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Interventions to prevent or treat obesity in adult Indigenous Australians: A systematic review

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ABSTRACT

Background: Aboriginal and Torres Strait Islander (Indigenous) Australians experience a disproportionately higher prevalence of obesity compared with non-Indigenous Australians. We aimed to describe existing research into lifestyle, pharmacological or surgical interventions for preventing or treating obesity in Indigenous Australians.

Methods: A systematic review of published and grey literature was performed. Medline, Embase, Emcare (on the OVID platform), Web of Science and website searches were conducted to April 2024. Observational and randomised studies of adult Indigenous Australians were included if an intervention was implemented to prevent and/or treat obesity and post-intervention results were reported. The PRISMA systematic review reporting methods was used to collate data.

Results: Of 1019 records screened, 17 were included; most described educational initiatives or lifestyle programs for improving diet and exercise. There were no reports of pharmacotherapies for weight management. The effect of lifestyle programs on weight reduction was modest (~2–4 kg after 4–12 months). There were five reports on short-term (12 week) structured exercise programs. Two non-randomised studies of structured exercise showed reduction in weight in the highest weight groups whilst the two randomised trials showed ~2 kg weight reduction compared with control. One observational study described mean ~26 kg weight reduction at two years after laparoscopic adjustable gastric banding in 26 Indigenous Australians.

Conclusions: Community-based lifestyle interventions to manage excess weight can be successfully conducted in Indigenous Australians, but with generally limited efficacy. Providing background community-based lifestyle programs may facilitate the conduct of randomised trials of newer, effective anti-obesity pharmacotherapy in this high priority population.

1. Introduction

Overweight and obesity has been identified as the second highest preventable risk factor contributing to the health gap experienced by Aboriginal and Torres Strait Islander people [1]. In 2018–2019, 74 % of Aboriginal and Torres Strait Islander adults had a body mass index (BMI) $\geq$ 25 kg/m^2 and $>$ 45 % had a BMI $\geq$ 30 kg/m^2 [2]. Importantly, Indigenous Australians experience a disproportionately higher prevalence of obesity compared with non-Indigenous Australians, being 1.5 times as likely to be living with obesity [2]. Several factors contribute to the high prevalence of obesity among Indigenous Australians, including socio-economic disparities, reduced access to healthcare and healthy food options, lack of culturally appropriate health promotion initiatives, past policies, intergeneration trauma and loss of culture [3–5]. A holistic approach that considers the unique socio-economic, historical, political and cultural determinants of health is central to

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preventing and treating obesity, and for reducing the health inequity among Indigenous Australians [6]. This is vital as obesity is a complex and multifactorial chronic disease that is associated with significant morbidity and mortality from several preventable conditions, and in particular, cardiometabolic diseases [7,8].

The prevention and management of obesity is founded on lifestyle modifications, including healthy diets and exercise [9]. Modest weight reduction (~5–10 %) has been associated with improvement in cardiometabolic risk factors, a reduction in obesity-related complications, and better quality of life in studies of non-Indigenous Australians [10]. Importantly, more substantial weight reduction (>10 %) may be associated with a reduction in cardiovascular events [10]. Very-low energy diets, pharmacotherapy and/or bariatric surgery are strategies that are recommended by the Australian Obesity Management Algorithm for weight reduction if target weight is not achieved or if weight reduction is not maintained [9,11]. Bariatric surgery achieves substantial and durable weight reduction of ~25–30 % in patients with obesity, but is not widely available [12]. Phase III clinical trials have shown that injectable incretin therapies such as liraglutide, semaglutide and tirzepatide for example, can reduce body weight and improve cardiometabolic risk factors in people with overweight or obesity without diabetes [13–15]. However, whether such approaches are effective in Indigenous Australians remains unclear.

The aim of this systematic review is to review the evidence for lifestyle modifications, pharmacotherapy and surgical interventions in preventing and treating obesity in adult Aboriginal and Torres Strait Islander Australians. This will provide a foundation for developing new strategies to successfully treat obesity in this high priority population. This systematic review was registered with The International Prospective Register of Systematic Reviews (PROSPERO registration number CRD42024540490).

2. Methods

2.1. Search strategy

In consultation with the researchers that included Indigenous Australians, an experienced health librarian developed and conducted search strategies using a combination of free-text (keyword) and thesaurus terms for Medline, Embase and Emcare (on the OVID platform). A keyword search was also developed and conducted for the Web of Science Core Collection. All database searches were conducted on 24th April 2024 and details of the search strategy, including search terms, are outlined in Supplemental Tables 1–4. The database search strategies prioritised sensitivity to maximise retrieval of relevant records. Grey literature search included websites listed in Supplemental Table 5. No language or publication date limits were applied to the search. Results were deduplicated using EndNote 21 (Clarivate Analytics, Philadelphia, PA, USA).

2.2. Eligibility criteria

Observational cohort, case-control or cross-sectional studies, and randomised trials were included in the review if: (i) the study cohort included Australian Aboriginal and/or Torres Strait Islander people; (ii) an intervention was implemented or described; (iii) the intervention aimed to prevent and/or treat obesity or manage body weight; and (iv) there was comparison of anthropometric data for pre- versus post-intervention or intervention versus no intervention (e.g., any non-exposed control groups). Studies were excluded if: (i) the intervention was not for adults (i.e., <18 years of age); (ii) the article was an editorial, commentary, review or study protocol; or (iii) changes in anthropometric measures associated with the intervention were not reported. Conference proceedings and abstracts were included in the review.

