



Cardiovascular disease risk reduction interventions for indigenous women: an umbrella review

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Abstract

Cardiovascular disease (CVD) prevention strategies are predominantly informed by studies conducted in men from the general population, which can disadvantage women—particularly Indigenous women—whose CVD needs differ in terms of symptom presentation, healthcare access, receipt of guideline-recommended care and sociocultural roles. This review aims to summarize the effectiveness of CVD prevention interventions in Indigenous women in the USA, Canada, New Zealand and Australia. Umbrella review of systematic reviews and randomized and non-randomized interventions examines the effectiveness of pharmacological and nonpharmacological interventions in reducing CVD risk in target countries in Indigenous adult studies with $\geq 50\%$ women. Systematic searches were conducted across six electronic databases between January and February 2024 (update: February 2025). Quality assessment applied standard methods and evidence was synthesized qualitatively. The protocol was PROSPERO registered (CRD42024575310). Six systematic reviews and 16 primary studies (7 randomized and 9 non-randomized; 11,473 participants; 50%–100% women) in Indigenous participants were included. Evidence was limited and generally of low certainty. Four randomized studies were exclusively in Indigenous women (Australia and USA). Only one pharmacological study was identified, investigating vitamin D in reducing blood pressure. Non-pharmacological interventions demonstrated potential to improve CVD risk factors, primarily adiposity, blood pressure, lipids, and glucose. Participant involvement was generally limited and continuation was problematic. This first umbrella review on CVD risk reduction in Indigenous women suggests an urgent need for high-quality evidence to inform and make CVD prevention accessible and equitable for them. Future studies should employ consumer-led, innovative, and context-specific strategies to ensure inclusive recruitment and sustain participant engagement.

Keywords indigenous people, cardiovascular disease, women's health, prevention, umbrella review

Contribution to Health Promotion

- Presents the first umbrella review of pharmacological and non-pharmacological cardiovascular disease (CVD) prevention strategies in Indigenous women in the USA, Canada, New Zealand, and Australia.
- Demonstrates that non-pharmacological CVD prevention strategies can be effective in reducing CVD risk in Indigenous women without CVD.
- Focuses on an urgent need for high-quality Indigenous women-specific evidence for effective and equitable cardiovascular health care for them.
- Highlights that CVD prevention strategies, including cardiovascular health promotion, must be co-designed in partnership with Indigenous women, communities and healthcare providers providing care to the community.

Introduction

Although cardiovascular disease (CVD) is often viewed as a disease impacting mostly men, in 2021, ~360 million individuals of each sex were living with CVD ([British Heart Foundation 2024](#)). It was the leading cause of death in both women and men, with CVD being responsible for 30% of total deaths in women globally ([World Health Organisation 2024](#)). Women's health issues are often focused on reproductive health, under-recognizing critical chronic health conditions including but not limited to CVD, type 2 diabetes mellitus (T2DM), hypertension, and mental health issues ([The Lancet 2023](#)). Cardiovascular health in women has been given less recognition than men's; increasing awareness of this from 1986 to 1993 prompted specific measures to increase equity, such as US National Institutes of Health (NIH) policies requiring inclusion of women as clinical trial participants and examining potential sex-differences in intervention outcomes ([Thomas and Braus 1998](#)). Women experience CVD differently compared with men ([Maas and Appelman 2010](#)). Women's risk of CVD increases postmenopausally via a multitude of complex physiological factors, including distinct patterns of sex hormone changes and increase in weight, blood pressure, and lipids ([El Khoudary et al. 2020](#)). Clinical manifestation of CVD varies between women and men. For example, presentations of non-cardiac symptoms such as shortness of breath, weakness, and fatigue are more commonly observed in women with ischaemic heart disease, which is the most common CVD in women ([Gilabert-Garcia et al. 2023](#)).

Since the NIH policy changes in the USA, women's cardiovascular health equity has gained significant attention in relevant clinical guidelines and policy documents ([Vervoort et al. 2024](#)). Awareness about the scale of CVD impact on women's health has risen, along with social and cultural changes that fostered women's agency in matters that impact their wellbeing ([Vogel et al. 2021](#)). There has been an increasing recognition of the need for women's health to be more inclusive—integrating sexual and reproductive health as well as chronic disease, including the large burden of CVD-related morbidity and mortality ([Carcel et al. 2024](#), [Peters et al. 2016](#), [Ramson et al. 2024](#), [The Lancet 2023](#)).

Despite improvements, the progress in women's cardiovascular health remains inequitable. There is consistent evidence that CVD in women remains 'understudied, under-recognized, under-diagnosed, and undertreated' ([Vogel et al. 2021](#)). Sex-disparities in diagnostic and treatment interventions known to contribute positive outcomes have been observed in the USA, Europe, and Australia ([Banks et al. 2020](#), [Fogg et al. 2019](#), [Maas and Appelman 2010](#), [Pagidipati and Peterson 2016](#), [Vogel et al. 2021](#)). There is also persistent disparity in reduction in CVD-related mortality in women between high-income versus low- and middle-income countries, and inequities remain in CVD assessment and evidence-based management, particularly among younger women ([Burgess 2022](#), [Vogel et al. 2021](#)). In settings where overall improvements have occurred, a social gradient in cardiovascular health outcomes persists ([Chaturvedi et al. 2024](#)). Furthermore, women continue to be underrepresented in CVD-related clinical trials ([Steinberg et al. 2021](#)).

Although Indigenous people experience a disproportionate burden of chronic diseases, including CVD, their representation

in clinical trials—randomized or non-randomized—remains low ([Umaefulam et al. 2022](#)). Between 2010 and 2022, there were 170 Indigenous-specific trials across the USA, Canada, New Zealand, and Australia, registered on publicly available trial registries, against 8302 trials in the non-Indigenous population ([Umaefulam et al. 2022](#)). At the intersection of sex and ethnicity, Indigenous women remain underrepresented in both randomized and non-randomized interventions, with 13% (22 of 170) of Indigenous-specific studies conducted in Indigenous women, accounting for 0.15% of trials conducted in the non-Indigenous population ([Umaefulam et al. 2022](#)). Under-representation limits the validity and applicability of trial evidence to Indigenous women. Consequently, Indigenous women receive cardiovascular health care based on evidence derived from findings of studies conducted predominantly with non-Indigenous men (and women). Hence, clinical and psychosocial approaches used in assessing and managing Indigenous women's cardiovascular health do not necessarily effectively address their health needs, contributing to inequity in cardiovascular health care for Indigenous women in the above countries. To address this evidence gap, this umbrella review aims to answer the following question: What is the current evidence on the effectiveness or efficacy of pharmacological and non-pharmacological primary prevention interventions in reducing cardiovascular risk factors in Indigenous women in USA, Canada, New Zealand, and Australia? Findings from this review will likely inform future CVD risk reduction interventions to be developed and implemented with Indigenous women in these settings.

Methods

Review type

An umbrella review was undertaken to synthesize evidence from existing systematic reviews that investigated CVD-related interventions in Indigenous communities. The exponential growth of systematic reviews can make it challenging for clinicians, researchers, and policymakers in navigating fragmented and sometimes conflicting findings. Umbrella reviews provide a high-level synthesis of diverse interventions and outcomes, enabling comparison across intervention strategies and identifying key gaps in the evidence. They are particularly valuable for informing practice and policy because they consolidate evidence, rather than duplicating efforts, assess quality of existing evidence and identify areas requiring further research ([Belbasis et al. 2022](#), [Papatheodorou and Evangelou 2022](#)).

Search strategy

The lead author, T.R. searched electronic databases PubMed, CINAHL, Embase, Emcare, Scopus, and Web of Science between January and February 2024, with an updated search completed in February 2025. The main search terms stemmed from the major themes of the review question and following the PICO method (Population, Intervention, Comparator and Outcome). [Supplement S1](#) presents a detailed search strategy. A librarian with expertise in health research literature provided guidance determining a search strategy that would capture most of the relevant literature. Female-specific search terms, 'female',

'women', were not used to capture studies that may have a mixed sample, with a view to extract and analyse sex-specific findings. No limit was applied on year of publication.

Selection criteria

Systematic reviews were eligible for inclusion if they examined evidence about CVD prevention strategies in adult Indigenous participants over 18 years of age or if findings and data specific to adult participants could be extracted. Pharmacological and non-pharmacological (i.e. lifestyle-based) intervention studies aimed at reducing CVD risk factors in Indigenous women, both randomized and non-randomized, were included except for studies specifically described by the authors as pilot studies or published protocols or referred to as pilot studies in corresponding papers publishing findings from the same studies.

Systematic reviews and primary studies were eligible for inclusion if they reported changes in the following, either as primary or secondary outcomes: blood pressure (BP), body weight/body mass index (BMI)/waist circumference (WC), lipids [total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C) and triglycerides], blood glucose (haemoglobin A1c), physical activity, smoking, and risk of CVD, measured using a country-specific assessment tools.

