

The effect of nutrition education on nutrition-related health outcomes of Aboriginal and Torres Strait Islander people: a systematic review

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Profound health disparities exist between Indigenous and non-Indigenous Australians.¹ Indigenous Australians have a significantly shorter life expectancy than their non-Indigenous counterparts, with an average of 11- and 10-year deficits between Indigenous and non-Indigenous males and females respectively.¹ Non-communicable diseases, such as cardiovascular disease and diabetes, contribute to 70% of this health gap.¹ The causes of this discrepancy in health status are complex and multi-factorial, and include a range of social, cultural and environmental factors. Policy makers are challenged to know what strategies are effective in improving Indigenous health.

Poor nutritional intake is a key contributor to the burden of disease in the Indigenous Australian population.¹ The arrival of the British settlers in Australia hallmarked a gradual shift in the traditional Indigenous Australian diet, high in fibre and protein and low in saturated fat, to one high in saturated fat and refined carbohydrates.² Poor nutrition is not only a risk factor for cardiovascular disease and diabetes; it also plays a fundamental role in overweight, obesity and insulin resistance.³ These conditions can further increase the likelihood of developing cardiovascular disease and diabetes.³ Improving nutritional intake is an essential component of protecting against and treating these conditions, and a key factor in reducing the burden of non-communicable disease.³

One strategy that has been employed to address poor nutritional intake is nutrition education. This can be defined as "any set of

Abstract

Objective: To determine the effectiveness of nutrition education on improving nutrition-related health outcomes in Aboriginal and Torres Strait Islander people.

Methods: Databases Medline, Cinahl, Scopus, ProQuest and ATSI Health were searched in September 2013 to identify nutrition education intervention studies in Indigenous Australian populations. Peer-reviewed and grey literature with nutrition-related biochemical or anthropometrical health outcomes were included in a qualitative comparative analysis.

Results: Of 1,162 studies identified from the search, six met inclusion criteria. Three studies were from a remote setting and three from an urban setting. Four of the six education interventions were shown to improve body mass index (BMI) and/or nutritional biochemical indicators. Components of the nutrition education interventions showing greatest effect included cooking skills workshops, group education sessions and store interventions. Community involvement in the program design was most strongly associated with a positive effect on BMI.

Conclusion: Nutrition education had some effect in reducing biochemical and anthropometric risk factors for chronic disease in Indigenous Australians.

Implications: Nutrition education can be considered as part of a range of strategies to improve nutrition-related health for Aboriginal and Torres Strait Islander people. Further evidence is needed to strengthen this recommendation.

Key words: Aboriginal and Torres Strait Islander, cardiovascular disease, diabetes, Indigenous, Australia, nutrition education, obesity, overweight

learning experiences designed to facilitate the voluntary adoption of eating and other nutrition-related behaviours conducive to health and wellbeing.⁴ Nutrition education has been a component of several health interventions conducted with Aboriginal and Torres Strait Islander people that have claimed to improve health outcomes.⁵⁻¹⁰ Yet, to the authors' knowledge, no previous systematic reviews have been conducted in this population to assess this objectively. A 1995 systematic review of nutrition education interventions conducted in a variety of population groups within the United

States found nutrition education could be effective in improving nutrition-related health outcomes.⁴ The authors reported that interventions focused on behavioural change and based on appropriate research into the target population and behaviour change theory were more effective than those simply focusing on the provision of information.⁴

In spite of many social, cultural and environmental barriers to good nutrition in the Indigenous Australian population, nutrition education continues to be included in treatment and prevention programs for non-communicable, nutrition-related

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diseases. The purpose of this systematic review was to evaluate the effectiveness of nutrition education on improving nutrition-related health outcomes in Indigenous Australian populations, with a specific focus on non-communicable diseases such as cardiovascular disease and diabetes. A subsidiary objective was to determine how and why nutrition education can be effective in Indigenous Australian communities.

Methods

Search strategy

Databases Medline, Cinahl, Scopus, ProQuest and ATSI Health were searched in September 2013. Reference lists of all included studies were scanned for potentially relevant citations. Papers not in English were excluded. There was no date limit as researchers felt that all previous interventions held significance to the research question. Population groups of all ages were sought. Both peer-reviewed and grey literature were considered.

The PICO (population, intervention, comparator, outcome) framework was used to generate relevant search terms, although presence of a comparator was determined after retrieval. The following search terms were used to identify records relevant to the topic: ('Indigenous' OR 'Aborigine' OR 'Torres Strait Islander') AND ('nutrition education' OR 'nutrition information' OR 'nutrition program' OR 'nutrition course' OR 'nutrition workshop' OR 'nutrition training' OR 'nutrition promotion' OR 'diet education') AND ('cardiovascular disease' OR CVD OR stroke OR cholesterol OR triglycerides OR 'heart disease' OR hyperlipidemia OR hyperlipidaemia OR 'high blood pressure' OR hypertension OR BMI OR 'body mass index' OR 'waist circumference' OR obese OR overweight OR adiposity OR diabetes OR HbA1c OR 'blood glucose'). Truncations of these terms were also used.