2.3. Study selection and data extraction

Two authors (NSRL and BBY) independently reviewed the search results using the pre-defined eligibility criteria. Potentially relevant studies were screened from titles and abstracts and full-text articles were then retrieved for review. Any discrepancies or disagreements were resolved through re-review and discussion between the authors. Data extracted from each included article were: first author, year of publication, study location and cohort, sample size, baseline weight measures, description of the intervention, follow-up period and outcomes for weight measures. Given that each study evaluated different combinations of anthropometric data such as body weight, BMI, waist circumference, waist-to-hip ratio and percentage body fat, these were all extracted where available. Risk of bias assessment for non-randomised observational studies was conducted using the Newcastle-Ottawa Scale (NOS) and for randomised controlled trials using the Cochrane risk of bias [16,17]. Briefly, the NOS scale contains eight items where each is assigned one point, except for the compatibility item which can be assigned up to two points (i.e., total of nine points). A NOS score of 7–9 indicates a high-quality study, 4–6 a medium-quality study and < 4 a low-quality study. This study was performed according to the Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) guidelines [18].

3. Results

The database search returned 1856 potentially relevant records, of which 879 duplicates were removed, leaving 977 records for screening. Of these, 38 reports were assessed for eligibility and a further 23 were excluded, leaving 15 reports. In addition, 42 records from websites were identified, of which 18 were assessed for eligibility and 16 were subsequently excluded, leaving 2 reports. Overall, 17 reports were included in this review (see Fig. 1: PRISMA flow chart) and a summary of the study cohort, intervention, comparator group, outcome and reported barriers to the intervention for each report are summarised in Table 1 [19–35]. Only two studies were randomised trials [28,29]. No reports were identified describing the use or effectiveness of pharmacotherapies for weight management in Indigenous Australians and no reports reported cardiovascular event rate data.

Most studies focused on interventions where education was provided around modifications to diet and/or exercise. Healthy lifestyle programs included the Waist loss or GutBuster program, the Looma Healthy Lifestyle Program, the Healthy Weight Program, the Diabetes Management and Care Program, the healthy lifestyle programme, the New South Wales Knockout Health Challenge, the Get Healthy Service (a free telephone-based service) and the Work It Out program [21–27,32–35]. The identified reports did not specify whether caloric restriction was a part of the weight loss intervention. Two studies in the 1980s evaluated weight loss after an intervention of “traditional” diet and lifestyle in 12 and 10 Aboriginal people, respectively [19,20]. The effect of lifestyle programs on body weight was modest (see Table 1), with the observational studies reporting a weight reduction of between 2 and 4 kg after follow-up duration of between 4 and 12 months [21,22,32,33]. A notable exception was the study by O’Dea *et al.*, conducted in middle-aged Aboriginal people with or without diabetes, who relocated to traditional country and undertook hunter-gatherer lifestyles, losing on average 8 kg and 6 kg, respectively, over a seven-week period [20]. Detailed analysis of food intake during the study by O’Dea *et al.*, revealed a low-energy intake with a mean of 1200 kcal/person/day [20].

There were five reports of structured exercise programs, which were of short-term duration (12 weeks) and mostly group-based [28,29,31,34,35]. Two non-randomised studies of structured exercise showed a reduction in weight only in the highest weight groups (the extreme obesity group for one study and the highest tertile of weight in another study) [34,35]. One randomised trial evaluated a 12-week structured

