.

Measures

Predictor variable

Throughout waves 2–7 of LSIC, primary carers were asked whether the study child had been bullied or treated unfairly at preschool or school by children or adults because they are Aboriginal. This direct racism measure was coded as a binary variable for analysis ('Yes, bullied [kids being mean to him/her]', 'Yes, treated unfairly [adult being mean to him/her]' or 'Yes, both bullied and treated unfairly' compared with 'No'). In wave 8 the structure of the question was changed slightly so that the primary carer was first asked whether the study child had been bullied or treated unfairly at school and if they responded positively to this question (study child was bullied, treated unfairly or both), they were then prompted to indicate whether this was because the study child is Aboriginal or Torres Strait Islander. Carer responses of 'always for this reason' or 'sometimes for this reason' were categorised as a child that had been bullied or unfairly treated due to being Aboriginal or Torres Strait Islander. The mean age of children at each wave in each cohort was then used to assign an age at which the direct racism measure was first responded to. First exposure was recorded at 4, 5 and 7 years; this was then collapsed into two exposure age categories, 4–5 years and 7 years. First exposure was limited to 4–7 years to ensure minimal overlap with the age range at which outcome variables were assessed (7–12 years). First exposure was recorded for children whose primary carer reported direct racism exposure at each age, excluding those who reported racism exposure at any previous age.

Outcome variables

Health outcomes included within this analysis were categorised as either mental health and behavioural issues or physical health. All outcomes were categorised into binary variables for analysis. All outcomes were taken from wave 8 except sleep difficulties which was last asked in wave 7.

Mental health and behavioural issues. Mental health and behavioural outcomes included measures of child mental health, sleep difficulties and behavioural issues at school. Child mental health status was determined by primary carer responses to the Strengths and Difficulties Questionnaire (SDQ), a measure of emotional and behavioural difficulties in children aged 4–17 years which provides a score ranging from 0 to 40. Total difficulty scores were categorised into abnormal (17–40), borderline (14–16) and normal (0–13) based on cut-off scores derived from community-based samples of children (Goodman, 1997). In this study, scores of 14–40 (combining borderline and abnormal) were used to indicate an increased risk of mental health problems. Study children were considered to be experiencing sleep difficulties when the primary

carer reported they usually had trouble getting to sleep or staying asleep over the past month. Study children were deemed to have behavioural issues at school where primary carers reported that the school had contacted them because their child had behaved badly at school in the last twelve months.

Physical health. Physical health outcomes included indicators of general health, obesity and being underweight. General health was coded as positive if the study child's health was indicated to be 'excellent', 'very good' or 'good' by the primary carer and coded as negative where their health was indicated to be 'fair' or 'poor'. Children's height and weight were translated into Body Mass Index (BMI)-for-age z-scores and then classified as obese or underweight based on WHO guidelines. Underweight was indicated by BMI-for-age z-scores below 2. Obesity was indicated by BMI-for-age z-scores above 2 (Australian Government Department of Social Services, 2018).

Covariates

Community variables. The Level of Relative Isolation (LORI) measure was used as an index for remoteness levels within Australia. LORI uses five categories of isolation; none (e.g. metropolitan areas), low, moderate, high and extreme (e.g. remote communities). Within LSIC, respondents in the 'high' and 'extreme' categories have been collapsed into one item – 'high/extreme isolation' – due to small sample size. The Index of Relative Indigenous Socioeconomic Outcomes (IRISEO) was used as an indicator of community level socio-economic outcomes. IRISEO is a ranked scale based on the employment, education, income and housing characteristics of Aboriginal peoples from Indigenous Areas across Australia (Biddle, 2009). IRISEO data from wave 1 of LSIC has been refined into quintiles for this analysis.

Primary carer variables. LSIC primary carers were asked to indicate the highest qualification they had completed. This measure was coded into a four-item variable including university-level education, certificate or post-school qualifications, completion of Year 11 to Year 12 or equivalent, and Year 10 completion or less. A six-item subjective rating of the family financial situation was collapsed into a three-item variable for analysis ('We run out of money before payday/We are spending more money than we get', 'We have just enough money to get us through to the next pay day/There's some money left over each week but we just spend it' and 'We can save a bit every now and then/We can save a lot'). Prior experience/s of homelessness were recorded from all primary carers in wave 3 based on whether there had been any times in the last five years when they did not have a place to live; homelessness was indicated for those that responded 'Yes, many times', 'Yes, a few times' or 'Yes, once'.

Child variables. Primary carers reported the study child's age and gender at each wave. Child age at wave 8 was collapsed into three categories: 7–8, 9–10 and 11–12 years.

Data analysis

Ordinal logistic regression was used to determine independent associations between the covariates and age of first exposure to racism. Two logistic regression models were then defined and fitted using the generalised linear mixed modelling (GLMM) framework to determine associations between age of first exposure to racism and health outcomes: the first model adjusted for child age and gender (model 1); the fully adjusted model (model 2) included child age and gender, geographic remoteness, area-level socioeconomic status and family-level socioeconomic status (primary carer reported highest education completed, financial difficulty and prior homelessness). A randomised cluster variable was developed within LSIC to identify respondents

living in close geographic proximity and to overcome bias introduced by the sampling method (Australian Government Department of Social Services, 2018). This variable was used as the grouping variable in random effects modelling. Models were fitted using PROC GLIMMIX in SAS (version 9.4, SAS Institute Inc., Cary, NC, USA, 2002–12) using compound symmetry as the covariance structure. Adaptive Gaussian quadrature methods were chosen as they have been shown to perform well with minimal bias when estimating the fixed effects of a GLMM for binary outcome clustered data where there are sufficient numbers of observations per random effect (Capanu, Gönen, & Begg, 2013).

Missing data

The predictor, outcome and covariate variables all contained a proportion of non-responses (missing data). Multiple imputation was used as a sensitivity analysis to determine the influence of missing data on parameter estimates. Cohort (younger or older) and number of major events experienced in the last year were used as auxiliary variables to assist with the prediction of missing data. Multilevel multivariate normal imputation with joint modelling was then conducted, generating 100 imputed datasets. Adaptive rounding was pursued on imputed datasets because model variables were either binary or categorical, although this did not return realistic data in all cases. Linear mixed effects models were then run on unrounded imputed data and pooled parameter estimates were compared against estimates from complete case analysis (see Appendix A). These analyses were conducted using the 'mitml' package (Grund, Robitzsch, & Lüdtke, 2018) in R studio (Version February 1, 1335 - © 2009–2019).

Ethics

Ethics approval for the LSIC was provided by the Australian Commonwealth Department of Health Departmental Ethics Committee and from state and territory Ethics Committees. The current analysis was approved by the Western Australian Aboriginal Health Ethics Committee and the University of Western Australia Human Research Ethics Committee.

Results

In the full sample the mean age of respondents was 2.4 years (SD: 1.6; age range: 0–6 years) at wave 1 and 9.3 years (SD: 1.5; age range: 7–12 years) by wave 8. Overall, 887 (50.4%) study children were male and 872 (49.6%) were female, 1534 (87.2%) study children were Aboriginal, 117 (6.7%) were Torres Strait Islander and 108 (6.1%) were both Aboriginal and Torres Strait Islander. First exposure to racial discrimination at 4–5 years was reported for 6.9% of our in-scope study sample and first exposure at 7 years was reported for 8.3% of children. By 7–12 years, 17% of study children were reported to have negative mental health or behavioural issues at school, 18% of children were obese, 4% were underweight and 3% of children were identified as having fair or poor general health. At 6–11 years, 21% of children were reported to have experienced difficulty sleeping.

After adjustment for all covariates, having a primary carer experience homelessness in the previous five years increased the odds of being first exposed to racism at age 7 by 1.9 times compared with being first exposed at age 4–5 and never being exposed (OR: 1.9; 95% CI: 1.1–3.2) (Table 1). No other sociodemographic factors increased the odds of first exposure to racial discrimination.

Overall, first exposure to racial discrimination at 4–5 years did not consistently increase the risk of mental and physical health outcomes relative to children first exposed to racism at age 7 (Table 2). Positive associations were observed between first exposure to direct racial discrimination at 4–5 and 7 years and each outcome related to mental health. In the fully adjusted model, statistically significant effects for negative mental health and sleep difficulties were seen in study children

Table 1

Distribution and multivariate associations between age of first exposure to direct racial discrimination and selected socio-demographic characteristics in Aboriginal children.

Variables	Age of first exposure to bullying or unfair treatment due to child being Indigenous			
	4–5 years % (n)	7 years % (n)	No exposure % (n)	Adjusted OR (95% CI)
Gender of child				
Male	45.2 (47)	48.4 (61)	51.3 (657)	Ref
Female	54.8 (57)	51.6 (65)	48.8 (625)	1.11 (0.79–1.57)
Age of child (years)				
7–8	41.4 (43)	54.8 (69)	37.7 (483)	-
9–10	10.6 (11)	16.7 (21)	13.9 (178)	-
11–12	48.1 (50)	28.6 (36)	48.4 (621)	-
Level of relative isolation				
None	25.6 (23)	38.0 (46)	26.7 (325)	Ref
Low	35.6 (32)	40.5 (49)	50.8 (619)	0.79 (0.50–1.26)
Moderate	25.6 (23)	9.9 (12)	13.5 (165)	1.08 (0.56–2.06)
High	13.3 (12)	11.6 (14)	9.0 (110)	1.04 (0.49–2.18)
Index of relative Indigenous socioeconomic outcomes				
Quintile 5 – most advantaged	16.5 (15)	21.3 (26)	14.3 (175)	Ref
Quintile 4	14.3 (13)	13.1 (16)	16.0 (195)	0.71 (0.39–1.30)
Quintile 3	28.6 (26)	36.9 (45)	42.0 (513)	0.74 (0.41–1.31)
Quintile 2	15.4 (14)	15.6 (19)	16.1 (197)	0.90 (0.47–1.72)
Quintile 1 – most disadvantaged	25.3 (23)	13.1 (16)	11.6 (142)	1.56 (0.74–3.30)
Primary carer highest education completed				
Never attended school to Year 10	33.3 (33)	42.5 (51)	43.5 (504)	Ref
Year 11/12	43.4 (43)	31.7 (38)	32.2 (374)	1.32 (0.89–1.96)
Diploma or Certificate	17.2 (17)	22.5 (27)	18.0 (209)	1.39 (0.87–2.22)
University	6.1 (6)	3.3 (4)	6.3 (73)	0.87 (0.37–2.06)
Financial difficulty				
Save a lot/save a bit every now and then	31.8 (28)	29.7 (35)	36.5 (429)	Ref
Some money left/just enough to get through	39.8 (35)	50.0 (59)	46.1 (541)	1.19 (0.81–1.76)
Spending more than we get/run out of money	28.4 (25)	20.3 (24)	17.4 (204)	1.34 (0.83–2.18)
Primary carer experienced homelessness				
No	86.8 (72)	85.6 (95)	92.6 (1011)	Ref
Yes	13.3 (11)	14.4 (16)	7.4 (81)	1.87 (1.10–3.18)

Odds ratios are adjusted for all variables that appear in the table excluding child age.

with first exposure to direct racism at 4–5 years and 7 years compared with those not exposed to racism. Risk for negative mental health was higher for children exposed at 4–5 years (OR: 2.8; 95% CI: 1.4–5.4) compared with those exposed for the first time at 7 years (OR: 2.1; 95% CI: 1.2–3.6). Study children were found to be at similar risk of sleep difficulties at 6–11 years when exposed to racism at 4–5 years (OR: 2.1; 95% CI: 1.1–4.3) and 7 years (OR: 2.2; 95% CI: 1.4–3.7) compared to those not exposed to racism. Study children with first exposure to direct racism at 7 years had 2.2 times the risk of behaviour issues at school (95% CI: 1.3–4.0; fully adjusted model) when compared with those not

Table 2

Multivariate models examining association between age of first exposure to direct racial discrimination and mental and physical health outcomes in Aboriginal children.

	Model 1		Model 2	
	β	Adjusted OR (95% CI)	β	Adjusted OR (95% CI)
Mental health				
No exposure	Ref		Ref	
First exposure age 4–5 years	0.54	1.72 (0.96–3.08)	1.01	2.76 (1.42–5.40)
First exposure age 7 years	0.57	1.77 (1.08–2.89)	0.75	2.11 (1.23–3.62)
Sleep difficulties				
No exposure	Ref		Ref	
First exposure age 4–5 years	0.35	1.43 (0.77–2.65)	0.75	2.13 (1.06–4.25)
First exposure age 7 years	0.74	2.09 (1.31–3.32)	0.79	2.20 (1.33–3.66)
Behaviour issues at school				
No exposure	Ref		Ref	
First exposure age 4–5 years	0.46	1.58 (0.84–2.96)	0.52	1.68 (0.77–3.67)
First exposure age 7 years	0.56	1.74 (1.04–2.92)	0.80	2.22 (1.25–3.95)
General health				
No exposure	Ref		Ref	
First exposure age 4–5 years	0.003	1.00 (0.23–4.36)	0.18	1.20 (0.26–5.59)
First exposure age 7 years	-0.25	0.78 (0.18–3.37)	-0.07	0.94 (0.21–4.17)
Underweight				
No exposure	Ref		Ref	
First exposure age 4–5 years	0.78	2.19 (0.73–6.54)	0.92	2.50 (0.67–9.31)
First exposure age 7 years	1.07	2.91 (1.12–7.57)	0.78	2.18 (0.66–7.22)
Obesity				
No exposure	Ref		Ref	
First exposure age 4–5 years	0.31	1.36 (0.71–2.61)	0.21	1.23 (0.55–2.74)
First exposure age 7 years	0.74	2.10 (1.21–3.63)	0.57	1.76 (0.96–3.22)

exposed; while a smaller effect was seen for first exposure at 4–5 years for this outcome (OR: 1.7; 95% CI: 0.8–3.7). A reparameterization of the model indicated that children with first exposure at 7 years had 1.3 times the risk of behavioural issues relative to those first exposed at 4–5 years (95% CI: 0.5–3.3).

No discernible effects were evident for general health in either the basic or fully adjusted model. We observed significant effects for being underweight (OR: 2.9; 95% CI: 1.1–7.6) and obesity (OR: 2.1; 95% CI: 1.2–3.6) in children with first exposure at age 7 in the model adjusted for child age and gender, although these effects were attenuated in the fully adjusted model. In this model, we continued to observe an increased risk for children being underweight in both those first exposed to racism at 4–5 years (OR: 2.5; 95% CI: 0.7–9.3) and 7 years (OR: 2.2; 95% CI: 0.7–7.2) compared with those not exposed, although these estimates were imprecise. Smaller effects were also observed for obesity, with imprecise estimates seen for those first exposed at 4–5 years (OR: 1.2; 95% CI: 0.6–2.7) and marginally significant effects seen for those first exposed at 7 years (OR: 1.8; 95% CI: 1.0–3.2) compared with those without racism exposure.

Analysis using imputed datasets resulted in pooled estimates for each outcome that were similar to estimates from complete case analysis. Pooled estimates fell within confidence intervals from complete case analysis and confidence intervals from both analyses overlapped considerably. All significant associations between racial discrimination and health outcomes found in complete case analysis were also found in analysis of imputed datasets.

Discussion

This study investigated whether the effect on health outcomes at 7–12 years differed by the age of first exposure to direct racism at school, thereby offering a novel method to understand how sensitive periods of exposure to racism influence later mental and physical health outcomes. We found limited evidence to support our expectation that first exposure to direct racial discrimination at a younger age (4–5 years) would pose an increased risk of later negative mental and physical health outcomes compared to first exposure at an older age (7 years). An increased risk of negative mental health was observed for first exposure at 4–5 years relative to 7 years, after adjustment for all covariates, though this relationship was not seen across other outcomes.

Overall, children with a first exposure to racism at either 4–5 or 7 years had a moderately increased likelihood of experiencing the negative mental health and weight-related outcomes under examination relative to children who were not exposed to racism. However, the effect estimates were imprecise for weight-related outcomes and behaviour issues at school with first exposure at 4–5 years in the fully adjusted model. The negative impact of racism on health in both international and Australian Indigenous populations is well established (King et al., 2009; Paradies, 2018; Paradies et al., 2008). Our study confirms that this impact is apparent early (ages 7–12) when first exposure to racism occurs at 4–5 and 7 years of age. Evidence supporting the heightened physiological and psychological vulnerability to adverse environments during early development is indisputable (Bagby, Martin, Chung, & Rajapakse, 2019; Fleming et al., 2018; Hanson & Gluckman, 2014; Heim & Binder, 2012). Similar patterns of increased vulnerability have been found with exposure to interpersonal racism as a stressor, though these are based on broad comparisons between child and adolescent or adult periods of exposure (Benner et al., 2018; Lee & Ahn, 2013; Schmitt et al., 2014). While the more granular periods of exposure examined within our study allowed closer investigation of the impact of first exposure to racism during childhood, we did not find evidence for differential effects on health from racism exposure earlier in childhood. This may be due in part to the small proportion of children with first exposure at these young ages. While children can recognise and enact discriminatory behaviour based on racial prejudice from age 5, awareness of this discrimination increases as children age, becoming more consistently detected by 8–10 years (Brown & Bigler, 2005). Concomitantly, the children in this study were 7 years or less at the time of collecting information on racial discrimination and may have had a lesser capacity or inclination to articulate and/or disclose their experiences. These factors, collectively, may have contributed to the small proportions reporting exposure and the resulting imprecision of estimates observed for some outcomes. Differences in the duration and frequency of racism exposure at each age also likely influence the impact of racism on health, though these aspects of racism exposure were unmeasured in this study. Larger longitudinal datasets incorporating time-limited measures of racism (e.g. exposure within previous 12 months) which capture the duration, frequency and context of racism exposure throughout childhood will allow for analysis that can more accurately confirm the presence of sensitive periods of exposure to racial discrimination during early development.

We observed an increased risk of negative mental health in children with first exposure to direct racism at 4–5 years compared with those first exposed at 7 years. Our findings align with the strong associations found between racism and negative mental health outcomes in adult and adolescent populations, and provide a unique insight into the impact of racism exposure during childhood (Benner et al., 2018; Paradies, 2006; Priest et al., 2013; Schmitt et al., 2014). Environmental stressors are understood to increase the risk of negative mental health via the disturbance of neurobiological systems implicated in stress responses and emotional regulation (Heim & Binder, 2012; McEwen & Gianaros, 2010). Exposure to stress early in life can reduce neurological adaptability to later difficulties, resulting in patterns of behaviour that

characterise a range of mental health disorders (Heim & Binder, 2012). It is likely that changes in neural plasticity throughout development lead to differential vulnerability to negative mental health from external stressors and that the nature and severity of the stressor also influences this vulnerability. However, sensitive periods of exposure to racial discrimination as a stressor are currently underexamined, particularly during childhood. Where the strength of this association has been compared across adolescent developmental periods, the positive association between emotional and behavioural difficulties and racial discrimination has been shown to be stronger in early rather than late adolescence (Benner et al., 2018). Although our study found a similar pattern during childhood, it is clear that complex intersections between the neurological, environmental and genetic factors which influence associations between racism and mental health outcomes must still be addressed. It is also important to note that resilience to racism as an early life stressor is among the potential outcomes of exposure. Integrating psychometric and neurobiological outcome data within the context of broader environmental and genetic factors may better identify sensitive periods of exposure to the negative mental health effects of racism.

In contrast to findings for the association between early exposure to racial discrimination and mental health, we saw that children first exposed to direct racism at a later age (7 years) were at an increased risk of behavioural issues at school and that there was minimal difference in the effect size of associations with sleep difficulties by age of first exposure. Emotional and behavioural difficulties are known to co-develop throughout childhood (Kelley, Bates, Dodge, & Pettit, 2000) and racial discrimination has been found to have a strong and consistent association with behavioural issues during childhood and adolescence, equal to the association with negative mental health outcomes (Priest et al., 2013). Our preliminary evidence for a stronger adverse effect at 7 years adds to these earlier findings, although a lack of statistical precision meant that we did not find a significant difference in the likelihood of behavioural issues for those first exposed at 7 years relative to 4–5 years. The stronger adverse effect at an older age may be due in part to the later expression of behavioural issues at school after an earlier experience of negative mental health, particularly as the measure under investigation captured only behavioural issues severe enough to result in the school contacting a parent or carer. In contrast, children with first exposure to racial discrimination during the earliest years of school were at significantly increased risk of sleep difficulties and there was minimal difference in the effect size of these associations with age. This may be explained in part by the links between sleep difficulties and both emotional and behavioural difficulties in children (Gregory & Sadeh, 2012), leading to strong associations at both younger and older ages. Overall, the contrast between these two observations may reflect different mechanisms underlying the association between racism and behavioural compared to mental health outcomes, particularly given the early developmental period under investigation. This finding strengthens the need to examine the longitudinal association between behavioural and mental health outcomes and racial discrimination in children as they move from early to late childhood and into adolescence.

We provide tacit evidence that first exposure to racism at either 4–5 or 7 years poses an increased likelihood of being underweight or experiencing obesity, although our expectation that first exposure at 4–5 years would increase the risk of later obesity or underweight status compared to first exposure at age 7 was not supported in this cohort of Aboriginal children. Estimates for obesity in this study reflect those observed between obesity and racial discrimination exposure in Aboriginal children aged between 5–10 years (Shepherd et al., 2017). Weight-related outcomes may be more consistently influenced by the timing of exposure to racial discrimination during later childhood (8–11 years) or by repeated exposures throughout childhood. In the current study, age of first exposure to racism was limited to 4–7 years to reduce overlap with the ages at which outcome measures were recorded (7–12 years). However, longitudinal data which captures data from

respondents across a broader age range (incorporating adolescence) would allow sensitive periods of exposure to racism to be examined more fully.

This study contributes to examinations of the impact of racial discrimination on the health of Aboriginal children by developing a novel exposure variable – age of first exposure – to explore sensitive periods of exposure to racism. To our knowledge, no other published study has examined age of first exposure to racism in Aboriginal children or characterised the health impacts of first exposure at different ages. As a prospective cohort study, the LSIC allows for an examination of temporal exposure variables which would not be possible within a cross-sectional study design. Alongside these strengths, a number of limitations should also be considered when interpreting our findings – principally related to the racism exposure variable. The exposure variable for racism in this study was based on the perceptions of primary carers, not the study children themselves. While primary carers were asked to report on the experiences of study children, these reports may not reflect the perceptions of racism in study children. There was a risk of respondent bias where primary carers also provided reports of outcome variables (i.e. mental health [SDQ], sleep difficulties and general health). In these cases, carers' assessments of racism and mental or physical health outcomes in children may have tended towards being uniformly positive or negative, whether consciously or not. The racism exposure variable was not time-limited and did not account for the frequency or severity of racism exposure. These factors reduce the sensitivity of this exposure as children with an array of experiences with racism were unable to be differentiated. Finally, despite the strength of the LSIC as a prospective cohort study, the sampling design was non-random due to practical and logistic considerations in site selection. As a result, the sample of study children in LSIC is not nationally representative of the population of Aboriginal children across Australia, although the sites selected for the study were intended to reflect the geographic distribution of Aboriginal children within Australia and the varied environments in which these children live (Australian Government Department of Social Services, 2018).

Conclusion

This study generates new evidence surrounding the impact of age of

first exposure to racism on mental and physical health outcomes in Aboriginal children. We provide further evidence that racial discrimination places Aboriginal children at a moderately increased risk of negative mental and physical health outcomes, with no evidence to suggest that these risks are consistently higher for first exposure at 4–5 years than 7 years across all the health outcomes under investigation. Although we did not observe consistently differential health vulnerability to racism with exposure at 4–5 and 7 years, exposure during this period of childhood may still be heightened compared to exposure in older childhood and adolescence. Examining longitudinal data which also captures these later developmental periods will assist in determining the presence and timing of sensitive periods of exposure to racism. Additionally, study designs and analytic models should integrate validated psychometric and biological outcomes alongside psychosocial covariates including cultural identity, social support and resilience where possible to ensure that the complex intersections between racism, health and environment are accounted for. Ultimately, this work can inform the timing of important public health initiatives to address the critical stressor of racism in vulnerable population groups.

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Declaration of competing interest

None.

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Appendix B. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ssmph.2019.100492>.

Appendix A

Multiple imputation and adapting rounding

Multiple imputation using mixed effects models is a relatively novel procedure and best practice recommendations are currently limited. Based on this limited literature, adaptive rounding of ordinal and binary variables returned from linear models using the 'mitml' package in R Studio was originally pursued in this analysis. First, ordinal variables were recoded into a series of dummy variables, these were then entered into linear mixed effects models for each health outcome. Adaptive rounding based on Bernaards et al. calculation for a cut-off score based on normal approximation to the binomial distribution was then applied to all variables (Bernaards, Belin, & Schafer, 2007). Ordinal variables were then recreated based on the dummy variables originally derived from each variable. However, due to the rounding procedure, cases would occasionally be returned where all levels of the ordinal variable were rounded to zero or more than one level of the variable was rounded to 1. This led to unrealistic cases where, for example, individuals were not allocated to any remoteness level or were allocated into multiple remoteness levels at once. Resolving this required implementing alternate or multiple rounding procedures, such as naïve rounding, to ensure that each case was allocated into a single category within ordinal variables. This process would likely lead to biased estimates and so we chose not to pursue any rounding procedure. Although the strategy of no rounding meant that continuous data was used in analysis, not the binomial data originally used with complete-case analysis, we preferred to treat both sets of data as continuous rather than introduce bias through rounding. To ensure estimates were comparable we contrasted the pooled estimates from linear models run on the imputed continuous data with linear models run on the complete-cases data.

Comparison of estimates from imputation and complete case analysis

	Imputation ^a	Complete cases
	β (SE)	β (SE)
Negative mental health		
No exposure	Ref	Ref
First exposure age 4–5/7	-0.05 (0.02)	-0.08 (0.02)
Sleep difficulties		
No exposure	Ref	Ref
First exposure age 4–5/7	-0.05 (0.02)	-0.07 (0.02)
Behaviour issues at school		
No exposure	Ref	Ref
First exposure age 4–5/7	-0.04 (0.02)	-0.05 (0.02)
General health		
No exposure	Ref	Ref
First exposure age 4–5/7	0.002 (0.01)	-0.001 (0.01)
Underweight		
No exposure	Ref	Ref
First exposure age 4–5/7	0.02 (0.01)	-0.02 (0.01)
Obesity		
No exposure	Ref	Ref
First exposure age 4–5/7	-0.05 (0.02)	-0.02 (0.03)

^a Models adjusted for child age and gender, geographic remoteness, area-level socioeconomic status and family-level socioeconomic status (primary carer reported highest education completed, financial difficulty and prior homelessness).