Study selection and data extraction

This review included studies involving Australian Aboriginal and Torres Strait Islander populations, a nutrition education aspect, a comparator and any study design. Studies were excluded if nutrition-related biochemical or anthropometrical health outcomes were not reported. The titles and abstracts of retrieved studies were screened by pairs of reviewers. Full text articles were obtained for any studies deemed potentially relevant. Studies were independently assessed for eligibility by two reviewers.

Disagreements were resolved through discussion.

For the included studies, researchers extracted data using a standardised data extraction form, including: methods (study design, location, selection of sample), participants (sample size, comparator, population characteristics), interventions (nutrition-related intervention, other intervention, length of follow-up) and outcomes (including biomedical and anthropometrical markers of nutrition-related health outcomes).

Assessment of risk of bias

Risk of bias was assessed for each individual study utilising the Academy of Nutrition and Dietetics Quality Criteria Checklist.¹¹ This tool focused on study relevance, selection bias, comparability of study groups, withdrawals, blinding, intervention, outcome validity and reliability, statistical analysis, whether conclusions were supported by results and funding bias. Two researchers independently assessed each study. Again, disagreements were resolved through discussion.

Synthesis of results

A meta-analysis could not be performed due to the heterogeneity between studies regarding the interventions and reporting of results. Therefore, a qualitative comparative analysis¹² of results was performed for all included studies. Qualitative comparative

analysis identifies the frequency of different elements of an intervention to the outcome.¹² Outcomes were only included in the comparative analysis if studies reported a statistically significant p value ($p \leq 0.05$, unless otherwise specified by the study) or stated that the result was statistically significant. All authors came together to map the frequency of elements that were significant in included studies based on data extraction information and agreed on findings of the analysis. More specifically, the education approaches were mapped against the outcome measures and the number of studies that had a statistically significant effect was scored accordingly. For example, two studies involving cooking skills workshops had an effect on body mass index (BMI) and two studies with community involvement in program design had an effect on plasma glucose.

Results

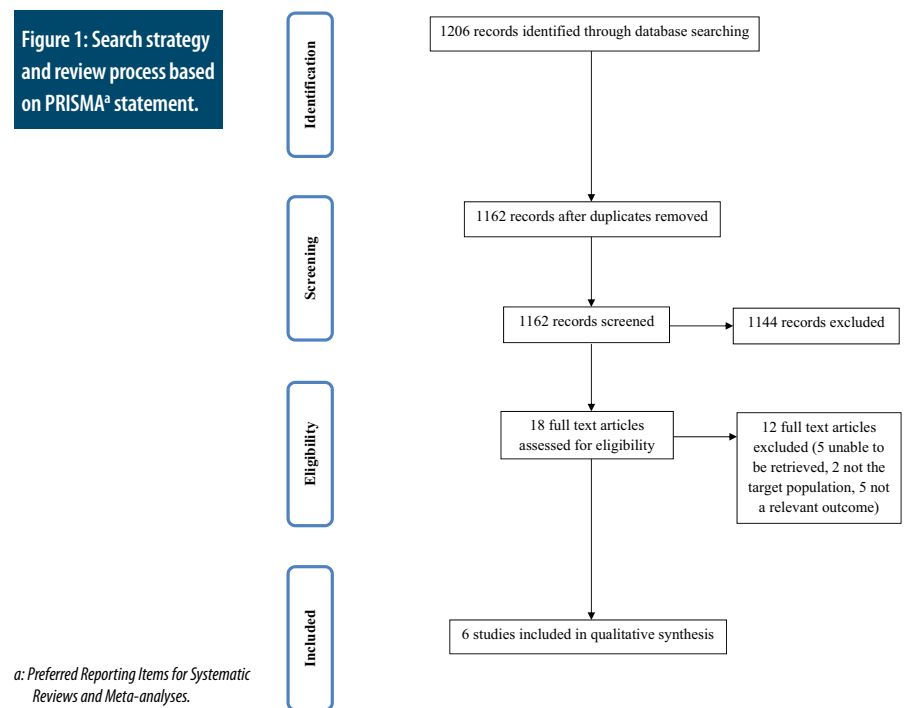
Study selection

The literature search retrieved 1,162 studies after duplicates were excluded, with 18 publications identified from this search for retrieval and possible inclusion in the review. From these, six publications were identified for inclusion in the review (Figure 1).

Studies unable to be retrieved

Of the 18 publications identified from the search for retrieval and possible inclusion,

Figure 1: Search strategy and review process based on PRISMA^a statement.



five were unable to be retrieved. Two of these were grey literature,^{13,14} one was a PhD thesis that appeared to focus mainly on qualitative methods,¹⁵ one appeared to relate to training Aboriginal health workers in nutrition education¹⁶ and the last was unclear¹⁷ and therefore unlikely to meet inclusion criteria.