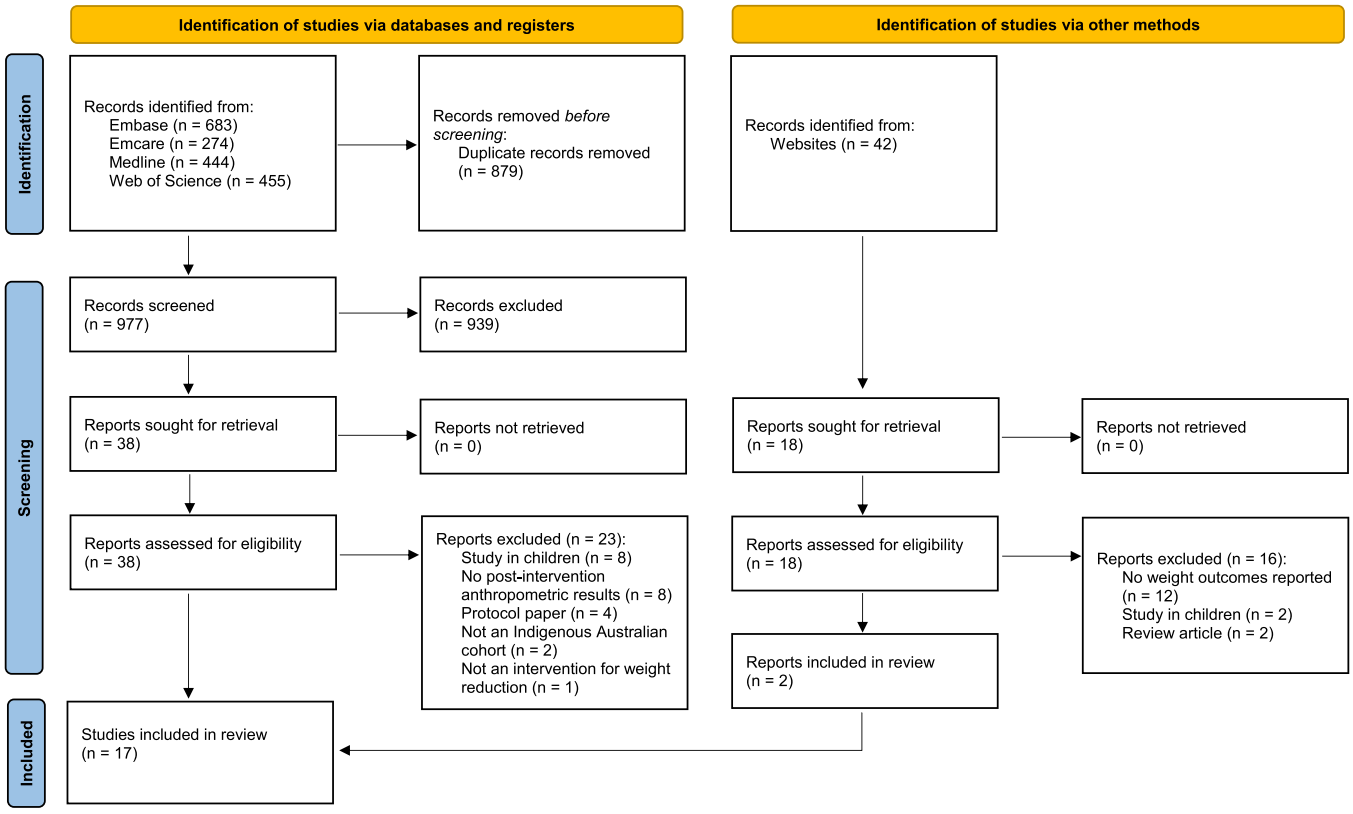

Fig. 1. Flow diagram of study selection.

group-based exercise and nutrition intervention in 100 urban Aboriginal and Torres Strait Islander women (51 were randomised to the intervention and 49 to a "waitlisted" control group) from the metropolitan area of Adelaide, South Australia [28]. The trial demonstrated that compared to control, the intervention led to significant reductions in weight and BMI of 1.85 kg ($p = 0.022$) and 0.76 kg/m^2 ($p = 0.013$), respectively, at the end of the program and 2.17 kg ($p = 0.028$) and 0.95 kg/m^2 ($p = 0.013$), respectively, at three months post-program [28]. Another randomised trial evaluated a 12-week supervised group-based sports and gym exercise intervention in 26 inactive Indigenous Australian men (16 were randomised to the intervention and 10 to the control group) from a regional New South Wales community [29]. The trial demonstrated that the intervention (n = 11 analysed) led to significant reductions in body weight (-1.3 kg vs +0.8 kg; $p = 0.042$) and mean BMI (reported −4.5 kg/m^2 vs +0.2 kg/m^2; $p = 0.013$) compared with control (n = 10).

Only one observational study described the outcomes of surgical management of obesity with laparoscopic adjustable gastric banding in 30 Indigenous Australians with obesity and diabetes from Rumbalara Aboriginal Co-operative, Victoria [30]. The study showed significant reductions in mean body weight of 26.2 kg, BMI of 9.9 kg/m^2 and waist circumference of 22.8 cm in 26 individuals after two years of follow-up [30].

Overall, there was a moderate to higher risk of bias, as summarised in Supplemental Tables 6 and 7. Risk of bias assessment of the observational studies demonstrated weaknesses in the selection of non-exposed cohorts (most studies had no comparator cohorts), ascertainment of exposure to the interventions (particularly as adherence to lifestyle interventions are difficult to measure), ascertainment of outcomes (some studies utilised self-reported outcomes and highlighted difficulties in measuring waist circumference) and a lack of comparability with non-exposed comparator cohorts (some studies compared their findings to the wider community or non-Indigenous Australians). Furthermore, many studies had high rates of loss to follow-up or non-attendance (attrition). There was an overall higher risk of bias in the randomised studies due to the inability to blind participants and persons measuring the outcomes to the exercise intervention, and incomplete outcome data from non-attendance at study visits or loss to follow-up (>25 %) [28, 29]. Allocation concealment was also not specified.

4. Discussion

This systematic review highlights that there is a paucity of high-quality evidence for interventions targeting overweight or obesity in Indigenous Australians. Most of the identified studies in Indigenous Australians were observational studies of community-based healthy lifestyle programs. Whilst some of the programs involved hundreds of people, the extent of regular participation in the programs and adherence to lifestyle modifications was not known. Moreover, the effect of interventions on anthropometric outcome measures are difficult to interpret in the setting of significant loss to follow-up (attrition bias) and participation bias, even in the randomised trials identified. The two randomised controlled trials of 12-week exercise programs that were included showed that the exercise interventions were effective, but follow-up was limited to only 3 months post-intervention [34,35]. Of note, there was only one small observational study reporting outcomes of bariatric surgery (specifically laparoscopic adjustable gastric banding) with measures at two years and no studies reporting outcomes of pharmacotherapy for weight reduction in Indigenous Australians [30].