Although this umbrella review initially intended to examine randomized and non-randomized interventions targeting primary prevention of CVD in Indigenous women, most studies conducted with this population group often included participants with and without existing CVD at baseline and included both sexes/genders. Considering the dearth of studies conducted with Indigenous people and taking an inclusive approach, studies with a mixed sample of female and male participants with and without CVD were included in this review. However, studies with <50% women participants were excluded. Studies conducted with Indigenous communities in the USA, Canada, New Zealand, and Australia who share a similar history of European colonization were included. Only literature published in the English language were included. [Supplement S2](#) presents a list of studies excluded from this review with reasons for exclusion.

Screening and appraisal

EndNote software was used to manage the search results. T.R. and A.B. independently performed screening of title and abstract on Covidence online platform. [Supplement S3](#) presents risk of bias (RoB) assessments using the revised Cochrane risk of bias tool for randomized controlled trials (RoB 2) and risk of bias in non-randomized studies of interventions (ROBINS-I) while systematic reviews were assessed using AMSTAR 2 ([Shea et al. 2017](#), [Sterne et al. 2016, 2019](#)). Studies were not excluded based on quality to support inclusion, considering limited published evidence on effective CVD prevention strategies in Indigenous women. Nevertheless, results were interpreted according to study quality, with clear statements where studies were of lower quality. Data were extracted using an extraction template (in MS Excel) specifically developed for this study. Heterogeneity in research question answered and methods used in primary studies, precluded meta-analysis. Therefore, findings were synthesized narratively.

Considering the representation of diverse Indigenous settings across studies included in this review, community engagement-related data were extracted using a study-specific template instead of a structured assessment tool. This review was registered with PROSPERO (CRD42024575310).

Results

A systematic search across six databases returned 5124 records. After removing duplicates and screening, six systematic reviews and 16 primary studies met the inclusion criteria, as presented in the PRISMA flow chart in [Fig. 1](#). No systematic reviews focused exclusively on studies conducted with Indigenous women and the proportion and/or number of female participants were inconsistently reported. None of the reviews presented sex- or gender-specific evidence.

The 16 primary studies included in this review had a total of 11 473 participants; 4 studies were conducted in Indigenous women exclusively while the rest included women as ~50%–78% of participants. Studies conducted in the USA utilized either 'American Indian women' or 'Native American women' to describe their study populations. In this review they will be respectfully referred to as Native American women.

Systematic reviews

[Table 1](#) summarizes the findings of the systematic reviews included in this umbrella review. Of the six systematic reviews, three examined the effectiveness of physical activity interventions ([Pedersen et al. 2022](#), [Pelletier et al. 2017](#), [Wicklum et al. 2021](#)) with another physical activity intervention in Indigenous people with T2DM ([Hurst et al. 2024](#)); one examined the effectiveness of nutrition interventions on improving health outcomes ([Nava et al. 2015](#)); and one investigated health-promoting interventions for reducing CVD risk factors ([Mbuzi et al. 2018](#)). Based on AMSTAR 2 assessment, two reviews were rated to have high confidence in their findings, one had moderate confidence, and three had low confidence.

Systematic reviews included in this umbrella review found physical activity and weight management ([Pedersen et al. 2022](#), [Pelletier et al. 2017](#), [Wicklum et al. 2021](#)) and diet and nutrition ([Nava et al. 2015](#)) interventions to be generally effective in improving CVD risk factors, including BMI, weight, BP, and lipids in Indigenous people in all four countries. One of the reviews that specifically focused on interventions targeting CVD prevention described the evidence to be promising but raised concerns regarding adequacy of the evidence and appropriateness of the methodological approaches ([Mbuzi et al. 2018](#)).

Primary studies

[Table 2](#) presents results from the randomized controlled trials (RCT) and non-randomized intervention studies included in this review.

Findings from eight of the 16 primary studies were reported in the systemic reviews included in this umbrella review ([Canuto et al. 2012](#), [Chan et al. 2007](#), [Foulds et al. 2011](#), [Gilliland et al. 2002](#), [Shah et al. 2015](#), [Shintani et al. 1991](#), [Sukala et al. 2012](#),

Table 1 Summary of outcomes from the systematic reviews ($n = 6$).

Study details	Scope/ setting	Numbers of studies included ($N =$ total participants); % of female participants where reported	CVD risk factor(s) addressed	Intervention duration (in range)	Review question(s)/objective(s)	Findings; women-specific evidence
Nava et al. (2015)	USA, Canada, Australia, New Zealand	19 (~5518); % of female participants not reported	Nutrition intervention	Not reported	To identify nutrition-based interventions that may be effective for the prevention and treatment of metabolic syndrome in the Navajo.	Most interventions were found to be effective in improving at least one indicator of metabolic syndrome, for example, improvement in weight, total cholesterol, HDL-C, LDL-C, blood glucose or HbA1c, SBP, and DBP. High-intensity (≥ 3 intervention/week) short-term activities were found to be the most effective.
Pelletier et al. (2017)	Canada	5 (703); % of female participants not reported	Physical inactivity	13 weeks to 24 months	Q1. Do physical activity interventions delivered among Indigenous populations living in Canada improve a) physical activity; b) physical fitness; and c) health status? Q2. Do previous physical activity interventions in the Indigenous populations in Canada incorporate aspects of holistic wellness and are they based on Indigenous values and beliefs about physical activity?	Physical activity interventions had the potential to improve weight management, hypertension and blood lipids, despite the lack of relevant studies, use wide variety of measurement tools and high-quality evidence. Did not report women-specific evidence. Community members, elders, and leaders were engaged in design, testing and implementation of the studies included in the review. Local Indigenous health professionals were engaged in programme delivery. Sustainability of the intervention beyond the research period or study findings ownership was not reported in reviewed studies.
Mbuzi et al. (2018)	Australia	8 (338 in intervention studies; 51 153 in a clinical audits)	Any cardiovascular health-promoting intervention	8–12 weeks; some interventions were ongoing	Q1. How effective are current programmes that aim to improve cardiovascular health of Indigenous Australians?	Limited number of Indigenous Australian-specific cardiovascular health-promoting interventions were identified. The findings suggested that cardiovascular health-promoting interventions held promises in improving cardiovascular health of Indigenous Australians. This review highlighted a need for interventions that would integrate Indigenous culture and needs.

Table 1 Continued

Study details	Scope/ setting	Numbers of studies included (N = total participants); % of female participants where reported	CVD risk factor(s) addressed	Intervention duration (in range)	Review question(s)/objective(s)	Findings; women-specific evidence
Perdersen <i>et al.</i> (2022)	USA	3; 183 participants; 69%–86% females	Physical inactivity	6 weeks	To examine completed interventions to increase physical activity among American Indians and Alaska Native older adults and considers recommended practices for research with Indigenous communities.	Interventions were effective in increasing physical activity level, improved blood pressure and mental health outcomes. However, the authors did not find evidence of community engagement and cultural tailoring of interventions.
Wicklum <i>et al.</i> (2021)	USA, Canada, New Zealand, Australia	15; 2198 participant; 66%–100% female participants, with unspecified proportion of female participants in one study	Physical inactivity or low level of physical activity	3 weeks to 12 months	To summarize the impact of physical activity-based wellness programmes for Indigenous women on their physical activity level, weight changes, and participation rates. Additionally, to explore which aspects of the programmes influenced outcomes, the effect of the programmes on participants' social community support, and if changes in social support systems influenced outcomes or participant experience.	Findings revealed that while some studies found physical activity-based interventions to be effective in improving physical activity level and related health outcomes (such as BMI and WC), other studies could not detect such benefits conclusively. The heterogeneity in study design may have contributed to the inclusiveness of these results. Furthermore, the authors suggested that considering cultural and community specific factors may improve outcomes.
Hurst <i>et al.</i> (2024)	New Zealand, USA	3, 86; 68%–72% female participants	T2DM	16 weeks to 6 months	To determine if health outcomes in Indigenous peoples with T2D could be improved by community-based exercise programmes and the features of those programmes that best meet their needs.	The authors indicated positive effects of group exercise on glycated haemoglobin (HbA1c), BMI, body weight, TC, BP, quality of life, and patient activation levels in high-adhering participants. They concluded that community-based exercise interventions can potentially improve health outcomes for Indigenous adults with T2DM when conducted with strong community engagement.

Table 2 Summary of findings—randomized and nonrandomized intervention studies ($n = 16$).