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RESEARCH ARTICLE

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Racial discrimination and allostatic load among First Nations Australians: a nationally representative cross-sectional study



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Abstract

Background: Increased allostatic load is linked with racial discrimination exposure, providing a mechanism for the biological embedding of racism as a psychosocial stressor. We undertook an examination of how racial discrimination interacts with socioecological, environmental, and health conditions to affect multisystem dysregulation in a First Nations population.

Methods: We conducted latent class analysis (LCA) using indicators of life stress, socioeconomic background, and physical and mental health from a nationally representative sample of Australian Aboriginal adults ($N = 2056$). We used LCA with distal outcomes to estimate the effect of the latent class variable on our derived allostatic load index and conducted a stratified analysis to test whether allostatic load varied based on exposure to racial discrimination across latent classes.

Results: Our psychosocial, environmental, and health measures informed a four-class structure; 'Low risk', 'Challenged but healthy', 'Mental health risk' and 'Multiple challenges'. Mean allostatic load was highest in 'Multiple challenges' compared to all other classes, both in those exposed (4.5; 95% CI: 3.9, 5.0) and not exposed (3.9; 95% CI: 3.7, 4.2) to racial discrimination. Allostatic load was significantly higher for those with exposure to racial discrimination in the 'Multiple challenges' class ($t = 1.74, p = .04$) and significantly lower in the 'Mental health risk' class ($t = -1.67, p = .05$).

Conclusions: Racial discrimination may not always modify physiological vulnerability to disease. Social and economic contexts must be considered when addressing the impact of racism, with a focus on individuals and sub-populations experiencing co-occurring life challenges.

Keywords: Racial discrimination, Allostatic load, Latent class analysis

Background

Racial discrimination is a well-established contributor to adverse physical health outcomes in ethnic/cultural minority populations [1–6]. Evidence detailing how racial discrimination affects physiology within the context of broader life circumstances is needed to encourage the

development of informed strategies to prevent or eradicate racism in the settings where it occurs. This approach is particularly essential for Indigenous populations within high-income countries, where racial discrimination is often compounded by ongoing social marginalisation, land dispossession, and loss of sovereignty [7].

In Australian Aboriginal and Torres Strait Islander (hereafter referred to as 'Aboriginal') populations, where the pervasiveness of racial discrimination is well documented across legal, healthcare, educational and employment settings, [8–10] assessing the link between the

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psychosocial stressor of racism and physical health remains a challenge. To date, indicators of physical health most commonly comprise self- or carer-rated general health status, with few significant associations found [11–16]. Self-reported general health can be a misleading indicator of physical health, particularly for socially disadvantaged populations who may underreport or understate adverse health outcomes [17, 18]. Clinical biomarkers present a stronger indicator of underlying biological risk factors or early precursors of disease, and are typically unrecognised or not acknowledged by individuals responding to general health self-report measures. Individual biomarkers for allostatic load have been observed to be significantly higher in Aboriginal compared with non-Aboriginal populations [19] and studies have begun to investigate the association between racism and individual biomarkers in Aboriginal populations [20–24]. However, single biomarkers are specific to individual physiological systems and cannot capture the interactions and adaptations occurring between systems which lead to dysregulation.

Allostatic load is an indicator of multisystem physiological dysregulation resulting from over- or under-activation of systems designed to adapt to stress (i.e. metabolic, cardiovascular, immune, and neuroendocrine systems) [25]. Long periods of repeated exposure to psychosocial stressors such as racial discrimination are proposed to increase allostatic load, [26] promoting pathophysiology and ultimately increasing morbidity and mortality [27]. Increased allostatic load has also been linked to multiple other markers of stress and adversity, including socioeconomic status [27–31]. Associations between racial discrimination and allostatic load indices that comprise multiple biomarkers have been established in international studies [32–45]. Two of these studies were focused on Indigenous adults attending university in western Canada [39, 40]. In these Canadian studies, childhood experiences of racial discrimination and past year experiences of racial discrimination were both significantly associated with an allostatic load index comprised of seven biomarkers. The sample was dichotomised into groups with high and low cultural continuity, as defined by engagement in cultural practices and values related to their Indigenous cultural heritage at the time of data collection. Both studies observed that cultural continuity buffered the harmful effects of racial discrimination on allostatic load, with the association reduced to non-significance for those with high cultural continuity [39, 40]. Several studies have situated racism within the multiple intersecting stressors known to be implicated in heightened allostatic load but did so using mediation analysis or analysis of effect modification to investigate the role of specific variables

measuring single environmental factors, such as emotional support, [37] social support, [43] racial background, [32, 33, 44] and socioeconomic status [32, 34]. Studies utilising this form of variable-centred analysis are less focused on examining the effects of multiple shared characteristics within population groups than on specified pathways between exposure and outcome variables. In contrast, person-centred analysis permits an examination of how racism is situated within—rather than isolated from—the complex reality of intersecting supports and stressors present within individual lives. Latent class analysis (LCA) is a form of person-centred analysis which identifies clusters or patterns of shared characteristics within groups of people and explores how outcomes of interest differ between these groups [46]. In this study, a latent class approach was used to determine whether exposure to racial discrimination could increase allostatic load for groups of people already experiencing many psychosocial stressors and adverse health, investigating whether racial discrimination can measurably increase allostatic load in the context of competing stressors and challenging circumstances.

This study undertakes the first examination of the role of racial discrimination on allostatic load in the context of broader socioecological, environmental, and health risk factors within a First Nations population. A more nuanced understanding of the role of racism is important in supporting intervention studies and policy approaches that seek to address the persistent impact of racism on population health disparities across the globe. We apply a latent class approach to nationally-representative data to first identify profiles of Aboriginal Australian adults defined by psychosocial stressors, environmental factors, health conditions, and mental health factors. We then examine the association between these profiles and an index of allostatic load. Finally, we examine the association between identified profiles and allostatic load after dichotomising the population into those with exposure to racial discrimination in the previous 12 months and those unexposed. Our primary objective was to determine the effect of exposure to racial discrimination on allostatic load in profiles of Aboriginal adults defined by stress-related psychosocial, environmental, and health factors.

Methods

Data were from the National Aboriginal and Torres Strait Islander Health Survey (NATSIHS) and National Aboriginal and Torres Strait Islander Health Measures Survey (NATSIHMS) components of the Australian Bureau of Statistics' (ABS) Australian Aboriginal and Torres Strait Islander Health Survey (AATSIHS) 2012–13. Full details of the data collection, recruitment, and sampling have been reported elsewhere [47, 48]. However, in brief, the AATSIHS selected a nationally

representative sample of Aboriginal Australians via stratified multistage area sampling of private dwellings across remote, non-remote areas, and discrete Aboriginal and Torres Strait Islander communities nationally. The AATSIHS collected comprehensive health information from the Aboriginal population to obtain national benchmark information on health-related issues, collect biomarkers of chronic disease, and monitor trends in Aboriginal health. Selected adult members of the household consenting to participate undertook face-to-face interviews with trained interviewers. The AATSIHS core sample had a response rate of 79.5% fully or adequately responding households, culminating in 12,947 respondents aged 2 years and over. Adults aged 18 years and over ($n = 8157$) were invited to participate in the NATSIHMS, where biomedical data from blood and urine tests was collected. The current study analysed data from respondents within the NATSIHMS subset of the AATSIHS ($n = 3293$). The sample was weighted by the ABS to represent the national Aboriginal population as at 30 June 2011 (the estimated population benchmark from the 2011 Census of Population and Housing). Within the NATSIHMS subset, only individuals who also participated in the NATSIHS component of the AATSIHS were retained ($n = 2060$) as participant characteristics provided within this survey component informed explanatory variables within LCA. Four respondents were recorded as a 'refusal' in answering the racial discrimination measure and were excluded from further analysis, resulting in a final sample of 2056 respondents (Fig. 1).

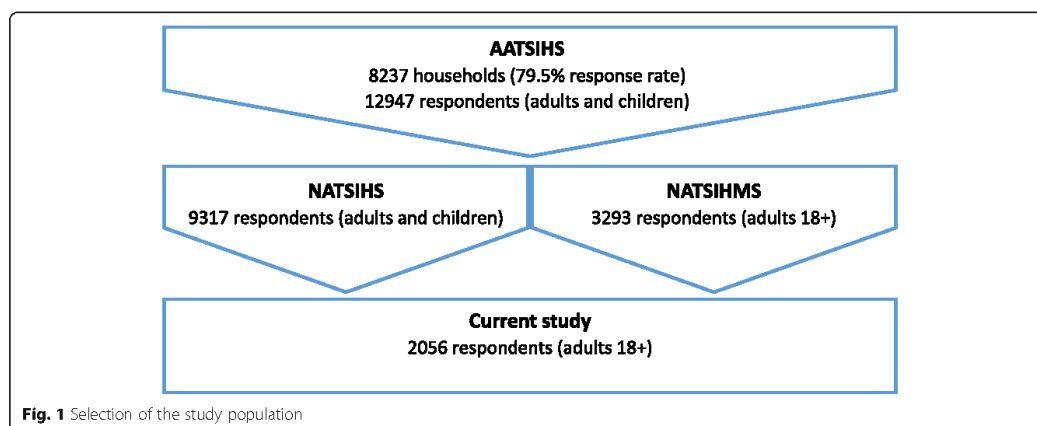
The ABS has initiated several strategies to build and strengthen engagement with Aboriginal communities and organisations and to ensure best practice in the collection and dissemination of data from Aboriginal populations [49]. Led by the Centre of Excellence for Aboriginal and Torres Strait Islander Statistics, the ABS

is guided by cultural protocols and procedures for engagement with Aboriginal peoples and communities developed in alignment with Indigenous data sovereignty principals [49, 50]. The current study received input and guidance on the study design and interpretation of findings from the Telethon Kids Institute Social Determinants of Aboriginal Health Community Advisory Group, an advisory group comprised of Aboriginal community members from the Perth region (Western Australia) established to ensure this research was directed and approved by the local Aboriginal community.

Measures

Outcome variable

The outcome was an allostatic load index derived from 10 biomarkers selected based on their relevance in measuring physiological systems implicated in allostatic load and availability within the NATSIHMS [27]. Biomarkers frequently used in allostatic load studies represent physiological systems implicated in both the primary and secondary effects of stress exposure, including the neuroendocrine system (e.g. cortisol, epinephrine, dopamine); immune system (e.g. Interleukin-6, tumour necrosis factor- α , C-reactive protein); metabolic system (e.g. high density lipoprotein cholesterol, triglycerides, glucose, insulin, albumin, creatinine); cardiovascular/respiratory systems (e.g. systolic/diastolic blood pressure, peak expiratory flow, heart rate); and anthropomorphic measures (e.g. waist-to-hip ratio, body mass index) [27]. The physiological systems represented in this allostatic load index reflect secondary outcomes associated with longer-term stress exposure, as biomarkers constituting primary effects were not collected within the NATSIHMS (i.e. stress hormones, cortisol, epinephrine and nor-epinephrine or pro- and anti-inflammatory cytokines) [27, 51]. We have used a multi-systemic composite



approach, including biomarkers representing several physiological systems to gain early indications of the secondary effects of stress [27, 51]. The biomarkers included in the current study were (cardiovascular system) systolic and diastolic blood pressure; (metabolic system) high density lipoprotein- (HDL) cholesterol, low density lipoprotein- (LDL) cholesterol, triglycerides, fasting glucose, plasma glycosylated haemoglobin (HbA1c), and albumin-creatinine ratio; (anthropomorphic) body mass index; and (immune system) C-reactive protein. To derive allostatic load, participants were given a value of '1' for each biomarker that fell within the highest quartile of sample values (or the lowest quartile for HDL cholesterol), with these values then summed to a total score (index range 0–10; biomarkers weighted equally). This method has been applied to numerous studies to predict health outcomes, including later mortality, and to examine the variation produced by stress and related psychosocial factors [27, 52].

Racial discrimination

Respondents were asked whether they had felt they had been treated badly in the last twelve months because they were Aboriginal or Torres Strait Islander (yes/no).

Explanatory variables

Respondents within this dataset will have varying allostatic load scores based on their psychosocial, environmental, and physiological circumstances, and history. Factors that capture these circumstances have been included as explanatory variables in LCA as they will account for a portion of the variability in models of allostatic load. We selected a total of 15 explanatory variables for assessment in LCA — these factors were primarily related to stress, mental health, and physical health. Factors related to stress included low socioeconomic status (current unemployment, low education, area level disadvantage), financial difficulties, perceived social support, and death in the family. Factors related to mental health included psychological distress and a sense of control or mastery, while factors related to physical health included past or present health conditions, exercise, and having limited facilities for sanitation in the home. Geographic remoteness was also included as this can have both positive and negative implications for stress, mental health, and physical health due to either environmental and lifestyle stressors within metropolitan areas or challenges accessing services and infrastructure within remote areas. Substance use was initially included, although mean differences in allostatic load were minimal for substance use indicator variables so that stress and physical and mental health factors were ultimately prioritised for analysis.

Included variables spanned individual level ($n = 10$), family level ($n = 3$), and area level ($n = 2$) characteristics (Table 1). All explanatory variables were dichotomised with the reference category set to the low risk category, except area-level socioeconomic status which was a five-level categorical variable with the reference category set to the highest socioeconomic quintile.

Individual level characteristics

Individual level characteristics included health conditions, social and emotional wellbeing, exercise, education, and employment.

Health condition variables analysed ($n = 4$) included current or pre-existing kidney, cardiac, diabetes, and respiratory conditions. These condition categories were derived from 10 specific conditions reported by respondents. Respondents reporting kidney disease were classified with a 'current or pre-existing kidney condition', respondents reporting heart attack, heart failure, hypertensive disease or stroke were classified with a 'current or pre-existing cardiac condition', respondents reporting asthma, bronchitis, chronic sinusitis, or hayfever and allergic rhinitis were classified with a 'current or pre-existing respiratory condition', and respondents reporting diabetes mellitus (Type 1, 2 or unknown) were classified with a 'current or pre-existing diabetes condition'. Each condition was considered present where the condition status was 'ever told has condition, still current and long-term'; 'ever told has condition, still current but not long-term'; 'ever told has condition, not current'; or 'not known or not ever told, but condition current and long-term'.

Social and emotional wellbeing variables analysed ($n = 3$) included the Kessler Psychological Distress Scale (Kessler-5), the Multidimensional Scale of Perceived Social Support (MSPSS) and an adaption of the Pearlin Mastery Scale. The Kessler-5 measure of psychological distress is derived from 5 items in the Kessler Psychological Distress Scale-10, designed to measure levels of negative emotional states in the four weeks prior to interview [53]. Responses were categorised according to the system used by the NATSIHS and dichotomised so that high/very high scores (12–25) indicate high levels of psychological distress while low scores (5–11) indicate low levels of psychological distress [54]. The MSPSS is a measure of perceived social support from family, friends, and significant others [55] and was derived from 6 items in the NATSIHS. A score of 6–18 was then generated so that a higher score indicated reduced social support. This scale was then dichotomised by categorising those in the top decile (at or above the 90th percentile) as having 'low social support'. The Pearlin Mastery Scale measures the extent to which individuals feel in control over their life outcomes [56] and was derived from 7 items in

Table 1 Explanatory variables and racial discrimination exposure

	n	%	95% CI	N ^a
Individual level characteristics				
Current or pre-existing kidney condition	138	6.8	5.2–8.4	2056
Current or pre-existing cardiac condition	836	40.2	37.2–43.2	2056
Current or pre-existing diabetes or related condition	693	31.7	28.9–34.4	2056
Current or pre-existing respiratory condition	857	45.6	42.5–48.6	2056
Psychological distress	617	30.5	27.7–33.4	2045
Low social support	129	12.7	9.9–15.4	947
Low sense of control	115	10.5	8.0–13.1	947
Did not meet exercise guidelines	507	53.2	49.0–57.5	949
Completed Year 11 or below	1087	51.1	47.9–54.2	1989
Unemployed or not in the labour force	1166	54.5	51.4–57.5	2056
Family level characteristics	n	%		N
Household financial stress	1122	54.8	51.7–58.0	1944
Family stressor - Death	798	50.0	46.5–53.5	1517
Limited facilities for sanitation at home	502	21.0	18.6–23.3	2054
Area level characteristics	n	%		N
1 – Most disadvantaged area	1233	54.5	51.4–57.6	2056
2	360	20.5	17.9–23.2	2056
3	205	10.9	9.0–12.8	2056
4	187	10.6	8.7–12.5	2056
5 – Least disadvantaged area	71	3.4	2.3–4.5	2056
Living in a remote area	1106	63.8	61.2–66.5	2056
Racial discrimination				
Exposure previous 12 months	292	14.6	12.4–16.8	2056

^aExplanatory variables include missing data

the NATSIHS. A score of 7–21 was then generated so that a higher score indicated a reduced sense of control. This scale was then dichotomised by categorising those in the top decile as having a ‘low sense of control’.

Exercise was derived from a single item indicating whether the amount of exercise or physical activity respondents undertook in the previous week reached 150 min as per Australian National Physical Activity and Sedentary Behaviour guidelines for adults. Respondents who did not undertake 150 min or more were categorised as ‘did not meet exercise guidelines’. Education was derived from a single item indicating whether respondents had completed educational attainment up to Year 11 completion. Respondents who indicated they had completed up to Year 11 education or had no educational attainment were categorised as ‘Completed Year 11 or below’. Employment was derived from a single item indicating whether respondents were unemployed (looking for part-time or full-time work) or not in the labour force, using a categorisation of labour force status in which the Federal Government Community Development Employment Projects scheme was included in the category of ‘unemployed or not in the labour force’.

Respondents who were unemployed or not in the labour force were categorised as ‘unemployed or not in the labour force’.

Family level characteristics

Family level characteristics included household financial stress, experiencing death as a family stressor, or having limited facilities for sanitation in the home.

Financial stress was derived from a single item indicating whether household members could raise \$2000 in an emergency. Respondents who indicated they could not raise \$2000 were categorised as experiencing ‘financial stress’. Death as a family stressor was derived from a single item indicating whether ‘death’ had occurred in the previous 12 months as a family stressor. Limited facilities for sanitation in the home was derived from a single variable indicating whether respondents’ homes had working facilities for washing people, washing clothes or bedding, preparing food, or sewerage facilities. Respondents who indicated that they had no working facilities for any one of these fundamental household tasks were categorised as having ‘limited facilities for sanitation at home’.

Area level characteristics

Area level characteristics included area level socioeconomic status and geographic remoteness. Area level socioeconomic status was determined from the Index of Relative Socioeconomic Disadvantage developed by the ABS [57]. This index ranks the relative level of disadvantage of areas using the attributes of all persons (Aboriginal and non-Aboriginal) in small areas, and includes measures of income, educational attainment, employment status, family composition, and employment categorisation (i.e. low skill occupations). For the purposes of this study, we have categorised the index values into quintiles. Geographic remoteness was determined according to the Australian Statistical Geographic Standard 2011 remoteness areas with non-remote areas encompassing 'major cities of Australia', 'Inner regional Australia' and 'Outer regional Australia', while remote areas encompassed 'Remote Australia' and 'Very Remote Australia'. Respondents living in remote areas were categorised as 'living in a remote area'.

Covariates

Age and gender were included as covariates in LCA models. Age was a continuous measure of respondent's age in single years. Gender was categorised as female/male with male as the reference category.

Data analysis

Multiple imputation by Chained Equations was conducted in SAS Enterprise Guide 7.15 to minimise potential bias due to missing biomarker data in the NATSIH MS (Additional file 1). The number of respondents with missing data ranged from 14 to 708 (0.7–34.4%) for each biomarker. Descriptive statistics and sample sizes for all biomarkers are included in Supplementary Table 1. Analysis was conducted on the final sample of 2056 respondents after imputation.

Preliminary analysis was run to generate the mean, standard error, and confidence intervals for our index of allostatic load. Percentage distributions of explanatory variables were calculated. Linear regression models, adjusted for age and gender, were used to test associations between each explanatory variable and allostatic load. These analyses were run in SAS Enterprise Guide Version 7.15.

LCA was used to identify health and psychosocial stress profiles of Aboriginal adults within our sample using the 15 explanatory variables. Statistical model fit was assessed using the Akaike Information Criterion (AIC), sample size adjusted Bayesian Information Criterion (BIC), log-likelihood, and entropy for models with 2–10 classes. After the model of best fit was identified, mean estimates of allostatic load were compared between classes using Bolck, Croon and Hagenaars

adjusted proportional assignment to calculate distal outcome estimates [58, 59]. Finally, racial discrimination exposure was included as a grouping variable in LCA to dichotomise the sample so that mean estimates of allostatic load could be compared between respondents who reported racial discrimination exposure and respondents with no reported racial discrimination exposure within each latent class. Differences in mean allostatic load with exposure to racial discrimination are reported both within and between latent classes in Supplementary Table 2. All LCA was conducted using the LCA Stata Plugin and LCA_Distal_BCH Stata function [60, 61] in Stata Version 16.0.

All analysis incorporated the ABS-generated person-weights produced for the NATSINPAS dataset. Use of these weights allows us to use sample population data to estimate outcomes for the total in-scope population [47]. All data was accessed and analysis run within the ABS DataLab environment [62].

Results

Summary statistics of the 2056 participants' responses for the 15 explanatory variables are presented in Table 1; frequencies ranged from 6.8% (current or pre-existing kidney disease) to 63.7% (living in a remote area). The sample was comprised of 53.6% females, with ages ranging from 18 to 75 years ($M = 41.5$, $SD = 21.2$). Means, standard errors, and 75th percentile cut-offs for each of the ten biomarkers comprising the allostatic load risk index are presented in Table 2. The number of biomarkers per individual observed to fall into the high-risk category ranged from 1 to 10, with a mean of 2.4 ($SD: 2.3$; 95% CI: 2.4, 2.5).

Increased age was significantly associated with increased allostatic load ($B = 0.1$, $p < .0001$), while allostatic load

Table 2 Allostatic load outcome variables

Biomarkers	Mean	SD	95% CI	P ₇₅	N
Systolic blood pressure	121.6	18.1	120.7–122.4	130.7	2056
Diastolic blood pressure	78.8	13.6	78.2–79.3	86.0	2056
Body mass index	29.6	9.1	29.3–29.9	33.9	2056
HDL cholesterol	1.2	0.3	1.2–1.2	0.9 ^b	2056
LDL cholesterol	2.9	1.4	2.9–3.0	3.5	2056
Triglycerides	1.7	0.9	1.6–1.7	2.1	2056
Fasting plasma glucose ^a	1.7	0.3	1.7–1.7	1.8	2056
HbA1c	5.8	1.4	5.8–5.9	5.9	2056
Albumin creatinine ratio ^a	0.2	1.4	0.1–0.2	0.9	2056
C-reactive protein ^a	1.1	1.4	1.1–1.2	2.0	2056
Allostatic load	Mean	SD	95% CI		N
Allostatic load risk index	2.4	2.3	2.3–2.5		2056

^aLog transformed

^bHDL cholesterol results within the lowest 25th percentile used to indicate risk (results from 0 to 0.9)

did not differ between male and female participants ($B = -0.02$, $p = .81$). There were statistically significant differences in mean allostatic load across many of the explanatory variables included in LCA, after adjustment for age and gender (Table 3). The estimated prevalence of racial discrimination exposure within the previous 12 months was 14.6% (95% CI: 12.4, 16.8). A statistically significant increase in mean allostatic load was observed in participants who reported racial discrimination, after adjustment for age and gender ($B = 0.38$, $p = .02$) (Table 3).

Latent class analysis

Fit indices for latent class models with 2 to 10 classes were generated (Table 4). The four-class model was chosen to represent the optimal number of classes based on an appropriate balance between the sample adjusted BIC, entropy, and log-likelihood estimates [46]. Item response probabilities for explanatory variables from the four-class model are presented alongside the probability of latent class membership both for respondents with and without exposure to racial discrimination in Table 5. The four-class model included (1) 'Low risk': characterised by low probabilities of current or pre-existing health conditions, mental health risk indicators, and low probabilities of socioeconomic risk factors; (2) 'Challenged but healthy': characterised by low probabilities of current or pre-existing health conditions, mental health risk indicators, but with moderate probability of experiencing death as a family stressor, and high probabilities of almost all socioeconomic risk factors including financial stress, living in a disadvantaged area, living in a remote area, unemployment, and low education; (3) 'Mental health risk': characterised by a high probability of psychological distress, moderate-high probability of financial stress and unemployment, high probability of a current or pre-existing respiratory condition and low probabilities of all other current or pre-existing health conditions; (4) 'Multiple challenges': characterised by high probabilities of current or pre-existing cardiac, respiratory, and diabetes or related conditions and a relatively high probability of a current or pre-existing kidney condition, moderate probabilities of psychological distress and experiencing death as a family stressor, and moderate-high probabilities of financial stress, low education, unemployment, and living in a disadvantaged area.

Latent classes and allostatic load

Mean allostatic load for each latent class was estimated after including the allostatic load risk index as a distal outcome in LCA in a model adjusted for age and gender (Table 5). Mean allostatic load was observed to vary significantly by latent class ($Z = 301.7$, $p < .001$) (Table 6). The 'Multiple challenges' class was observed to have the highest mean allostatic load (4.05; 95% CI: 3.84, 4.26). This estimate was significantly higher than mean

estimates for all other classes, while the estimate for the 'Challenged but healthy' class was significantly higher than the 'Low risk' ($B = 0.44$, $SE = 0.07$, $p < .0001$) and 'Mental health risk' ($B = 0.39$, $SE = 0.09$, $p < .0001$) classes. No significant difference in allostatic load was observed between the 'Low risk' and 'Mental health risk' classes.

Latent classes, allostatic load and racial discrimination

Mean allostatic load for each latent class was again estimated in an extended latent class model that dichotomised respondents into those exposed and unexposed to racial discrimination in the previous 12 months before including the allostatic load index as a distal outcome (Table 5). This permitted mean allostatic load to be estimated in each latent class both for individuals with and without exposure to racial discrimination in the previous 12 months. Mean allostatic load varied significantly between latent classes both for those with ($Z = 67.5$, $p < .001$) and those without exposure to racial discrimination ($Z = 235.5$, $p < .001$) (Table 6).