Our findings are in line with a prior literature review which concluded that studies targeting healthy lifestyles in Indigenous Australians are undertaken infrequently and that few studies in this population utilise randomisation or control groups for comparisons [36]. To address the unmet need for the prevention and care of obesity in Indigenous Australians, there is need for high-quality evidence of safe and effective interventions. Importantly, randomised controlled trials are more likely to lead to changes in clinical practice, policies and guidelines. However, adequate representation of Indigenous Australians

Table 1
Summary of included reports.

Author and year	Population	Study design	Intervention	Comparison	Outcomes (weight measures)	Barriers to intervention reported
O'Dea *et al.*, (1982)	12 Aboriginal people from the Mowanjum Community, Western Australia: • Age 24.3 ± 1.0 * years • 10 women (83.3 %) • Weight 66.8 ± 3.7 * kg • BMI 23.6 ± 1.4 * kg/m^2	Observational study of "traditional" lifestyle	Almost exclusively seafood diet: low in fat and carbohydrate and high in protein to represent "traditional" diets (caloric restriction not specified) for 2 weeks	None	• Mean weight loss of 2.4 kg during the first week and 0.3 kg during the second week of diet	• The intervention involved relocation to an isolated region where participants gathered their own foods with no access to store foods or beverages
O'Dea *et al.*, (1984)	10 Aboriginal people with diabetes and 4 without diabetes from the Mowanjum Community, Western Australia. Diabetes group: • Age 53.9 ± 1.8 * years • 5 women (50 %) • Weight 81.9 ± 3.4 * kg • BMI 27.2 ± 1.1 * kg/m^2 No diabetes group: • Age 52.3 ± 4.3 * years • 2 women (50 %) • Weight 76.7 ± 3.4 * kg • BMI 25.3 ± 0.7 * kg/m^2	Observational study of "traditional" lifestyle	Relocated to traditional country to live a hunter-gatherer lifestyle for 7 weeks where the only food eaten was that hunted or gathered by the participants; detailed analysis of food intake during the study revealed a low-energy intake (mean 1200 kcal/person/day)	None	• Diabetes group: mean weight loss of 8.1 kg and reduction in BMI of 2.7 kg/m^2 over the 7-week period • No diabetes group: mean weight loss of 5.8 kg and reduction in BMI of 1.9 kg/m^2 over the 7-week period	• The intervention involved relocation to an isolated region where participants gathered their own foods with no access to store foods or beverages
Egger *et al.*, (1999)	45 Indigenous men with 1 year follow-up from Torres Strait region of Northern Australia: • Age 41 ± 12.3 years • Weight 107 ± 18.2 kg • BMI 34.7 ± 5.4 kg/m^2 • WC 118 ± 13.6 cm • WHR 1.05 ± 0.05	Observational study of diet and exercise	"Waist loss" / "GutBuster" program: reducing fat intake, increasing dietary fibre intake (caloric restriction not specified), increasing daily movement and changing "obesogenic" habits; intervention duration not specified	None	• Mean weight, BMI, WC and WHR were significantly reduced by 3.3 kg, 1.1 kg/m^2, 4.0 cm, 0.07 cm and 3.9 kg respectively ($p < 0.001$ for all) at 1 year	• Inadequate supply of fresh fruit and vegetables, low-fat dairy products and other low-fat foods • Reduced physical activity due to animals and motor vehicles
Egger *et al.*, (2000)	45 Indigenous men from Torres Strait region of Northern Australia: • Age 41 ± 12.3 years • Weight 106.4 ± 17.8 kg • WC 117.8 ± 13.4 cm	Observational study of diet and exercise	"GutBuster" program (see above): modified to local conditions (e.g., flip charts by local artists and resources from an existing weight program for Indigenous women)	None	• Mean weight and WC, WHR were reduced by 3.25 kg and 4.01 cm and 1 year respectively	• See above
Rowley *et al.*, (2000)	49 Aboriginal people with diabetes or overweight from the Looma community, Western Australia. Intervention group (n = 32): • Age 49 ± 3 * years • 24 women (75 %) • BMI 28.5 ± 0.8 * kg/m^2 • 14 (44.1 %) diabetes No intervention group (did not actively participate; n = 17): • Age 43 ± 4 * years • 10 women (58.8 %) • BMI 28.9 ± 1.1 * kg/m^2 • 8 (47.1 %) diabetes	Observational study of diet and exercise	Looma Healthy Lifestyle Program: educational sessions, regular physical activity groups and dietary changes (caloric restriction not specified), supported by cooking classes/store tours among the high-risk people; intervention duration not specified	No intervention group and cross-sectional data from the community because of growing awareness in the wider community and new community initiatives	• Mean BMI was significantly reduced (not specified) in the intervention group compared with no intervention at 6 months ($p = 0.012$); no difference in BMI was apparent after 12–24 months • In the community, mean BMI increased significantly by 1.6 kg/m^2 from 22.6 kg/m^2 ($p = 0.028$) in people aged 15–34 years but did not change significantly from 26.4 kg/m^2 in those aged ≥ 35 years ($p = 0.909$) over the 4-year period	• Not all persons were active participants in the interventions • Lack of sustained weight loss over the longer period may suggest difficulties with adherence
Dunn *et al.*, (2001)	260 Aboriginal and Torres Strait Islander people from Queensland: • 218 women (83.8 %) • Baseline anthropometric measures not specified	Observational study of diet and exercise	Healthy Weight Program: a community-based series of workshops on food (caloric restriction not specified) and individual assessments by trained facilitators for 8 weeks	None	• Of n = 91 individuals with data at first and third screenings (screenings were monthly), weight loss was seen in 66.3 % of women and 78.5 % of men and waist reduction in 69.2 % (further details not specified)	• Inadequate time and support to facilitate the program • Poor participation after the 8th week • Low motivation • Lack of transport • Running the program afterhours

