Public Health 221 (2023) 10–16

Contents lists available at ScienceDirect

Public Health

journal homepage: www.elsevier.com/locate/puhe

Original Research

Trends and associations between maternal characteristics and infant birthweight among Indigenous and non-Indigenous people in Tasmania, Australia: a population-based study

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A R T I C L E I N F O

Article history:
Received 17 October 2022
Received in revised form
16 May 2023
Accepted 19 May 2023

Keywords:
Birthweight
Infants
Maternal characteristics
Australian Indigenous and non-Indigenous populations
Tasmania

A B S T R A C T

Objective: This study aimed to investigate the trends and associations of maternal characteristics and birthweight among Indigenous and non-Indigenous infants.
Study design: This was a retrospective population-based study.
Methods: Fourteen years (2005–2018) of birthweight and perinatal health data of live-born singletons and their mothers obtained from the Tasmanian Data Linkage Unit were used to assess the trends and associations between maternal characteristics and infant birthweight using regression modelling.
Results: Compared with non-Indigenous mothers (n = 76,750), Indigenous mothers (n = 3805) had a significantly higher prevalence of risk factors during the 14-year period. Although the prevalence of prepregnancy obesity and gestational diabetes mellitus (GDM) markedly increased in both groups, the rate of increase was higher ($P < 0.001$) for Indigenous than non-Indigenous mothers. Smoking, alcohol consumption and illegal drug use during pregnancy reduced over the years, and there was no significant difference in the rate of reduction between the groups. Large-for-gestational-age (LGA) births increased while small-for-gestational-age (SGA) births decreased in both groups over time. In addition, high birthweight (HBW) births decreased while low birthweight (LBW) births increased. The rates of increase in LGA and LBW births and the rates of decrease in SGA and HBW births were significantly higher in Indigenous mothers compared with non-Indigenous mothers ($P < 0.001$ for all). The association between Indigenous ethnicity and LBW and SGA births weakened after adjusting for other confounding maternal and perinatal variables. LBW and SGA were positively associated with Indigenous ethnicity, age <18 years, smoking, alcohol consumption and illegal drug use, pre-eclampsia, underweight prepregnancy body mass index and low socio-economic status. Women with higher parity, pre-existing diabetes and prepregnancy overweight or obesity were more likely to give birth to an infant with HBW or LGA.
Conclusions: The prevalence of risk factors for abnormal birthweight is higher among Tasmanian Indigenous mothers, contributing to a gap in birthweight outcomes between Indigenous and non-Indigenous infants. The dramatic increase in prepregnancy obesity and GDM in both groups highlight the importance of screening and management of GDM during pregnancy. Comprehensive programmes co-designed and co-managed in consultation with Indigenous people are needed to support healthy lifestyle choices among Indigenous women to address the barriers to individuals adopting behaviour change and to help close the health outcomes–related gap between Indigenous and non-Indigenous mothers and infants.

Introduction

Aboriginal and Torres Strait Islander peoples are disproportionately affected by the burden of cardiovascular and metabolic diseases than the non-Indigenous population in Australia. Life

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https://doi.org/10.1016/j.puhe.2023.05.016
0033-3506/

expectancy is 10–11 years lower, and the age of onset of chronic diseases is much earlier compared with their non-Indigenous counterparts.[1,2] Abrupt loss of traditional lifestyle postcolonisation, intergenerational trauma, socio-economic disadvantage, racism and discrimination have contributed to this escalating early cardiometabolic risk in First Nations people in Australia.[3] To eradicate this inequality in life expectancy, the Australian Government has committed to policies aimed at 'Closing the Gap'.[4] One of the main targets of this programme has been to increase the proportion of Indigenous infants with a healthy birthweight.

Birthweight is a strong predictor of neonatal mortality and morbidity.[5] A U-shaped association with later life cardiometabolic disease risk predisposes individuals born with both HBW and LBW to a higher risk of adulthood chronic diseases.[6–8] Several maternal demographic, health, nutrition and lifestyle factors during the prenatal period have been identified as strong determinants of infant birthweight. Maternal smoking, alcohol consumption, low socio-economic status and hypertensive disorders are known risk factors of LBW,[9] whereas high prepregnancy body mass index (BMI), excess gestational weight gain (GWG) and GDM are mainly associated with HBW.[10] A better understanding of trends and associations of these modifiable maternal factors with birthweight could help inform public health measures to improve the health of future generations.