Mean estimated allostatic load was significantly higher for those in the 'Multiple challenges' class with exposure to racial discrimination compared to those unexposed ($t = 1.74$, $p = .04$), while allostatic load was significantly lower for those in the 'Mental health risk' class with exposure to racial discrimination compared to those unexposed ($t = -1.67$, $p = .05$) (Table 7). The 'Multiple challenges' class was observed to have the highest mean allostatic load compared with all other classes both for those with exposure to racial discrimination in the previous 12 months (4.48; 95% CI: 3.95, 5.00) and for those unexposed (3.95; 95% CI: 3.73, 4.18).

Discussion

This study presents a first exploration of how patterns of psychosocial stressors, environmental and mental health factors, and health conditions within latent classes affect multisystem dysregulation in a First Nations population. We used LCA with distal outcomes to identify profiles of Aboriginal Australian adults defined by these factors, examine the association between these profiles and an index of allostatic load, and determine whether the association between latent classes and allostatic load differed for those exposed and unexposed to racial discrimination.

Our study observed that allostatic load was significantly increased for individuals with exposure to racial discrimination in the 'Multiple challenges' class compared to those unexposed to racial discrimination in this class. By contrast, allostatic load was significantly lower for those exposed to racial discrimination in the 'Mental health risk' class compared to those unexposed. No significant difference in allostatic load was observed between those exposed and unexposed to racial discrimination in

Table 3 Mean allostatic load by explanatory variables

Explanatory variables	Mean	SE	B ^a	95% CI	P-value
Current or pre-existing kidney condition					
Yes	3.3	0.2	0.39	0.03–0.74	0.03
No	2.4	0.1	Ref	...	...
Current or pre-existing cardiac condition					
Yes	3.1	0.1	0.53	0.48–0.59	<.0001
No	2.0	0.1	Ref	...	...
Current or pre-existing diabetes or related condition					
Yes	3.6	0.1	1.19	0.99–1.39	<.0001
No	1.9	0.1	Ref	...	...
Current or pre-existing respiratory condition					
Yes	2.5	0.1	−0.09	−0.27–0.09	0.31
No	2.4	0.1	Ref	...	...
Psychological distress					
Yes	2.4	0.1	−0.02	−0.21–0.17	0.84
No	2.5	0.1	Ref	...	...
Low social support					
Yes	2.4	0.2	0.09	−0.36–0.54	0.68
No	2.1	0.1	Ref	...	...
Low sense of control					
Yes	2.6	0.2	0.32	−0.07–0.71	0.10
No	2.1	0.1	Ref	...	...
Did not meet exercise guidelines					
Yes	2.3	0.1	0.16	−0.09–0.41	0.20
No	2.0	0.1	Ref	...	...
Completed Year 11 or below					
Yes	2.8	0.1	0.45	0.26–0.63	<.0001
No	2.1	0.1	Ref	...	...
Unemployed or not in the labour force					
Yes	2.7	0.1	0.43	0.24–0.61	<.0001
No	2.1	0.1	Ref	...	...
Financial stress					
Yes	2.7	0.1	0.77	0.60–0.94	<.0001
No	2.1	0.1	Ref	...	...
Family stressor – Death					
Yes	2.7	0.1	0.62	0.41–0.82	<.0001
No	2.0	0.1	Ref	...	...
Limited facilities for sanitation at home					
Yes	2.8	0.1	0.61	0.40–0.82	<.0001
No	2.3	0.1	Ref	...	...
Index of Relative Socioeconomic Advantage and Disadvantage					
1 – Most disadvantaged	2.6	0.1	1.27	0.79–1.75	<.0001
2	2.6	0.1	1.07	0.59–1.56	<.0001
3	2.3	0.2	0.87	0.35–1.39	0.001
4	2.2	0.2	0.78	0.25–1.30	0.004

Table 3 Mean allostatic load by explanatory variables (Continued)

Explanatory variables	Mean	SE	B ^a	95% CI	P-value
5 – Least disadvantaged	1.3	0.2	Ref	...	...
Living in a remote area					
Yes	2.9	0.1	0.90	0.72–1.07	<.0001
No	2.2	0.1	Ref	...	...
Racial discrimination exposure previous 12 months					
Yes	2.7	0.1	0.28	0.04–0.51	0.02
No	2.4	0.1	Ref	...	...

^aBeta estimates indicate group differences in mean allostatic load

other latent classes. The ‘Multiple challenges’ class was characterised by high proportions of individuals who reported experiencing death as a family stressor, financial stress, unemployment, and low education, alongside current or pre-existing diabetes and cardiac conditions. Overall, our results indicate that racial discrimination can measurably increase allostatic load for groups of Aboriginal adults with this profile of psychosocial stress and health vulnerability, suggesting that these individuals were still physiologically susceptible to the additional psychosocial stressor of racism.

This study confirms that while exposure to racial discrimination has an effect on the physiological dysregulation linked with allostatic load, this effect is significant only in select contexts. Allostatic load was significantly increased between those exposed and unexposed to racial discrimination within the ‘Multiple challenges’ class, significantly decreased between those exposed and unexposed to racial discrimination within the ‘Mental health risk’ class, and no significant differences were observed between those exposed and unexposed in the remaining classes. Multiple individual stressors were significantly associated with increased allostatic load after adjustment for age and gender, providing an indication of the variety of psychosocial stressors that can affect allostatic load. Overall, results from these analyses suggest that not all

circumstances in which Aboriginal people live lend themselves to an increased vulnerability from the adverse physiological effects of racism. These findings underscore that we cannot easily summarise the broader circumstances of Aboriginal peoples’ lives or the continuing adaption of those lives to the adversities often present within them. Racial discrimination is frequently numbered among these adversities, yet when examining the impact of racism on physiological health it is worth broadening the scope of analysis to include, rather than adjust for, socioecological, environmental, and health factors. This is especially the case where these factors have the potential to moderate the body’s physiological response to stress.

Findings from this study show that Aboriginal adults living in high stress environments with low socioeconomic resources have a higher allostatic load than those living in a low stress environment with high socioeconomic resources. This is the case even in the absence of reported health conditions and psychological distress. Respondents in the ‘Challenged but healthy’ class were observed to have a significantly higher allostatic load than respondents in the ‘Low risk’ class in the total sample, both before and after grouping for racial discrimination exposure. Both class profiles indicated low proportions of those with pre-existing health conditions

Table 4 Fit indices for one to ten latent class models

Number of classes	Log-likelihood	AIC	BIC (sample size adjusted)	Change in BIC	Entropy
1	–17,394	7715	7759		–2.06
2	–16,537	6039	6130	– 1629	0.73
3	–16,259	5522	5659	– 471	0.70
4	–16,141	5324	5508	– 151	0.70
5	–16,079	5237	5468	–40	0.70
6	–16,031	5179	5456	–12	0.68
7	–15,985	5126	5449	–7	0.68
8	–15,950	5093	5464	+ 15	0.70
9	–15,930	5091	5508	+ 44	0.71
10	–15,912	5092	5556	+ 48	0.71

Table 5 Latent class membership, item response probabilities, and mean allostatic load estimates by latent class and racial discrimination exposure

Latent class membership probabilities	Low risk	Challenged but healthy	Mental health risk	Multiple challenges
Racial discrimination exposure	0.220	0.188	0.231	0.362
No racial discrimination exposure	0.308	0.278	0.174	0.240
Item response probabilities				
Current or pre-existing diabetes or related condition	0.189	0.138	0.142	0.770
Current or pre-existing cardiac condition	0.258	0.179	0.311	0.861
Current or pre-existing respiratory condition	0.459	0.159	0.686	0.594
Current or pre-existing kidney condition	0.020	0.027	0.033	0.188
Psychological distress	0.096	0.248	0.655	0.357
Low social support	0.005	0.199	0.210	0.211
Low sense of control	0.000	0.000	0.237	0.147
Did not meet exercise guidelines	0.448	0.560	0.388	0.594
Family stressor – Death	0.459	0.674	0.519	0.630
Financial stress	0.157	0.875	0.678	0.586
Limited facilities for sanitation at home	0.020	0.464	0.152	0.208
Completed Year 11 or below	0.265	0.697	0.485	0.624
Unemployed or not in the labour force	0.109	0.711	0.733	0.740
Living in area of relative disadvantage	0.279	0.918	0.443	0.539
Living in a remote area	0.121	0.900	0.052	0.303
Mean allostatic load	Estimate (95% Confidence Intervals)			
Full sample (n = 2056)	1.67 (1.49, 1.85)	2.58 (2.41, 2.74)	1.75 (1.45, 2.04)	4.05 (3.84, 4.26)
Racial discrimination exposure (n = 292)	1.88 (1.35, 2.41)	2.85 (1.83, 2.74)	1.20 (0.61, 1.79)	4.48 (3.95, 5.00)
No racial discrimination exposure (n = 1764)	1.64 (1.45, 1.83)	2.67 (2.49, 2.85)	1.78 (1.46, 2.11)	3.95 (3.73, 4.18)

or psychological distress, although the ‘Challenged but healthy’ class had considerably higher proportions of respondents indicating financial stress, unemployment, low education, and area-level disadvantage compared to the ‘Low risk’ class. Our findings suggest that the financial stress and resource deprivation related to low socioeconomic status (SES) contributes to a higher allostatic load burden in Aboriginal adults with otherwise positive physical and mental health profiles. Strong and consistent associations between lower SES and allostatic load have been empirically established [29, 63] and various mediators of the association between SES and allostatic load have been identified [32]. Economic difficulties encountered during adulthood have also been observed to amplify allostatic load in those exposed to stressors during childhood and adolescence, suggesting that SES can have an additive effect where maladaptive physiologic patterns have already been established [64]. Mechanisms like this illustrate how allostatic load can be indicative of past stress, providing a marker of the cumulative physiological toll exacted on the body over time. These observations suggest that allostatic load provides both an indication of past challenges and a risk factor for future physiological response patterns [29]. Where individuals

have faced many stressors or challenging environments in the past, these patterns are more likely to be physiologically damaging and disease-promoting [65]. Based on results from this study, it appears that SES-related determinants can contribute to increases in physiological dysregulation for Aboriginal adults and that measures of SES must be accounted for when examining allostatic load in this population.

Levels of allostatic load were significantly lower for respondents characterised by indicators of psychological distress (‘Mental health risk’) compared to respondents characterised by low SES (‘Challenged but healthy’). In fact, levels of allostatic load for those in the ‘Mental health risk’ class were comparable to those observed in the ‘Low risk’ class. Additionally, those in the ‘Mental health risk’ class with exposure to racial discrimination were observed to have significantly lower allostatic load compared to those who were unexposed. These findings suggest that the components of adverse mental health incorporated into LCA models did not completely explain an observable increase in allostatic load and that exposure to racial discrimination interacts with mental health to measurably reduce allostatic load. Strong evidence for a link between allostatic load and adverse

Table 6 Wald chi-squared tests, allostatic load risk index

Full Sample		Estimate	SE	Wald statistic	P-value
Low risk	Challenged but healthy	−0.436	0.065	44.939	<.001
Low risk	Mental health risk	−0.048	0.109	0.192	ns
Low risk	Multiple challenges	−0.888	0.062	206.248	<.001
Challenged but healthy	Mental health risk	0.388	0.094	16.913	<.001
Challenged but healthy	Multiple challenges	−0.453	0.0439	106.449	<.001
Mental health risk	Multiple challenges	−0.841	0.093	82.170	<.001
	Omnibus test			301.737	<.001
Racial discrimination exposure					
Low risk	Challenged but healthy	−0.196	0.181	1.176	ns
Low risk	Mental health risk	0.447	0.306	2.136	ns
Low risk	Multiple challenges	−0.869	0.161	29.121	<.001
Challenged but healthy	Mental health risk	0.644	0.281	5.246	<.025
Challenged but healthy	Multiple challenges	−0.673	0.124	29.442	<.001
Mental health risk	Multiple challenges	−1.317	0.266	24.518	<.001
	Omnibus test			67.507	<.001
No racial discrimination exposure					
Low risk	Challenged but healthy	−0.488	0.069	50.119	<.001
Low risk	Mental health risk	−0.085	0.119	0.515	ns
Low risk	Multiple challenges	−0.881	0.067	173.425	<.001
Challenged but healthy	Mental health risk	0.402	0.103	15.315	<.001
Challenged but healthy	Multiple challenges	−0.393	0.0469	70.174	<.001
Mental health risk	Multiple challenges	−0.795	0.102	61.179	<.001
	Omnibus test			235.537	<.001

mental health has been observed in international studies and allostatic load has been proposed as a likely predictor of adverse mental health in Aboriginal populations [19, 66, 67]. Currently, further research is required to fully determine the association between increased allostatic load and adverse mental health in Aboriginal Australian populations. Cortisol and cortisone levels measured from hair samples of Aboriginal young adults were not significantly associated with psychological distress in the Aboriginal Birth Cohort Study, [68] while no significant association was observed between an allostatic load index comprised of multiple biomarkers and depressive symptoms in recent research undertaken with Aboriginal adolescents and adults in Queensland, Australia [69]. However, the Queensland study observed

that anhedonia and insomnia sub-scores were significantly associated with increased allostatic load in one of the study sites, suggesting that depression symptomology can influence allostatic load [69]. Our observation that psychological distress and low sense of control are not significantly associated with allostatic load in regression analysis adjusted for age and gender suggests a less marked association with these mental health symptoms. However, the implications of our observation that allostatic load is lower for those with a high mental health risk profile who report exposure to racial discrimination are less clear. Emerging evidence from Aboriginal populations indicates that chronic exposure to psychosocial stressors can lead to suppression of the hypothalamic-pituitary-adrenal (HPA) axis measured via lower cortisol,

Table 7 Mean difference between those exposed and unexposed to racial discrimination, within latent classes

	Mean difference – exposed compared with unexposed	SE of difference between means	T statistic	P-value
Low risk	0.239	0.293	0.82	0.206
Challenged but healthy	−0.383	0.240	−1.47	0.072
Mental health risk	−0.585	0.350	−1.67	0.048
Multiple challenges	0.524	0.300	1.74	0.041

cortisone, and a blunted cortisol awakening response [24, 68, 70]. Although a broader set of biomarkers were incorporated into our allostatic load index, the combination of stressors present within our mental health risk profile in addition to racial discrimination exposure may be indicative of this type of physiological response.

The strengths of this study include the novel investigation of allostatic load, racial discrimination and psychosocial, environmental and health factors in a large nationally representative sample of Australian Aboriginal adults. As allostatic load is conceptualised as an indicator of the cumulative effects of stress and adversity, our study design ensured that a broad range of factors were accounted for when examining the link between racial discrimination and this measure of physiological dysregulation. Alongside these strengths, our study encountered some limitations. First, our study was cross-sectional and could not account for interactions between racial discrimination, psychosocial, environmental and health factors, and allostatic load over time. We are unable to determine whether exposure to racial discrimination had occurred prior to the previous 12 months, or the frequency and duration of this exposure. Neither are we able to determine the temporal sequence of many explanatory variables included in LCA, racial discrimination exposure and the development of physiological dysregulation captured by the index of allostatic load. Second, a critical component within the literature on life and environmental stress concerns perceptions of stress [71]. Respondents in this study were unable to indicate the presence or degree of stress they perceived in response to individual measures included as explanatory factors in LCA. Third, the measure of racial discrimination utilised in this study was a single-item measure that has not been methodologically validated. Racism is a complex phenomenon and multi-item measures have been shown to be more reliable and able to capture this complexity [72]. Validated, multi-item racial discrimination measures have been developed for Aboriginal populations (e.g. the Measure of Indigenous Racism Experiences) [73] and would more accurately reflect the experience of racism for these populations. Fourth, although the biomedical data collected in this study over 2012–13 represents the most recent and comprehensive available in a nationally representative Aboriginal population dataset, these data are now several years old. Despite this, there have been few significant changes in the social, economic, and health circumstances of Aboriginal children and families across Australia since the AATS IHS data were collected. Accordingly, we strongly believe the data continue to be a relevant and useful resource for examination of the circumstances of Aboriginal and Torres Strait Islander peoples. Finally, many individual biomarkers included in the allostatic load

index used within this study are predictive of the current or previous health conditions reported by respondents that were used in latent class formation. For those in the 'Multiple challenges' class, levels of allostatic load are likely primarily driven by the high proportion of respondents reporting the presence of these conditions.

Conclusions

We observed that allostatic load was significantly increased for those exposed to the psychosocial stressor of racism in a profile of Aboriginal adults already experiencing multiple challenges and adverse health. Our findings also indirectly imply that Aboriginal individuals with fewer challenges, greater resources, or differing life circumstances (e.g. living in a remote area) were more physiologically resilient to the additional stressor of racial discrimination. This finding does nothing to diminish the importance of responding to racial discrimination as a social determinant of health, rather it highlights that the specific conditions of Aboriginal people's lives must be accounted for when attempting to understand the link between racism and physiological health. The harmful effects of racism on Aboriginal health are modifiable and a stronger understanding of the circumstances in which they occur can encourage the development of evidence-based prevention strategies to mitigate their onset and continuation. Prevention strategies may take the form of intervention programs with linked evaluations or policy approaches which cut across multiple systems (e.g. healthcare, education, housing) to address the impact of racism on national health disparities.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-020-09978-7>.

Additional file 1. Detailed description of multiple imputation.

Additional file 2. STROBE statement. Checklist of reporting guidelines for observational studies (cross-sectional).

Additional file 3: Table S1. Complete cases and imputed values for individual biomarkers and allostatic load risk index.

Additional file 4: Table S2. Mean difference in allostatic load between those exposed and unexposed to racial discrimination, within and between class comparisons.

Abbreviations

AIC: Akaike Information Criterion; ACR: Albumin-creatinine ratio; AATS IHS: Australian Aboriginal and Torres Strait Islander Health Survey; ABS: Australian Bureau of Statistics; BIC: Bayesian Information Criterion; CI: Confidence interval; HDL: High density lipoprotein; Kessler-5: Kessler Psychological Distress Scale; LCA: Latent class analysis; LDL: Low density lipoprotein; MSPSS: Multidimensional Scale of Perceived Social Support; NATS IHS: National Aboriginal and Torres Strait Islander Health Measures Survey; NATSIHS: National Aboriginal and Torres Strait Islander Health Survey; HbA1c: Plasma glycosylated haemoglobin; SE: Standard error; SD: Standard deviation

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Authors' contributions

LC conceived of and designed the study. LC conducted the primary statistical analysis and imputation analysis. CCJS, LC, MNC, and SRZ interpreted the data. LC wrote the initial drafts of the manuscript. All authors have read, revised and approved the final manuscript.

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Availability of data and materials

The data that support the findings of this study are available from the Australian Bureau of Statistics but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the Australian Bureau of Statistics.

Ethics approval and consent to participate

Ethics approval for this study was granted by the Western Australian Aboriginal Health Ethics Committee (809) and the University of Western Australia Human Research Ethics Committee (RA/4/20/4069). Written consent for the Australian Aboriginal and Torres Strait Islander Health Survey was provided to the Australian Bureau of Statistics.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Appendix 2

Keywords – subjects 0-17 years

1. baby
2. babies
3. toddler*
4. infant*
5. child*
6. youth
7. teen*
8. adolescen*
9. young people
10. young person
11. Preschool*
12. Pre-school*

MeSH – subjects 0-17 years

13. Adolescent
14. Child
15. Infant

16. **1-15 (OR)**

Keywords – discrimination

17. (discrim* OR bias OR prejud*) OR racis*

Keywords – discrimination type

18. (race OR racial* OR ethnic* OR cultur* OR religio* OR migrant* OR immigra* OR refugee OR indigenous OR aborigin*)

Keywords – longitudinal studies

19. (longit* OR cohort* OR “follow up” OR “follow-up” OR prospective OR retrospective OR panel study OR panel survey OR cohort analyS)

16 AND 17 AND 18 AND 19

Supplementary Table 1: Mediating variables

Study	Mediating variable	Outcome category	Outcome variable	Association ¹
Hautala, 2016	Decreased school bonds	Anger	Aggression	Y
	Increased delinquent peer associations	Anger	Aggression	Y
	Increased depression	Anger	Aggression	N
Gibbons, et al. 2012	Reduced self-control	Anger	Anger	Y
Park, et al. 2017	More frequent outward anger expression	Anxiety	Anxiety	Y
	More frequent anger suppression	Anxiety	Anxiety	N
	More frequent anger control	Anxiety	Anxiety	N
Rosenthal, et al. 2015	More negative emotional symptoms	Blood pressure	Systolic blood pressure	Y
	More negative emotional symptoms	Blood pressure	Diastolic blood pressure	Y
	More negative emotional symptoms	BMI	BMI	Y
Lorenzo-Blanco & Unger, 2015	Increased perceived stress	Cigarette smoking	Cigarette smoking	Y
Berkel, et al. 2010	Increased Mexican American values	Conduct disorder	Externalising symptoms	Y
Simons, et al. 2003	Increased system blaming	Delinquent behaviour	Delinquency	N
	Increased justified aggression	Delinquent behaviour	Delinquency	Y (males)
	Increased anger	Delinquent behaviour	Delinquency	Y
	Increased depression	Delinquent behaviour	Delinquency	Y
	Increased anger	Delinquent behaviour	Delinquency	Y
	Increased hostile view of relationships	Delinquent behaviour	Delinquency	Y
Wheeler, et al. 2015²	Decreased maternal solicitation	Depression	Depressive symptoms	Y
Lambert, et al. 2009	Low perceived academic control	Depression	Depressive symptoms	N
	Low perceived social control	Depression	Depressive symptoms	N
Lorenzo-Blanco & Unger, 2015	Increased perceived stress	Depression	Depression	Y
Davis, et al. 2016	Increased public prosocial behaviour	Depression	Depressive symptoms	Y
	Increased altruistic prosocial behaviour	Depression	Depressive symptoms	Y
Park, et al. 2017	More frequent outward anger expression	Depression	Depression	Y
	More frequent anger suppression	Depression	Depression	N
	More frequent anger control	Depression	Depression	N

Walker, et al. 2017	Increased depressive symptoms	Depression	Death ideation	N
Zeiders, 2017	Greater daily stress	Depression	Internalising symptoms	N
	Lower sleep quality	Depression	Internalising symptoms	N
	Lower sleep duration	Depression	Internalising symptoms	N
Berkel, et al. 2010	Increased Mexican American values	Depression	Internalising symptoms	Y
Kogan, et al. 2015	Reductions in racial self-esteem	Depression	Depressive symptoms	Y
Gibbons, et al. 2004	Increased affiliation with friends using drugs	Drug/substance use	Substance use	Y
Gibbons, et al. 2007	Increased affiliation with friends using drugs	Drug/substance use	Substance use	Y
Brody, et al. 2012	Decreased school engagement	Drug/substance use	Substance use	Y
	Increased affiliation with substance using peers	Drug/substance use	Substance use	Y
Gibbons, et al. 2004	Increased distress	Drug/substance use	Substance use	Y
Gibbons, et al. 2010	Increased anger	Drug/substance use	Substance use	Y
	Increased behavioural willingness	Drug/substance use	Substance use	Y
	Increased distress	Drug/substance use	Substance use	N
Gibbons, et al. 2012	Reduced self-control	Drug/substance use	Substance use	Y
	Increased anger	Drug/substance use	Substance use	Y
Basanez, et al. 2013	Increased depression	Drug/substance use	Substance use	N
Kam & Cleveland, 2011	Development of acculturation stress	Drug/substance use	Substance use	Y
Anderson, et al. 2015²	Higher levels of parental depressive symptoms	Emotional difficulties	Emotional problems	Y
	Higher levels of undesirable parenting behaviours	Emotional difficulties	Emotional problems	Y
Becares, et al. 2015²	Increased maternal psychological distress	Emotional difficulties	Socioemotional difficulties	Y
	Increased harsh parenting practices	Emotional difficulties	Socioemotional difficulties	Y
Davis, et al. 2016	Increased depressive symptoms	Prosocial behaviour	Altruistic prosocial behaviour	Y
	Increased depressive symptoms	Prosocial behaviour	Public prosocial behaviour	N
Brittian, et al. 2013	Increased Mexican American values	Prosocial behaviour	Altruistic prosocial tendencies	N
	Increased Mexican American values	Prosocial behaviour	Anonymous prosocial tendencies	Y
	Increased Mexican American values	Prosocial behaviour	Compliant prosocial tendencies	Y

	Increased Mexican American values	Prosocial behaviour	Dire prosocial tendencies	Y
	Increased Mexican American values	Prosocial behaviour	Emotional prosocial tendencies	Y
	Increased Mexican American values	Prosocial behaviour	Public prosocial tendencies	Y
Roberts, et al. 2012	Increased deviant affiliations	Risk-taking behaviour	Sexual risk taking	Y
	Increased negative affect	Risk-taking behaviour	Sexual risk taking	Y
Stock, et al. 2013	Increased substance use behaviour	Risk-taking behaviour	Risky sex	Y
Rosenthal, et al. 2015	More negative emotional symptoms	Self-rated health	Overall self-rated health	Y

¹ Where significant associations were found, significance was indicated by $p < 0.05$ or bias corrected confidence intervals. Indirect associations were in a positive direction in all studies except Berkel, et al. 2010 (decreased conduct disorder), Rosenthal, et al. 2015 (decreased self-rated health) and Davis, et al. 2016 (decreased depressive symptoms).

² Studies examined vicarious racial discrimination experiences of parents.