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Table 1 (*continued*)

Author and year	Population	Study design	Intervention	Comparison	Outcomes (weight measures)	Barriers to intervention reported
Unknown, (2005)	34 Aboriginal and Torres Strait Islander people with full data from Queensland: • Number of women not specified • BMI 28.5 kg/m^2 (men) and 37.1 kg/m^2 (women) • WC 103.7 cm (men) and 118.6 cm (women)	Observational study of diet and exercise	Healthy Weight Program: a community-based series of workshops on food (caloric restriction not specified) and individual assessments by trained facilitators; intervention duration not specified	None	• Weight loss and waist reduction was seen in over half of participants (56.5 % and 57 % respectively); further details, including follow-up time, not specified	• Time of program • Lack of funding to provide incentives • Stigma • Poor attendance and high attrition • Transport • Facilitator capacity • Venue availability
Gracey *et al.*, (2006)	418 Aboriginal people from Aboriginal communities in the tropical north of Western Australia: • Age 38.7 ± 14.9 years (men) and 41.0 ± 17.4 years (women) • 237 women (56.7 %) • Weight 81.9 ± 19.8 kg (men) and 72.9 ± 19.2 kg (women) • BMI 27.3 ± 5.9 kg/m^2 (men) and 28.4 ± 7.2 kg/m^2 (women) • WC 92.7 ± 14.9 cm (men) and 97.9 ± 17.8 kg/m^2 (women)	Observational study of diet and exercise	Diabetes Management and Care Program: to address "lifestyle" diseases such as diabetes and obesity by improving awareness, healthier living (caloric restriction was not specified), detection, testing and treatment; intervention duration of was not specified	None	• In one community, 49 % of participants had lost weight and 61 % had lower BMI after several months, with improvements in BMI and WC being more marked in people with diabetes (mean BMI reduction of 0.6 kg/m^2 and mean WC reduction of 2.2 cm); further details, including follow-up time, were not specified	• Program operating among individuals in low socio-economic areas • Lack of availability of fresh, affordable and nutritious food • High temperatures impeding exercise during the day • Dependent on partnerships with Aboriginal communities, their local management, and relevant service providers
Chan *et al.*, (2007)	101 overweight urban Indigenous Australians from North Stradbroke Island and Redland Bay, Queensland. Diabetes group (n = 44): • Mean age 56.5 (52.8–60.1) * * years • 34 women (77.3 %) • Mean BMI 34 (32−36)* * kg/m^2 • Mean WC 108 (103−112) * * cm • Mean WHR 0.92 (0.88–0.95)* * Impaired fasting glucose group (n = 11): • Mean age 49.8 (40−60)* * years • 6 women (54.5 %) • Mean BMI 36 (27−45)* * kg/m^2 • Mean WC 109 (93−126)* * cm • Mean WHR 0.90 (0.79–1.00)* * No diabetes group (n = 46): • Mean age 43 (39−47)* * years • 33 women (75.6 %) • Mean BMI 34 (28−33)* * kg/m^2 • Mean WC 98 (91−104)* * cm • Mean WHR 0.88 (0.82–0.93)* *	Observational study of diet and exercise	The healthy lifestyle programme: based on improving physical activity and dietary intake (caloric restriction was not specified) plus self-monitoring of fasting plasma glucose in participants with diabetes; intervention duration not specified	None	• In 80 participants with follow-up data, there was a significant reduction in WC of 3.1 cm (p = 0.01) but not BMI (p = 0.09) or WHR (p = 0.14) at 6 months	• Not discussed
Canuto *et al.*, (2012)	100 urban Aboriginal and Torres Strait Islander women from Adelaide, South Australia, metropolitan area. Intervention group: • Mean age 39.8 (36.7–43.1) * * years • Mean weight 94.0 (88.1–99.9)* * kg • BMI 36.1 (34.0–38.2)* * kg/m^2 • WC 104.2 (100.0–108.3) * * cm • WHR 0.87 (0.85–0.88)* *	Randomised trial of a program for exercise and diet	Randomised to 12-weeks of a structured group-based exercise and nutrition program (caloric restriction was not specified): The Aboriginal and Torres Strait Islander Women's Fitness Program (n = 51)	Randomised to "waitlisted" control group (n = 49)	• Compared with control, there were significant reductions in weight and BMI of 1.85 kg (p = 0.022) and 0.76 kg/m^2 (p = 0.013) respectively immediately post-intervention (n = 71) and 2.17 kg (p = 0.028) and 0.95 kg/m^2 (p = 0.013) respectively at 3 months post-program (n = 56)	• Relatively low attendance rates for the program (overall ~40 % for exercise sessions) • Difficulty in organising appointments for data collection • Difficulty assessing WC as assessors were conscious to be sensitive and appropriate