A limited number of studies have assessed changes in maternal determinants of birthweight in Indigenous and non-Indigenous populations in Australia since the 'Closing the Gap' programme commenced in 2008. Indigenous mothers from an urban setting in Melbourne had higher rates of health risk behaviours and pregnancy complications than non-Indigenous mothers, and the birthweight of Indigenous infants was lower than non-Indigenous infants.[11] Similar findings have been reported from the Northern Territory[10] and Queensland.[12] Tasmania records Australia's highest rates of overweight/obesity and people living in low socio-economic areas and lowest educational outcomes, all important determinants of birthweight.[13,14] No study has compared the trends in birthweight and associated maternal factors in Indigenous and non-Indigenous people in the island state of Tasmania where Indigenous people represent 5.4% (~30,000 people) of the total population.[15] We used Tasmanian perinatal data from 2005 to 2018, which cover a period of precommencement and 10 years post-commencement of the 'Closing the Gap' framework to explore (1) trends in the prevalence of risk factors of abnormal birthweight in Indigenous and non-Indigenous mothers, (2) trends in birthweight outcomes of Indigenous and non-Indigenous infants, and (3) associations between maternal variables and infant birthweight.

Methods

Study cohort and data availability

The study cohort included all mothers and infants with a record in the Tasmanian Perinatal Collection from 1 January 2005 to 31 December 2018. The data comprised mothers who gave birth in public and private hospitals or at home (later transferred to a public hospital after birth). Perinatal data of mothers and infants linked by the Tasmanian Data Linkage Unit were received in November 2020. All singleton live births with gestational age 24–43 weeks and weighing 400–6000 g at birth were used in the current analysis.

Exposures

Mothers were considered Indigenous if they identified themselves as being of Aboriginal or Torres Strait Islander origin. Maternal age at delivery was calculated using the mother's date of birth and date of delivery. Parity was the total number of previous pregnancies that have resulted in a live birth/stillbirth, excluding the current pregnancy. Socio-economic status was based on the area of residence of the mother using the Index of Relative Advantage and Disadvantage (IRSAD) decile rankings within the state (1–3: low, 4–7: middle and 8–10: high). Smoking/alcohol consumption and illegal drug use during pregnancy were based on mothers' self-reported data. Prepregnancy conditions such as type 1 or type 2 diabetes, hypertension and pre-eclampsia were indicated by midwives and likely based on hospital clinical records. Diagnosis of GDM was based on the Australian Diabetes in Pregnancy Society Guidelines.[16] These Guidelines recommend a two-stage approach: women at risk of hyperglycaemia are tested early in pregnancy and women who have not previously been tested undergo a 75 g oral glucose tolerance test at 24–28 weeks' gestation. The mother's weight around the time of conception is self-reported and was used in conjunction with either measured or self-reported height to calculate maternal prepregnancy BMI (underweight: <18.5, normal: 18.5–25, overweight: 25–30, and obese: >30 kg/m^2). Gestational age at birth was determined by clinical assessment, and a birth before 37 weeks' gestation was considered preterm.

Outcomes

The outcome variables were mean birthweight, birthweight category and size-for-gestational-age. World Health Organization (WHO) classification[17] was used to categorise birthweight as LBW (<2500 g), normal birthweight (2500–4000 g) and HBW (>4000 g). Infants' size-for-gestational-age was determined based on the 2020 Australian national birthweight percentiles by sex and gestational age,[18] with SGA <10th percentile, LGA as >90th percentile and appropriate-for-gestational-age (AGA) as 10th to 90th percentile.

Data analysis

Descriptive statistics included mean (standard deviation) for normally distributed continuous variables and count (percentage) for categorical variables. Trends in descriptive variables were plotted as percentage vs. year with 95% confidence intervals calculated using the Clopper-Pearson method. Differences in the trends in the maternal risk factors and birthweight outcomes were assessed using linear regression for continuous variables, logistic regression for binary variables and multinominal regression for nominal variables. Estimates of ethnicity–year interaction terms were used to assess any differences in trends (slopes) between the two ethnic groups. The odds ratios were expressed as percentage increase/reduction.

Associations between exposure variables and mean birthweight were explored using univariate analysis, and mixed effects linear regression was used for multivariate analysis. The relationships of exposure variables to the abnormal birthweight categories (LBW or HBW in reference to normal birthweight; SGA or LGA in reference to AGA) were investigated with multinominal logistic regression. As prepregnancy BMI data were available only after the year 2010, analysis was performed in two ways: first, using the whole data set (2005–2018) and, second, using only 2010–2018 data. In the subset of 2010–2018 data, missing data were found in maternal age (3.1%), diabetes status (3.2%), hypertensive disorders (0.7%), prepregnancy BMI (22.4%), smoking (3.4%), alcohol consumption (3.6%), illegal drug use (1.1%) and socio-economic status (0.3%) and were assumed to be missing at random. Accordingly, three models were developed for each regression analysis: Model 1 used 2005–2018 data without including prepregnancy BMI as an exposure variable and excluding records with missing data; Model 2 used 2010–2018 data including prepregnancy BMI as an exposure variable and excluding records with missing data; Model 3 used 2010–2018 data including prepregnancy BMI as an exposure variable and handling missing values using Multivariate Imputation by Chained Equations. Interaction terms were added to models to check whether the effect of each exposure variable on birthweight outcome varies depending on Indigenous status (e.g. ethnicity:prepregnancy BMI). There were no significant differences in predictors of birthweight outcomes between the models; hence, Model 3 results are presented. All analyses were conducted using R statistical software (version 4.2.0; R Foundation for Statistical Computing, Vienna, Austria), and the statistical significance level was set at $\alpha = 0.05$.