Supplementary Table 2: Mediating variables

Study	Mediating variable	Outcome category	Outcome variable	Association ¹
Hautala, 2016	Decreased school bonds	Anger	Aggression	Y
	Increased delinquent peer associations	Anger	Aggression	Y
	Increased depression	Anger	Aggression	N
Gibbons, et al. 2012	Reduced self-control	Anger	Anger	Y
Park, et al. 2017	More frequent outward anger expression	Anxiety	Anxiety	Y
	More frequent anger suppression	Anxiety	Anxiety	N
	More frequent anger control	Anxiety	Anxiety	N
Rosenthal, et al. 2015	More negative emotional symptoms	Blood pressure	Systolic blood pressure	Y
	More negative emotional symptoms	Blood pressure	Diastolic blood pressure	Y
	More negative emotional symptoms	BMI	BMI	Y
Lorenzo-Blanco & Unger, 2015	Increased perceived stress	Cigarette smoking	Cigarette smoking	Y
Berkel, et al. 2010	Increased Mexican American values	Conduct disorder	Externalising symptoms	Y
Simons, et al. 2003	Increased system blaming	Delinquent behaviour	Delinquency	N
	Increased justified aggression	Delinquent behaviour	Delinquency	Y (males)
	Increased anger	Delinquent behaviour	Delinquency	Y
	Increased depression	Delinquent behaviour	Delinquency	Y
	Increased anger	Delinquent behaviour	Delinquency	Y
	Increased hostile view of relationships	Delinquent behaviour	Delinquency	Y
	Increased hostile view of relationships	Delinquent behaviour	Delinquency	Y
Wheeler, et al. 2015 ²	Decreased maternal solicitation	Depression	Depressive symptoms	Y
Lambert, et al. 2009	Low perceived academic control	Depression	Depressive symptoms	N
	Low perceived social control	Depression	Depressive symptoms	N
Lorenzo-Blanco & Unger, 2015	Increased perceived stress	Depression	Depression	Y
Davis, et al. 2016	Increased public prosocial behaviour	Depression	Depressive symptoms	Y
	Increased altruistic prosocial behaviour	Depression	Depressive symptoms	Y
Park, et al. 2017	More frequent outward anger expression	Depression	Depression	Y
	More frequent anger suppression	Depression	Depression	N
	More frequent anger control	Depression	Depression	N

Walker, et al. 2017	Increased depressive symptoms	Depression	Death ideation	N
Zeiders, 2017	Greater daily stress	Depression	Internalising symptoms	N
	Lower sleep quality	Depression	Internalising symptoms	N
	Lower sleep duration	Depression	Internalising symptoms	N
Berkel, et al. 2010	Increased Mexican American values	Depression	Internalising symptoms	Y
Kogan, et al. 2015	Reductions in racial self-esteem	Depression	Depressive symptoms	Y
Gibbons, et al. 2004	Increased affiliation with friends using drugs	Drug/substance use	Substance use	Y
Gibbons, et al. 2007	Increased affiliation with friends using drugs	Drug/substance use	Substance use	Y
Brody, et al. 2012	Decreased school engagement	Drug/substance use	Substance use	Y
	Increased affiliation with substance using peers	Drug/substance use	Substance use	Y
Gibbons, et al. 2004	Increased distress	Drug/substance use	Substance use	Y
Gibbons, et al. 2010	Increased anger	Drug/substance use	Substance use	Y
	Increased behavioural willingness	Drug/substance use	Substance use	Y
	Increased distress	Drug/substance use	Substance use	N
Gibbons, et al. 2012	Reduced self-control	Drug/substance use	Substance use	Y
	Increased anger	Drug/substance use	Substance use	Y
Basanez, et al. 2013	Increased depression	Drug/substance use	Substance use	N
Kam & Cleveland, 2011	Development of acculturation stress	Drug/substance use	Substance use	Y
Anderson, et al. 2015 ²	Higher levels of parental depressive symptoms	Emotional difficulties	Emotional problems	Y
	Higher levels of undesirable parenting behaviours	Emotional difficulties	Emotional problems	Y
Becares, et al. 2015 ²	Increased maternal psychological distress	Emotional difficulties	Socioemotional difficulties	Y
	Increased harsh parenting practices	Emotional difficulties	Socioemotional difficulties	Y
Davis, et al. 2016	Increased depressive symptoms	Prosocial behaviour	Altruistic prosocial behaviour	Y
	Increased depressive symptoms	Prosocial behaviour	Public prosocial behaviour	N
Brittian, et al. 2013	Increased Mexican American values	Prosocial behaviour	Altruistic prosocial tendencies	N
	Increased Mexican American values	Prosocial behaviour	Anonymous prosocial tendencies	Y
	Increased Mexican American values	Prosocial behaviour	Compliant prosocial tendencies	Y

	Increased Mexican American values	Prosocial behaviour	Dire prosocial tendencies	Y
	Increased Mexican American values	Prosocial behaviour	Emotional prosocial tendencies	Y
	Increased Mexican American values	Prosocial behaviour	Public prosocial tendencies	Y
Roberts, et al. 2012	Increased deviant affiliations	Risk-taking behaviour	Sexual risk taking	Y
	Increased negative affect	Risk-taking behaviour	Sexual risk taking	Y
Stock, et al. 2013	Increased substance use behaviour	Risk-taking behaviour	Risky sex	Y
Rosenthal, et al. 2015	More negative emotional symptoms	Self-rated health	Overall self-rated health	Y

¹ Where significant associations were found, significance was indicated by $p < 0.05$ or bias corrected confidence intervals. Indirect associations were in a positive direction in all studies except Berkel, et al. 2010 (decreased conduct disorder), Rosenthal, et al. 2015 (decreased self-rated health) and Davis, et al. 2016 (decreased depressive symptoms).

² Studies examined vicarious racial discrimination experiences of parents.

Supplementary Table 3: Direct associations between racial discrimination and health outcomes from included studies

Author/s	Year	Title	Health outcome/s	Association/s ^{1,2,3}
Simons, Ronald L. Chen, Yi-Fu Stewart, Eric A. Brody, Gene H.	2003	Incidents of discrimination and risk for delinquency: A longitudinal test of strain theory with an African American sample	Delinquency	As a test of whether discrimination leads to delinquency, authors selected only respondents who reported no involvement in delinquency at T1 and examined the extent to which discrimination predicted these respondents having become involved in delinquency by T2 (controlling for inept parenting and affiliation with deviant peers). The standardised regression coefficient between discrimination T1 and delinquency T2 was .18 and the coefficient between discrimination T2 and delinquency T2 was .20. Both coefficients were statistically significant ($p \leq .05$).
Wong, C. A. Eccles, J. S. Sameroff, A.	2003	The influence of ethnic discrimination and ethnic identification on African American adolescents' school and socioemotional adjustment	Depressive symptoms; Anger; Self-esteem; Psychological resilience; Problem behaviours	Perceived discrimination by peers and perceived discrimination by teachers were negatively related to adolescents' psychological resiliency (peers: -.20; teachers: -.22, $p < .0001$), and self-esteem (peers: -.17; teachers: -.23, $p < .0001$). Perceived discrimination by peers and perceived discrimination by teachers were positively related to anger (peers: .26; teachers: .35, $p < .0001$), depressive symptoms (peers: .36; teachers: .41, $p < .0001$) and problem behaviours (peers: .20; teachers: .29, $p < .0001$).
Caldwell, C. H. Kohn-Wood, L. P. Schmeelk-Cone, K. H. Chavous, T. M. Zimmerman, M. A.	2004	Racial discrimination and racial identity as risk or protective factors for violent behaviours in African American young adults	Violent behaviour	Hierarchical linear regression analysis found that the inclusion of experiences with racial discrimination explained an additional 3% of the variance in violent behaviours over prior adolescent risk factors ($\beta = .28$; $p < .001$)
Gibbons, F. X., Gerrard, M., Cleveland, M. J., Wills, T. A., & Brody, G.	2004	Perceived Discrimination and Substance Use in African American Parents and Their Children: A Panel Study	Distress	In SEM T1 adolescent's discrimination predicted change in distress for adolescents and not the reverse ($p < .001$). Discrimination directed at adolescents was only indirectly associated with T2 substance use via change in distress and friend's substance use (both $p < .001$).

Brody, Gene H., et al.	2006	Perceived discrimination and the adjustment of African American youths: a five-year longitudinal analysis with contextual moderation effects	Depressive symptoms; Conduct disorder	In SEM analysis, the intercept for perceived discrimination was not significantly associated with the slope for conduct problems (.03), but it was associated significantly and negatively with the slope for depressive symptoms (-.34, $p < .05$). This suggests a “ceiling effect” in which youths who experience higher levels of discrimination during late childhood are less likely to develop additional depressive symptoms over time than those who initially experience less discrimination.
Simons, R. L. et al.	2006	Supportive Parenting Moderates the Effect of Discrimination upon Anger, Hostile View of Relationships, and Violence among African American Boys	Violent delinquency	Negative binomial regressions assessing the effect of discrimination and supportive involvement on the change in violent delinquency found that both T2 discrimination and increased T1>T2 discrimination predicts increased involvement in violent delinquency (T2: $b = .37$, $p < .01$; T1>T2: $b = .19$, $p < .05$).
Greene, M. L. Way, N. Pahl, K.	2006	Trajectories of perceived adult and peer discrimination among Black, Latino, and Asian American adolescents: patterns and psychological correlates	Depressive symptoms; Self-esteem	The time varying levels of depression and self-esteem were predicted from the time varying levels of perceived discrimination by adults and peers. Discrimination by adults ($\beta = -.41$, $p < .001$) and peers ($\beta = .38$, $p < .001$) were both negatively associated with self-esteem at initial status, indicating that adolescents who reported more discrimination also reported lower self-esteem. Discrimination by adults ($\beta = .28$, $p < .001$) and peers ($\beta = .20$, $p < .001$) were also both positively associated with depressive symptoms at initial status, indicating that adolescents who reported more discrimination reported more depressive symptoms.
Yu-Wen, Ying Meekyung, Han	2006	The Effect of Intergenerational Conflict and School-Based Racial Discrimination on Depression and Academic Achievement in Filipino American Adolescents	Depression	Using multiple regression models controlling for gender, longitudinal models using T1 discrimination to predict T2 depression found that school-based racial discrimination was not associated with depression.

Gibbons, F. X. et al.	2007	Early Experience with Racial Discrimination and Conduct Disorder as Predictors of Subsequent Drug Use: A Critical Period Hypothesis	Substance use	In SEM, T1 adolescent discrimination was a direct predictor of T3 substance use ($\beta=.17$, $p=.02$).
Jones, Matthew	2008	Longitudinal and reciprocal effects of ethnic identity and experiences of discrimination on psychosocial adjustment of Navajo (Diné) adolescents	Self-esteem; Social functioning; Depression; Drug use frequency; Drug use problems; Delinquent behaviour	Hierarchical regression analysis was calculated separately for males and females. Main effects for T1 discrimination were found to account for unique variance in the outcomes of T2 drug use frequency ($\beta=-.385$, $p=.007$) and self-esteem ($\beta=-.274$, $p=.072$) but not T2 social functioning, depression, drug use problems or delinquent behaviour for males. No significant associations were found between T1 discrimination and T2 outcomes for females.
Mesch, Gustavo S. Turjeman, Hagit Fishman, Gideon	2008	Perceived discrimination and the well-being of immigrant adolescents	Depressive symptoms; Self-efficacy	OLS multivariate analysis found after controlling for initial levels, perceived discrimination in public places increased levels of depression ($\beta=.10$, $p<.01$) but had no association with self-efficacy while perceived depression at school increased depression ($\beta=.15$, $p<.01$) and decreased self-efficacy ($\beta=-.10$, $p<.05$). These patterns held for OLS regression for change scores (change in discrimination/change in depression)
Neblett, Enrique W., et al.	2008	Patterns of Racial Socialization and Psychological Adjustment: Can Parental Communications About Race Reduce the Impact of Racial Discrimination?	Depressive symptoms; Perceived stress; Wellbeing; Problems behaviours	General linear model (GLM) analyses of variance (ANOVA) were estimated with age, gender, parent's highest level of education completed, and discrimination experiences at T1 included as covariates and discrimination at T2 included as a main effect in models. After controlling for the covariates, the results from the analyses indicate that individuals who experienced greater discrimination in the past year experienced more depressive symptoms ($\beta=.13$; $p<.01$), higher levels of perceived stress ($\beta=.16$; $p<.01$), and lower levels of well-being ($\beta=.08$; $p<.05$) at T2. No association was found for problem behaviours.

Benner, A. D. Kim, S. Y.	2009	Experiences of discrimination among Chinese American adolescents and the consequences for socioemotional and academic development	Alienation; Depressive symptoms	Discrimination at T1 predicted all T2 developmental outcomes ($\beta=.15$, $p<.05$, for alienation and $\beta=.16$, $p<.05$, for depressive symptoms).
Curtis, C.W.	2009	Race matters: Racial identity and protection against the negative influences of racism	Anxiety; Self-esteem	Multiple regression found that after controlling for gender, racism was a marginally significant predictor of anxiety ($\beta=.31$, $p=.052$). No significant association was found between racism and self-esteem.
Juang, Linda P. Cookston, Jeffrey T.	2009	Acculturation, Discrimination, and Depressive Symptoms among Chinese American Adolescents: A Longitudinal Study	Depressive symptoms	Latent growth models were used to identify that initial levels of discrimination predicted T3 levels of depression ($\beta=.30$, $p<.0001$) such that higher levels of discrimination at T1 predicted higher subsequent levels of depressive symptoms. Additionally, changes in discrimination were associated with changes in depressive symptoms ($\beta=.03$, $p<.001$), such that an increase in discrimination was associated with an increase in depressive symptoms. Though changes in discrimination did not predict T3 depression.
Lambert, S. F., et al.	2009	Perceptions of Racism and Depressive Symptoms in African American Adolescents: The Role of Perceived Academic and Social Control	Depressive symptoms	SEM analysis was conducted on females and males separately. For females, discrimination was found to be significantly positively associated with concurrent and later depressive symptoms ($\beta=.30$, $p<.001$). However, no significant association was found for males ($\beta=.13$, $p=.12$)
Slonim-Nevo, V, et al.	2009	The Impact of Familial and Environmental Factors on the Adjustment of Immigrants	Psychological distress; Self-esteem	After adjustment for all covariates, change in perceived discrimination from T1>T2 was found to significantly predict change in psychological distress ($\beta=.24$, $p\leq.005$) but no significant association was found for self-esteem or for associations between T2>T3 change in discrimination and either outcome.

Tartakovsky, Eugene	2009	The Psychological Well-Being of Unaccompanied Minors: A Longitudinal Study of Adolescents Immigrating From Russia and Ukraine to Israel Without Parents	Self-esteem; Body image; Social competence; Behaviour problems; Loneliness	Hierarchical linear models were used to determine the longitudinal association between discrimination and wellbeing post-migration. The effect of perceived discrimination was significant for all indexes of psychological well-being in the postmigration period except social competence (self-esteem: $\beta=.062$, $p<.05$; body image: $\beta=.096$, $p<.05$; behaviour problems: $\beta=.598$, $p<.001$; loneliness: $\beta=.188$, $p=.05$).
Berkel, Cady, et al.	2010	Discrimination and adjustment for Mexican American adolescents: A prospective examination of the benefits of culturally-related values	Externalising symptoms; Internalising symptoms	SEM was used to test the direct paths from discrimination to internalising and externalising symptoms. A significant direct path was found from discrimination to internalising symptoms ($\beta=.20$, $p\leq.001$) but not from discrimination to externalising symptoms.
Gibbons, F.X., et al.	2010	Exploring the link between racial discrimination and substance use: what mediates? What buffers?	Did not test for direct associations (only indirect associations in mediation analysis)	
Correa-Velez, Ignacio Gifford, Sandra M. Barnett, Adrian G.	2010	Longing to belong: social inclusion and wellbeing among youth with refugee backgrounds in the first three years in Melbourne, Australia	Physical health; Psychological wellbeing; Social wellbeing; Subjective health; Happiness	Generalised estimating equations were used to determine the predictors of young refugee's health and wellbeing. Perceived discrimination was a significant predictor of only the physical domain (comprising activities of daily living; dependence on medications and medical aids; energy and fatigue; mobility; pain and discomfort; sleep and rest; work capacity), with young people who had experienced discrimination scoring lower in their physical domain (mean change - 4.52, $p.011$). Discrimination did not significantly predict any other health outcomes.

Deng, S. Kim, S. Y. Vaughan, P. W. Li, J.	2010	Cultural orientation as a moderator of the relationship between Chinese American adolescents' discrimination experiences and delinquent behaviours	Delinquent behaviours	Hierarchical regression models were used to show that adolescents who reported high levels of chronic daily discrimination were at increased risk for delinquent behaviours ($\beta=.09$, $p<.01$)
Smokowski, P. R. Rose, R. A. Bacallao, M.	2010	Influence of risk factors and cultural assets on Latino adolescents' trajectories of self-esteem and internalizing symptoms	Internalising symptoms; self-esteem	Longitudinal hierarchical linear models were used to test the moderating effect of parent-adolescent conflict in the association between racial discrimination and health outcomes. When parent-adolescent conflict was not included in the model, perceived discrimination was significantly associated with lower self-esteem ($\beta=-.05$, $p<0.05$). However, once the model included parent-adolescent conflict this completely suppressed the effect for discrimination ($\beta=-0.04$, $p=NS$). Effects for depression were non-significant in models both with and without parent-adolescent conflict.
Brodish, A. B. Cogburn, C. D. Fuller-Rowell, T. E. Peck, S. Malanchuk, O. Eccles, J. S.	2011	Perceived Racial Discrimination as a Predictor of Health Behaviours: The Moderating Role of Gender	Healthy eating; Exercise; Substance use	More cumulative perceived racial discrimination was related to less healthy eating at age 30 ($p<.001$), as was expected. The results of the multiple group analysis revealed that relationship between cumulative discrimination and healthy eating at age 30 did not vary by gender. More cumulative discrimination was marginally related to more exercise at age 30 ($p=.10$). More cumulative discrimination was related to more substance use at age 30 ($p=.001$).
Brody, G., et al.	2011	Perceived discrimination, serotonin transporter linked polymorphic region status, and the development of conduct problems	Conduct problems	Latent growth construct modelling was used to find that in the first model using the full sample (including both participants with ss or sl alleles and those with ll alleles) perceived discrimination was associated with a significantly higher rate of change in conduct problems across adolescence ($\beta=0.61$, $p<.01$).

Martin, Monica J. McCarthy, Bill Conger, Rand D. Gibbons, Frederick X. Simons, Ronald L. Cutrona, Carolyn E. Brody, Gene H.	2011	The Enduring Significance of Racism: Discrimination and Delinquency Among Black American Youth	General delinquency; Violent delinquency	Cross-lagged effects revealed that discrimination in 1997 was associated with significant relative increases in general delinquency from 1997 to 1999 ($\beta = .19$); moreover, discrimination in 1999 predicted relative increases in general delinquency from 1999 to 2002 ($\beta = .11$). Additionally, discrimination in 1997 significantly predicted relative increases in violent delinquency from 1997 to 1999 ($\beta = .17$), and discrimination in 1999 predicted relative increases in violent delinquency from 1999 to 2002 ($\beta = .21$). All significant at the $p \leq .05$ level.
Galliher, R. V. Jones, M. D. Dahl, A.	2011	Concurrent and longitudinal effects of ethnic identity and experiences of discrimination on psychosocial adjustment of Navajo adolescents	Self-esteem; Social functioning; Substance use	A series of hierarchical regression equations were calculated separately for male adolescents and female adolescents, testing longitudinal associations by predicting substance use, self-esteem, and social functioning T2 scores from T1 discrimination. For males, a strong and consistent direct effect of discrimination emerged in predicting higher substance use over time ($\beta = .371$ -.415, $p = .010$ -.003) but no association was found for self-esteem or social functioning. No consistent direct effects between discrimination and health outcomes were observed for females
Kam, Jennifer A. Cleveland, Michael J.	2011	Perceived Discrimination as a Risk Factor for Latina/o Youth's Substance Use: Do Parent- and Peer-Based Communication and Relationship Resources Act as Protective Factors?	Substance use	SEM was used to test a mediation model in which the direct path from racial discrimination to substance use was tested. Perceived discrimination was not found to be significantly associated with last-30-days ATOD use ($\beta = .06$, $p = .24$).
Le, T. N. Stockdale, G.	2011	The influence of school demographic factors and perceived student discrimination on delinquency trajectory in adolescence	Delinquency	Students' perceptions of lower prejudice in their student body seemed to function as a protective factor across all groups, in that students who were more likely to disagree with the statement that students in their school who were prejudiced had lower initial delinquency estimates. Although African American students ranked highest in terms of reporting that students in their schools were prejudiced as compared with the other groups, all groups were adversely affected by discrimination as noted by the fact that student prejudice increased the

initial level of delinquency for all. However, these estimates were only marginally significant at the $p < .10$ level.

Seaton, E. K. Neblett, E. W. Upton, R. D. Hammond, W. P. Sellers, R. M.	2011	The moderating capacity of racial identity between perceived discrimination and psychological well-being over time among African American youth	Psychological wellbeing	The longitudinal relationship between psychological well-being and discrimination bothered (i.e., treated as a time-varying covariate) was assessed using a multivariate latent class model. Although individuals with higher reported frequency levels of racial discrimination at T1 had lower initial levels of psychological well-being at T1 ($\beta = -.06$, $p < .01$), frequency of discrimination at T1 was not found to predict changes in the rate of psychological well-being (i.e., the slope factor for psychological well-being) over time ($\beta = .01$, $p > .05$) and longitudinal models testing the relationship did not reveal any statistically significant results using an alpha level of .05.
Alderete, Ethel, et al.	2012	Smoking and exposure to racial insults among multiethnic youth in Jujuy, Argentina	Cigarette smoking	Multivariate models controlling for covariates found a significant main effect for racial insults on current smoking ($p = .003$) which was significantly modified by ethnicity so that Amazonian respondents who reported having ever experienced racial insults while in the ninth grade (2006) had almost four times the odds of current smoking in the tenth grade (2007), compared with respondents of this ethnic group who were not exposed to insults (OR = 3.8; 95% CI 1.4–10.4). Respondents of the Indigenous-unspecified group who experienced racial insults in the previous wave had relatively lower, but still significant increased, odds of current smoking in the tenth grade (adjusted OR 1.8; 95% CI 1.1–2.8), compared with those of the same group who did not report exposure to insults.

Astell-Burt, T. Maynard, M. J. Lenguerrand, E. Harding, S.	2012	Racism, ethnic density and psychological well-being through adolescence: evidence from the Determinants of Adolescent Social Well-Being and Health longitudinal study	Psychological wellbeing	Racism was associated with poorer psychological well-being trajectories for all ethnic groups ($p < .001$). Those who reported racism had higher mean total difficulties score (poorer psychological well-being) compared to those who did not, in each ethnic group. The improvement in psychological well-being was greater for those who reported racism than those who did not, indicating that the impact of racism on psychological well-being decreased with age. Age-specific mean difference in TDS (95% confidence interval) between those who experienced racism and those who did not at age 12 years 1.88 (1.75 to 2.01); 1.19 (1.07 to 1.31) at age 16 years for boys; 2.29 (2.12 to 2.47) at age 12 years; 1.43 (1.29 to 1.57) at age 16 years for girls. This effect was constant across ethnic groups.
Brody, Gene H. Kogan, Steven M. Chen, Yi-Fu	2012	Perceived discrimination and longitudinal increases in adolescent substance use: gender differences and mediational pathways	Substance use	Poisson regression was run to find the effect of discrimination on substance use across T1 and T3, controlling for T1 discrimination. A significant direct path between perceived discrimination and substance use was observed ($\beta = 0.56$, $p < .05$), although this was reduced to non-significance with the addition of mediators.
Dixon, B. et al.	2012	Maternal experiences of racial discrimination and child weight status in the first 3 years of life	BMI z-score	In fully adjusted models, compared with children whose mothers reported 0 experiences, those whose mothers reported >3 domains of 'Experiences of Discrimination' had lower birth weight for gestational age z-score ($\beta = 20.25$; 95% CI: 20.45, 20.04), lower 6 month WFA z-score ($\beta = 20.34$; 95% CI: 20.65, 20.03) and lower 3-year BMI z-score ($\beta = 20.33$; 95% CI: 20.66, 0.00).
Fuller-Rowell, T. E. Cogburn, C. D. Brodish, A. B. Peck, S. C. Malanchuk, O. Eccles, J. S.	2012	Racial discrimination and substance use: longitudinal associations and identity moderators	Substance use	Initial models were estimated to replicate the main effect of discrimination on substance use. In SEM, T3 discrimination was found to predict changes in substance use ($\beta = .163$, $p = .013$).

Gerrard, M. et al.	2012	Coping with racial discrimination: the role of substance use (STUDY 3)	Substance use	Hierarchical regressions found that there was a significant main effect for discrimination on substance use ($\beta=.29$, $p<.05$)
Gibbons, F.X., et al.	2012	The erosive effects of racism: reduced self-control mediates the relation between perceived racial discrimination and substance use in African American adolescents.	Substance use; Self-control; Anger	For the associations between discrimination and self-control the path from discrimination slope (increases in discrimination over time) to self-control slope was significant and negative ($\beta =-.24$, $p < .01$). Meaning that increases in discrimination from T1 to T4 were associated with increases in self-control during the same time period. Additionally, a direct path from discrimination intercept to early (W2) use was found ($\beta=.16$, $p < .01$) and T1/T2 discrimination had a direct negative path to T2 self-control ($p = .02$), and positive paths to T2 anger ($p < .001$) and T2 use ($p = .01$). The total effect of discrimination on T2 use was: $z = 3.72$, $p < .001$.
Roberts, M. E., et al.	2012	From racial discrimination to risky sex: prospective relations involving peers and parents	Sexual risk-taking; negative affect	The total effect of early discrimination (age 10 or 11) on later risky sexual behaviour (age 18 or 19) was significant ($t=4.52$, $p<.001$). Early discrimination was also positively related to deviant affiliations, negative affect, and attitudes about sex (for total effects, all t s > 3.48 , all p s $<.001$).