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Table 1 (*continued*)

Author and year	Population	Study design	Intervention	Comparison	Outcomes (weight measures)	Barriers to intervention reported
					• No significant difference in WC	
Mendham *et al.*, (2015)	26 inactive Indigenous Australian men from a regional New South Wales community. Intervention group: • Age 39.5 ± 10.6 years • Weight 95.4 ± 11.5 kg • BMI 31.6 ± 3.1 kg/m^2 • WC 103.5 ± 8.5 cm • WHR 0.96 ± 0.1	Randomised trial of a program for exercise	Randomised to 12-weeks of supervised group-based sports and gym exercises (n = 16)	Randomised to control group where normal activity and diet was maintained (n = 10)	• The exercise program (n = 11) led to significant change in weight (−1.3 vs +0.8 kg; p = 0.042), BMI (reported −4.5 vs +0.2 kg/m^2; p = 0.013), WC (−3.3 vs 1.5 cm; p = 0.004) and WHR (−0.02 vs no change; p = 0.041) compared with control (n = 10) after 12 weeks	• 5 participants excluded from the 12-week analysis due to < 50 % attendance
O'Brien *et al.*, (2016)	30 Indigenous Australians with obesity (BMI >30 kg/m^2) and diabetes from Rumbalara Aboriginal Co-operative, Victoria: • Mean age 44.6 years • 26 women (86.7 %) • Weight 118.8 ± 22.9 kg • BMI 44.8 ± 8.4 kg/m^2 • WC 133.9 ± 17.7 cm	Observational study of surgical management	Laparoscopic adjustable gastric banding	Non-Indigenous Australians from a prior randomised controlled trial	• In those with 2-year follow-up (n = 26), there were significant reductions in mean weight of 26.2 kg, BMI of 9.9 kg/m^2 and WC of 22.8 cm (p < 0.001 for all) after 2 years • Indigenous people had greater reductions in weight and WC	• Intervention required initial period of learning, development of trust and sharing of relevant information to improve the informed consent process • Preference to have healthcare provided by local community, requiring training and experience • Adverse events following surgery
Esgin *et al.*, (2017)	15 inactive Indigenous Australians in a metropolitan setting: • Age 32 ± 6.6 years • Reported 55 % women • Baseline weight and BMI measures not specified	Observational study of exercise	Supervised exercise training program for 12 weeks	None	• Significant reduction in percentage body fat (34.4 ± 8.2 % to 32.4 ± 8.5 %; p = 0.033) for participants completing the intervention (n = 11)	• Not specified
Passmore *et al.*, (2017)	586 Aboriginal people in 22 teams from 19 Aboriginal communities across New South Wales: • Age 39 ± 13.6 years • 414 women (72.0 %) • Weight 98.54 ± 22.4 kg • BMI 35.7 ± 7.8 kg/m^2 • WC 113.3 ± 16.8 cm	Observational study of diet and exercise	New South Wales Knockout Health Challenge 2013: a community-led weight loss and healthy lifestyle program for Aboriginal communities where teams compete to achieve weight loss (caloric restriction was not specified) over a 16-week period	None	• Among participants with data at four time points (n = 122), there were significant reductions in weight and BMI of 2.3 kg and 0.9 kg/m^2 respectively at the end of the 16-week challenge and 2.3 kg and 0.8 kg/m^2 respectively at 9 months after the challenge compared with baseline (p < 0.001 for all)	• Compared with women, men were less likely to participate and to reduce their BMI during the challenge • More effects are needed to support increase in vegetable intake • Loss of follow-up
Quinn *et al.*, (2017)	1462 Aboriginal people participating in the New South Wales Get Healthy Service; the below data is for those who completed 6-month coaching: • Mean age and proportion women not specified • Weight 97.3 ± 20.3 kg • BMI 35.7 ± 6.7 kg/m^2 • WC 111.3 ± 15.2 cm	Observational study of diet and exercise	Get Healthy Service: a free telephone-based service/coaching program supporting healthy eating (caloric restriction was not specified), physical activity, reducing alcohol intake and maintaining healthy body weight for 6 months	Non-Aboriginal people	• Significant reductions in mean weight of 3.3 kg (n = 103; p = 0.001), BMI of 1.2 kg/m^2 (n = 101; p = 0.001) and WC of 6.2 cm (n = 74; p < 0.0001) at 6 months • No significant difference in anthropometric improvements between Aboriginal and non-Aboriginal people	• Need to improve referral rates from Aboriginal Health works, including education and training staff in using the service
Mills *et al.*, (2017)	85 Aboriginal and Torres Strait Islander people with cardiovascular disease or ≥ 1 risk factor (includes overweight or obesity) from southeast Queensland: • Age 55.26 ± 13.86 years • 61 women (71.8 %) • BMI 36.89 ± 9.65 kg/m^2 • Weight 98.90 ± 27.97 kg • WC 116.32 ± 19.86 cm • WHR 0.94 ± 0.09	Observational study of education and exercise	Work It Out program: educational sessions delivered by health professionals followed by group exercise developed by exercise physiologist or physiotherapist for 12 weeks per cycle	None	• No significant difference in weight (p = 0.113), BMI (p = 0.15), WC (p = 0.63) and waist/hip ratio (p = 0.95) after 12 weeks • Mean weight was significantly reduced by 1.6 kg (p = 0.037) in participants classified with extreme obesity (BMI >40 kg/m^2)	• Missing data on outcome measures due to non-attendance; however, the program was designed to allow flexibility in attendance