Author and year	Country	Programme name	Participants	Study design	Objectives	Intervention components	Duration	Sample size	Outcomes reported	Length of follow-up	Overall	Community engagement	Quality score
Studies conducted exclusively with Indigenous women													
Patade <i>et al.</i> (2008)	USA	—	Postmenopausal Native American women with mild-to-moderately hypercholesterolaemia, with no hormone replacement therapy use for at least 6 months before the study	RCT	To investigate the extent to which the daily incorporation of ~30 g of flaxseed, for a period of 3 months into diet on lipid profile.	Inclusion of flaxseed and/or oat bran fibre to diet where flaxseed was given in the form of muffins, bread and power. Oat bran fibre was given to the relevant group in the form of muffins and bread. Thus, there were two intervention groups. Control: muffins and breads made of white flour.	3 months; daily consumption of the intervention food	55; age range 47–63 years; 42 participated in the follow-up.	TC: 7%↓* LDL-C: 10%↓* HDL-C: ↑ Triglyceride: 3%↓ (flaxseed); 8.5%↓ (flaxseed + oat bran fibre)	—	Regular flaxseed consumption improved cholesterol levels.	None	Some concerns (RoB)
Thompson <i>et al.</i> (2008)	USA	—	American Indian women aged ≥18 years without T2DM	RCT	To assess the impact of a low-intensity intervention on T2DM risk among young urban American Indian women	1-hour group session once a month on healthy eating, physical activity, goal-setting and social support	5 months	200	WC: 92.1 cm vs 90.8 cm at 6 months; 91.7 cm vs 90.9 cm at 12 months; 91.9 cm vs 90.5 cm at 18 months (intervention vs control) ↓* TC: 4.20 mmol/L vs 4.28 mmol/L at 6 months; 4.20 mmol/L vs 4.22 mmol/L at 12 months; 4.18 mmol/L vs 4.27 mmol/L at 18 months (intervention vs control) ↓* LDL-C: 2.28 mmol/L vs 2.28 mmol/L at 6 months; 2.26 mmol/L vs 2.23 mmol/L at 12 months; 2.28 mmol/L vs 2.27 mmol/L at 18 months (intervention vs control; intervention favoured control) ↓*	6, 12 and 18 months	Both control and intervention achieved these improvements. Note, control group was offered Native health magazine in mail, address change postcards, clinic visit reminders, and phone calls to schedule clinic visits during the intervention period and the intervention later.	Content development Indigenous researcher involvement	Some concerns (RoB)
Canuto <i>et al.</i> (2012)	Australia	Aboriginal women's fitness programme	Aboriginal and Torres Strait Islander women aged ≥18 with WC of ≥80 cm	Waitlist control RCT	To evaluate the effectiveness of a 12-week structured exercise and nutrition programme in a cohort of urban Aboriginal and Torres Strait Islander women on WC, weight and biomedical markers of metabolic functioning from baseline to programme completion. The secondary outcome was to assess whether the outcomes were maintained at 3-month postprogramme follow-up	Intervention had four components: — 2 × 60 min group cardiovascular and resistance training group sessions/week; — incidental walking (pedometer reading of 10 000 steps/day; self-recorded in a diary) — 4 nutrition education workshops; — positive	12 weeks	100	Immediately after intervention: Weight: 1.65 kg (intervention vs control) ↓* BMI 0.66 kg/m ² (intervention vs control) ↓* HC: 0.84 cm (intervention vs control) ↓ SBP: 1.24 mmHg DBP: 2.46 mmHg (intervention vs control) ↓ 3 months postintervention: Weight: 2.50 kg (intervention vs control) ↓* BMI: 1.03 kg/m ² (intervention vs control) ↓* HC 1.50 cm (intervention vs control) ↓ SBP: 4.09 mmHg DBP: 2.17 mmHg (intervention vs control) ↓	3 months, 3 month postintervention	Modest improvements were observed in weight and BMI. The intervention did not show any effect on WC, and metabolic measures.	Study design Community concern over randomized design Governance and Indigenous researcher involvement	High RoB

Table 2 Continued

Author and year	Country	Programme name	Participants	Study design	Objectives	Intervention components	Duration	Sample size	Outcomes reported	Length of follow-up	Overall	Community engagement	Quality score
Gepner et al., 2015	USA	—	Native American postmenopausal women without known CVD, with serum 25-hydroxyvitamin [25(OH)D] between 10 and 60 ng/ml	RCT	To examine the effect of Vitamin D supplement on blood pressure	reinforcement and encouragement –fortightly newsletter with exercise and nutrition tips. Waitlist group received the pedometer and the diary, monthly newsletter with a recipe and tips on physical activity and healthy eating and could attend the nutrition workshop	6 months; daily dose of Vitamin D ₃	98; mean age 61	Aortic SBP: 110.5 mmHg vs 114.0 mmHg (high dose vs low dose) ↓ Aortic pulse pressure: 36.5 mmHg vs 38.9 mmHg (high dose vs low dose) ↓	—	When compared two groups, the intervention had no effect on any of the outcomes.	None	Low (RoB)
Studies that included indigenous women and men													
Shintani et al. (1991)	USA	Waianae Diet Programme (WDP)	Native Hawaiians women and men who were obese	Non-randomized/Pre-post study	To assess the effectiveness of traditional Hawaiian diet fed <i>ad libitum</i> to Native Hawaiians with multiple risk factors for cardiovascular disease on obesity and cardiovascular risk factors	Pre-Western contact, traditional Hawaiian food was served twice/day at a communal meal site. The approach was to feed the participants a diet rich in complex carbohydrate and low in fat. Taro (a starchy root-like potatoes), poi (a mashed form of taro), sweet potato, yams, breadfruit, greens (fern shoots and leaves of taro, sweet potato, and yams), fruit, seaweed, fish, and chicken. All foods were served either raw or steamed in a manner that approximated ancient styles of cooking	21 days	20; 50% women	Weight: 120 kg vs 11.2 kg (before vs after) ↓* BMI: 39.6 kg/m ² vs 37.0 kg/m ² (before vs after) ↓* Cholesterol: 5.76 mmol/L vs 4.95 mmol/L (before vs after) ↓* HDL: 0.967 mmol/L vs 0.905 mmol/L (before vs after) ↓ LDL: 3.81 mmol/L vs 3.37 mmol/L (before vs after) ↓* Cholesterol: HDL-C: 6.3 vs 5.7 (before vs after) ↓ Triglycerides: 2.67 mmol/L vs 1.56 mmol/L (before vs after) ↓* SBP: 133.6 mmHg vs 122.1 mmHg (before vs after) ↓* DBP: 84.2 mmHg vs 75.3 mmHg (before vs after) ↓*	—	The WDP was an effective approach in the treatment of obesity and associated cardiovascular disease risk factors in this population of Native Hawaiians. Acceptability and adherence were high, which suggests that the WDP	None	Moderate (ROBINS-I)
Gilliland et al. (2002)	USA	Strong in body and spirit	Native American women and men with T2DM	Non-randomized/Pre-post	To determine effectiveness of culturally appropriate lifestyle intervention on risk factors for diabetes complication	Culturally appropriate T2DM educational material, skill development and social support (Family group vs one-on-one vs usual care)	Approx. Once every ~6 weeks for 10 months	104; 72% women	HbA1c: 0.5% vs 0.3% vs 1.2% (family group vs one-on-one vs usual care; with significant increase in usual care) ↓ Weight: 2.0 lb vs 1.8 lb vs 1.8 lb (family group vs one-on-one vs usual care) ↓	—	Overall small changes in HbA1c and weight were observed.	Study design Content development Community concern over randomized design	Moderate (ROBINS-I)