Basáñez, Tatiana Unger, Jennifer B. Soto, Daniel Crano, William Baezconde-Garbanati, Lourdes	2013	Perceived discrimination as a risk factor for depressive symptoms and substance use among Hispanic adolescents in Los Angeles	Substance use; Depression	Linear regression analysis found a statistically significant main effect of perceiving discrimination in 9th grade on drug use in 11th grade ($\beta=0.10$, $p<.01$). The multiple linear regression model also indicated a significant main effect of perceiving discrimination in 9th grade on depression in 11th grade ($\beta=0.23$, $p<.01$).
Benner, A. D. Graham, S.	2013	The antecedents and consequences of racial/ethnic discrimination during adolescence: does the source of discrimination matter?	Psychological maladjustment	No significant effects on psychological adjustment were observed in adolescents who perceived greater discrimination from school personnel or in adolescents who perceived greater discrimination by societal institutions. Adolescents who perceived greater discrimination by peers reported greater psychological maladjustment ($\beta=.14$, $p<.001$).
Brittian, Aerika S. O'Donnell, Megan Knight, George P. Carlo, Gustavo Umaña-Taylor, Adriana J. Roosa, Mark W.	2013	Associations Between Adolescents' Perceived Discrimination and Prosocial Tendencies: The Mediating Role of Mexican American Values	Public prosocial behaviours; Compliant prosocial behaviours; Emotional prosocial behaviours; Dire prosocial behaviours; Altruistic prosocial behaviours; Anonymous prosocial behaviours	A longitudinal model was evaluated using structural equation modelling (SEM), examining the direct effects of T1 perceived discrimination on T3 prosocial tendencies (i.e., compliant, emotional, dire, anonymous, altruistic, and public). T1 discrimination was related positively to T3 public ($\beta=.14$, $p<.01$) prosocial tendencies and negatively related to T3 compliant ($\beta=-.12$, $p<.01$), T3 emotional ($\beta=-.12$, $p<.05$), T3 dire ($\beta=-.10$, $p<.01$), and T3 altruistic ($\beta=-.19$, $p<.001$) prosocial tendencies.

Ford, K. R. Hurd, N. M. Jagers, R. J. Sellers, R. M.	2013	Caregiver experiences of discrimination and African American adolescents' psychological health over time	Depressive symptoms; Wellbeing; Perceived stress	Caregivers' discrimination experiences and adolescents' symptoms of depression were positively correlated at the trend level, indicating that when caregivers reported more discrimination experiences, adolescents reported increased depressive symptoms ($\beta=.05$, $p<.10$). Caregivers' perceived discrimination experiences were negatively related to adolescents' psychological well-being, such that increased caregiver perceptions of discrimination were related to lower adolescent ratings of well-being ($\beta=-.09$, $p<.001$). There was no significant association between caregivers' discrimination experiences and adolescents' perceived stress.
Gibbons, F. X., Gerrard, M., Weng, C.-Y., & Wills, T. A	2013	Early and cumulative effects of perceived racial discrimination on African American adolescents' substance use: A latent growth curve analysis (Unpublished data see chapter: Prospecting Prejudice: An Examination of the Long-Term Effects of Perceived Racial Discrimination on the Health Behaviour and Health Status of African Americans in 'Drug Use Trajectories Among Minority Youth')	Substance use	A latent growth curve structural equation model (SEM) with FACHS adolescents (average age 10.5–18.5) examined the relations between the initial level and slope (i.e., growth across all five waves) of perceived racial discrimination and level and slope of marijuana use from W3 to W5. Level of racism was a strong predictor of level of substance use ($\beta=.31$, $p<.001$) and the slope (trajectory) of racism from W1 to W5 was found to be a significant predictor of the trajectory (slope) of substance use ($\beta=.29$, $p<.01$).
Nair, R. L. White, R. M. Roosa, M. W. Zeiders, K. H.	2013	Cultural stressors and mental health symptoms among Mexican Americans: a prospective study	Internalising symptoms; Externalising symptoms	Discrimination was positively related to increases in internalizing symptoms from T1 to T2. On average, a one unit change in discrimination resulted in an increase of 2.87 internalizing symptoms across the 2-year time period ($\Gamma=2.87$, $p<.01$). No significant main effect was found for discrimination on conduct disorder.

		examining the impact of the family and neighbourhood context		
Niwa, Erika Yoshiko	2013	The impact of ethnic and racial discrimination on the social and psychological adjustment of early adolescents: A mixed-method, longitudinal study	Self-esteem; Depressive symptoms	Hierarchical linear regression analyses were conducted to predict psychological adjustment (self-esteem and depressive symptoms) from cluster membership for each of the different source/forms of discrimination (implicit and explicit discrimination from adults and peers). Adolescents in the high-decreasing cluster for explicit discrimination from peers were more likely to have lower self-esteem than their peers who experienced no explicit discrimination from their peers (group 1) ($\beta = -.18$, $p < .01$). Discrimination from adults had no significant effect on self-esteem. Adolescents who experienced moderate-stable explicit discrimination from adults were more likely to have higher depressive symptoms than those who did not experience such discrimination ($\beta = .10$, $p < .05$). Discrimination from peers had no significant effect on depression.
Stock, M.L. et al.	2013	The Effects of Racial Discrimination on the HIV-risk Cognitions and Behaviours of Black Adolescents and Young Adults	Substance use; Risky sex	The effects of T1-T4 discrimination separately on T4 use and T4 risky sex (controlling for previous behaviour) were both significant; $b = .12$, $\beta = .13$; $p < .001$, respectively. The direct effect of discrimination on T5 use was significant, $b = .08$, $p < .04$ and the direct path from discrimination to T5 risky sex was marginal ($p < .09$)

Toomey, R. B. Umana-Taylor, A. J. Updegraff, K. A. Jahromi, L. B.	2013	Ethnic identity development and ethnic discrimination: examining longitudinal associations with adjustment for Mexican-origin adolescent mothers	Self-esteem; Depressive symptoms; Risky behaviour	Across ethnic identity status groups, ethnic discrimination significantly predicted decreases in self-esteem over time, although small in nature (β 's ranged from $-.17$ to $-.19$, all $p < .01$). Again, across ethnic identity statuses, discrimination predicted increases in depressive symptoms over time, albeit the effect size was small (β 's ranged from $.20$ to $.26$, all $p < .001$). The association between discrimination and risky behaviours was significant, moderately-sized, and positive for diffuse adolescents ($\beta = .30$, $p < .01$), but there was no significant association between discrimination and later engagement in risky behaviours for foreclosed or achieved ethnic identity statuses.
Zeiders, K. H. Umana-Taylor, A. J. Derlan, C. L.	2013	Trajectories of depressive symptoms and self-esteem in Latino youths: examining the role of gender and perceived discrimination	Self-esteem; Depressive symptoms	Perceived ethnic discrimination was a significant predictor of the intercept ($\beta = -.12$, $p < .01$) and slope ($\beta = -.03$, $p < .05$ one-tailed); that is, individuals who reported greater levels of perceived ethnic discrimination reported lower levels of self-esteem at T2 and a significantly slower rate of growth in self-esteem across time. Perceived ethnic discrimination was a significant predictor of the intercept ($\beta = .26$, $p < .001$); adolescents who reported higher levels of perceived ethnic discrimination at T2 tended to also report greater levels of depressive symptoms at T2. Perceived discrimination did not significantly predict rate of growth in depressive symptoms.
Brody, G. H. Lei, M. K. Chae, D. H. Yu, T. Kogan, S. M. Beach, S. R.	2014	Perceived discrimination among African American adolescents and allostatic load: a longitudinal analysis with buffering effects	Allostatic load	High and stable levels of perceived discrimination across adolescence forecast AL at age 20 ($b = .923$, 95% CI: $0.027, 1.819$, $p < .05$). With the confounder variables controlled, perceptions of high and stable levels of discrimination still forecast higher AL levels at age 20 ($b = 1.088$, 95% CI: $0.177, 1.999$, $p < .05$).
English, D. Lambert, S. F. Ialongo, N. S.	2014	Longitudinal associations between experienced racial discrimination and depressive symptoms in African American adolescents	Depressive symptoms	Experienced racial discrimination in grade t was significantly associated with depressive symptoms in grade $t + 1$ across all 4 years (Grades 7–8: $\beta = .08$, $p < .05$; Grades 8–9: $\beta = .12$, $p < .01$; Grades 9–10: $\beta = .10$, $p < .05$).

Han, Yoonsun	2014	Differential size of the discrimination-depression relationship among adolescents of foreign-born parents in the US	Depressive symptoms	The quantile regression results presented that the association between perceived discrimination and depressive symptoms was significant, yet, that there was a substantial difference in the size of the stressor-response relationship along the conditional depressive symptoms distribution. The estimated coefficients for the 25th, 50th, 75th, and 90th percentiles were 0.19 ($p = .001$), 0.19 ($p = .020$), 0.28 ($p = .016$), and 0.67 ($p = .001$), respectively. Such results indicated that on the 90th conditional quantile, the experience of perceived discrimination was associated with having a higher depressive symptom score by 0.67 points, after accounting for other stressors and control variables.
Lambert, S. F. Robinson, W. L. Ialongo, N. S.	2014	The role of socially prescribed perfectionism in the link between perceived racial discrimination and African American adolescents' depressive symptoms	Depressive symptoms	Racial discrimination in 7th grade predicted increases in socially prescribed perfectionism in 8th grade ($\beta = .07$, $p < .05$), and eighth grade socially prescribed perfectionism predicted increases in depressive symptoms ($\beta = .06$, $p < .05$). However, the indirect effect was not significant, and a model including the direct effect of 7th grade discrimination on 9th grade depressive symptoms had a significantly improved fit over the model without the direct effect ($\chi^2 \text{ diff } (1) = 7.20$, $p < .01$).
Niwa, Erika Y. Way, Niobe Hughes, Diane L.	2014	Trajectories of Ethnic-Racial Discrimination Among Ethnically Diverse Early Adolescents: Associations with Psychological and Social Adjustment	Self-esteem; Depressive symptoms	Hierarchical linear regression analyses were conducted to predict psychological and social adjustment in eighth grade from cluster membership after controlling for demographics and sixth-grade adjustment. Adolescents in the moderate-stable adult discrimination cluster were more likely to have lower self-esteem than those who experienced no adult discrimination ($b = -.19$, $p < .001$). Adolescents in the moderate and high-decreasing peer discrimination clusters were more likely to have lower self-esteem than those who experienced no peer discrimination ($b = -.28$, $p < .05$; $b = -.19$, $p < .001$). Adolescents in the moderate-stable adult discrimination profile were more likely to have higher depressive symptoms than their peers who experienced no adult discrimination ($b = .12$, $p < .001$). Only adolescents in the moderate-decreasing peer discrimination profile ($b = .16$, $p < .05$) were more likely to have higher depressive symptoms than those who experienced no peer discrimination but there was no difference between the high- and low-decreasing profiles.

Smith-Bynum, M. A. Lambert, S. F. English, D. Ialongo, N. S.	2014	Associations between trajectories of perceived racial discrimination and psychological symptoms among African American adolescents	Depressive symptoms; Aggressive behaviour; Anxious symptoms	In grades 9 and 10, adolescents in the increasing discrimination trajectory reported significantly more anxious and depressive symptoms than adolescents in the stable low discrimination trajectory (all significant at the $p < .01$ level). The likelihood of being in the increasing depression trajectory was significantly greater for youth in the increasing discrimination trajectory than for youth in the low discrimination trajectory (logit = 1.67, $p < .01$). The probability of being in the high aggression trajectory was nearly 2 times greater (.13/ .07) for youth in the increasing discrimination trajectory than the low discrimination trajectory. However, the regression of high aggression trajectory on the increasing discrimination trajectory was not significant (logit = .73, ns).
Unger, J. B. Schwartz, S. J. Huh, J. Soto, D. W. Baezconde-Garbanati, L.	2014	Acculturation and perceived discrimination: predictors of substance use trajectories from adolescence to emerging adulthood among Hispanics	Cigarette smoking; Alcohol use; Marijuana use	Growth curve analyses examined each participant's trajectory of substance use from 9th grade (2005) to EA follow-up (2012) and identified variables (in 9th grade) that predict the intercept (initial level) and linear slope of the growth trajectory. Analysis found that perceived discrimination at baseline was positively associated with the intercept (initial level) of tobacco ($\beta = .064$), alcohol ($\beta = .117$), and marijuana use ($\beta = .108$) (all $p < .05$) but not the slope.
Adam, E. K. et al.	2015	Developmental histories of perceived racial discrimination and diurnal cortisol profiles in adulthood: A 20-year prospective study	Waking cortisol; Cortisol awakening response; Diurnal cortisol slope; Average cortisol across the day	There were no significant effects of cumulative racism on waking cortisol for Whites. A significant race by cumulative racism interaction revealed that for Blacks, waking cortisol decreased 17% for every 1 SD higher cumulative racism from adolescence through young adulthood ($b = -.185$, $p = .006$). There was a significant effect of cumulative racism on the cortisol awakening response, with the CAR being 18% lower for every SD increase in cumulative racism ($b = -.197$, $p = .008$). There was a significant effect of cumulative racism on diurnal cortisol slope, with cortisol slopes declining 1% per hour more slowly (being 1% flatter) for every SD increase in cumulative racism from adolescence through young adulthood for both Blacks and Whites ($b = .012$, $p = .008$). There was no significant effect of cumulative PRD on average cortisol across the day ($b = 1.22$, $p = .65$).

Correa-Velez, I. Gifford, S. M. McMichael, C.	2015	The persistence of predictors of wellbeing among refugee youth eight years after resettlement in Melbourne, Australia	Subjective health; Happiness	Perceived discrimination was a significant predictor of wellbeing; refugee migrant youth who had experienced discrimination scored significantly lower in both subjective health status (0.32 lower on average; 95% CI:0.59-0.05; p.022) and levels of happiness (0.37 lower on average; 95% CI: 0.57-0.17; p<.001).
Harding, S., et al.	2015	The Determinants of young Adult Social well-being and Health (DASH) study: diversity, psychosocial determinants and health	SDQ total difficulties score (socioemotional difficulties)	Perceived racism was consistently associated with poorer psychological well-being across gender, ethnicity and age. For example, mean difference in total difficulties scores between boys who experienced racism and those who did not at age 12 years was -1.88 (-1.75 to -2.01) and at 16 years was -1.19 (-1.07 to -1.31)
Hou, Y. Kim, S. Y. Wang, Y. Shen, Y. Orozco-Lapray, D.	2015	Longitudinal Reciprocal Relationships Between Discrimination and Ethnic Affect or Depressive Symptoms Among Chinese American Adolescents	Depressive symptoms	To test bidirectional relationships between discrimination and adolescent outcomes, a model was fitted with family income and parental educational level, adolescents' age, gender, and nativity as covariates (model fit was good). Within this model, more perceived discrimination at T1 related to more depressive symptoms at T2 ($\beta=.13$, $p<.05$), and this association remained significant from T2 to T3 ($\beta=.13$, $p<.05$). Conversely, more depressive symptoms at T2 related to more perceived discrimination at T3.
Kogan, S. M. Yu, T. Allen, K. A. Brody, G. H.	2015	Racial microstressors, racial self-concept, and depressive symptoms among male African Americans during the transition to adulthood	Depressive symptoms	SEM models of the association between racism and depression controlling for hostility, conduct problems, affiliations with deviant peers, and socioeconomic disadvantage found that racial discrimination from ages 16 to 18 significantly predicted changes in depressive symptoms at age 20 ($b=.19$, $p<.05$).

Lorenzo-Blanco, E. I. Unger, J. B.	2015	Ethnic Discrimination, Acculturative Stress, and Family Conflict as Predictors of Depressive Symptoms and Cigarette Smoking Among Latina/o Youth: The Mediating Role of Perceived Stress	Perceived stress; Depressive symptoms; Cigarette smoking	Standardized path coefficients indicated that everyday discrimination was associated with higher levels of perceived stress ($b=.14$, $p<.001$), and perceived stress, in turn, was related with higher levels of depressive symptoms ($b=.46$, $p<.001$) and more cigarette smoking ($b=.09$, $p<.05$). The direct links from everyday discrimination to symptoms of depression and cigarette smoking were not significant.
Ríos-Salas, Vanessa Larson, Andrea	2015	Perceived discrimination, socioeconomic status, and mental health among Latino adolescents in US immigrant families	Depressive symptoms; Self-esteem	Multivariate logistic regression analysis found that adolescents who reported experiencing societal discrimination were significantly more likely to score in the top 50th (OR:1.27, $p<.01$), 25th (OR:1.31, $p<.01$), and 10th (OR:1.28, $p<.01$) percentiles of depressive symptoms. This was also the case for adolescents who reported experiencing interpersonal discrimination (50th - OR:1.54, $p<.01$; 25th - OR:1.65, $p<.01$; 10th - OR:1.30, $p<.05$). Perceived societal discrimination was found to be associated with the likelihood of falling below the median score of self-esteem (50th percentile - OR:1.11, $p<.05$), while non-significant associations between interpersonal discrimination and low self-esteem scores were found (bottom 25% - OR:1.29, $p=.10$; 10% - OR:1.30, $p=.10$).
Anderson, R. E. et al.	2015	Pathways to Pain: Racial Discrimination and Relations Between Parental Functioning and Child Psychosocial Well-Being	Emotional problems	Structural equation modelling was used to evaluate the fit of the hypothesized model and to examine whether parental experiences with discrimination were related to children's emotional and behavioural problems directly and indirectly through parent depression and parenting behaviours. In analysis of direct effects, parent reported discrimination was found to be positively related to children's emotional problems ($\beta=.25$, $p<.01$).
Rosenthal, Lisa, et al.	2015	Weight- and race-based bullying: Health associations among urban adolescents	Systolic blood pressure; Diastolic blood pressure; BMI; Overall self-rated health	Regression analyses were conducted to test whether weight- and race-based bullying during T2 had direct associations with the four health outcome variables during T2. Weight- and race-based bullying were entered as simultaneous predictors in all four analyses that had the four health variables as outcomes (systolic blood pressure, diastolic blood pressure, BMI and overall self-rated health during T2). Because the same outcome variables from T1 were controlled, these analyses predicted change in the health variables from T1 to T2. All direct

associations between race-based bullying and health outcomes were non-significant.

Becares, L. Nazroo, J. Kelly, Y.	2015	A longitudinal examination of maternal, family, and area-level experiences of racism on children's socioemotional development: Patterns and possible explanations	Socioemotional difficulties	Maternal experiences of racist insults and disrespectful treatment from shop staff, and family experiences of unfair treatment at T1, all had a direct effect on children's socioemotional development at T3 (Coefficient for direct effect of racist insults: 1.048, bias corrected 95% Confidence Interval: 0.42-1.81; Coefficient for direct effect of disrespectful treatment from shop staff: 1.168, bias corrected 95% Confidence Interval: 0.33-1.93; Coefficient for direct effect of family experiences of unfair treatment: 0.690, bias-corrected 95% Confidence Interval: 0.08-1.40). Maternal unfair treatment and living in an area where racially motivated insults and attacks are fairly or very common were not associated with children's emotional difficulties.
Sirin, Selcuk R., et al.	2015	Discrimination-Related Stress Effects on the Development of Internalizing Symptoms Among Latino Adolescents	Anxious-depressed; Withdrawn-depressed; Somatic symptoms	To determine whether discrimination-related stress predicted the health outcomes over time, a time-varying predictor of discrimination-related stress was added to each model. Discrimination-related stress was found to significantly predict the level of anxious-depressed symptoms ($b=.05$, $p.02$) and withdrawn-depressed symptoms ($b=.06$, $p.004$) over time. However, marginally significant associations were found for somatic symptoms ($b=.04$, $p.06$) over time.
Wheeler, L. A. Updegraff, K. A. Crouter, A.	2015	Mexican-origin parents' work conditions and adolescents' adjustment	Did not test for direct associations (only indirect associations in mediation analysis)	

Yip, Tiffany	2015	The Effects of Ethnic/Racial Discrimination and Sleep Quality on Depressive Symptoms and Self-Esteem Trajectories Among Diverse Adolescents	Depressive symptoms; Self-esteem; Anxiety	Discrimination was associated with higher levels of initial values of depressive symptoms ($b=.06$, $p<.05$). Discrimination was not related to initial levels of self-esteem or higher initial levels of anxiety.
Zeiders, K. H. Umana-Taylor, A. J. Updegraff, K. A. Jahromi, L. B.	2015	An idiographic and nomothetic approach to the study of Mexican-origin adolescent mothers' socio-cultural stressors and adjustment	Depressive symptoms; Risk-taking behaviours	A marginally significant within-person discrimination effect was found ($b=2.41$, $p=.05$), suggesting that increases in discrimination levels within an individual related to increases in depressive symptoms at a subsequent wave, taking into account prior levels of depressive symptoms and other covariates (e.g., age at T1, nativity, economic hardship). A significant between-person discrimination effect also emerged ($b=8.24$, $p<.001$) suggesting that individuals who reported greater experiences of discrimination (compared to the overall sample), tended to report greater depressive symptoms. While no within-person effect was found for discrimination and risk-taking behaviours, a significant between-person effect was seen ($b=.17$, $p<.01$) suggesting that individuals who reported greater levels of discrimination (compared to the overall sample mean), tended to report greater risk-taking behaviours.
Alderete, Ethel, et al.	2016	Effect of appreciation for Indigenous cultures and exposure to racial insults on alcohol and drug use initiation among multiethnic Argentinean youth	Alcohol use in previous month; Binge drinking in previous month; Marijuana use; Inhalant or solvent use; Cocaine use; Other drug use	In multivariate logistic regression models exposure to racial insults increased rates of binge drinking in the previous 30 days ($OR = 1.6$; 95% $CI = 1.2-2.1$). Exposure to racial insults was not a significant risk factor for general alcohol use in the past month or any form of drug/substance use.

Armenta, B. E. Sittner, K. J. Whitbeck, L. B.	2016	Predicting the Onset of Alcohol Use and the Development of Alcohol Use Disorder Among Indigenous Adolescents	Onset of alcohol use; Alcohol use disorder	Perceived discrimination was positively and significantly related to the development of an alcohol use disorder ($\beta=.17$, $p<.01$) but not significantly related to the onset of alcohol use.
Brody, Gene H. Miller, Gregory E. Yu, Tianyi Beach, Steven R. H. Chen, Edith	2016	Supportive family environments ameliorate the link between racial discrimination and epigenetic aging: A replication across two longitudinal cohorts	Epigenetic aging	For the SHAPE cohort, no main effects were detected. For the AIM cohort, high and stable levels of racial discrimination were associated with a higher epigenetic aging score at age 22, $b=1.470$, 95% CI (0.236-2.704), $p=.020$.
Davis, Alexandra N., et al.	2016	The Longitudinal Associations Between Discrimination, Depressive Symptoms, and Prosocial Behaviours in U.S. Latino/a Recent Immigrant Adolescents	Depressive symptoms; Altruistic prosocial behaviour; Public prosocial behaviour	The mental health strain model included the direct (i.e., unmediated) associations between discrimination at T1 and prosocial behaviours at T3, as well as a mediated path through depressive symptoms. Results indicated that discrimination at T1 positively predicted depressive symptoms at T2 ($\beta=.29$, $p<.001$). The direct links between discrimination at T1 and prosocial behaviours at T3 were not statistically significant
Espinoza, G. Gonzales, N. A. Fuligni, A. J.	2016	Parent Discrimination Predicts Mexican-American Adolescent Psychological Adjustment 1 Year Later	Internalising symptoms; Externalising symptoms; Self-esteem; Substance use	A series of hierarchical linear regressions predicting internalizing problems revealed that after accounting for the controls (i.e., gender, grade, generational status, school, parent education, whether mother was primary caregiver, adolescent discrimination and T1 internalizing problems), parent discrimination was a significant predictor of internalising problems ($\beta=.12$, $p<.05$) and self-esteem ($\beta=-.14$, $p<.01$). As parent reports of discrimination increased, there was an increase in their adolescents' internalizing problems and a decrease in their self-esteem one year later. The models predicting externalizing problems and substance use revealed that parent discrimination did not predict these adjustment indicators.

Hautala, Dane Steven	2016	Three studies examining the mechanisms linking stress exposure to delinquency and substance use among North American indigenous adolescents	Aggression; Depressive symptoms	Perceived racial discrimination did not have an effect on aggression at T3 in the multivariate models. Instead, the effect seems to be completely indirect. Perceived racial discrimination had a marginal positive effect on T3 depressive symptoms ($\beta=.07$, $p=.07$).
Hughes, Diane Del Toro, Juan Harding, Jessica F. Way, Niobe Rarick, Jason R. D.	2016	Trajectories of Discrimination Across Adolescence: Associations with Academic, Psychological, and Behavioural Outcomes	Psychological adjustment; Behaviour problems	Parameter estimates from the unconditional growth models were estimated for the latent intercepts and latent slopes for each of the three indicators of perceived discrimination separately. The intercept of perceived discrimination from non-school adults predicted significantly more behaviour problems ($\beta=.03$, $p<.001$) at the end of eighth grade but no significant association with psychological adjustment ($\beta=-.03$, $p<.10$). The sixth-grade intercept of overt peer discrimination predicted significantly poorer psychological adjustment ($\beta=-.10$, $p<.001$) in eighth grade and more behaviour problems in 8th ($\beta=.02$, $p<.001$). Covert peer discrimination in sixth grade predicted significantly more behaviour problems in eighth grade ($\beta=.03$, $p<.001$) and only marginally significantly worse psychological adjustment ($\beta=-.12$, $p<.10$).

Lorenzo-Blanco, Elma I. Unger, Jennifer B. Oshri, Assaf Baezconde-Garbanati, Lourdes Soto, Daniel	2016	Profiles of bullying victimization, discrimination, social support, and school safety: Links with Latino/a youth acculturation, gender, depressive symptoms, and cigarette use	Depression; Lifetime cigarette use; Past 30-day cigarette use	Multinomial logistic regression analyses were used to examine the associations of profile groups (highest perceived discrimination and lowest protective factor, high bullying and high social support, very high bullying and very high discrimination, highest protective and lowest risk factor) with depressive symptoms and cigarette smoking by treating depressive symptoms and cigarette smoking as distal outcomes. At T1 and T2, youth in the Highest Protective and Lowest Risk Factor Group reported the lowest levels of depressive symptoms (T1 mean: 1.57, T2 mean: 1.68), and youth in the Very High Bullying and Very High Perceived Discrimination Group reported the highest levels of symptoms of depression (T1 mean: 2.38, T2 mean: 2.21). Across time points (T1–3), youth in the Highest Perceived Discrimination and Lowest Protective Factor Group (T3 OR:2.5; 95%CI:1.5-3.4), youth in the High Bullying and High Social Support Group (T3 OR:1.3; 95% CI:0.9-1.7), and youth in the Very High Bullying and Very High Perceived Discrimination Group (T3 OR: 2.0; 95%CI:0.7-3.3) were more likely to have smoked cigarettes at some point in their lives compared to youth in the Highest Protective and Lowest Risk Factor Group (reference group). A similar pattern of results emerged for past-30-day smoking. At T1-3, youth in the Highest Perceived Discrimination and Lowest Protective Factors Group (T3 OR:2.6; 95%CI:1.6-3.7) and youth in the Very High Bullying and Very High Perceived Discrimination Group (T3 OR:2.4; 95%CI:0.7-4.1) were much more likely to report past-30-day smoking than youth in the High Bullying and High Social Support Group (T3 OR:0.5; 95%CI:0.2-0.9) and youth in the Highest Protective and Lowest Risk Factor Group (reference group).