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Table 1 (*continued*)

Author and year	Population	Study design	Intervention	Comparison	Outcomes (weight measures)	Barriers to intervention reported
Hu *et al.*, (2019)	406 Aboriginal and Torres Strait Islander people with chronic conditions or at risk of chronic disease from southeast and central Queensland: • Age 52.9 ± 14.2 years • 254 women (62.6 %) • BMI 35.26 ± 8.22 kg/m^2 (n = 347) • Weight 97.95 ± 24.97 kg (n = 351) • WC 113.43 ± 17.52 cm (n = 347) • WHR 0.96 ± 0.10 (n = 338)	Observational study of education and exercise	Work It Out program: educational sessions delivered by health professionals followed by group exercise developed by exercise physiologist or physiotherapist for 12 weeks per cycle	None	• In the overall group there were significant reductions in mean WC of 1.79 cm ($p < 0.001$) and WHR of 0.007 ($p = 0.043$) after 12 weeks • In the highest tertile of each measure, there were significant reductions in mean weight of 2.59 kg ($p = 0.025$), BMI of 0.71 kg/m^2 ($p = 0.029$), WC 5.09 cm ($p < 0.001$) and WHR of 0.033 ($p < 0.001$)	• As above

Abbreviations – BMI body mass index, WC waist circumference, WHR waist-to-hip ratio
*Standard error of mean
**95 % confidence interval

in clinical trials addressing chronic diseases, such as obesity, type 2 diabetes and cardiovascular disease, has been limited to date [37,38]. There have also been concerns around the cultural acceptability of clinical trials and that randomisation may be divisive within Aboriginal communities [39]. Yet, several randomised trials have been completed with Indigenous peoples in Australia and worldwide [40–43]. Randomised controlled trials in Indigenous Australians can be feasible and successful if 'cultural integrity' is intrinsic to the design and execution of the study [44]. In this context, cultural integrity entails the "right of Aboriginal Peoples to maintain and develop the central and significant elements of their ancestral culture", which includes the understanding of health and well-being[44]. To uphold cultural integrity and respect cultural values, strong community engagement and co-design of all aspects of the research from start to end with Aboriginal communities and research partners is crucial [44,45]. Moreover, studies need to be culturally safe, appropriate, tailored to Aboriginal health services (including Aboriginal Community Controlled Health Organisations) and founded on strong ethical principles [40,44,45].

It has been suggested that interventions for weight reduction in Indigenous Australians are more likely to be sustainable and effective if they are: 1) culturally acceptable, 2) conveniently located, 3) easily incorporated into the daily schedule, 4) able to accommodate the preferences of participants, 5) able to show goal attainment which is realistic and appropriate, 6) conducted in groups, and 7) conducted within the community by local Aboriginal and Torres Strait Islander health services and people [3,46]. Indeed, several studies have shown that the design, implementation and ownership of weight reduction interventions by community members is a critical determinant of program effectiveness, adherence and sustainability [28,29,32]. A recent review of diabetes and obesity interventions in Indigenous people in Australia, Canada, New Zealand and the United States also highlighted that health promotion interventions are more effective when co-developed and delivered locally by Indigenous people [47]. Nonetheless, the main barriers reported by several studies identified in our review were the low rates of participation, high rates of loss to follow-up, lack of availability to fresh, nutritious and affordable foods, and inadequate support to facilitate programs (see Table 1). The prevention and management of obesity in Indigenous Australians should therefore also include strategies that addresses systemic factors such as access to healthy foods and healthcare services, healthy lifestyle education, government policies, community and family support, financial disadvantage and mental health, among others.

Whilst supervised lifestyle interventions are essential for weight reduction, the addition of pharmacotherapies or bariatric surgery for weight management may be required. Bariatric surgery (or also known as "metabolic" surgery) is currently the most effective therapy for weight management, as it can achieve substantial and durable weight reduction (~25–30 %) in people with obesity [12]. Bariatric surgery has favourable effects on cardiometabolic risk factors and its safety has substantially improved over time [12]. A meta-analysis and systematic review of 39 cohort studies has suggested that bariatric surgery reduces cardiovascular and all-cause mortality [48]. Despite its proven benefits, the evidence for outcomes following bariatric surgery in Indigenous Australians remains scarce [49]. In our systematic review, only one of the studies identified examined outcomes of bariatric surgery in Indigenous Australians. This was a small observational study (n = 30, with n=26 with two-year follow-up data) that examined laparoscopic adjustable gastric banding, which is no longer a common approach compared with laparoscopic sleeve gastrectomy and laparoscopic roux-en-Y gastric bypass [12,30]. Although weight outcomes at two years was favourable, one patient experienced an early adverse event and seven experienced late adverse events [30]. In addition, equitable access to bariatric surgery remains an issue[49].