Results

Study cohort

The analytical cohort of this study included 3805 Indigenous (4.9%) and 76750 non-Indigenous (95.1%) live singleton infants born in Tasmania from 2005 to 2018 and their mothers (Supplementary Fig. 1).

Trends in maternal characteristics

On average, Indigenous mothers were 3.36 years younger ($P < 0.001$) than non-Indigenous mothers. The mean age at the time of delivery increased by 0.08 years per year ($P < 0.001$), with no significant difference between the groups. Teenage pregnancies were 2.7 times more frequent ($P < 0.001$) among Indigenous than non-Indigenous women. There was a decrease in the prevalence of teenage mothers, but the reduction was lower (5% vs. 6% reduction per year, $P < 0.001$) in Indigenous compared with non-Indigenous mothers. Advanced maternal age (>35 years) was 58% less likely among Indigenous mothers, with the rate reducing by 0.7% per year. In contrast, the prevalence of mothers aged >35 years increased by 1.3% per year in non-Indigenous mothers ($P < 0.001$).

Indigenous mothers showed a higher prevalence ($P < 0.001$ for all) of several risk factors, namely, smoking, illegal drug use, prepregnancy obesity and low socio-economic status than non-Indigenous mothers (Fig. 1). The prevalence of smoking (5% reduction per year), alcohol consumption (17% reduction per year) and illegal drug use (5% reduction per year) decreased ($P < 0.001$ for all), and there were no significant differences in the rates of reduction between the two groups. The prevalence of GDM markedly increased in both groups, but the rate of increase was higher in Indigenous than non-Indigenous mothers (18% vs. 17% increase per year, $P < 0.001$).

Similarly, the prevalence of prepregnancy obesity increased in both groups, and the rate was higher (3% vs. 2.5% increase per year, $P < 0.001$) in Indigenous compared with non-Indigenous mothers. Almost half of the Indigenous mothers lived in socio-economically disadvantaged areas compared with less than one-third of non-