Table 2 Continued

Author and year	Country	Programme name	Participants	Study design	Objectives	Intervention components	Duration	Sample size	Outcomes reported	Length of follow-up	Overall	Community engagement	Quality score
Chan <i>et al.</i> (2007)	Australia	The Healthy Lifestyle Programme (HELP)	Aboriginal peoples who were overweight and may or may not be diabetic	Non-randomised/Pre-post/Prospective cohort efficacy study	The primary aim of this study was to determine the effectiveness of lifestyle intervention on improving cardiovascular and cardiovascular risks of people with/without T2DM (in those who did not have T2DM risk factors)	Culturally appropriate community-based education programme targeted to cardiovascular risks of people with/without T2DM and were overweight; Components were self-monitoring of (i) fasting plasma glucose (in diabetic participants) and (ii) physical activity modification (using pedometers) Control: None	2 years; dose related information not reported	101; ~75% were female; ≥20 years	SBP: 3.3 mmHg (before vs after) ↓; DBP: 4.6 mmHg (before vs after) ↓* mean atrial BP: 4.2 (before vs after) ↓* LDL-C: 0.09 mmol/L (before vs after) ↓; HDL-C: 0.09 mmol/L (before vs after) ↓* Triglyceride: -0.18 mmol/L (before vs after) ↓* WC: -3.1 cm (before vs after) ↓*; (all participants) BMI: 0.4 kg/m ² (before vs after) ↓ HbA1c: 0.31% (before vs after) ↓* (worsen for diabetic group)	6 months, then Biannually for 2 years	Study design Content development Community concern over randomized design A general trend towards improvement was observed. However, due to small effect sizes, only the improvements in WC and total cholesterol were deemed to have clinical significance immediately postintervention. Participants available at follow-up was 80 (79%).	Moderate (ROBINS-I)	
Kattlemann <i>et al.</i> (2010)	USA	—	American Indians with T2DM	RCT	To determine if culturally adapted educational lessons based on the Medicine Wheel Model for Nutrition in addition to the usual dietary education would lead to better control of T2DM than receiving just the usual dietary education from personal providers	Dietary lesson that encouraged consumption of traditional Northern Plain diet: protein (25% of calories), moderate in carbohydrate (45%–50% of calories), low in fat (25%–30% of calories) Monthly group session for 2 hours. Participants could attend talking circle (i.e. intragroup support session) after each session.	6 months	114; 76% were females	Weight: 94.1 kg vs 94.1 kg (intervention vs control) ↓ BMI: 34 kg/m ² vs 33.7 kg/m ² (intervention vs control) ↓ TC: 199 mmol/L vs 187 mmol/L (intervention vs control) ↓ LDL-C: 107 mmol/L vs 102 mmol/L (intervention vs control) ↓ HDL-C: 45 mmol/L vs 42 mmol/L (intervention vs control) ↓ HbA1c: 8.4% vs 8.5% (intervention vs control) ↓ Triglyceride: 227 mmol/L vs 227 mmol/L (intervention vs control) ↓ Intervention group improved in weight, BMI while control groups achieved improvement in TC and HDL-C	—	The intervention did not lead to any difference between two groups with regards to weight loss, BMI, HbA1c. Difference in triglyceride measures were likely because of the increase experienced by the intervention group.	Some concern (RoB)	
Foulds <i>et al.</i> (2011)	Canada	Hearts in Training	Aboriginal Canadians aged ≥18 without CVD, both healthy individuals and those with chronic conditions such as T2DM,	Non-randomized/Pre-post study	To evaluate the effectiveness of the Hearts in Training community-based physical activity interventions among	Participants self-selected one of three physical activity interventions: walking, walk/running or running, designated	13-weeks	273; ~78% females	Overall change reported in women: Weight: 81.8 kg vs 81.8 kg (before vs after) ↓ BMI: 30.9 kg/m ² vs 30.9 kg/m ² (before vs after) ↓ WC: 98.7 cm vs 96.5 cm (before vs after) ↓	13 weeks (immediately postintervention)	Self-selected exercise regimen appeared to have a positive effect of the intervention was noted.	Study design Intervention delivery Governance Indigenous	Serious (ROBINS-I)

Table 2 Continued

Author and year	Country	Programme name	Participants	Study design	Objectives	Intervention components	Duration	Sample size	Outcomes reported	Length of follow-up	Overall	Community engagement	Quality score
			previous history of CVD and hypertension		British Columbian Aboriginal populations for reducing CVD risk factors	Walk10K, LTR10K, and Run10K			vs after ↓* SBP: 117.5 mmHg vs 116.9 mmHg (before vs after) ↓ DBP: 72.7 mmHg vs 72.1 mmHg (before vs after) ↓ TC: 4.80 mmol/L vs 4.68 mmol/L (before vs after) ↓* HDL-C: 1.42 mmol/L vs 1.45 mmol/L (before vs after) ↓ Total C: HDL-C: 3.64 vs 3.50 (before vs after) ↓ Overall change reported in men: Weight: 91.6 kg vs 89.6 kg (before vs after) ↓ BMI: 30.6 kg/m ² vs 29.9 kg/m ² (before vs after) ↓ WC: 104.7 cm vs 102.0 cm (before vs after) ↓ SBP: 125.1 mmHg vs 122.5 mmHg (before vs after) ↓ DBP: 77.8 mmHg vs 75.9 mmHg (before vs after) ↓ TC: 4.78 mmol/L vs 4.60 mmol/L (before vs after) ↓ HDL-C: 1.11 mmol/L vs 1.15 mmol/L (before vs after) ↓ Total C: HDL-C: 4.88 vs 4.69 (before vs after) ↓ SBP improved in age groups <30 years, 30–39 years and ≥50 years; TC improved in 30–39 years age group HbA1c: 10.6% vs 8.8% (resistance vs aerobic) ↓ TC: 4.5 mmol/L vs 4.7 mmol/L (resistance vs aerobic) ↓ LDL-C: 2.4 mmol/L vs 2.7 mmol/L (resistance vs aerobic) ↓ HDL-C: 1.3 mmol/L vs 1.1 mmol/L (resistance vs aerobic) ↓ Triglycerides: 2.0 mmol/L vs 1.9 mmol/L (resistance vs aerobic; improved for aerobic) ↑* BMI: 42.7 kg/m ² vs 44.5 kg/m ² (resistance vs aerobic) ↓ WC: 124.3 cm vs 131.1 cm (resistance vs aerobic) ↓ SBP: 125.6 mmHg vs 131.1 mmHg (resistance vs aerobic; improved for			researcher involvement	
Sukala <i>et al.</i> (2012)	NZ	—	Polynesian adult women and men	RCT	To evaluate the effectiveness of two exercise modalities for improving HbA1c and associated clinical outcomes Polynesian adults with T2DM and visceral obesity	—Resistance training vs Aerobic training —Supervised group exercise sessions —3 times/week —40–60 min, with progressive increase in time	16 weeks	18; ~72% were females	The interventions were not sufficient to reduce HbA1c. Aerobic exercise reduced BP but increased triglycerides.		Some concern over randomized design		

Table 2 Continued

Author and year	Country	Programme name	Participants	Study design	Objectives	Intervention components	Duration	Sample size	Outcomes reported	Length of follow-up	Overall	Community engagement	Quality score
Shah <i>et al.</i> (2015)	USA	—	Native American women and men with T2DM (by American Diabetes Association definition)	Non-randomized/Pre-post study	To assess a home-based education intervention using Community Health Representatives (CHRs) in Improving Patient Activation Measure and T2DM-related clinical outcomes	1 hour/month group sessions and HbA1c review Monthly educational activities by CHR, followed by home-based individualized education follow-up	6 months	60; 68% were females	BMI: 33.8 kg/m ² vs 32.4 kg/m ² (before vs after) ↓* HbA1c: 8.12% vs 7.39% (before vs after) ↓* Glucose: 158.6 mg/dl vs 134.8 mg/dl (before vs after) ↓* TC: 159.4 mg/dl vs 147.9 mg/dl (before vs after) ↓* Triglycerides: 161.0 mg/dl vs 123.0 mg/dl (before vs after) ↓* Urinary albumin creatinine ratio: 34.5 mg/ALB/g CR vs 34.5 mg/ALB/g CR 52.3 mg/ALB/g CR (before vs after) ↓	6 months (immediately postintervention)	CHR-led diabetes educational intervention led to a reduced HbA1c.	Study design Content development Intervention delivery Community concern over randomized design	Moderate (ROBINS-I)
Teufel-Shone <i>et al.</i> (2015)	USA	Lifestyle Balance; in SDP+DP	American Indians/Alaska Native women and men who were prediabetic	Non-randomized/Pre-post/Prospective cohort study	To evaluate changes in food habit	16 education session plus lifestyle coaching; 5 sessions address healthy food choices and food preparation techniques designed to reduce fat and calorie intake; 11 sessions cover physical activity, stress management, and self-motivation. Lifestyle coaches who deliver the curriculum one-on-one or in small groups to help participants achieve and maintain weight and behaviour goals.	16 weeks	1420; 75% women	Weight and BMI: Change in healthy and unhealthy food score (measured with food frequency questionnaire) led to significant improvement in weight and BM 1 month postintervention; the effect sustained when reassessed a year later. Changes in Fasting blood glucose, SBP, LDL-C, were observed 1 month after intervention but not after a year. Changes in HDL-C, DBP, and Triglycerides were not significant at any assessment rounds.	12 months	Changes in some of the diabetes risk factors were observed after changes in food habit.	Content development Intervention	Moderate (ROBINS-I)
Mills <i>et al.</i> (2017)	Australia	Work it out	Aboriginal and Torres Strait Islander women and men at risk of or with CVD	Non-randomized/Pre-post study	To evaluate the programme for its effect on clinical outcome measures in participants with or at risk of CV disease.	Two hours per week health education and physical activity sessions conducted by multidisciplinary allied health professionals.	12 weeks	85; 72% female	Increase in distance walked during 6-minute walk test: 0.38 km vs 0.43 km (before vs after) ↑* Weight: 98.90 kg vs 98.3 kg (before vs after) ↓ BMI: 35.8 kg/m ² vs 35.6 kg/m ² (before vs after; those with extreme had significant change in weight) ↓ WC: 116.3 cm vs 115.73 cm (before vs after) ↓ SBP: 128.2 mmHg vs 127.50 mmHg (before vs after; those with high SBP at baseline	—	Overall, there was a tendency towards improvement in those with highest BMI and high BP.	Study design Content development Intervention delivery Governance Indigenous researcher involvement	Moderate (ROBINS-I)