Evans, S. Z. Simons, L. G. Simons, R. L.	2016	Factors that Influence Trajectories of Delinquency Throughout Adolescence	Delinquency	Group-based trajectory models were used to identify four trajectory groups regarding onset and frequency of delinquency throughout adolescence. These groups included a 'negligible delinquency' group (increased their offending only slightly through adolescence), an 'early starter/declining' group (individuals that begin at a high level of offending but decrease gradually over time), a 'late starters' group (adolescents that begin with one of the lowest levels of offending but then sharply increase to have one of the highest average rates) and an 'early starter/chronic' group (individuals with the highest levels of delinquency throughout adolescence). Multinomial logistic regression was then used to determine associations with predictor variables. Experiences with racial discrimination increased the odds of being in the early starter/declining group compared with the early starter/chronic group (OR:0.97, $p<.05$) and of being in the early starter/chronic group compared with the negligible group (OR: 1.07, $p<.05$). Change in racial discrimination experiences increased the odds of being in all groups except the early starter/declining group compared to the negligible group (ORs ranging from 0.95-1.05, all $p<.05$).
Richardson, B.L.	2016	The relationships between African American adolescents' daily racial discrimination, daily racial socialization, and racial identity with academic and psychological outcomes	Positive affect; Negative affect	Hierarchical linear regression models were used to determine that daily racial discrimination was not related to daily positive affect ($b=0.56$, $p=.29$) and there was a marginally significant effect of daily racial discrimination on daily negative affect ($b=0.99$, $p=.06$).
Stein, G. L. Supple, A. J. Huq, N. Dunbar, A. S. Prinstein, M. J.	2016	A longitudinal examination of perceived discrimination and depressive symptoms in ethnic minority youth: The roles of	Depressive symptoms	The main effects model included the two discrimination latent factors (intercept and slope) and the predictor variables. Positive associations between intercept latent factors representing baseline peer discrimination and adult discrimination were found with depressive symptoms in these models (peer discrimination coefficient: .17, $p<.01$; adult discrimination coefficient: .22, $p<.001$). A statistically significant association indicating that increased reports of discrimination from

		attributional style, positive ethnic/racial affect, and emotional reactivity		peers were positively associated with increased depressive symptoms (coefficient: .35, $p < .05$). This same association, however, was nonsignificant in the discrimination-from-adults model.
Unger, Jennifer B. Soto, Daniel W. Baezconde-Garbanati, Lourdes	2016	Trajectories of perceived discrimination from adolescence to emerging adulthood and substance use among Hispanic youth in Los Angeles	Cigarette smoking; Alcohol use; Marijuana use; Hard drugs use	Compared with the group with low and stable discrimination (group 1), the group with increasing discrimination (group 2) had a higher risk of alcohol (OR: 1.4; 95%CI: 1.1-1.8), marijuana (OR: 1.4; 95%CI: 1.2-1.7), and hard drug use (OR: 1.8; 95%CI: 1.4-2.3). The group with initially high but decreasing discrimination (group 3) had a higher risk of cigarette smoking (OR: 1.5; 95%CI: 1.2-1.9) and alcohol use (OR: 1.6; 95%CI: 1.2-2.2). The group with high and stable discrimination (group 4) had a higher risk of alcohol (OR: 2.1; 95%CI: 1.4-3.1), marijuana (OR: 1.5; 95%CI: 1.1-2.0), and hard drug use (OR: 2.0; 95%CI: 1.4-2.8).
Lo, C. C. Hopson, L. M. Simpson, G. M. Cheng, T. C.	2017	Racial/Ethnic Differences in Emotional Health: A Longitudinal Study of Immigrants' Adolescent Children	Depression; Self-esteem	Although significant cross-sectional associations between perceived discrimination and the perception that discrimination would continue regardless of education were found with depression and self-esteem (T2 to T2) for Hispanic and Asian adolescents, no associations were found between discrimination and health outcomes longitudinally (T2-T1 discrimination and T2 health outcome) across any ethnic group.
Park, I. J. Wang, L. Williams, D. R. Alegria, M.	2017	Does anger regulation mediate the discrimination-mental health link among Mexican-origin adolescents? A longitudinal mediation analysis using multilevel modelling	Anxiety; Depression	With regard to the average within-person total effects of perceived discrimination (PRaCY) on mental health, both total effects were statistically significant ($c^* = .362$, $p = .0013$ for anxiety, and $c^* = .455$, $p < .0001$ for depression); that is, perceived racial/ethnic discrimination was associated with more anxiety and depression, respectively, intra-individually over time.
Priest, N. Perry, R. Ferdinand, A. Kelaheer, M. & Paradies, Y.	2017	Effects over time of self-reported direct and vicarious racial discrimination on depressive symptoms	Loneliness; Depressive symptoms	Direct racism was found to be positively and independently associated with both loneliness ($\beta = .291$, $p = .001$) and depressive symptoms ($\beta = .431$, $p = .000$) over time. Vicarious racism was found to be unrelated to both loneliness ($\beta = .074$, $p = .359$) and depression ($\beta = .172$, $p = .172$).

		and loneliness among Australian school students		
Shepherd, Carrington C.J. Li, Jianghong Cooper, Matthew N. Hopkins, Katrina D. Farrant, Brad M.	2017	The impact of racial discrimination on the health of Australian Indigenous children aged 5–10 years: analysis of national longitudinal data	Mental health; General health; Sleep difficulties; Obesity; Injury; Asthma	In fully adjusted models, children exposed to direct racism were found to be at significantly increased risk of negative mental health (OR: 2.3; 95%CI: 1.5-3.5), sleep difficulties (OR: 2.7; 95%CI: 1.8-4.2), obesity (OR: 1.6; 95%CI: 1.0-2.7) and asthma (OR: 2.0; 95%CI: 1.2-3.5) but not poor general health or injury. Primary carer perceptions of racism significantly increased the risk of sleep difficulties (OR: 1.9; 95%CI: 1.2-3.2) and asthma (OR: 2.6; 95%CI: 1.4-4.7) in fully adjusted models where racism was persistent (experienced twice opposed to a single exposure). No associations were found between primary carer perceived racism and negative mental health, obesity, poor general health or injury. Primary carer perceptions of family racism did not significantly increase the risk of any health outcomes for children.
Walker, Rheeda, et al.	2017	A Longitudinal Study of Racial Discrimination and Risk for Death Ideation in African American Youth	Death ideation; Depressive symptoms; Anxiety symptoms	A significant positive association was found for T1 racial discrimination and later, death ideation at T2, $r(722)=.21$, $p<.05$, as well as T2 depressive symptoms, $r(722)=.17$, $p<.05$ and T2 anxiety symptoms, $r(722)=.18$, $p<.05$.
Zeiders, K. H.	2017	Discrimination, daily stress, sleep, and Mexican-origin adolescents' internalizing symptoms	Daily stress levels; Daily sleep quality; Daily sleep duration	Structural equation modelling was used to examine the relations between discrimination, daily stress and sleep behaviours. Findings suggested that perceived discrimination predicted daily stress levels ($\beta=.27$, $p<.01$) and sleep quality ($\beta=-.26$, $p<.05$), but did not predict daily sleep duration.

Garrett, et al.	2017	The effects of perceived racial/ethnic discrimination on substance use among youths living in the Cherokee Nation	Cigarette smoking; Past month alcohol use; Past month heavy drinking; Prescription drug misuse; Marijuana use; Other drugs use	Compared to those who reported experiencing no perceived racial discrimination, those who reported high frequency of perceived racial discrimination were significantly more likely to report heavy alcohol use, prescription drug misuse, and other drug use. After controlling for potential confounders, large and statistically significant effects were seen on heavy alcohol use (OR: 2.48 95% CI: 1.01, 6.13), prescription drug misuse (OR: 4.67 95% CI: 1.87, 11.69), and other drug use (OR: 6.66 95% CI: 2.05, 21.64). The effects on past month alcohol use, marijuana and smoking cigarettes, however, were not statistically significant after adjustment for potential confounders.

¹ Associations between racial discrimination and health outcomes were considered unique where exposure variables were modelled with outcomes on independent populations. Where studies ran analysis on multiple racial discrimination exposure variables (e.g. measuring direct racism and vicarious racism or racism perpetrated by peers and racism perpetrated by adults), each association between a racial discrimination exposure variable and health outcome was considered unique. Associations were also considered unique where studies ran analysis on independent sub-samples of the population (e.g. males and females). Associations testing effect modification by individual variables (e.g. gender) were not considered unique. Finally, population sub-groups identified through analysis such as group-based trajectory modelling were not considered independent and any associations between multiple racial discrimination trajectory groups (e.g. high and stable discrimination, low and increasing discrimination, etc.) and a health outcome were considered as a single unique association.

² No direct associations were recorded for studies which conducted mediation analysis without testing a direct association between racial discrimination and a health outcome.

³ Only longitudinal associations were considered in studies examining both cross-sectional and longitudinal associations between racial discrimination and health outcomes.

Supplementary Table 4: Publications considered ineligible for inclusion

Title	Reason
Negative Effect of Racial Discrimination on Minority Youth in the Juvenile Justice System (396)	No health outcome
Ethnic and gender differences in self-esteem (397)	Racial discrimination not exposure variable
Negative Affect and Alcohol Use Among Non-Hispanic White and Mexican American Adolescents (398)	Cross-sectional
Negotiating race and racism: Black youth in racially dissonant schools (399)	Cross-sectional
The Effects of Socioeconomic Status, Perceived Discrimination and Mastery on Health Status in a Youth Cohort (400)	Racial discrimination not exposure variable
Perceived school environments, perceived discrimination, and school performance among children of Mexican immigrants (401)	No health outcome
Large arterial elasticity varies as a function of gender and racism-related vigilance in black youth (402)	Experimental study
Interactive Effects of Perceived Racism and Coping Responses Predict a School-Based Assessment of Blood Pressure in Black Youth (403)	Cross-sectional
Why are you following me? the impact of perceived negative youth experiences on the behavioural and emotional outcomes in African American urban youth (404)	Cross-sectional
Discrimination and exiting homelessness among homeless adolescents (405)	Racial discrimination not exposure variable
Longitudinal trajectories of ethnic identity among urban Black and Latino adolescents (406)	No health outcome
Race–Ethnic Inequality and Psychological Distress: Depressive Symptoms from Adolescence to Young Adulthood (407)	Racial discrimination not exposure variable
Explaining racial and ethnic differences in children's use and stimulant medications (408)	Racial discrimination not exposure variable
Cultural identity and experiences of prejudice and discrimination of Afghan and Iranian immigrant youth (409)	Qualitative data
Cultural stressors, supportiveness, and psychopathology among Mexican American adolescents: A test of three competing models (410)	Cross-sectional
The "model minority" and their discontent: examining peer discrimination and harassment of Chinese American immigrant youth (411)	No health outcome
A closer look at peer discrimination, ethnic identity, and psychological well-being among urban Chinese American sixth graders (412)	Cross-sectional
Racial identity, social context, and race-related social cognition in African Americans during middle childhood (413)	No health outcome

Latino adolescents' academic success: The role of discrimination, academic motivation, and gender (414)	No health outcome
Intergenerational Experiences of Discrimination in Chinese American Families: Influences of Socialization and Stress (415)	No health outcome
Identity stability and change among ethnic minority adolescents and the dynamics of stigma and identity in the context of schools and academic achievement (416)	No health outcome
Perceived discrimination and linguistic adaptation of adolescent children of immigrants (417)	No health outcome
Cultural Differentiation or Self-Exclusion: On Young Turks' and Repatriates' Dealing with Experiences of Discrimination in Germany (418)	No health outcome
A longitudinal examination of parenting behaviours and perceived discrimination predicting Latino adolescents' ethnic identity (419)	No health outcome
Integrated schools, segregated curriculum: effects of within-school segregation on adolescent health behaviours and educational aspirations (420)	No health outcome
Perceived racial, socioeconomic and gender discrimination and its impact on contraceptive choice (421)	Age range >18yrs
Social determinants of adolescent risk behaviours: An examination of depressive symptoms and sexual risk, substance use, and suicide risk behaviours (422)	Cross-sectional
The intersection of school racial composition and student race/ethnicity on adolescent depressive and somatic symptoms (423)	Cross-sectional
Examining the association between discrimination and risky social networks among illicit drug users (424)	Age range >18yrs
School racial composition and race/ethnic differences in early adulthood health (425)	Racial discrimination not exposure variable
Racial discrimination and racial socialization as predictors of African American adolescents' racial identity development using latent transition analysis (426)	No health outcome
Ethnic identity and gender as moderators of the association between discrimination and academic adjustment among Mexican-origin adolescents (427)	No health outcome
Racial differences in age at first sexual intercourse: residential racial segregation and the black-white disparity among U.S. adolescents (428)	Racial discrimination not exposure variable
Residential racial segregation and racial differences in sexual behaviours: an 11-year longitudinal study of sexual risk of adolescents transitioning to adulthood (429)	Racial discrimination not exposure variable
The role of residential segregation in racial health disparities during childhood (430)	Racial discrimination not exposure variable
Racial discrimination, racial/ethnic segregation, and health behaviours in the CARDIA study (431)	Age range >18yrs
Perceived Discrimination and Children's Mental Health Symptoms (432)	Cross-sectional

The relationship between risk and resilience, racial microaggression, ethnic identity, and well-being in young adulthood (433)	Age range >18yrs
Acculturative stress or resilience? A longitudinal multilevel analysis of sojourners' stress and self-esteem (434)	Racial discrimination not exposure variable
Cross-generational effects of discrimination among immigrant mothers: perceived discrimination predicts child's healthcare visits for illness (435)	Cross-sectional
Exploring the impact of skin tone on family dynamics and race-related outcomes (436)	No health outcome
Social determinants of adolescent depression: an examination of racial difference (437)	Cross-sectional
The Role of Perceived Peer Prejudice and Teacher Discrimination on Adolescent Substance Use: A Social Determinants Approach (438)	Cross-sectional
Association between childhood school segregation and changes in adult sense of control in the African American health cohort (439)	Age range >18yrs
Racial discrimination is associated with distressing subthreshold positive psychotic symptoms among US urban ethnic minority young adults (440)	Age range >18yrs
Perceptions of intragroup rejection and coping strategies: malleable factors affecting Hispanic adolescents' emotional and academic outcomes (441)	Racial discrimination not exposure variable
Why and when is ethnic harassment a risk for immigrant adolescents' school adjustment? understanding the processes and conditions (442)	No health outcome
A mediational model of racial discrimination and alcohol-related problems among African American college students (443)	Age range >18yrs
Workplace Discrimination Predicting Racial/Ethnic Socialization Across African American, Latino, and Chinese Families (444)	No health outcome
Race-ethnic discrimination, major depression, and alcohol use disorder among us-born and immigrant minorities: Using a nationally representative sample to test the moderating relationships of cultural and social factors (445)	Age range >18yrs
Predicting high-risk versus higher-risk substance use during late adolescence from early adolescent risk factors using latent class analysis (446)	Racial discrimination not exposure variable
Racial and Gender Discrimination, Early Life Factors, and Chronic Physical Health Conditions in Midlife (447)	Age range >18yrs
Cumulative structural disadvantage and racial health disparities: the pathways of childhood socioeconomic influence (448)	Age range >18yrs
Risk pathways for suicide among Native American adolescents (449)	Qualitative data
Mexican origin youths' trajectories of perceived peer discrimination from middle childhood to adolescence: variation by neighbourhood ethnic concentration (450)	No health outcome

The developmental influence of skin tone on psychosocial outcomes among African American youth (451)	No health outcome
Racial/Ethnic Discrimination, Posttraumatic Stress Symptoms, and Alcohol Problems in a Longitudinal Study of Hispanic/Latino College Student (452)	Age range >18yrs
Perceived Discrimination and Heavy Episodic Drinking Among African-American Youth: Differences by Age and Reason for Discrimination (453)	Age range >18yrs
The Role of Racial Discrimination in the Economic Value of Education Among Urban, Low-Income Latina/o Youth: Ethnic Identity and Gender as Moderators (454)	No health outcome
When do immigrant adolescents feel personally discriminated against? Longitudinal effects of peer preference (455)	No health outcome
Genetic sensitivity to emotional cues, racial discrimination and depressive symptoms among African-American adolescent females (456)	Cross-sectional
An Unwelcomed Digital Visitor in the Classroom: The Longitudinal Impact of Online Racial Discrimination on Academic Motivation (457)	No health outcome
Resilience to adversity and the early origins of disease (458)	Review paper
Adding to the Education Debt: Depressive Symptoms Mediate the Association between Racial Discrimination and Academic Performance in African Americans (459)	No health outcome
Effects of minority status and perceived discrimination on mental health (460)	Age range >18yrs
Immigrant optimism or anticipated discrimination? Explaining the first educational transition of ethnic minorities in England (461)	No health outcome
The Influence of General Discrimination and Social Context on Young Urban Expecting Couples' Mental Health (462)	Age range >18yrs
The influence of perceived racial discrimination on depressive symptoms and school outcomes among Asian American adolescents (463)	Cross-sectional
Romantic Relationship Commitment Behaviour Among Emerging Adult African American Men (464)	No health outcome
Latino parent acculturation stress: Longitudinal effects on family functioning and youth emotional and behavioural health (465)	Racial discrimination not exposure variable
Longitudinal Effects of Latino Parent Cultural Stress, Depressive Symptoms, and Family Functioning on Youth Emotional Well-Being and Health Risk Behaviours (466)	Racial discrimination not exposure variable
A Longitudinal Study of the Effects of Discrimination on the Acculturation Strategies of International Students (467)	No health outcome
Discrimination-Related Stress and Behavioural Engagement: The Moderating Effect of Positive School Relationships (468)	No health outcome

Racial Socialization, Racial Identity, and Academic Attitudes Among African American Adolescents: Examining the Moderating Influence of Parent-Adolescent Communication (469)	No health outcome
How school norms, peer norms, and discrimination predict interethnic experiences among ethnic minority and majority youth (470)	No health outcome
Racial discrimination, weakened school bonds, and problematic behaviours: Testing a theory of African American offending (471)	No health outcome
Cumulative Effect of Racial Discrimination on the Mental Health of Ethnic Minorities in the United Kingdom (109)	Age range >18yrs
Neighbourhood Characteristics and Expectations of Racially Discriminatory Experiences Among African American Adolescents (472)	No health outcome
A prospective, longitudinal study of cigarette smoking status among North American Indigenous adolescents (473)	Racial discrimination not exposure variable
Racial Discrimination during Adolescence Predicts Mental Health Deterioration in Adulthood: Gender Differences among Blacks (474)	Age range >18yrs
In Pursuit of Belonging: Acculturation, Perceived Discrimination, and Ethnic--Racial Identity among Latino Youths (475)	No health outcome
Impostor phenomenon and mental health: The influence of racial discrimination and gender (476)	Racial discrimination not exposure variable
Racial Discrimination, Racial Socialization, and Crime: Understanding Mechanisms of Resilience (477)	No health outcome
Ethnic/racial discrimination moderates the effect of sleep quality on school engagement across high school (478)	No health outcome
Racial discrimination and perinatal sleep quality (479)	Age range >18yrs
Racial discrimination mediates race differences in sleep problems: A longitudinal analysis (480)	Age range >18yrs
Asian Americans: The mediating effects of family on the longitudinal impact of discrimination on self-esteem and wellbeing (481)	Age range >18yrs
Acculturation-related stressors and Latino immigrant adolescent depressive symptoms: A multiple mediation analysis of stressors and resources by gender and immigrant generational status (482)	Racial discrimination not exposure variable
Can Interethnic Friends Buffer for the Prejudice Increasing Effect of Negative Interethnic Contact? A Longitudinal Study of Adolescents in the Netherlands (483)	Racial discrimination not exposure variable
Cigarette smoking initiation among youth in the United States: Nativity, acculturation, peer influences, and family bonding (484)	Racial discrimination not exposure variable

Perceived Discrimination and Mexican-Origin Young Adults' Sleep Duration and Variability: The Moderating Role of Cultural Orientations (485)	Age range >18yrs
Stress process of illicit drug use among U.S. immigrants' adolescent children: A longitudinal study (486)	Racial discrimination not exposure variable
A longitudinal study of acculturative stress and homesickness: high-school adolescents immigrating from Russia and Ukraine to Israel without parents (487)	No health outcome
Contextual stress and health risk behaviours among African American adolescents (488)	Racial discrimination not exposure variable
Stressors in multiple life-domains and the risk for externalizing and internalizing behaviours among African Americans during emerging adulthood (489)	Age range >18yrs
Longitudinal precursors of young adult light smoking among African Americans and Puerto Ricans (490)	Age range >18yrs
Perceived racial/ethnic discrimination, posttraumatic stress symptoms, and health risk behaviours among Mexican American adolescents (491)	Age range >18yrs
Patterns of acculturative stress: Continuity, discontinuity, and adjustment among Latino youth (492)	Racial discrimination not exposure variable
Acculturation, gender, depression, and cigarette smoking among U.S. Hispanic youth: the mediating role of perceived discrimination (493)	Racial discrimination not exposure variable
A longitudinal analysis of Hispanic youth acculturation and cigarette smoking: the roles of gender, culture, family, and discrimination (494)	Racial discrimination not exposure variable
Perceptions of discrimination, protective factors, and social development in adolescents (495)	Racial discrimination not exposure variable
'You Just Don't Understand Me!' Determinants of Second Generation Asian and Latino Youth Self-Esteem (496)	Racial discrimination not exposure variable
Perceived racial discrimination as a barrier to college enrolment for African Americans (497)	No health outcome
Childhood Adversity and Early Initiation of Alcohol Use in Two Representative Samples of Puerto Rican Youth (498)	Racial discrimination not exposure variable
A longitudinal examination of racial identity and racial discrimination among African American adolescents (499)	No health outcome
Racial identity, racial discrimination, perceived stress, and psychological distress among African American young adults (500)	Age >18yrs T2
Relational Schemas, Hostile Romantic Relationships, and Beliefs About Marriage among Young African American Adults (501)	No health outcome
Aggressive delinquency among North American Indigenous Adolescents: trajectories and predictors (502)	Racial discrimination not exposure variable

A longitudinal examination of Latino adolescents' ethnic identity, coping with discrimination, and self-esteem (503)	Racial discrimination not exposure variable
Racial/ethnic differences in weight-related teasing in adolescents (504)	Racial discrimination not exposure variable
School climate, discrimination, and depressive symptoms among Asian American adolescents (505)	Racial discrimination not exposure variable
Parental racial socialization as a moderator of the effects of racial discrimination on educational success among African American adolescents (506)	No health outcome
Gender differences in the association between perceived discrimination and adolescent smoking (507)	Cross-sectional
The protective role of ethnic identity for urban adolescent males facing multiple stressors (508)	Age >18yrs T2
Childhood school segregation and later life sense of control and physical performance in the African American Health cohort (509)	Racial discrimination not exposure variable
Mexican American adolescents' profiles of risk and mental health: A person-centred longitudinal approach (510)	Racial discrimination not exposure variable
Discrimination, racial identity, and cytokine levels among African-American adolescents (511)	Age >18yrs T2
Does health predict the reporting of racial discrimination or do reports of discrimination predict health? Findings from the National Longitudinal Study of Youth (69)	Age >18yrs T2
Racism, identity and psychological well-being: a longitudinal perspective on politically embattled relations (512)	Age >18yrs T2
The Role of Perceived Discrimination during Childhood and Adolescence in Understanding Racial and Socioeconomic Influences on Depression in Young Adulthood (513)	Age >18yrs T2
Associations between maternal experiences of racism and early child health and development: findings from the UK Millennium Cohort Study (514)	Cross-sectional
Context Matters: Links Between Neighbourhood Discrimination, Neighbourhood Cohesion and African American Adolescents' Adjustment (515)	Cross-sectional
Perceived Discrimination and Children's Mental Health Symptoms (432)	Cross-sectional
Depressive symptoms and externalizing behaviours among Hispanic immigrant adolescents: Examining longitudinal effects of cultural stress (516)	Racial discrimination not exposure variable
Trajectories of cultural stressors and effects on mental health and substance use among Hispanic immigrant adolescents (517)	Racial discrimination not exposure variable
Adding to the Education Debt: Depressive Symptoms Mediate the Association between Racial Discrimination and Academic Performance in African Americans (459)	No health outcome
Racial discrimination and substance abuse: Risk and protective factors in African American adolescents (518)	Review paper

Racial Discrimination, Ethnic-Racial Socialization, and Crime: A Micro-Sociological Model of Risk and Resilience (519)	Cross-sectional
Racial discrimination and pathways to delinquency: Testing a theory of African American offending (520)	Cross-sectional

Appendix 3

Supplementary Table 5: Accumulation of direct racism: Missing cases

		Cases (n=594)		Missing (n=1165)	
		Count	%	Count	%
Gender	Male	293	49.3	594	51.0
	Female	301	50.7	571	49.0
Cohort***	Birth	295	49.7	715	61.4
	Child	299	50.3	450	38.6
Aboriginal status	Aboriginal	523	88.1	1011	86.8
	Torres Strait Islander	35	5.9	82	7.0
	Both Aboriginal and Torres Strait Islander	36	6.1	72	6.2
Age (years)***	7	6	1.0	37	3.2
	8	220	37.0	560	48.1
	9	69	11.6	118	10.1
	10	19	3.2	43	3.7
	11	233	39.2	336	28.8
	12	47	7.9	70	6.0
	13	0	0.0	1	0.1
	Mean age (years)				
		9.7		9.3	
LORI***	None	183	32.6	250	22.7
	Low	275	48.9	547	49.6
	Moderate	63	11.2	190	17.2
	High	41	7.3	116	10.5
Financial difficulty***	Yes	316	57.6	719	68.2
	No	233	42.4	336	31.9
IRISEO*	1 (most disadvantaged)	48	8.5	169	15.3
	2	89	15.8	193	17.4
	3	248	44.0	442	39.9
	4	88	15.6	157	14.2
	5 (most advantaged)	91	16.1	146	13.2
Primary carer highest education achieved*	University	41	7.1	48	5.1
	Diploma, Certificate or other non-school qualification	124	21.6	151	15.9
	Year 11 to high school completion	190	33.0	320	33.8
	Never attended school to Year 10	220	38.3	429	45.3