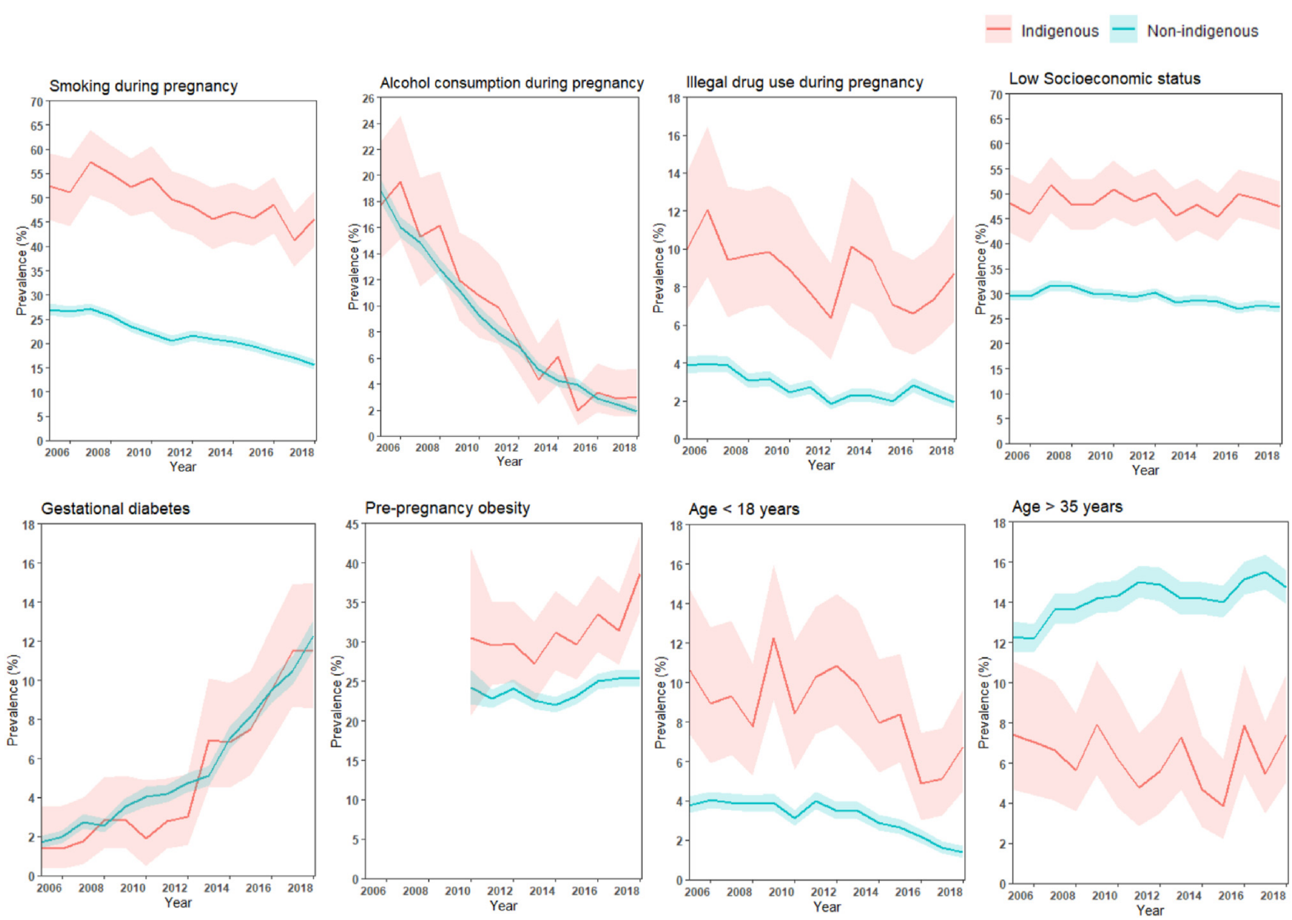

Fig. 1. Prevalence of risk factors of abnormal birthweight in Indigenous and non-Indigenous mothers of live singleton infants born in Tasmania 2005–2018. Shaded areas show 95% confidence intervals.

Indigenous women. Over time, there was a reduction of women living in low socio-economic areas, but the reduction was lower (1% vs. 1.2% reduction per year, $P < 0.001$) in Indigenous compared with non-Indigenous mothers.

Trends in infant birthweight

On average, Indigenous infants weighed 121 g less and had a birthweight Z-score of 0.2 units less than non-Indigenous infants. The mean birthweight (−6 g per year) and birthweight Z-score (−0.01 units per year) decreased over time, with no significant differences in the rate of reduction between the two groups ($P = 0.793$ for both, Fig. 2). LBW and SGA births were higher, whereas the HBW and LGA births were lower among Indigenous compared with non-Indigenous infants ($P < 0.001$ for all trends; Fig. 3). With increasing years, HBW decreased (by 2.19% per year in Indigenous and 2.18% per year in non-Indigenous; $P < 0.001$), LGA increased (1.6% vs. 0.6% per year; $P < 0.001$), LBW increased (2.63% vs. 2.34% per year; $P < 0.001$) and SGA decreased (2.25% vs. 2.2% per year; $P < 0.001$).

Associations between maternal variables and infant birthweight

The mean birthweight of Indigenous infants was lower (−121 g; $P < 0.001$) than non-Indigenous infants in the univariate analysis (Table 1), and this difference reduced (−55 g, $P < 0.001$) after adjusting for maternal and perinatal variables (Supplementary Table 1). Maternal age <18 or >35 years, smoking, alcohol consumption, illegal drug use, GDM, hypertension, pre-eclampsia, underweight prepregnancy BMI and low socio-economic status were negatively associated with mean birthweight. Parity, pre-existing diabetes and overweight/obese prepregnancy BMI were positively associated with mean birthweight (Table 1).

Indigenous infants had a higher likelihood of LBW and SGA than non-Indigenous infants even after adjusting for maternal and perinatal variables (Table 1 and Supplementary Table 1). According to the results of the univariate analysis, Indigenous ethnicity, age<18 years, maternal smoking, alcohol consumption, illegal drug use, pre-eclampsia, underweight prepregnancy BMI and low socio-economic status increased the likelihood of giving birth to an LBW and SGA infant. In contrast, higher parity, pre-existing diabetes and prepregnancy overweight or obesity in mothers increased the likelihood of giving birth to an infant with HBW and LGA. Age >35 years was positively associated with both LGA and SGA but not with HBW or LBW. IRSAD ranking 4–7 was positively associated with all abnormal birthweight/size-for-gestational-age groups. The infants exposed to GDM in utero had a lower mean birthweight (−29 g; $P < 0{\cdot}001$), and 17% increased risk of having an LBW than the infants of mothers without diabetes. Interestingly, the GDM-exposed infants also had a 37% increased risk of having an LGA birth than their counterparts (Table 1). Models with ethnicity:prepregnancy BMI interaction (data not shown) showed that for Indigenous births, the effects of overweight and obese prepregnancy BMI on birthweight were stronger (mean birthweight further increased by 33 g and 24 g, respectively, $P < 0.001$). Consistently, for mothers with prepregnancy overweight/obesity, the odds of having HBW or LGA infants increased further if the mother was Indigenous ($P < 0.05$).