Table 2 Continued

Author and year	Country	Programme name	Participants	Study design	Objectives	Intervention components	Duration	Sample size	Outcomes reported	Length of follow-up	Overall	Community engagement	Quality score
Jiang <i>et al.</i> (2018)	USA	Lifestyle Balance; in SDPI-DP	American Indians/Alaska Native women and men who were prediabetic	Non-randomized/Pre-post/Prospective cohort study	To evaluate long-term outcome of a T2DM prevention programme	<ul style="list-style-type: none"> —Healthy diet and increased physical activity to achieve and maintain 7% weight loss (compared to baseline weight) —Culturally tailored wherever possible Weekly group sessions —Supplemented by monthly lifestyle coaching session and motivational interviewing for goal attainment. —Continued support postintervention via quarterly T2DM prevention group/community activity 	16 weeks	8652; 72% females	had significant decline while those with normal SBP at baseline had significant increase↑ DBP: 80.5 mmHg vs 80.3 mmHg (before vs after; those with normal DBP at baseline had a significant increase)↑ HC: 123.5 cm vs 122.9 cm (before vs after)↓ Weight: on average 3.8% loss of baseline weight (attenuated to 2.8%, 1.5% and 1.1% at 1, 3 and 6 years respectively) ↓* Small but consistent improvement in triglycerides, HDL-C, LDL-C, and smoking status but not BP	Up to 10 years	Postintervention weight loss was associated with reduced incidents of diabetes. Content development (ROBINS-I)	Moderate	
Karavunov <i>et al.</i> (2021)	Canada	—	Innu women and men with ≤7.5% HbA1c	RCT	To determine if shared medical appointments (SMAs) could provide culturally appropriate, effective treatment to Innu patients with relatively well-controlled T2DM, as an alternative to standard, 'one-on-one' care	Monthly 45 m individual-level shared medical appointments (SMAs) —Care was provided by family physician, dietitian, diabetic educator, and included Q&A and free discussion. —Translator provided where necessary	6 months	23; ~56% females	HbA1c: 7.41% vs 6.92% at 6 months and 8.02% vs 7.26% (intervention vs control) ↑	6 and 12 months	Although participants identified the intervention as beneficial in the qualitative part of the study, there was no evidence that it improved T2DM control.	None Some concern (RoB)	

Table 2 Continued

Author and year	Country	Programme name	Participants	Study design	Objectives	Intervention components	Duration	Sample size	Outcomes reported	Length of follow-up	Overall	Community engagement	Quality score
Dissanayake <i>et al.</i> (2025)	Australia	Hope for Health	Aboriginal residents aged 18–65 years of a remote Northern Territory community with body mass index (BMI) ≥ 25 kg/m ² or waist circumferences exceeding ≥ 94 cm (men) or ≥ 80 cm (women)	Non-randomized/Pre-post study	To evaluate the impact of a 4-month dietary and lifestyle programme co-designed and led by Aboriginal people on weight and metabolic markers, diet, and physical activity in overweight and obese adults in a remote Aboriginal community.	Culturally tailored dietary information, 'on-country' health retreat, health coaching, individual health coaching sessions	4 months	66 (55 completed assessments at both baseline and endline)	Weight: 85.1 kg vs 83.6 kg (before vs after) ↓* BMI: 30.6 kg/m ² vs 30.0 kg/m ² (before vs after) ↓* WC: 108.9 cm vs 105.7 cm (before vs after) ↓* TC: 4.8 mmol/L vs 4.8 mmol/L (before vs after) ↓ LDL-C: 2.8 mmol/L vs 2.5 mmol/L (before vs after) ↓* HDL-C: 0.9 mmol/L vs 1.0 mmol/L (before vs after) ↓** Triglycerides: 2.4 mmol/L vs 2.5 mmol/L (before vs after) ↓ HbA1c: 41 mmol/mol vs 39.0 mmol/mol (before vs after) ↓* Cholesterol ratio: 5.5 vs 5.0 (before vs after) ↓* SBP: 132.0 mmHg vs 131.1 mmHg (before vs after) ↓ DBP: 81.3 mmHg vs 79.4 mmHg (before vs after) ↓	4 months	Clinically significant reduction in weight and several other cardiometabolic risk factors was observed.	Study design Content development Community concern over randomized design Intervention delivery Governance Indigenous researcher involvement	Moderate (ROBINS-I)

BMI, body mass index; DBP, diastolic blood pressure; HDL-C, high-density lipoprotein; LDL-C, low-density lipoprotein; SBP, systolic blood pressure; TC, total cholesterol; WC, Waist circumference.

↓ = no effect; ↑ = significant increase; ↓* = significant decrease.

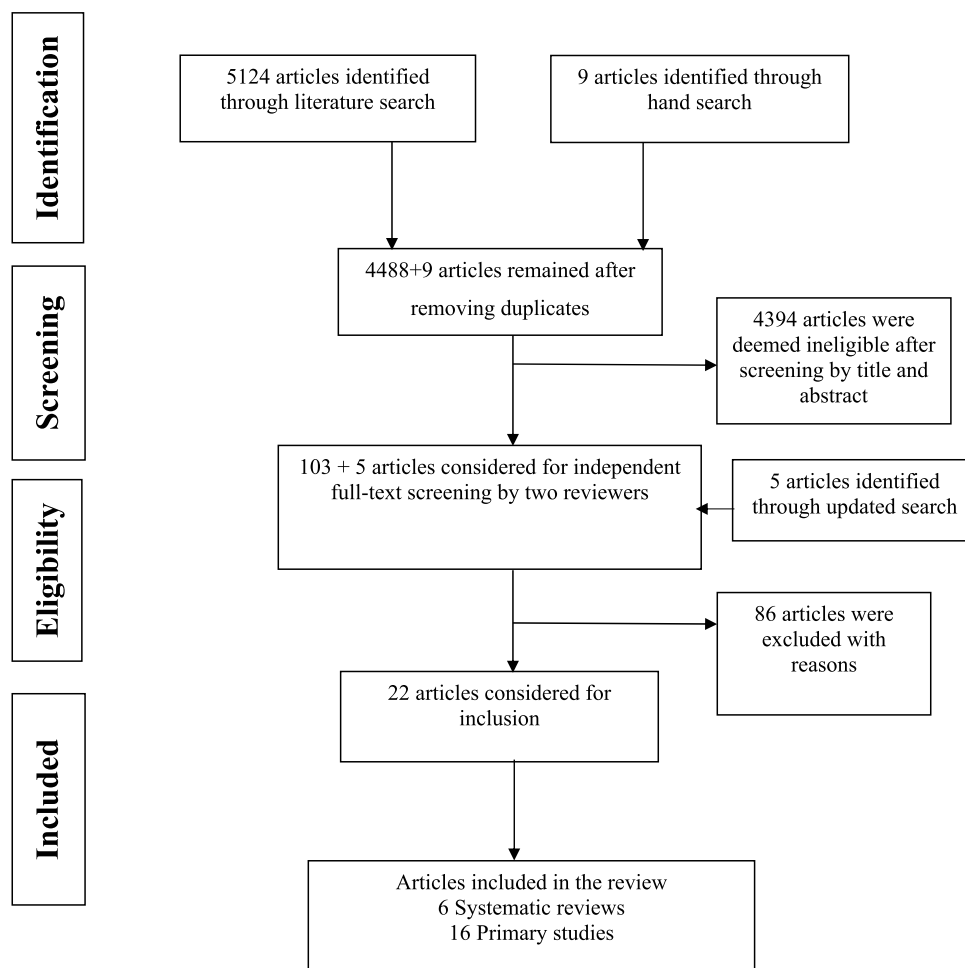


Figure 1 Literature search process using PRISMA flowchart.