Pharmacotherapy for weight management can assist with initial weight reduction, long-term maintenance and/or prevention of weight regain [11]. In particular, incretin therapies may be an important management option for obesity in Indigenous Australians due to their proven efficacy and safety in non-Indigenous cohorts and greater ease of access compared with bariatric surgery; this is especially relevant in rural and remote regions of Australia. Liraglutide (a glucagon-like peptide-1 [GLP-1] receptor agonist), semaglutide 2.4 mg (another GLP-1 receptor agonist) and tirzepatide (a glucose-dependent insulinotropic polypeptide and GLP-1 receptor agonist) are currently approved by the Australian Therapeutic Goods Administration for the treatment of obesity, but are not reimbursed on the Pharmaceutical Benefits Scheme [11]. It may be beneficial to consider policy reforms to subsidise the cost of approved weight management pharmacotherapies for Indigenous Australians, who are a high priority population. Importantly. the SELECT trial demonstrated that semaglutide 2.4 mg weekly can significantly reduce cardiovascular events in patients with cardiovascular disease and overweight or obesity without diabetes [50]. Also, recent studies of tirzepatide have demonstrated that it can reduce body weight by ~15 kg in people with overweight or obesity without diabetes [14].

Both semaglutide and tirzepatide are administered as weekly subcutaneous injections [14,15,50]. This could conceivably allow a study in which participants visit a community centre or are visited by an

Aboriginal Health Worker on a weekly basis to receive treatment. On the horizon are even more pharmacotherapies that promise to transform the management of obesity, including oral formulations and multi-receptor agonists [51,52]. The efficacy, safety, cost-effectiveness and acceptability of these novel pharmacotherapies in Indigenous Australian populations needs to be considered in further studies. Providing a culturally appropriate background community-based educational or lifestyle intervention similar to those described above, may facilitate the conduct of a randomised clinical trial using new pharmacotherapy for weight management in Indigenous Australians [21,22,32,33]. However, the integration of such therapies into broader public health strategies for the management of obesity in Indigenous Australians requires careful consideration of the communities' unique needs, including the social determinants of health and culturally appropriate messaging [3]. Future research should prioritise the evaluation of pharmacotherapy for weight management within Indigenous populations and explore whether these therapies can help optimise lifestyle interventions and community health programs that aim to prevent and treat obesity. The findings of these studies might facilitate subsidised access to pharmacotherapy treatment for Indigenous Australians.

Limitations of this systematic review must be noted. Firstly, the heterogeneity in study methodologies, study cohorts and reporting of outcomes prevented the use of meta-analysis techniques, including individual participant data analyses. Secondly, we excluded studies where the effect of interventions on anthropometric measures was not reported; therefore, potentially effective interventions for improving nutrition and physical activity, and subsequently reducing body weight, may not have been included. Thirdly, lifestyle interventions in Indigenous Australians may not be published in medical journals and as such we searched the grey literature (e.g., Australian Indigenous HealthInfoNet). Fourthly, we did not include studies of dietary and exercise interventions targeting childhood obesity. Lastly, there may have been overlap in the studies included, where some interventions and potentially, patient cohorts, were reported in multiple publications. Despite these limitations, our robust methodology, search strategy and systematic approach provides an important outline of the current literature, highlighting gaps in knowledge and setting the stage for future research on obesity prevention and management in Indigenous Australians. The strengths of this systematic review include the focussed research question, comprehensive description of interventions from over 40 years of publications, and adherence to the PRISMA guidelines.

In conclusion, there is limited evidence from randomised trials on interventions that prevent or treat obesity in Indigenous Australians. Given the high prevalence of obesity in Indigenous Australians and the rapidly transforming landscape of weight management with pharmacotherapies, new interventional studies that involve Indigenous Australian communities at every stage of the research process should be prioritised. There are instances where community-based educational or lifestyle interventions have been accepted and employed to some effect by Indigenous Australians. Culturally appropriate community-based programs of this nature could provide a background for randomised clinical trials of novel anti-obesity medications in this high priority population.

CRediT authorship contribution statement

Ford Josephine: Writing – review & editing, Conceptualization. **Lan Nick S. R.:** Writing – original draft, Validation, Methodology, Investigation. **Yeap Bu B.:** Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Conceptualization. **Dwivedi Girish:** Writing – review & editing, Project administration, Methodology, Conceptualization. **Jones Glynis:** Writing – review & editing, Validation, Methodology, Investigation. **Gregory Lionel:** Writing – review & editing, Conceptualization.

Ethical approval

Not applicable since this study is a systematic review.

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Declaration of Competing Interest

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.orcp.2025.04.003.

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