Discussion

This is the first study to assess trends and associations between maternal variables and infant birthweight among Indigenous and non-Indigenous people in Tasmania. Our findings show there has been an upsurge in prevalence of prepregnancy obesity and GDM in both Indigenous and non-Indigenous women; however, the rate of increase has been higher in Indigenous mothers. The prevalence of

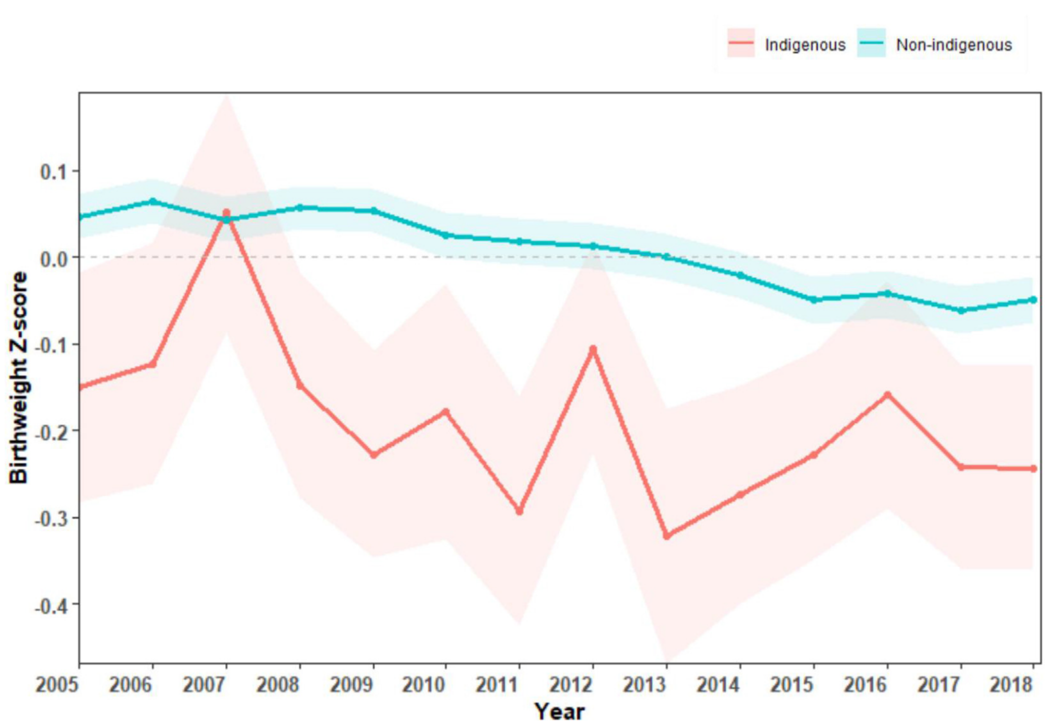

Fig. 2. Birthweight *Z*-score and 95% confidence intervals for live singleton infants born in Tasmania 2005–2018. Birthweight Z-score of each infant was calculated as (birthweight − mean birthweight of all infants)/standard deviation of the birthweight of all infants by year. Number of infants born each year: 5733, 5954, 6093, 6178, 6138, 5814, 6035, 5692, 5761, 5607, 5428, 5598, 5290, and 5234, respectively. Shaded areas show 95% confidence intervals.