Thompson *et al.* 2008). Seven of the 16 primary studies included in this review were RCTs (Canuto *et al.* 2012, Gepner *et al.* 2015, Karaivanov *et al.* 2021, Kattelman *et al.* 2010, Patade *et al.* 2008, Sukala *et al.* 2012, Thompson *et al.* 2008), seven were non-randomized/pre-post studies (Chan *et al.* 2007, Dissanayake *et al.* 2025, Foulds *et al.* 2011, Gilliland *et al.* 2002, Mills *et al.* 2017, Shah *et al.* 2015, Shintani *et al.* 1991), and two employed a prospective cohort study design to assess effectiveness of CVD risk factor reduction interventions (Jiang *et al.* 2018, Teufel-Shone *et al.* 2015). Four studies, all RCTs, were conducted exclusively with Indigenous women (Canuto *et al.* 2012, Gepner *et al.* 2015, Patade *et al.* 2008, Thompson *et al.* 2008). Amongst studies that included both women and men as participants, only one reported sex-specific findings, with no differences in findings between the two groups (Foulds *et al.* 2011). Only one study exclusively recruited participants without known CVD (Gepner *et al.* 2015). Interventions were implemented in the community or at community healthcare facilities and delivered individually (3/14) or in groups (7/14; papers describing the same intervention were counted once), or a combination of individual and group sessions (4/14); one study did not report intervention delivery mode, and another compared group vs individual delivery to examine differences in effect. Average intervention duration was ~6 months (ranged 3 weeks to 2 years), with follow-up period ranging from 3 months to 10 years. Of the seven RCTs, only one had a RoB while five showed some concern of RoB

and one had high RoB. All but one non-randomized intervention showed moderate concerns of RoB, with the remaining one having serious concerns.

Intervention components

Primary studies included in this review predominantly assessed effectiveness of non-pharmacological, lifestyle-based, interventions (Canuto *et al.* 2012, Chan *et al.* 2007, Dissanayake *et al.* 2025, Foulds *et al.* 2011, Gilliland *et al.* 2002, Jiang *et al.* 2018, Karaivanov *et al.* 2021, Kattelman *et al.* 2010, Mills *et al.* 2017, Shah *et al.* 2015, Shintani *et al.* 1991, Sukala *et al.* 2012, Teufel-Shone *et al.* 2015, Thompson *et al.* 2008), with one study assessing flaxseed in daily diet to improve cholesterol in Native American women with mild to moderate hypercholesterolaemia (Patade *et al.* 2008). Interventions components primarily included dietary/nutritional counselling, structured physical activity sessions, and T2DM self-management education sessions. Only one pharmacological intervention examined different doses of Vitamin D on BP of postmenopausal Native American women (Gepner *et al.* 2015).

Eight out of 16 primary studies addressed T2DM management via better glycaemic control (Gilliland *et al.* 2002, Karaivanov *et al.* 2021, Sukala *et al.* 2012) or weight loss (Jiang *et al.* 2018, Teufel-Shone *et al.* 2015, Thompson *et al.* 2008) or both (Shah *et al.* 2015, Thompson *et al.* 2008). One study conducted with

Aboriginal and Torres Strait Islander people highlighted high rates of CVD and T2DM in Indigenous communities in Australia (Chan *et al.* 2007) while two studies addressed CVD risk factors in Aboriginal and Torres Strait Islander people with and without CVD (Dissanayake *et al.* 2025, Mills *et al.* 2017). Three studies addressed excessive weight and obesity (Canuto *et al.* 2012, Dissanayake *et al.* 2025, Shintani *et al.* 1991) while physical inactivity (Foulds *et al.* 2011), moderate hypercholesterolaemia (Patade *et al.* 2008), and hypertension (Gepner *et al.* 2015) was addressed by one study each.

Effectiveness

Of the 16 primary studies, 13 lifestyle-based interventions examined were effective in reducing one or more CVD risk factors: weight (Canuto *et al.* 2012, Dissanayake *et al.* 2025, Jiang *et al.* 2018, Mills *et al.* 2017, Shintani *et al.* 1991), BMI (Canuto *et al.* 2012, Dissanayake *et al.* 2025, Mills *et al.* 2017, Shah *et al.* 2015, Shintani *et al.* 1991, Teufel-Shone *et al.* 2015), WC (Chan *et al.* 2007, Dissanayake *et al.* 2025, Thompson *et al.* 2008), BP (Chan *et al.* 2007, Mills *et al.* 2017, Shintani *et al.* 1991), TC (Chan *et al.* 2007, Foulds *et al.* 2011, Patade *et al.* 2008, Shah *et al.* 2015, Shintani *et al.* 1991), LDL-C (Dissanayake *et al.* 2025, Patade *et al.* 2008, Shintani *et al.* 1991), triglyceride (Chan *et al.* 2007, Dissanayake *et al.* 2025, Shah *et al.* 2015, Shintani *et al.* 1991), and HbA1c (Dissanayake *et al.* 2025, Shah *et al.* 2015), in participants either at risk of CVD or with existing CVD. One study reported a reduction in long-term risk of T2DM in participants who experienced moderate to small weight loss postintervention (Jiang *et al.* 2018). Only one study reported a significant increase in high-density lipoprotein (HDL-C) after intervention (Dissanayake *et al.* 2025).

Of the four RCTs conducted with Indigenous women, one showed effectiveness in reducing BMI and weight and sustaining the reduction 3 months postintervention via a combination of structured physical activity sessions and nutrition education (vs waitlist control) (Canuto *et al.* 2012), while another reported reduction in TC and LDL-C via intake of flaxseed as a dietary supplement (vs no supplement) (Patade *et al.* 2008). One of the RCTs that assessed effectiveness of a health education intervention in reducing the risk of T2DM in Native American women showed significant decrease in WC, TC, and LDL-C, with differences between the intervention and control groups (Thompson *et al.* 2008). The only study investigating a pharmacological intervention was an RCT that compared the effect of a high-dose versus low-dose Vitamin D supplement on BP in postmenopausal Native American women (Gepner *et al.* 2015), which found no significant effect of the intervention on improving BP. It was the only RCT in this review with a low RoB. One of the above studies reported improvements in BP (Canuto *et al.* 2012).

One RCT that assessed effectiveness of two physical activity regimes (aerobic vs resistance) found improved BP in aerobic versus resistance group participants and no difference in HbA1c (Sukala *et al.* 2012). A Medicine wheel-based health education model to support better management of T2DM did not lead to any difference between two groups for weight loss, BMI, HbA1c; some within-group improvements were observed (Kattelman *et al.* 2010). One RCT assessed the effectiveness of shared medical appointments (vs usual one-to-one care) to better manage T2DM and found no significant effect on participants'

HbA1c levels (Karaivanov *et al.* 2021). Qualitative data indicated that the shared medical appointment model was liked by the participants (Karaivanov *et al.* 2021).

Non-randomized studies used a community-based approach to implement lifestyle modification programmes targeting CVD and T2DM risk factors (such as fasting plasma glucose, BP, excessive body weight) (Chan *et al.* 2007, Mills *et al.* 2017), overweight and obesity (Shintani *et al.* 1991); Dissanayake *et al.* 2025, Mills *et al.* 2017), T2DM (Foulds *et al.* 2011, Jiang *et al.* 2018, Teufel-Shone *et al.* 2015), risk factors for T2DM complication (Gilliland *et al.* 2002), and hypertension (Foulds *et al.* 2011), in participants without CVD and/or with existing CVD. One study, which employed a cohort efficacy design, reported that, in the long-term, a T2DM prevention programme was effective in reducing body weight. In this study a moderate-to-small reduction in body weight (i.e. 3% to $\geq 5\%$ of baseline weight) was associated with up to 64% lower risk of developing T2DM within 6 year of follow-up (Jiang *et al.* 2018). Another study, which assessed a community health worker-led home-based T2DM management educational programme, reported that BMI, HbA1c, triglycerides, and urinary albumin creatinine ratio improved after the 6-month intervention period (Shah *et al.* 2015).

Community engagement

Information was extracted regarding whether or not Indigenous communities had the opportunity to provide input into the study design, development, delivery and governance, and whether the study team included Indigenous researchers. Engagement with participating communities and/or Indigenous researchers varied across studies and was inconsistently reported, with 75% (12/16) reporting any evidence of community engagement and the remaining studies reporting none. Having Indigenous voices in study governance teams and Indigenous researchers in the author group were the least commonly reported items while having community input in study design, development, and delivery were the most reported aspects of Indigenous engagement in the development, governance, and deliver of the interventions. Nine primary studies reported that participating communities were engaged in intervention content development (Chan *et al.* 2007, Dissanayake *et al.* 2025, Gilliland *et al.* 2002, Jiang *et al.* 2018, Mills *et al.* 2017, Shah *et al.* 2015, Teufel-Shone *et al.* 2015, Thompson *et al.* 2008), with one reporting that the communities had input in study design as well as intervention delivery (Shah *et al.* 2015). One study reported that intervention contents could be adapted or tailored to cultural local culture (e.g. content translated into Indigenous language, incorporation of traditional food etc.) without indication of community involvement in such tailoring (Jiang *et al.* 2018). Another study reported that it 'was designed as a culturally appropriate, community-based intervention model'; however, it did not report whether the study had any input from the target community in design, delivery or governance of the study (Shintani *et al.* 1991).