*0.05 **0.001 ***<.0001

Supplementary Table 6: Accumulation of vicarious racism via the primary carer: Missing cases

		Cases (n=764)		Missing (n=995)	
		Count	%	Count	%
Gender	Male	375	49.1	512	51.5
	Female	389	50.9	483	48.5
Cohort*	Birth	460	60.2	550	55.3
	Child	304	39.8	445	44.7
Aboriginal status	Aboriginal	671	87.8	863	86.7
	Torres Strait Islander	47	6.2	70	7.0
	Both Aboriginal and Torres Strait Islander	46	6.0	62	6.2
Age (years)*	7	29	3.8	14	1.4
	8	352	46.1	428	43.0
	9	79	10.3	108	10.9
	10	29	3.8	33	3.3
	11	225	29.5	344	34.6
	12	50	6.5	67	6.7
	13	0	0.0	1	0.1
	Mean age (years)				
		9.3		9.5	
LORI	None	191	25.1	242	26.7
	Low	385	50.7	437	48.3
	Moderate	112	14.7	141	15.6
	High	72	9.5	85	9.4
Financial difficulty	Yes	496	66.9	539	62.5
	No	246	33.2	323	37.5
IRISEO	1 (most disadvantaged)	103	13.5	114	12.6
	2	112	14.7	170	18.7
	3	336	44.0	354	39.0
	4	109	14.3	136	15.0
	5 (most advantaged)	104	13.6	133	14.7
Primary carer highest education achieved	University	42	5.8	47	5.9
	Diploma, Certificate or other non-school qualification	125	17.4	150	18.7
	Year 11 to high school completion	232	32.2	278	34.6
	Never attended school to Year 10	321	44.6	328	40.9

*0.05 **0.001 ***<.0001

Supplementary Table 7: Accumulation of vicarious racism via the family: Missing cases

		Cases (n=928)		Missing (n=831)	
		Count	%	Count	%
Gender	Male	461	49.7	426	51.3
	Female	467	50.3	405	48.7
Cohort	Birth	549	59.2	461	55.5
	Child	379	40.8	370	44.5
Aboriginal status	Aboriginal	821	88.5	713	85.8
	Torres Strait Islander	56	6.0	61	7.3
	Both Aboriginal and Torres Strait Islander	51	5.5	57	6.9
Age (years)*	7	32	3.5	11	1.3
	8	425	45.8	355	42.7
	9	92	9.9	95	11.4
	10	30	3.2	32	3.9
	11	293	31.6	276	33.2
	12	56	6.0	61	7.3
	13	0	0.0	1	0.1
	Mean age (years)				
		9.3		9.5	
LORI***	None	281	31.7	152	19.5
	Low	450	50.7	372	47.8
	Moderate	98	11.1	155	19.9
	High	58	6.5	99	12.7
Financial difficulty	Yes	555	64.2	480	64.9
	No	309	35.8	260	35.1
IRISEO***	1 (most disadvantaged)	84	9.4	133	17.1
	2	130	14.6	152	19.5
	3	372	41.8	318	40.8
	4	147	16.5	98	12.6
	5 (most advantaged)	158	17.7	79	10.1
Primary carer highest education achieved*	University	65	7.4	24	3.8
	Diploma, Certificate or other non-school qualification	171	19.3	104	16.3
	Year 11 to high school completion	294	33.3	216	33.8
	Never attended school to Year 10	354	40.1	295	46.2

*0.05 **0.001 ***<.0001

Supplementary Table 8: Age of first exposure direct racism: Missing cases

		Cases (n=1531)		Missing (n=228)	
		Count	%	Count	%
Gender	Male	771	50.4	116	50.9
	Female	760	49.6	112	49.1
Cohort**	Birth	854	55.8	156	68.4
	Child	677	44.2	72	31.6
Aboriginal status	Aboriginal	1336	87.3	198	86.8
	Torres Strait Islander	101	6.6	16	7.0
	Both Aboriginal and Torres Strait Islander	94	6.1	14	6.1
Age (years)*	7	38	2.5	5	2.2
	8	663	43.3	117	51.3
	9	153	10.0	34	14.9
	10	58	3.8	4	1.8
	11	513	33.5	56	24.6
	12	105	6.9	12	5.3
	13	1	0.1	0	0.0
	Mean age (years)				
		1531	9.4	228	9.1
LORI*	None	397	27.5	36	16.4
	Low	707	48.9	115	52.3
	Moderate	207	14.3	46	20.9
	High	134	9.3	23	10.5
Financial difficulty	Yes	895	64.3	140	65.7
	No	496	35.7	73	34.3
IRISEO*	1 (most disadvantaged)	183	12.6	34	15.4
	2	238	16.4	44	19.9
	3	590	40.7	100	45.3
	4	225	15.5	20	9.1
	5 (most advantaged)	214	14.8	23	10.4
Primary carer highest education achieved	University	86	6.1	3	2.5
	Diploma, Certificate or other non-school	260	18.5	15	12.4
	Year 11 to high school completion	466	33.2	44	36.4
	Never attended school to Year 10	590	42.1	59	48.8

*0.05 **0.001 ***<.0001

Supplementary Table 9: Age of first exposure vicarious racism via the primary carer: Missing cases

		Cases (n=1504)		Missing (n=255)	
		Count	%	Count	%
Gender	Male	757	50.3	130	51.0
	Female	747	49.7	125	49.0
Cohort	Birth	863	57.4	147	57.7
	Child	641	42.6	108	42.4
Aboriginal status*	Aboriginal	1297	86.2	237	92.9
	Torres Strait Islander	105	7.0	12	4.7
	Both Aboriginal and Torres Strait Islander	102	6.8	6	2.4
Age (years)	7	41	2.7	2	0.8
	8	657	43.7	123	48.2
	9	165	11.0	22	8.6
	10	54	3.6	8	3.1
	11	482	32.1	87	34.1
	12	104	6.9	13	5.1
	13	1	0.1	0	0.0
	Mean age (years)				
		1504	9.4	255	9.4
LORI***	None	324	22.7	109	46.0
	Low	706	49.4	116	49.0
	Moderate	244	17.1	9	3.8
	High	154	10.8	3	1.3
Financial difficulty*	Yes	903	65.7	132	57.4
	No	471	34.3	98	42.6
IRISEO***	1 (most disadvantaged)	209	14.6	8	3.4
	2	457	17.3	34	14.3
	3	1052	41.5	95	39.9
	4	1256	14.2	41	17.2
	5 (most advantaged)	1433	12.4	60	25.2
Primary carer highest education achieved*	University	69	5.3	20	8.8
	Diploma, Certificate or other non-school	223	17.2	52	22.8
	Year 11 to high school completion	432	33.4	78	34.2
	Never attended school to Year 10	571	44.1	78	34.2

*0.05 **0.001 ***<.0001

Supplementary Table 10: Age of first exposure vicarious racism via the family: Missing cases

		Cases (n=1593)		Missing (n=166)	
		Count	%	Count	%
Gender	Male	801	50.3	86	51.8
	Female	792	49.7	80	48.2
Cohort	Birth	926	58.1	84	50.6
	Child	667	41.9	82	49.4
Aboriginal status	Aboriginal	1387	87.1	147	88.6
	Torres Strait Islander	108	6.8	9	5.4
	Both Aboriginal and Torres Strait Islander	98	6.2	10	6.0
Age (years)*	7	42	2.6	1	0.6
	8	723	45.4	57	34.3
	9	161	10.1	26	15.7
	10	56	3.5	6	3.6
	11	507	31.8	62	37.4
	12	103	6.5	14	8.4
	13	1	0.1	0	0.0
	Mean age (years)				
		1593	9.4	166	9.7
LORI***	None	408	27.1	25	15.9
	Low	755	50.1	92	42.7
	Moderate	205	13.6	140	30.6
	High	140	9.3	157	10.8
Financial difficulty	Yes	511	35.1	58	38.9
	No	944	64.9	91	61.1
IRISEO*	1 (most disadvantaged)	186	12.3	31	19.6
	2	244	16.1	38	24.6
	3	631	41.7	59	37.3
	4	229	15.1	16	10.1
	5 (most advantaged)	223	14.7	14	8.9
Primary carer highest education achieved	University	84	5.8	5	7.5
	Diploma, Certificate or other non-school	263	18.1	12	17.9
	Year 11 to high school completion	490	33.7	20	29.9
	Never attended school to Year 10	619	42.5	30	44.8

*0.05 **0.001 ***<.0001

Appendix 4

Multiple imputation and adapting rounding

Multiple imputation using mixed effects models is a relatively novel procedure and best practice recommendations are currently limited. Based on this limited literature, adaptive rounding of ordinal and binary variables returned from linear models using the 'mitml' package in R Studio was originally pursued in this analysis. First, ordinal variables were recoded into a series of dummy variables, these were then entered into linear mixed effects models for each health outcome. Adaptive rounding based on Bernaards et al. calculation for a cut-off score based on normal approximation to the binomial distribution was then applied to all variables. Ordinal variables were then recreated based on the dummy variables originally derived from each variable. However, due to the rounding procedure, cases would occasionally be returned where all levels of the ordinal variable were rounded to zero or more than one level of the variable was rounded to 1. This led to unrealistic cases where, for example, individuals were not allocated to any remoteness level or were allocated into multiple remoteness levels at once. Resolving this required implementing alternate or multiple rounding procedures, such as naïve rounding, to ensure that each case was allocated into a single category within ordinal variables. This process would likely lead to biased estimates and so we chose not to pursue any rounding procedure. Although the strategy of no rounding meant that continuous data was used in analysis, not the binomial data originally used with complete-case analysis, we preferred to treat both sets of data as continuous rather than introduce bias through rounding. To ensure estimates were comparable we contrasted the pooled estimates from linear models run on the imputed continuous data with linear models run on the complete-cases data.

Comparison of estimates from imputation and complete case analysis

	Imputation ¹	Complete cases
	β (SE)	β (SE)
Negative mental health		
No exposure	Ref	Ref
Ever exposed	0.08 (0.03)	0.10 (0.03)
Sleep difficulties		
No exposure	Ref	Ref
Ever exposed	0.10 (0.03)	0.10 (0.03)
Behaviour issues at school		
No exposure	Ref	Ref
Ever exposed	0.07 (0.03)	0.08 (0.03)
Tried cigarettes²		
No exposure	Ref	Ref
Ever exposed	0.04 (0.02)	0.05 (0.02)
Tried alcohol[^]		
No exposure	Ref	Ref
Ever exposed	0.03 (0.04)	0.06 (0.04)
General health		
No exposure	Ref	Ref
Ever exposed	-0.01 (0.01)	-0.01 (0.01)
Underweight		
No exposure	Ref	Ref
Ever exposed	0.03 (0.01)	-0.02 (0.01)
Obesity		
No exposure	Ref	Ref
Ever exposed	0.09 (0.03)	0.07 (0.03)

¹ Models adjusted for child age and gender, geographic remoteness, area-level socioeconomic status and family-level socioeconomic status (primary carer reported highest education completed, financial difficulty and prior homelessness).

² Child cohort only

Appendix 5

Appendix 5 provides the supplementary material for Chapter 8. This supplementary material will be provided alongside the final manuscript prepared for submission. Pages 329 to 334 provide details of the item analysis carried out to derive the racial discrimination exposure measure, including Supplementary Tables 11-14 and Supplementary Figures 1 and 2. Pages 335 to 339 provide descriptive tables for all variables included in analysis based on complete case data. Supplementary Tables 15 and 17 provide count, proportion and 95% confidence intervals around the proportion estimates for the racial discrimination items and the Strengths and Difficulties Questionnaire outcome measure. Supplementary Tables 16, 18 and 19 provide the count data for missing values for all variables included in analysis and the reason for missing data as coded within the Longitudinal Study of Indigenous Children.

Model fitting procedure for the racism scale

The racial discrimination module as used in Wave 10 of the Footprints in Time: The Longitudinal Study of Indigenous Children (LSIC) comprises 14 ordinal scaled items asked of the study child (see Supplementary Table 11). Each item was scaled from 1 (Always) to 6 (Never).

All item distributions were inspected for missing data and outliers prior to model specification. Univariate distributions revealed that the two items within the news media/social media subdomain to contain a disproportionate level of either missing data and/or “don’t know” responses. For this reason, these items were not deemed suitable for onward imputation processes and were removed from consideration. All initial estimation procedures were conducted on complete (non-missing) data. Model specification was undertaken with reference to the theoretical and practical rationales for their inclusion in the design of LSIC.

Supplementary Table 11: Racial discrimination module within LSIC (study child)

Subdomain	Item
Personal	In the past 12 months, how often did people try to pick fights with you because you're Aboriginal and/or Torres Strait Islander?
	In the past 12 months, how often were you told you're not Aboriginal and/or Torres Strait Islander?
	In the past 12 months, how often were you told you get all this free stuff because you're Aboriginal and/or Torres Strait Islander?
	In the past 12 months, how often were you stared at rudely because you're Aboriginal and/or Torres Strait Islander?
	In the past 12 months, how often were you ignored by people because you're Aboriginal and/or Torres Strait Islander?
	In the past 12 months, how often did some Aboriginal or Torres Strait Islander people say you don't look Aboriginal and/or Torres Strait Islander?
	In the past 12 months, how often were you told that you are too sensitive (too worried) about racism?
	In the past 12 months, how often did you see people being treated unfairly simply because they are Aboriginal and/or Torres Strait Islander?
School	In the last 12 months/year at school, do you think teachers only noticed some students doing stuff wrong because they were Aboriginal or Torres Strait Islander students?
	In the last 12 months/year at school, do you think teachers treated some students as if they were dumb because they were Aboriginal or Torres Strait Islander?
	In the last 12 months/year at school, do you think teachers did not care about the cultural needs of Aboriginal or Torres Strait Islander students?
	In the last 12 months/year at school, do you think teachers thought they knew everything about Aboriginal or Torres Strait Islander people even though they don't?
News media/social media	In the last 12 months did you think the news and media only focused on bad stories about Aboriginal and Torres Strait Islander people?
	In the last 12 months did you think social media (like IG, Facebook) allowed people to say horrible things about Aboriginal and Torres Strait Islander people and their communities?

Initial exploration for item suitability for scaling was undertaken in SPSS (Version 24). Prior to onward confirmatory factor analysis principal components analysis was undertaken to determine whether the scale items were unidimensional or, instead, comprised more than one dimension or factor. Pearson product

moment correlations were input along with initial communalities of 1.0 and the default extraction of all components (i.e. factors) with Eigen values ≥ 1.0 . The Keiser-Meyer-Olkin measure of sampling adequacy was excellent (0.88) suggesting high item factorability and communalities ranged from 0.47-0.70. Two factors were extracted accounting for 57.2% of the shared item variance. The two factors were rotated via Varimax to assist interpretability. This resulted in a good definition for two factors with four of the twelve items loading on one factor and five of the twelve items loading on the second factor. These factors have been labelled, for convenience, FACTOR1 and FACTOR2.

From this basis, confirmatory factor analysis was then undertaken. Congeneric models were specified for each set of items, and polychoric correlations along with their respective asymptotic covariance matrix were input to LISREL 9.3 and using the ADF-WLS estimator. All models were identified using the procedure outlined by Jöreskog and Sörbom (1989, p. 86).

Each fitted model is presented in tabular form (Supplementary Tables 12 and 13) with the following information:

- a) A table with the LSIC item variable name and the exact wording of the item (column 1)
- b) The factor item loading (column 2)
- c) Item factor score regression weights (column 3): we present the unadjusted and then the proportionally adjusted (in italics) factor score regression coefficients, either of which may be used to weight the original items to form a composite score. We chose to use the proportionally adjusted factor score regression coefficients to calculate the composite scores because proportional adjustment results in a composite scale that takes the same range as the original item pool.
- d) Model fit characteristics (column 4). The choice of fit indices takes into account the following properties of the data: (1) initial model complexity – all models here are considered ‘simple’ one-factor congeneric models with 4 to 6 indicator items with uncorrelated error, (2) sample sizes are large with most samples in excess of $N = 3500$, (3) item distributions violate assumptions of normality by a high degree with the resultant selection of the ADF-WLS estimator. Table 4 summarises the model fit indices used in this report. The principal model fit index used in this report is the SRMR < 0.10 . This index is most sensitive to model misspecification in simple models (as opposed to misspecification in complex models) and is not sensitive to the model estimation method where sample sizes are large. The SRMR is used in conjunction with one of two other indices: (1) the NNFI (or TLI as it is also known) > 0.95 . The NNFI is moderately sensitive to simple model misspecification, less sensitive to distributional properties and sample size. (2) With ADF-WLS bigger samples (≥ 250) are recommended, or the CFI > 0.95 . Under large sample ADF-WLS the CFI shares similar characteristics to the NNFI (Hu & Bentler, 1998) (Weston & Gore, 2006).
- e) As is conventional, the Chi Square goodness of fit measure and its associated degrees of freedom are provided. However, as Chi Square is overly sensitive to very large sample sizes and prone to rejecting the null, this is not employed here to determine model fit.

In addition to these measures of model fit, the H-index of scale reliability (Hancock & Mueller, 2006) is also calculated. This is a measure of the *proportion of variance* accounted for in the underlying factor and is selected for reporting here rather than the traditional Cronbach’s alpha. The H-index is the preferred indicator of scale reliability for ordinal measures (see Hancock and Mueller, 2006). It represents the squared correlation (i.e. variance) between the underlying latent construct (i.e. factor) and the optimum linear composite formed by its indicators (i.e. items). Broadly speaking, magnitudes of $H \geq 0.80$ are considered desirable with respect to scale performance.

Interpretation of models

Each model is presented with a general summary of model adequacy. Models were judged as follows:

- a) Good: model meets all three specified criteria (Supplementary Table 14) for the SRMR, NNFI and CFI
- b) Acceptable: model meets SRMR criteria and at least one of either the NNFI or the CFI criteria
- c) Not acceptable: model fails to meet the SRMR criteria or model meets the SRMR criteria but does not meet the criteria for both the NNFI and the CFI.

Supplementary Table 12: Model fit, racial discrimination: school

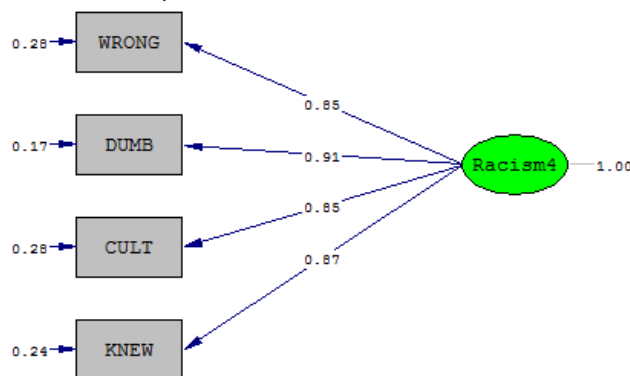
LSIC Racial discrimination module School	Item loadings ^a λ_x	Regression weights ^b	Model characteristics ^c
In the last 12 months/year at school, do you think teachers only noticed some students doing stuff wrong because they were Aboriginal or Torres Strait Islander students? (WRONG)	0.850	0.216 <i>0.204</i>	N = 303 df = 2 $\chi^2 = 29.8$
In the last 12 months/year at school, do you think teachers treated some students as if they were dumb because they were Aboriginal or Torres Strait Islander? (DUMB)	0.912	0.380 <i>0.358</i>	SRMR = 0.03 NNFI = 0.96 CFI = 0.96
In the last 12 months/year at school, do you think teachers did not care about the cultural needs of Aboriginal or Torres Strait Islander students? (CULT)	0.848	0.213 <i>0.201</i>	
In the last 12 months/year at school, do you think teachers thought they knew everything about Aboriginal or Torres Strait Islander people even though they don't? (KNEW)	0.870	0.251 <i>0.237</i>	H = 0.93 Good

^a Partial regression coefficients of the item on the underlying construct.

^b Upper figures are raw factor score indices and lower figures (in italics) are proportionally adjusted factor score regression indices.

^c Models were fitted via Weighted Least Squares using polychoric correlations and their asymptotic covariance matrix via LISREL 9.2 (SSI Inc., 2007).

Supplementary Figure 1: Model fit, racial discrimination module: school

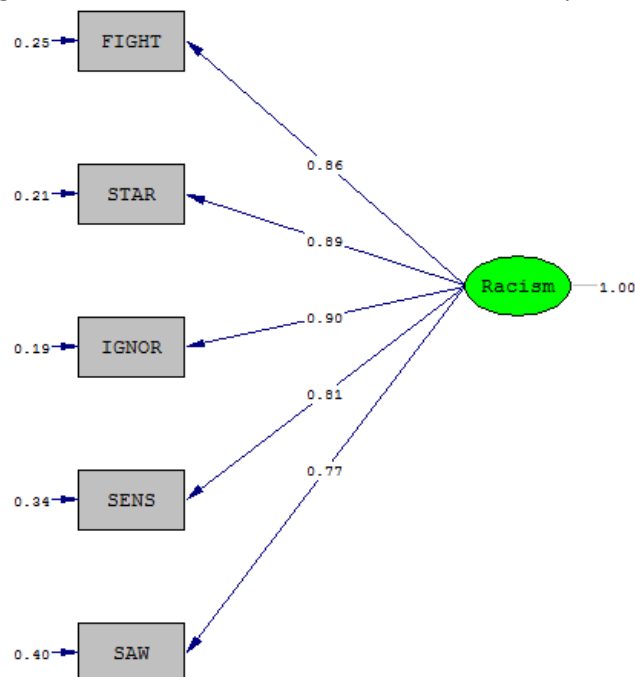


Chi-Square=29.82, df=2, P-value=0.00000, RMSEA=0.000

Supplementary Table 13: Model fit, racial discrimination: personal

LSIC Racial discrimination module Personal	Item loadings λ_x	Regression weights	Model characteristics
In the past 12 months, how often did people try to pick fights with you because you're Aboriginal and/or Torres Strait Islander? (FIGHT)	0.864	0.222 0.205	SRMR = 0.04 NNFI = 0.89 CFI = 0.90 H = 0.93 Good
In the past 12 months, how often were you stared at rudely because you're Aboriginal and/or Torres Strait Islander? (STAR)	0.890	0.279 0.257	
In the past 12 months, how often were you ignored by people because you're Aboriginal and/or Torres Strait Islander? (IGNOR)	0.899	0.306 0.282	
In the past 12 months, how often were you told that you are too sensitive (too worried) about racism? (SENS)	0.810	0.154 0.142	
In the past 12 months, how often did you see people being treated unfairly simply because they are Aboriginal and/or Torres Strait Islander? (SAW)	0.771	0.124 0.114	

Supplementary Figure 2: Model fit, racial discrimination module: personal



Chi-Square=42.58, df=5, P-value=0.00000, RMSEA=0.000

Supplementary Table 14: Goodness-of-fit statistics, summary of minimum guidelines

Measure	Criterion used
Standardised Root Mean Residual (SRMR) Bentler, 1995 Hu and Bentler, 1998	SRMR < 0.10 SRMR is the average difference between the predicted and observed variances and covariances in the model, based on standardised residuals. A value of zero indicates perfect fit. This measure tends to be smaller as sample size increases and as the number of parameters in the model increases. A value less than 0.05 is considered a good fit and below .10 an adequate fit.
Non-Normed Fit Index (NNFI/TLI) Tucker and Lewis, 1973	NNFI > 0.95 Also referred to as the Tucker-Lew Index (TLI), the NNFI should have a value between 0.90 and 0.95 to be deemed 'acceptable', and above 0.95 to be deemed 'good'.
Comparative Fit Index (CFI) Hu and Bentler, 1995	CFI > 0.95 Relatively insensitive to sample size, the CFI tests the proportionate improvement in fit by comparing the target model with the independence model, and a value approximating zero. A value between 0.90 and 0.95 is acceptable, and above 0.95 is good.

Supplementary Table 15: Personal racism – complete cases

Variable	N	%	CI
How often did people try to pick fights with you because you're Aboriginal and/or Torres Strait Islander?			
Always	3	0.7	0.0-1.4
Most of the time	14	3.1	1.6-4.5
Fair bit	9	2.0	0.8-3.2
Little bit	26	5.7	3.5-8.0
Not much	41	9.0	6.2-11.9
Never	361	79.5	75.1-83.9
Don't know	13	2.8	1.3-4.3
How often were you stared at rudely because you're Aboriginal and/or Torres Strait Islander?			
Always	3	0.7	0.0-1.5
Most of the time	2	0.5	0.0-1.1
Fair bit	9	2.1	0.7-3.4
Little bit	40	9.2	6.2-12.2
Not much	30	6.9	4.5-9.3
Never	352	80.7	76.6-84.9
Don't know	31	6.6	4.3-8.9
How often were you ignored by people because you're Aboriginal and/or Torres Strait Islander?			
Always	3	0.7	0.0-1.4
Most of the time	7	1.6	0.4-2.7
Fair bit	4	0.9	0.02-1.8
Little bit	23	5.1	2.9-7.4
Not much	30	6.7	3.0-10.5
Never	380	85.0	81.2-88.8
Don't know	19	4.1	2.3-5.8
How often were you told that you are too sensitive (too worried) about racism?			
Always	5	1.2	0.1-2.2
Most of the time	4	0.9	0.1-1.8
Fair bit	7	1.6	0.3-3.0
Little bit	14	3.2	1.5-5.0
Not much	26	6.0	3.7-8.3
Never	378	87.1	84.1-90.1
Don't know	29	6.3	4.2-8.4
How often did you see people being treated unfairly simply because they are Aboriginal and/or Torres Strait Islander?			
Always	7	1.6	0.4-2.9
Most of the time	18	4.2	2.4-5.9
Fair bit	24	5.5	3.4-7.7
Little bit	42	9.7	6.8-12.5
Not much	38	8.8	5.8-11.7
Never	305	70.3	65.5-75.1
Don't know	33	7.1	5.0-9.2

Supplementary Table 16: Personal racism – Missing data reason

Personal racism variables	Don't know¹ (-2)	Refused¹ (-3)	Not asked² (-5)	Not asked of cohort³ (-6)	Non-responding person⁴ (-9)	Total missing⁵ %	Total
People tried to pick fights with you because you're Aboriginal and/or Torres Strait Islander?	13	11	17	1	15	2.7	514
You were stared at rudely because you're Aboriginal and/or Torres Strait Islander?	31	11	17	1	15	8.2	514
You were ignored by people because you're Aboriginal and/or Torres Strait Islander?	19	12	17	1	15	6.0	514
You were told that you are too sensitive (too worried) about racism?	29	15	17	1	15	8.6	514
You saw people being treated unfairly simply because they are Aboriginal and/or Torres Strait Islander?	33	11	17	1	15	8.6	514

¹ When explicitly available as an option in the questionnaire

² Indicates a question that has been skipped due to normal sequencing or a free text or numeric answer category which has been intentionally left blank

³ Some questions are only asked of B cohort or K cohort

⁴ For items from merged datasets – e.g. where a respondent has completed a P1 survey but not a SC survey

⁵ Excluding those not asked, not asked of cohort and non-responding person.