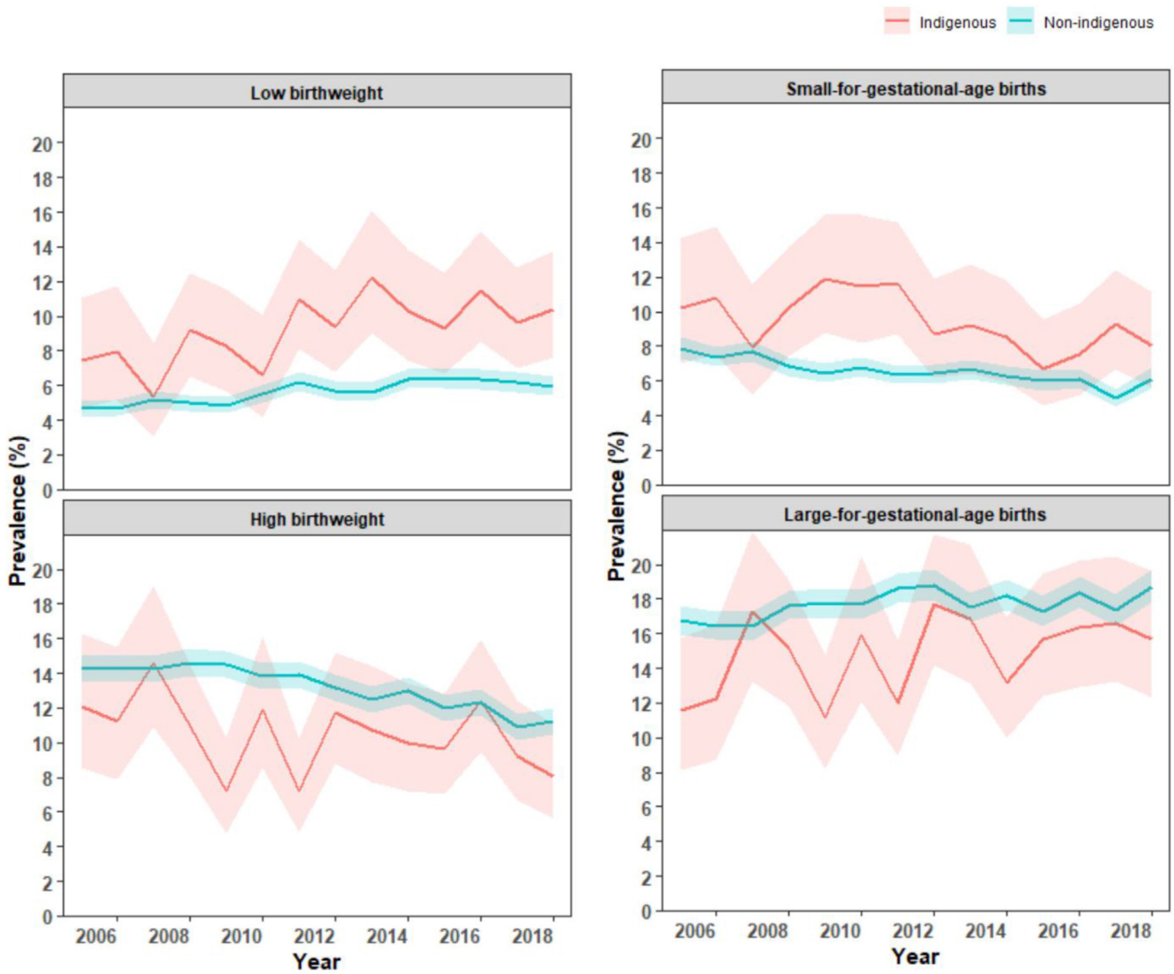

Fig. 3. Prevalence of low birthweight, high birthweight, small-for-gestational-age and large-for-gestational-age births among live singleton infants born in Tasmania from 2005 to 2018. Shaded areas show 95% confidence intervals.

smoking, alcohol consumption and illegal drug use has decreased in both groups at similar rates. LGA births increased while SGA births decreased in both groups of mothers over time; however, the rate of increase in LGA births and the rates of decrease in SGA births were significantly higher in Indigenous mothers compared with non-Indigenous mothers. GDM and prepregnancy obesity increased the risk of LGA births, whereas smoking, alcohol consumption, illegal drug use, hypertensive disorders, underweight prepregnancy BMI and low socio-economic condition in mothers increased the risk of SGA births.

Our findings are somewhat consistent with similar studies across Australia. A retrospective cohort analysis of births (n = 38,382) at an urban hospital in Melbourne from 2010 to 2015 showed that Indigenous women had higher levels of health risk factors, such as smoking and prepregnancy obesity, and pregnancy complications, such as GDM and pre-eclampsia.[11] On average, Indigenous infants' birthweight was 290 g lower than non-Indigenous infants; however, this was no longer significant after controlling for the effects of maternal variables.[11] On the contrary, in Tasmanian infants, birthweight differences existed even after adjusting for covariates, potentially because of differences in the predictor variables used in model construction.

Hare et al.[10] examined the effect of pre-existing diabetes and GDM on abnormal birthweight outcomes over three decades (1987–2016) in the Northern Territory. They observed large increases in the prevalence of GDM over time in both ethnic groups, with a higher rate in Indigenous women in 2016 (13% vs. 11%). Although the GDM rates reported in Indigenous mothers were less than non-Indigenous mothers in Tasmania, the rate of increase was higher in Indigenous than non-Indigenous mothers. It is possible that this slightly lower GDM prevalence in Tasmanian Indigenous mothers may be a result of inadequate screening for GDM to antenatal visits in which GDM is tested because of remoteness of the area of living, poor communication between service providers, previous experiences of discrimination or unfair treatment by healthcare providers and the perception that mainstream healthcare services may be unsafe as opposed to traditional ways of giving birth.[19,20]

In the Indigenous population in the Northern Territory, the rates of HBW and LGA significantly increased while SGA decreased from 1987 to 2016. LBW rates did not significantly change over this period.[10] Similarly, we observed increases in LGA rates and reductions in SGA rates among Indigenous people in Tasmania from 2005 to 2018; however, the trends of LBW and HBW were quite the opposite. This shows that the trends in birthweight can vary depending on the birthweight classification used, for example, WHO categorisation vs. size-for-gestational-age categorisation. Although WHO categorisation is more commonly used to identify infants with abnormal foetal growth, that is, LBW and HBW, some studies have shown that they may not be valid for all populations.[21] In addition, several studies[11,22,23] have indicated that the health of Indigenous newborns is better assessed using gestational age instead of birthweight. Besides, the adverse outcomes associated

Table 1
Univariate-unadjusted associations between maternal variables and infant birthweight.