Discussion

Summary of results

This umbrella review presents the first examination of the effects of pharmacological and non-pharmacological interventions in

improving CVD risk factors in Indigenous women in the USA, Canada, New Zealand, and Australia. Six systematic reviews and 16 primary studies were identified. Of the primary studies, only four were conducted exclusively among Indigenous women, only one study was assessed to have a low RoB, and only one study reported sex-specific findings, suggesting a dearth of high-quality experimental studies specific to improving Indigenous women's cardiovascular health. There was a notable lack of studies conducted specifically with Indigenous women and studies presenting sex-specific outcomes when including participants of both sexes. Overall, the systematic reviews and primary studies suggest that non-pharmacological or lifestyle-based interventions—including physical activity, diet and nutrition modification and counselling, and T2DM self-management education—can be effective in improving CVD risk factors in Indigenous women without prior CVD. These risk factors include weight, BMI, WC, TC, LDL-C, triglycerides, and HbA1c. While the findings of this umbrella review align with those presented in the systematic reviews included in this review, its strength lies in its focus on how a diverse array of interventions benefited Indigenous women's cardiovascular health—and are often underrepresented in the broader analyses of evidence relating to CVD assessment and prevention. Moreover, 50% of the primary studies were also captured in the systematic reviews included in this umbrella review. This overlap indicates limited representation of Indigenous women in the broader CVD literature, reinforcing the need for continued generation of high-quality evidence on effective CVD prevention strategy in this population group.

Across the wide range of CVD interventions, only 16 primary studies were identified, which is very few for drawing meaningful conclusion by intervention type. Importantly, no studies evaluated interventions with major impacts on CVD risk factors—BP lowering or lipid-lowering medications. While these interventions are likely to be effective in Indigenous women, direct evidence from studies of Indigenous women is lacking. Furthermore, implementation considerations such as uptake, adherence, and service use are strongly influenced by sociocultural factors. Therefore, multiple elements of generalisability from non-Indigenous populations cannot be assumed. Small sample sizes and heterogeneity in topics covered meant that performing a meta-analysis with 'women only' studies was not feasible.

Effectiveness of interventions

CVD risk factors

Half of the primary studies included in this umbrella review addressed either risk of T2DM or promoted better T2DM management. Five of these studies demonstrated effectiveness diabetes education and lifestyle programmes—including risk and self-management skill development, dietary counselling and motivation for physical activity—in achieving better glycaemic control (Gilliland *et al.* 2002) or weight loss (Jiang *et al.* 2018, Teufel-Shone *et al.* 2015) or both (Dissanayake *et al.* 2025, Shah *et al.* 2015, Thompson *et al.* 2008). The emphasis on T2DM (risk) management in the above interventions seems logical given high prevalence of T2DM in Indigenous people in the USA, Canada, New Zealand, and Australia, including in Indigenous women who bear heavier burden of T2DM-related

morbidity and mortality compared with non-Indigenous women (Australian Institute of Health and Welfare 2024c, Cheran *et al.* 2023, Holder-Pearson and Chase 2022, Wedekind *et al.* 2021). It is a major risk factor for CVD and as such, preventing and better managing T2DM in Indigenous women at risk of CVD offers dual benefit.

Overweight and obesity or physical inactivity were addressed in six studies through either physical activity or diet, with one study combining physical activity and T2DM self-management education (Chan *et al.* 2007). Three systematic reviews included in this umbrella review examined physical activity focused interventions that addressed obesity and overweight in Indigenous adults (Pedersen *et al.* 2022, Pelletier *et al.* 2017, Wicklum *et al.* 2021). Obesity and overweight are more prevalent in Indigenous people in the USA, Canada, New Zealand, and Australia, particularly in women (Kurtz *et al.* 2022). Colonization and its impact on the Indigenous ways of living, loss of access to land and changes in dietary composition and its association with health and wellbeing of Indigenous people were noted in the wider literature (Bell *et al.* 2017, Vallengia and Snodgrass 2015).

We identified limited, high-quality, recent evidence about strategies to manage hypertension in Indigenous women. Modifiable risk factors such as sedentariness, suboptimal diet and smoking and cardiometabolic factors such as obesity, T2DM, high cholesterol, and hypertension have been persistently high among Indigenous populations in the USA, Canada, New Zealand, and Australia compared with non-Indigenous populations in these countries (Zaman *et al.* 2025). Indigenous people, including Indigenous women, experience a high prevalence of hypertension, with high rates also in those experiencing other CVD risk factors, particularly T2DM and obesity (Australian Institute of Health and Welfare 2024a, Eberly *et al.* 2023). Māori and Pacifica and Aboriginal and Torres Strait Islander women experience a higher prevalence of hypertension compared with non-Indigenous women in New Zealand and Australia, respectively (Australian Institute of Health and Welfare 2024b, McLean *et al.* 2013). Risk of CVD is also greater in Native Americans, including women, experiencing T2DM (Breathett *et al.* 2020). While these risk factors can be prevented and ameliorated through appropriate preventive measures, there is limited of high-quality Indigenous-specific evidence about whether and to what extent these measures contribute to preventing CVD in Indigenous people, including women. Existing literature shows that lifestyle modification interventions such as diet and nutrition and physical activity can improve CVD risk factors (Jones *et al.* 2025, Patnode *et al.* 2017, Rippe and Angelopoulos 2019).

It is important to note that smoking cessation was included as an intervention component in only one primary study reviewed. However, limited detail was provided about the nature of the intervention or its outcomes (Jiang *et al.* 2018). Smoking is a leading cause of CVD-related mortality and morbidity in both men and women, with the magnitude of harm increasing with duration and intensity of tobacco use (Banks *et al.* 2019, Pirie *et al.* 2013, Stanaway *et al.* 2018). Evidence from population-based studies suggests that smoking significantly increases risks of ischaemic heart disease, heart attack, and other types of heart disease in women more than men (Banks *et al.* 2019, Pirie *et al.* 2013). While the majority of Indigenous women do not smoke, there are higher smoking prevalences in Indigenous compared

to general populations, including among Indigenous women, in all four countries—reflecting the legacy of tobacco as a tool of colonization (Glover 2025). Futures intervention studies should examine strategies that can effectively support Indigenous women quitting smoking to support CVD prevention.

Pharmacological interventions such as antihypertensive and lipid-lowering medications proved to be effective in preventing cardiovascular events. However, these evidence-based CVD prevention strategies are often not implemented systematically to manage CVD or CVD risk in women (Al Hamid *et al.* 2024, Hyun *et al.* 2017). The evidence base for CVD assessment, prevention, and management reflects limited representation of clinical trials conducted with Indigenous populations, including trials that effectively recruited Indigenous participants and reported Indigenous-specific outcomes—highlighting an important evidence gap (McBride *et al.* 2022, Umaefulam *et al.* 2022, Xu *et al.* 2022).

Risk of bias and level of community engagement

Reported effectiveness of interventions did not appear to differ based on whether they were delivered individually or in groups. However, all interventions delivered through a mixed approach reported positive outcomes. For most studies, effectiveness did not seem to vary across studies with different level of RoB. However, the only study assessed as having a low RoB was unable to detect any significant change in the target risk factor (i.e. hypertension) (Gepner *et al.* 2015). In contrast, the study identified as having a serious RoB concern reported effectiveness in significantly reducing WC in women and men, and TC in women (Foulds *et al.* 2011).

There is evidence that chronic condition management and/or prevention interventions that were co-developed with and delivered by Indigenous people and had the research agenda set up by the target communities were effective in improving health and wellbeing (Glover *et al.* 2015, Kurtz *et al.* 2022). This review identified that information regarding community engagement in development and delivery of the interventions and reporting of evidence was inconsistently reported and the level of engagement varied across studies. Effectiveness of interventions did not seem to vary according to level of community engagement reported in the studies. Indigenous women experience complex barriers in engage with healthcare system due to racial and gender discriminations, which may contribute to their low participation in clinical research, including trials. Future studies should consider co-developing interventions with Indigenous women and participating communities to ensure that the interventions are tailored to women's needs, which in turn can contribute to greater acceptability, consistent engagement and ultimately better cardiovascular health outcomes.