Supplementary Table 17: Outcome variables – complete cases

Outcome variables	N	Mean	Confidence intervals
SDQ total difficulties	486	11.1	10.6-11.7

Supplementary Table 18: Outcome variables – Missing data reason

Outcome variables	Don't know ¹ (-2)	Refused ¹ (-3)	Refused section ² (-4)	Not asked ³ (-5)	Not asked of cohort ⁴ (-6)	Missing data ⁵ (-8)	Non-responding person ⁶ (-9)	Total missing ⁷ %	Total
SDQ total difficulties			6		1	3	15	1.8	514

¹ When explicitly available as an option in the questionnaire

² When explicitly available as an option in the questionnaire. Used both for the screener question for a section that can be refused as well as all the variables within that section

³ Indicates a question that has been skipped due to normal sequencing or a free text or numeric answer category which has been intentionally left blank

⁴ Some questions are only asked of B cohort or K cohort

⁵ Data not collected where it might be expected. Used where an answer is not provided, although based on sequencing and programming an answer should have been provided

⁶ For items from merged datasets – e.g. where a respondent has completed a P1 survey but not a SC survey

⁷ Excluding those not asked, not asked of cohort and non-responding persons

Supplementary Table 19: Remaining explanatory variables – Missing data reason

Covariates	Other (-1)	Don't know ¹ (-2)	Refused ¹ (-3)	Refused section ² (-4)	Not asked ³ (-5)	Not asked of cohort ⁴ (-6)	Missing data ⁵ (-8)	Non- respondin g person ⁶ (-9)	Total missing ⁷	Total
Child gender									0	514
Child age									0	514
LORI								3	3	514
IRISEO								3	3	514
Parent's highest education							26	3	29	514
Short of money – Meals								3	3	514
Short of money – Welfare		1						3	3	514
Short of money – School		1						3	3	514
Smoked during last year*		13 (3)	8 (0)		13 (456)	1		15	21	514
Drank alcohol during last year		7 (4)	5 (0)		13 (425)	1		15	18	514
Social skills - empathy	52				1				1	514
Quizzed or questioned by police		9	9		17	1		15	26	514
Told to 'move on', warned, cautioned by police		8	9		17	1		15	26	514
Charged with an offence by police		8	9		17	1		15	26	514
Police contact**		5	9		17	1		15	26	514

¹ When explicitly available as an option in the questionnaire.

² When explicitly available as an option in the questionnaire. Used both for the screener question for a section that can be refused as well as all the variables within that section.

³ Indicates a question that has been skipped due to normal sequencing or a free text or numeric answer category which has been intentionally left blank.

⁴ Some questions are only asked of B cohort or K cohort.

⁵ Data not collected where it might be expected. Used where an answer is not provided, although based on sequencing and programming an answer should have been provided.

⁶ For items from merged datasets – e.g. where a respondent has completed a P1 survey but not a SC survey.

⁷ Excluding those not asked of cohort and non-responding persons (child survey) and 'other' or 'don't know' responses which will be excluded in final analysis but not imputed.

*This question was only asked of those who reported that they had tried cigarettes. I recoded the 'no' response to include those who also said they did not try cigarettes. The 'no' response includes both those who tried cigarettes over a year ago and those who never tried cigarettes.

**This question was recoded so that those with the highest level of police contact were coded first, then the second highest, then the third highest. This ensured that children with the highest level of contact who likely also had the second highest and third highest were only counted once.

Appendix 6

Multiple imputation by Chained Equations (MICE) was used to minimise potential bias due to missing biomarker data in the NATSIHMS. The number of respondents with missing data ranged from 14-708 for each biomarker (Supplementary Table 20). Five imputed datasets were generated with all biomarkers listed for imputation and ABS person-weights included as the weighting variable.

Pooled distal outcome estimates and standard errors were calculated from estimates generated by the five imputed datasets both for outcomes from results overall and from results grouped by racial discrimination exposure. Wald test estimates and standard errors comparing mean differences in allostatic load between latent classes were pooled from output generated by the five imputed data sets. The Z-test was then used to determine whether mean differences were statistically significant between latent classes. This process was repeated for both results overall and results grouped by exposure to racial discrimination. Finally, mean differences in allostatic load between those with and without exposure to racial discrimination within each latent class were compared using a one-tailed t-test based on pooled distal outcome estimates and standard deviations calculated from pooled standard errors and sample sizes within each group.

STROBE Statement

Checklist of items that should be included in reports of observational studies

Section/Topic	Item No	Recommendation	Reported on Page No
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(a) Cohort study—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants	5-6
		(b) Cohort study—For matched studies, give matching criteria and number of exposed and unexposed Case-control study—For matched studies, give matching criteria and the number of controls per case	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-11
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-11
Bias	9	Describe any efforts to address potential sources of bias	11
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	12
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	11-12
		(b) Describe any methods used to examine subgroups and interactions	12
		(c) Explain how missing data were addressed	11
		(d) Cohort study—If applicable, explain how loss to follow-up was addressed Case-control study—If applicable, explain how matching of cases and controls was addressed	12

Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy
(e) Describe any sensitivity analyses

NA

Section/Topic	Item No	Recommendation	Reported on Page No
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	12
		(c) Consider use of a flow diagram	7 (TBD)
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12-13
		(b) Indicate number of participants with missing data for each variable of interest	11 & Supp Table 1
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	N/A
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	N/A
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	15, Table 1, Table 2
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	16, Table 3
		(b) Report category boundaries when continuous variables were categorized	9-11
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Tables 4-7
Discussion			
Key results	18	Summarise key results with reference to study objectives	19
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	22-23
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	19-22
Generalisability	21	Discuss the generalisability (external validity) of the study results	22
Other Information			

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	26

**Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.*

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

Supplementary Table 20: Allostatic load outcome variables

Biomarkers	Complete cases			Imputed		
	Mean	SD	N	Mean	SD	N
Systolic blood pressure	122.1	19.4	1949	121.6	18.1	2056
Diastolic blood pressure	79.3	11.7	1949	78.8	13.6	2056
Body mass index	29.3	7.1	1922	29.6	9.1	2056
HDL cholesterol	1.2	0.3	2042	1.2	0.3	2056
LDL cholesterol	2.9	0.9	1348	2.9	1.4	2056
Triglycerides	1.7	1.0	1386	1.7	0.9	2056
Fasting plasma glucose ¹	1.7	0.3	1386	1.7	0.3	2056
HbA1c	6.0	1.5	2036	5.8	1.4	2056
Albumin creatinine ratio ¹	0.4	1.6	1908	0.2	1.4	2056
C-reactive protein ¹	1.3	1.1	2042	1.1	1.4	2056
Allostatic load						
Allostatic load risk index	3.23	2.15	1152	2.4	2.3	2056

¹ Log transformed

Supplementary Table 21: Mean difference in allostatic load between racism exposure and no exposure, within and between latent class comparisons

No racial discrimination exposure	Racial discrimination exposure	Mean difference	SE of difference between means	T statistic	P-value
Class 1	Class 1	0.239	0.293	0.82	0.206
Class 2	Class 2	-0.383	0.240	-1.47	0.072
Class 3	Class 3	-0.585	0.350	-1.67	0.048
Class 4	Class 4	0.524	0.300	1.74	0.041
Class 1	Class 2	-0.791	0.291	-2.718	0.003
Class 1	Class 3	0.092	0.325	0.283	0.389
Class 1	Class 4	-2.075	0.300	-6.917	<.001
Class 2	Class 3	0.500	0.298	1.676	0.047
Class 2	Class 4	-1.667	0.270	-6.170	<.001
Class 3	Class 4	-2.752	0.326	-8.440	<.001



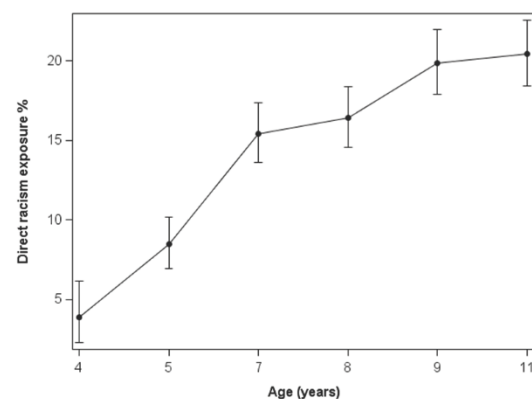
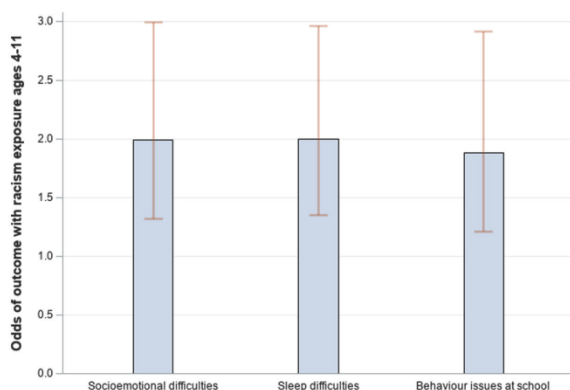
Racism and the health of Aboriginal and Torres Strait Islander children

Leah Cave | Telethon Kids Institute | January 2020

Racism is a social determinant of health. Research shows that racism has a negative impact on your health and wellbeing – no matter who you are. Research conducted at the Telethon Kids Institute found that racism is commonly experienced by Aboriginal[†] children at school and that racism increases children's risk of mental health difficulties.

➤ Based on national data from the Longitudinal Study of Indigenous Children, our research found that racism begins during the first years of school, at age 4.

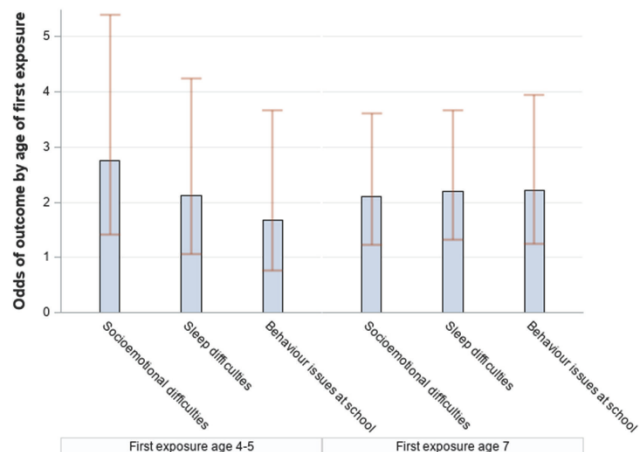
➤ Exposure to racism increases steadily with age and by the age of 11, 20% of children have experienced racism at school at least once.



➤ Aboriginal children exposed to racism between 4-11 years have around twice the risk of socioemotional difficulties, sleep difficulties and behaviour issues at school.⁴

➤ Aboriginal children who first experience racism at 4-5 years are at an increased risk of later negative mental health (at 7-12 years) compared to children who first experience racism at age 7.⁵

➤ Racism negatively affects mental health and other related outcomes in Aboriginal children but that children first exposed to racism at a younger age experienced the most adverse effects on their mental health.



[†] Throughout this document, the term 'Aboriginal' is used to refer to Aboriginal and Torres Strait Islander populations across Australia.

Despite the evidence, implementing effective responses to racism remains an ongoing challenge. Targeted responses are particularly vital during childhood as the early years present a critical period of health vulnerability to adversity and stress.



Schools are a universal platform to implement change.

Education and awareness are key to preventing racism and prejudice and can begin during the first years of school. We recommend:

- **Recognition of Aboriginal histories and cultures** as part of Australia's shared national identity and meaningful incorporation of these into the classroom.
- **Development of a school Reconciliation Action Plan** to ensure ongoing implementation of reconciliation activities. Reconciliation Australia's Narragunnawali program is designed to support schools and early learning centres with these processes: www.reconciliation.org.au/narragunnawali/.
- **Engagement with the school community** to gauge knowledge and awareness of Aboriginal culture and our shared history. Identify ways to encourage support amongst parents and families, working through potential barriers together.
- **Keep learning local.** Find out the Aboriginal language/s spoken in the area surrounding the school and investigate local Aboriginal history and important sites. Identify and reach out to relevant Aboriginal organisations to help guide this process, such as the regional Land and Sea Council, Language Resource Centre or local Elders council.



No matter which school a child steps into, that school must be a safe place.

Consistency and accountability is needed in the culture and learning environment of schools. We recommend:

- **Support schools to implement the *Aboriginal Cultural Standards Framework*** developed by the Western Australian Department of Education. The Framework is a valuable resource to ensure schools advance towards cultural responsiveness but more direct guidance and resources are needed by schools to support consistent implementation.
- **Set up an Aboriginal family and community advisory committee** to allow genuine opportunities for input, advise and development of initiatives which address Aboriginal students' needs. Aboriginal families and communities can also support appropriate implementation of the Aboriginal Cultural Standards Framework and help guide schools' improvement planning.
- **Collaboration between schools** at different stages in the journey towards cultural responsiveness to support consistency between schools in a local area. Schools can share best-practice initiatives that are working well and work through challenges and barriers together.



Prevention is crucial but schools must also actively respond to racism.

Anti-racism activities are called for, resources vary from online videos to structured school-based anti-racism programs. We recommend:

- **Development and implementation of an anti-racism program** targeted to children and families of children in WA schools from pre-primary to Year 12. While anti-racism activities, tools and school-based programs have been developed and piloted nationally, use and support of these resources in WA schools is dependent on interest from individual schools. We propose developing a pilot program in selected WA Department of Education schools in consultation with Aboriginal family and community advisory committees. The program can integrate relevant components from best-practice evidence-based anti-racism activities and programs currently available, including:
 - Anti-prejudice activities (pre-primary to Year 2) and anti-racism activities (Year 3 and up): www.racismnoway.com.au
 - 'Kids Together Now', an anti-racism classroom app designed for use over a school term for students aged 8-10 years: www.alltogethernow.org.au/kids-together-now/.
 - The 'SOAR Project (Speak Out Against Racism)', a school-based bystander anti-racism program for Years 5-9 piloted in New South Wales and Victorian schools: www.csrn.cass.anu.edu.au/research/projects/soar-speak-out-against-racism.



Policy and practice recommendations were developed and finalised by members of the Telethon Kids Institute Social Determinants of Aboriginal Health Community Advisory Group:

(back row from left)

Ralph Mogridge; Carrington Shepherd; Leah Cave; Emma Castle; Jayde Conway; Lakkiera Miller; Raelene Hayward; Justin Kickett;

(front row)

Janet Hansen; Doreen Nelson;

(not pictured)

Doris Getta; and Fred Penny.

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Appendix 8

Appendix 8 first describes ethical considerations for conducting research with Aboriginal and Torres Strait Islander peoples and how these have been integrated into the current thesis, followed by a description of several decolonising methodologies to inform ongoing research for this PhD candidate.

Conducting research with Aboriginal and Torres Strait Islander peoples

The body of work within this thesis was conducted using two secondary data sources, Footprints in Time: The Longitudinal Study of Indigenous Children, and the Australian Aboriginal and Torres Strait Islander Health Survey. Each of these data sources were developed and the data collected according to the principles and practices of the Commonwealth Department of Social Services and the Australian Bureau of Statistics respectively, as detailed in Section 4.3 of the Methodology chapter within this thesis. While I did not have any individual control over the practices of the agencies managing the data used in this thesis, there were several practices that I used as a researcher to ensure that this body of research adhered to high ethical standards of research with Aboriginal and Torres Strait Islander peoples. There are also several methodologies that were not pursued, partly due to the use of secondary quantitative data, but which I plan to integrate into future research projects.

Ethical considerations

Indigenous governance. Many Aboriginal and Torres Strait Islander communities which are defined through shared language, social and cultural history, and/or geographic space have existing governance structures or governing bodies which represent members within that community. Where such governance exists, it is ideal for researchers to work with these governing bodies and bring together the researcher/s, relevant academics, government or organisation representatives, and the community. (1) These relationships must be led by a dynamic which is responsive and accountable to the community first and foremost. Prior to developing these relationships, representatives for the community must be able to make an informed judgement about the value and necessity of the research for their community. (2) The limitations of the project and a realistic view of the researchers' ability to address the needs identified within the community must be discussed. Research projects which fail to deliver on unrealistic promises of policy or practice change, or which do not meet community expectations to build research capacity or provide data and results back to the community, will lose community trust in future research projects. (3) It is also crucial that researchers are aware of the strain placed on communities by extensive collaboration and participation in research projects and realistically assess the community's resources and capacity before placing additional responsibility on already overburdened individuals. (1)

The research project for the current thesis took place in the Perth metropolitan region, although the data sources used represented Aboriginal and Torres Strait Islander communities across Australia. No single governance body represents the Aboriginal and Torres Strait Islander community in Perth, instead multiple governance structures exist across specific sectors (e.g., language centres, health services) or attached to specific institutions (e.g., universities). Governance structures also exist in the community through recognised Elders or Elders councils. Within the Telethon Kids Institute, where this research project was conducted, the Kulunga Aboriginal Unit provides oversight for cultural governance within research projects and ensures that the research is assessed by the Aboriginal and Torres Strait Islander community in Perth at multiple levels. Research conducted for this thesis was assessed first by the Kulunga Aboriginal Unit and, after meeting their approval, was submitted for ethical approval to the Western Australian Aboriginal Health Ethics Committee. On the recommendation of the Kulunga Aboriginal Unit and submitted as part of this ethics application, this research project sought to bring together a community advisory group comprised of Aboriginal and/or Torres Strait Islander individuals from the Perth metropolitan region. Advisory group members were first identified via recommendations from the Kulunga Aboriginal Unit and subsequently via recommendations from initial group members. While we sought to ensure adequate gender, age and geographic representation within the advisory group, the group did not represent all Aboriginal and Torres Strait Islander peoples within the Perth metropolitan region. However, all members opted to commit to the group (titled the *Social Determinants of Aboriginal Health Community Advisory Group* [SDAH CAG]), indicated that they had the capacity to participate, and many members saw the group as an opportunity to volunteer as a social service, to build their skills and familiarity with research, or learn about and contribute to a research topic they were passionate about.

Community-based research. A community-based approach to research is strongly focused on the process of the research project, not solely on the outcomes. The process of developing, conducting, disseminating and translating research must be respectful towards the communities involved in the research and enable people within those communities to heal, educate, identify solutions, develop capacity, and build self-determination. (1) Community-based research must be aware of and responsive to the processes already taking place within communities so that those processes can be supported and enhanced by the research project, not sidelined or subverted. Existing local knowledge must be respected and integrated into the research to protect against the paradigm of the research 'expert' dominating and negating Indigenous knowledge within the community. (1)

As stated above, the current thesis conducted secondary data analysis, not community-based research. However, some elements of community-based research processes were integrated through the SDAH CAG. Although the 'community' defined within this group was a very general one – individuals identifying as Aboriginal or Torres Strait Islander within the Perth metropolitan region – members did have a shared cultural identity and a common interest in representing and interpreting their lived experience of racial

discrimination. SDAH CAG members were able to describe experiences of interpersonal racial discrimination and discuss the varied effects of structural racism and colonisation on their lives and the lives of their friends and families in a safe and supported environment during SDAH CAG meetings. Although SDAH CAG members were frustrated by these experiences and described feelings of distress in response to the initial event/s, members stated that they found the process of discussing and interpreting these events cathartic. SDAH CAG members expressed the desire to educate the broader community about the presence of structural racism in Australian society and the impact of their individual experiences with racial discrimination through a conference presentation which was co-presented by Fred Penny, Janet Hansen and myself. During this presentation, the personal narratives from Fred and Janet were given precedence over the quantitative research findings, which were described in brief at the end of the presentation to highlight the ongoing harmful effects of racial discrimination on Aboriginal and Torres Strait Islander children. This type of presentation format ensures that the quantitative empirical evidence being presented acts to enhance the personal narratives of community members, rather than negating or reducing their validity. This format also privileges evidence gained from lived experience and Aboriginal worldviews, legitimatising this evidence alongside evidence produced within a Western biomedical framework.

Indigenous research agendas. Many First Nations researchers recognise that Indigenous research is not just a research activity, but a political one. Challenging and transforming research frameworks and social policies and practices can be seen as just as crucial as the research processes and outputs themselves. (1, 4) Researchers working within Indigenous contexts must conduct research that is valid and rigorous in the eyes of the broader research community while also being useful, just, and accessible in the eyes of the First Nations community. (1) This is the unique challenge posed by the Indigenous research agenda. Although catering equally to these different perspectives presents a difficult balancing act, this challenge ensures that the complexities of conducting research with a First Nations community are worked through appropriately and provides guidance for researchers to do things the 'right way'. (1)

Policy and practice recommendations have been a central component of the current thesis from the initial research proposal. It was clear from initial discussions with the SDAH CAG that the research should lead to recommendations for demonstrable change in the way that racial discrimination was dealt with by primary and secondary schools in Western Australia. The development of the research and policy summary document was a direct result of these calls to action and this document will continue to form the template for an 'executive summary' style document for ongoing dissemination. Initial discussions surrounding a potential anti-racism program to be implemented in schools began with a presentation at the Western Australia Commission for Children and Young People in 2020. Development of an appropriate intervention to respond to experiences of racial discrimination by Aboriginal and Torres Strait Islander children is a long-

term goal of the current thesis and proposals for future research projects will be structured around this aim.

Decolonising methodologies

While I have not applied decolonising methodologies within the framework of the current thesis, my approach to community involvement, knowledge translation, and principals of fairness and equity are consistent with broader practices involved in decolonising the research process. Learning about these methodologies has served to strengthen the skillset available to me as a researcher focused on Aboriginal and Torres Strait Islander wellbeing and I will seek opportunities to integrate these methodologies into all future research projects to ensure that these projects are more meaningful and robust.

Story telling or yarning. The use of oral histories and the integration of first-person narratives into qualitative research methodologies have enabled the individual perspectives of Aboriginal and Torres Strait Islander peoples to inform research in integral ways. While story telling can give power to individual narratives, it also contributes to a collective narrative in which all Aboriginal and Torres Strait Islander peoples can place themselves. Story telling serves the dual purpose of informing research while also making connections between the past and future, between members of a community, and between generations. Research can interpret valued information from story telling already taking place within communities, acknowledging the value of knowledge already present while engaging in a minimally invasive research practice for both the community and the story teller. (1) Yarning has been identified as a qualitative methodology for understanding Aboriginal and Torres Strait Islander perspectives and prioritising Indigenous ways of communicating. (5) Research topic yarning could be used to create a relaxed and interactive environment which enables the participant to navigate through and around the research topic in a way that they are comfortable with, while still maintaining a deliberate beginning and end point for the conversation. (6) Unlike a formal interview, direct questioning is not used, and the yarn continues without interruption while discussing topics relevant to the research project. (6)

Intervening. Participatory Action Research (PAR) and Community-Based Participatory Research (CBPR) are methods which focus on the research process being a proactive method for change while centring the perspectives and knowledge of community members as expertise within the research. (5) These intervention-focused approaches can be centred on structural changes and changes to institutional policy and practice as defined by the community who have invited the research project in. (1) Importantly, PAR and CBPR both ideally bring direct benefits to the communities involved. Change is directed by issues of local relevance, opportunities are provided for community members to be trained as community researchers and to build research and evaluation capacity within the community, community members define how results are disseminated, and the existing strengths and capacity within the community are identified and built on. (5) Critically, where intervention-based research is conducted well, the research,

intervention, and evaluative activities are sustainable, and the community will have the capacity to continue these activities long after the research project has ceased.

Reframing. As a process, reframing can be integrated into any research methodology. Reframing consists of ensuring that Aboriginal and Torres Strait Islander peoples have control over the ways that the social conditions and issues specific to them are interpreted, described, and considered. Historically, many of the social issues experienced by Aboriginal and Torres Strait Islander communities have been framed without reference to the broader social and historical context which influence those issues. (4) The marginalisation, dispossession, and loss of self-determination directly related to colonisation are not consistently linked to a continuous history experienced by almost all Aboriginal and Torres Strait Islander peoples to the present day. Government, community services, and the media in particular have at times dissociated the social conditions in which Aboriginal and Torres Strait Islander peoples live from this history, placing sole responsibility on the individual for their perceived 'success' or 'failure'. Qualitative and quantitative methodologies can utilise reframing by identifying the full complexities of the environment and social conditions relevant to the research. Defining the issue and determining solutions to respond to the issue is part of the process of reframing. Community-based intervention research thereby involves the entirety of the community, considering the social and historical context and identifying within this both the problems and the solution. (1)

Sharing. Sharing is related to the process of research dissemination and is a responsibility of research. Research dissemination and knowledge translation can be inaccessible, mystified through discipline-specific jargon, and devoid of context and meaning for non-researchers. The purpose of sharing is to demystify the knowledge and information gained from research so that the community can be informed about the topics and issues which are relevant to them or which potentially affect them. (1) Speaking in terms which can be understood by those outside the research community is critical to ensuring the process of sharing can take place. In this way, sharing does not end after the researcher has communicated to the community, rather sharing continues in the communication between community members. Sharing may not necessarily take the form of a written document. More commonly, sharing would take place during a community forum or shared space where the researcher can be involved with the audience through reflection or debate and can be challenged. (1) The research may need to be emotionally involved with the audience, listening and responding to grief, anger, and laughter within the protocols of the community. Sharing can overlap with both story telling and intervening. Sharing can take place after yarning, where the participant has been able to deeply engage in the research question so that some answers begin to form. Through intervention-based PAR, sharing would take place as a stage within the research process, enabling the participants to reflect on the goals of the project and to assess whether and how further research will take place.

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