Maternal variables	Mean difference in birthweight		Abnormal birthweight group				Abnormal size-for-gestational-age category			
			Low birthweight		High birthweight		Small for gestational age		Large for gestational age	
	Estimate	(95% CI)	OR (95% CI)		OR (95% CI)		OR (95% CI)		OR (95% CI)	
Indigenous ethnicity	−121	(−126, −116)*	1.71	(1.66, 1.76)*	0.81	(0.79, 0.84)*	1.44	(1.40, 1.49)*	0.86	(0.84, 0.89)*
Age <18 years	−142	(−149, −136)*	1.7	(1.63, 1.76)*	0.76	(0.73, 0.79)*	1.61	(1.55, 1.67)*	0.63	(0.61, 0.65)*
Age >35 years	−5.2	(−8.5, −2.0)*	0.99	(0.97, 1.02)	0.99	(0.97, 1.01)	1.03	(1.00, 1.05)ϒ	1.14	(1.13, 1.16)*
Parity	21	(20, 21)*	1.02	(1.01, 1.03)*	1.12	(1.12, 1.13)*	0.94	(0.94, 0.95)*	1.16	(1.15, 1.16)*
Smoking	−292	(−295, −289)*	2.65	(2.60, 2.69)*	0.42	(0.41, 0.42)*	2.65	(2.61, 2.70)*	0.44	(0.43, 0.44)*
Alcohol consumption	−62	(−67, −56)*	1.13	(1.09, 1.17)*	0.83	(0.81, 0.86)*	1.45	(1.41, 1.50)*	0.77	(0.75, 0.78)*
Illegal drug use	−465	(−472, −458)*	3.77	(3.65, 3.89)*	0.29	(0.27, 0.31)*	3.38	(3.27, 3.49)*	0.35	(0.33, 0.37)*
Gestational diabetes mellitus	−80	(−85, −76)*	1.17	(1.13, 1.20)*	0.72	(0.70, 0.74)*	0.88	(0.86, 0.91)*	1.37	(1.35, 1.40)*
Pre-existing diabetes	28	(15, 42)*	1.37	(1.26, 1.50)*	1.65	(1.55, 1.75)*	0.64	(0.56, 0.73)*	3.65	(3.48, 3.83)*
Hypertension	−65	(−71, −59)*	1.25	(1.20, 1.30)*	0.87	(0.84, 0.90)*	1.1	(1.06, 1.15)*	1.22	(1.19, 1.25)*
Pre-eclampsia	−510	(−517, −502)*	6.37	(6.18, 6.57)*	0.75	(0.71, 0.79)*	2.96	(2.85, 3.07)*	0.98	(0.95, 1.02)
Obese prepregnancy BMI	123	(120, 125)*	0.88	(0.86, 0.90)*	1.77	(1.74, 1.79)*	0.79	(0.77, 0.80)*	2.07	(2.04, 2.10)*
Overweight prepregnancy BMI	97	(95, 100)*	0.86	(0.84, 0.88)*	1.5	(1.48, 1.52)*	0.89	(0.87, 0.91)*	1.57	(1.55, 1.59)*
Underweight prepregnancy BMI	−238	(−244, −232)*	2.26	(2.19, 2.33)*	0.49	(0.47, 0.51)*	1.74	(1.69, 1.80)*	0.52	(0.50, 0.54)*
IRSAD ranking 1–3	−80	(−82, −77)*	1.68	(1.65, 1.72)*	0.94	(0.92, 0.95)*	1.56	(1.53, 1.59)*	0.94	(0.93, 0.96)*
IRSAD ranking 4–7	−16	(−18, −13)*	1.31	(1.29, 1.34)*	1.03	(1.01, 1.04)*	1.22	(1.20, 1.25)*	1.03	(1.02, 1.05)*

BMI, body mass index; CI, confidence interval; IRSAD, Index of Relative Advantage and Disadvantage;
Estimates for the mean difference in birthweight and odds ratios (OR) of birthweight categories associated with the listed maternal predictors compared to their reference levels were obtained from univariate linear regression and multinomial logistic regression, respectively, using 2010-2018 data (N = 50459) and handling missing values using Multivariate Imputation by Chained Equation.
The dummy variables along with reference groups (ref) used for different maternal variables are as follows: Indigenous status: Indigenous vs. non-Indigenous (ref); maternal age at delivery: <18 years, 18–35 years (ref), and >35 years; parity: primiparous (ref) vs. multiparous; maternal prepregnancy BMI: underweight (<18·5 kg/m^2), normal (18·5–25 kg/m^2, ref), overweight (25–30 kg/m^2), and obese (>30 kg/m^2); diabetes status: non-diabetic (ref), pre-existing diabetes (type 1 and type 2), and gestational diabetes; hypertensive disorders: none (ref), hypertension, and pre-eclampsia; smoking during pregnancy: no (ref) vs. yes; alcohol consumption no (ref) vs. yes; illegal drug use during pregnancy: no (ref) vs. yes; socio-economic status based on IRSAD decile rankings:1–3: low, 4–7: middle, or 8–10: high (ref). The results of the adjusted analysis are presented in Supplementary Table 1.
*Statistical significance at $P < 0.001$.
ϒ$P = 0.037$.

with birthweight of an infant can differ based on the category of size-for-gestational-age the infant is allocated to.[24,25] Hence, trends of SGA and LGA may give better predictions in relation to future health risks than LBW and HBW.