Fewer studies reported any barriers in participating in the interventions, sex-specific or otherwise. However, most studies reported some information about low level of engagement in intervention activities and/or assessments, which offer some insight into what might have influenced the level of engagement in those studies. Three RCTs conducted with women only, reporting some relevant information in their study limitations from which participant level barriers can be gleaned. One study conducted with Aboriginal and Torres Strait Islander women reported low exercise and physical activity attendance rate (Canuto *et al.*

2012). Furthermore, this study reported high attrition—difficulty in arranging assessments appointments which ultimately reduced the statistical power of the study. Another study conducted with Native American women reported similar challenges—low attendance and noncontinuation (Thompson *et al.* 2008). Reasons for low attendance and frequent cancellation and rescheduling of assessments appointments were not reported in either of the studies. A third study conducted with postmenopausal Native American women reported high levels of noncontinuation in the control arm without reporting any likely reason behind it (Patade *et al.* 2008). A community-based non-randomized intervention reported that difficulties in determining true attrition rate as many participants did not attend assessments (Foulds *et al.* 2011). A physical activity-based RCT that retained 69% of the participants also reported a low level of session attendance, with work, family, illness of self and funeral being the reasons for nonattendance (Sukala *et al.* 2012). One study conducted with Native American and Alaska Natives to estimate long-term risk of T2DM reported high attrition rate over 10 years of follow-up (64%–84% after Year 1) (Jiang *et al.* 2018). One non-randomized study reported participants not being able to take part in an on-country retreat as part of the intervention due to being away for the community or family responsibilities (Dissanayake *et al.* 2025). In contrast, one RCT conducted with Native American women (76%) and men (24%), reported high level of attendance as a study success and suggested that this may be due to engaging with the community at the beginning of the study and having input from community leaders and other members in the development of study tools, provision for transport facility, and timing of the study (Kattelman *et al.* 2010). A non-randomized study conducted with Native American participants attributed delivering the intervention and collecting data through home visits to retention of all participants to completion (Shah *et al.* 2015) while another study had no participants drop out but did not report any reason (Karaivanov *et al.* 2021). Accordingly, it is important to note that reported effectiveness in primary studies included in this review did not vary across intervention or follow-up duration.

Implications for future interventions for Indigenous women

In this review, we identified one RCT with low RoB conducted exclusively with Indigenous women. Although participation of women in clinical trials has improved, women are still under sampled in CVD-related clinical trials and sex-specific evidence about disease-specific presentation, assessment, and management is critical in providing equitable and evidence-based care to women (Peters *et al.* 2016). When considering the intersection of ethnicity and gender, Indigenous women remain markedly underrepresented in CVD-related clinical trials—facing a dual disadvantage compared with men and women in the general population (Umaefulam *et al.* 2022, Xu *et al.* 2022). CVD assessment and management is largely informed by evidence derived from studies conducted predominantly in men. Consequently, women are often treated using the same clinical approach as men, without adequate consideration of their physiological, clinical and social needs (Van Dlemen *et al.* 2021). Better understanding of

how biological, societal and behavioural differences influence cardiovascular health of population subgroups that are at high risk of experiencing CVD can offer critical insight into risk factor reduction and preventive care. Meaningful engagement and co-design of CVD prevention intervention that centres Indigenous women's lived experiences—from priority setting and determining the study design through to evaluating process and outcomes—should be embedded as standard practice. By embedding Indigenous leadership throughout conception, methodology, analysis, and reporting, studies are more likely to produce findings that authentically reflect Indigenous women's lived experiences, as this review demonstrates. Incorporating validated community engagement assessment tools into study appraisal would recognise and incentivise meaningful community engagement, strengthening the credibility of evidence.

When conducted with rigour, RCTs are regarded as generating the highest standard evidence on the causal relationship between an intervention and its outcomes of interest (Bondemark and Ruf 2015, Grossman and Mackenzie 2005). Six studies, including two RCTs, reported that an RCT design was deemed inappropriate in the community context they were implemented (Canuto *et al.* 2012, Chan *et al.* 2007, Dissanayake *et al.* 2025, Gilliland *et al.* 2002, Shah *et al.* 2015, Sukala *et al.* 2012). There is an increasing body of literature that show that RCTs may not yield expected benefit for Indigenous communities as this research design is often inconsistent with Indigenous cultural views and ethical principles relevant to Indigenous health research (Esgin *et al.* 2023, Luke *et al.* 2023). Taking examples from health RCTs conducted with Aboriginal and Torres Strait Islander communities in Australia, Jacups and Bradley (2023) said that RCTs may not generate meaningful results in health issues where social determinants play a critical contributing role (Jacups and Bradley 2023). However, examples of effective RCTs conducted via meaningfully engaging with Indigenous communities in all stages of the research—starting from agenda setting through to dissemination—under Indigenous leadership, culturally appropriate, ethical and high-quality RCTs can be conducted (Glover *et al.* 2015). Where conducting RCTs is infeasible, community-based non-randomized interventions with better participant retention strategies can offer valuable evidence, particularly about long-term health outcomes. While an attrition rate of 5% is deemed acceptable, over 20% is considered concerning due to likelihood of increased biases, including the loss of statistical power (Schulz and Grimes 2002). Future studies may benefit from adopting innovative and culturally appropriate engagement strategies to optimize participant recruitment and retention.

Strengths and limitations

We identified several gaps in the evidence. Firstly, there are small number of RCTs conducted in Indigenous women that could contribute to building a robust evidence base about effective strategies to reduce CVD risk factors and prevent CVD in this population. Most studies, randomized or otherwise, included a mixed sample of female and male participants with or without existing CVD, and did not report sex-specific primary prevention related results, further contributing to paucity of evidence on effective strategies of CVD prevention in at-risk Indigenous women

who often experience complex challenges in achieving optimum health and wellbeing. Secondly, half of the primary studies, including three of the four RCTs conducted exclusively with Indigenous women, reported high level of loss-to-follow-up, with indication of implications for the study effect sizes. However, information about what factors may have influenced such high level of attrition was not provided to be able to inform the designing of future studies in similar settings. Thirdly, data regarding tailoring interventions for Indigenous communities were inconsistently and inadequately reported. Finally, none of the studies reported whether interventions were developed taking women's gender roles and social and cultural lived experiences into considerations or whether these factors were taken into account in analysing or interpreting the evidence. Taking biological sex and social and cultural construct-based gender identity into account is critical because these aspects can impact women's ability to participate in health interventions, including clinical trials, influence the effect of interventions and the natural course of health conditions (Ain and Rasool 2024, Goldstein *et al.* 2024). Although this umbrella reviewed aimed to examine what works in reducing CVD risk factors in Indigenous women at risk of CVD, studies with mixed samples of both women and men and participants with and without CVD were included to support the inclusion of critical evidence offered by community-based interventions. Sex-specific results were reported in only one of the studies conducted with participants of both sexes/genders. Similarly, none of the studies enrolling participants without and with existing CVD reported findings disaggregated for primary prevention. Therefore, a lack of availability of sex- and primary prevention-specific data in the mixed sample studies meant that the impacts of the interventions on women specifically could not be ascertained.

Conclusion

A systematic assessment and synthesis of six existing reviews and 16 primary studies conducted exclusively or predominantly with Indigenous women in the USA, Canada, New Zealand, and Australia suggest that non-pharmacological or lifestyle-based intervention can be effective in improving CVD risk factors in Indigenous women without prior CVD. The quality of evidence supporting this conclusion is, however, limited, indicating an urgent need for high-quality evidence about effective CVD prevention strategies in Indigenous women to ensure effective and equitable cardiovascular health care for them. Future CVD risk reduction interventions should consider partnership and co-design with Indigenous communities as early as setting the research agenda, determining appropriate and acceptable methodology, co-developing interventions with Indigenous woman, the community and healthcare providers providing care to the community.

Acknowledgements

The authors extend their gratitude to Ms Vesna Bircik, Librarian, University of Melbourne for their support in the literature search. They also extend that gratitude to the anonymous reviewers for their constructive comments which further improved the quality of this review.

Author Contributions

The lead author, T.R., and the senior author, S.E. jointly initially formulated the review idea while T.R. formulated the review question and subsequently gathered consensus from co-authors through meetings. T.R. led the conduct of the review and writing of the manuscript. All co-authors provided input in evidence synthesis, reviewed drafts of the manuscript, and approved the final version.

Tabassum Rahman (Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Software, Writing—original draft), Amie Bingham (Data curation, Formal analysis, Investigation, Writing—review & editing), Melinda J Carrington (Funding acquisition, Methodology, Writing—review & editing), Richard Chenhall (Funding acquisition, Writing—review & editing), Francine Eades (Funding acquisition, Writing—review & editing), Grace Joshy (Funding acquisition, Writing—review & editing), Emily Banks (Funding acquisition, Methodology, Writing—review & editing), and Sandra Eades (Conceptualization, Funding acquisition, Methodology, Project administration, Supervision, Writing—review & editing)

Supplementary material

Supplementary material is available at [Health Promotion International](https://doi.org/10.1080/14443157.2025.2521157) online.

Conflict of interests

None declared.

Funding

This review was conducted as part of a National Health and Medical Research Council (MRF2026248) funded project, under the Medical Research Future Fund, Indigenous Health Research scheme (MRF2026248). E.B. receives support from the National Health and Medical Research Council (Investigator Fellowship reference number 2017742). M.J.C. receives an endowed fellowship from the Filippo and Maria Casella Cardiology Centre of Excellence.

Data availability

The data underlying this article are available in the article and in its online [supplementary material](#).

Conflicts of interest

None declared.

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