Our regression analysis shows that associations of Indigenous ethnicity with LBW and SGA births weakened after adjusting for maternal covariates. This suggests that moderating inequalities in mothers will help to diminish birthweight disparities between Indigenous and non-Indigenous people in Tasmania. Prevalence of maternal smoking and low socio-economic status has reduced over the years; however, it has been continuously high in Indigenous mothers compared with non-Indigenous mothers, and it may have contributed to low mean birthweight and high probability of SGA in Tasmanian Indigenous infants. Furthermore, the substantial increase in LGA births may be related to the rising proportions of prepregnancy obesity and GDM. The yearly increase in the rate of prepregnancy obesity and GDM was higher in Indigenous mothers compared with their non-Indigenous counterparts. This may be partly explained by changes in Indigenous food habits over time. Availability and marketing of junk food, limited access to high-quality fresh produce and financial instability, which reduces the affordability of healthy food, are some of the factors associated with food insecurity in Indigenous people.[26] Addressing these issues and improving nutrition in Indigenous women from a young age should be a priority of intervention strategies, especially because they are at increased risk of central fat deposition compared with their non-Indigenous parallels,[27] a plausible mediator of maternal obesity and adverse pregnancy outcomes including GDM and LGA. System-wide interventions are required to support smoking cessation and improve food security, especially among Indigenous people. Enhancing their socio-economic conditions through increased employment and education opportunities should also be a continuing goal. It is important that programmes are co-designed and managed in consultation with Aboriginal and Torres Strait Islander people to ensure culturally sensitive approaches.

A strength of this study is the use of population-wide data that minimises selection bias and enhances generalisability. Moreover, we accounted for the effect of prepregnancy BMI on birthweight trends from 2012 to 2018, which has not been the case with some other studies.[10] As we retrospectively assessed state-wide hospital data collections, the self-reported data included in the datasets may be associated with social desirability bias and recall bias. There was high variability in the trajectories of Indigenous mothers and infants, whereas the trajectories of non-Indigenous mothers and infants were smoother. This indicates that further information is needed to explain this variability observed for the Indigenous group. Factors including mothers' education status, income and health care may be relevant; however, such individual-level data are not available through Tasmanian Perinatal Data Collection. In addition, the lower sample size of Indigenous compared with non-Indigenous population also could be another potential reason for the greater variability in Indigenous data. The exposure variables used in our study explained only one-third of the variation in infant birthweight. Hence, future studies should consider other important maternal predictors of infant birthweight, including maternal education level, GWG and glycaemic levels in mothers with GDM. Moreover, birthweight is only a proxy of an infant's nutritional status; it is incapable of differentiating between various components of body composition, including fat mass. Given that excess fat mass accumulation during foetal life may increase the risk of obesity and associated diseases later in life, and adiposity during infancy is determined by a range of maternal factors,[28,29] future studies would benefit from examining recent trends in infant body composition and their association with maternal exposures in Indigenous and non-Indigenous people.

Overall, our study provides a unique opportunity to understand the contributions from drifts in maternal characteristics to birthweight disparity in Indigenous and non-Indigenous people in Tasmania during recent years. Over time, the prevalence of some maternal risk factors, such as smoking, alcohol consumption and illegal drug use, have decreased at a similar pace in both groups. However, the rate of increase in GDM and maternal prepregnancy obesity has been higher in Indigenous mothers, which could explain the higher rate of increase in LGA births in Indigenous, than non-Indigenous mothers. Comprehensive co-designed programmes managed in collaboration with Indigenous people are essential to address the barriers to behaviour change through culturally sensitive approaches and to support healthy lifestyle choices before, throughout and after pregnancy.

Author statements

Acknowledgements

The authors would like to thank the following organisations: the Department of Health, Tasmania, for the supply of Tasmanian Perinatal Data Collection; and the Tasmanian Data Linkage Unit for undertaking the linkage of these data sets, This research was supported by an Australian Government Research Training Program (RTP) Scholarship to M.P. Herath.

Ethical approval

The study was approved by the Human Research Ethics Committee, Tasmania (Approval No. 20469).

Funding

Not applicable.

Competing interests

All other authors declare no competing interests.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2023.05.016.

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