Characteristics of included studies

The six included studies comprised one comparative study with a concurrent control, four case series with pre-test and post-test outcomes and one pragmatic randomised controlled trial. Studies varied from Level III-1 to Level IV evidence according to the National Health and Medical Research Council (NHMRC) guidelines.¹⁸ Research was published over a time span of 19 years, from 1993 to 2012. A total of 348 subjects were included from all six studies. Sample sizes tended to be small and ranged from 13 to 100 participants. Program durations were between five days and four years, while length of follow-up ranged from three months to four years.

Three studies were conducted in a remote setting,^{5,6,10} while the remaining three were undertaken in an urban setting.⁷⁻⁹ Five out of six studies included both male and female participants.^{5-8,10} One study included only female participants.⁹ The mean age of participants at baseline was reported in four studies and ranged from 40 to 51 years.^{5,7-9} Four of the six studies reported mean BMI at baseline,^{5,6,8,9} which was between 23.3 kg/m² and 36.6 kg/m² (Table 1).

Effects of interventions on nutrition-related health outcomes revealed by the qualitative comparative analysis

Four of the six interventions produced statistically significant results in favour of the intervention.^{5-7,9} The remaining two studies did not report a *p* value or state whether results were statistically significant,^{8,10} so their results were excluded from analysis. In the study conducted by Rowley et al.,⁵ only results from the high-risk cohort and not the wider community were considered. This was because reviewers were unable to ascertain the community's exposure to the intervention.

The most substantial impact of the interventions was on BMI, which in three studies resulted in a mean decrease.^{5,6,9} Statistically significant improvements were also reported by some studies for several

other outcome measures: Rowley⁵ reported a mean decrease in two-hour plasma glucose and triglycerides; Lee⁶ found mean decreases in systolic blood pressure, diastolic blood pressure, cholesterol and triglycerides, as well as two-hour plasma glucose in a subset of the cohort; Harris and Curtis⁷ reported a mean decrease in HbA1c; and Canuto⁹ reported a mean decrease in weight. Longstreet⁸ reported a trend toward a mean decrease in weight and waist circumference.

Factors contributing to the success of interventions

Components of the nutrition education interventions that had the greatest impact on the mean decrease in BMI included cooking skills workshops, group education sessions and store interventions such as store tours and shelf talkers (labels put on the shelves in community stores to identify healthy options and encourage people to switch to a healthier choice when shopping or remind them of the importance of eating healthy foods).¹⁹ Other contributing factors included store tours and newsletters that provided healthy recipes and nutrition tips. Overall, group education settings yielded a wider variety of positive results than individual education settings.

Of the non-nutrition education interventions and program features, community involvement in the program design was most strongly associated with a positive effect on BMI. Other contributing factors included community involvement in the program implementation, the involvement of an Aboriginal health worker, environmental changes (such as improved quality and quantity of fresh produce in the store and increased availability of healthier food choices), improved access to health care (from a Diabetes Nurse Educator), physical activity interventions and provision of equipment such as pedometers.

Quality of included studies

According to the chosen quality assessment instrument,¹¹ two studies were assessed as being of overall positive quality,^{5,9} suggesting they had a low risk of bias. Two studies were assessed as being of overall neutral quality,^{6,8} and two studies were assessed as being of overall negative quality.^{7,10} Increased risk of bias was mainly due to lack of blinding within studies, lack of rigorous statistical analysis and poor attendance at and compliance with interventions.

Discussion

This systematic literature review aimed to evaluate the effectiveness of nutrition education at improving nutrition-related health outcomes in Indigenous Australian populations and to determine how and why nutrition education can be effective in Indigenous Australian communities. Six studies were reviewed and incorporated 348 subjects across both urban and remote settings. A qualitative comparative analysis found that four of the six interventions produced statistically significant results in favour of the intervention.^{5-7,9} The most substantial impact of the interventions was on BMI, but improvements were also reported for 2-hour plasma glucose, HbA1c, systolic and diastolic blood pressure, triglycerides, cholesterol and weight. Within the nutrition education interventions, components that had the greatest impact included cooking skills workshops, group education sessions and store interventions. Of the non-nutrition education interventions and program features, community involvement in the program design was most strongly associated with a positive effect on BMI. Other contributing factors included community involvement in the program implementation, the involvement of an Aboriginal health worker, environmental changes, improved access to health care, physical activity interventions and provision of equipment such as pedometers.

There was a strong association between community involvement in the design of the program and successful outcomes. This supports previous work, which suggested that long-term collaborative partnerships between researchers or program staff and communities were associated with improvements in population-level health outcomes.^{20,21} One example of a program in which the community had a fundamental role in all aspects of its design and implementation was the Looma Healthy Lifestyle.⁵ This program was initiated by community members out of concern arising from diabetes-related deaths in the community and was tailored to address the barriers to good health within this particular community.⁵ The researchers reported that program initiatives were met with an enthusiastic response and high levels of involvement.⁵ At the time of publication, the Looma Healthy Lifestyle has continued to operate six years after its commencement,

Table 1: Summary of included studies.

Author/year	Program Name/ Location	Study design/ NHMRC level of evidence ¹⁸	Nutrition education intervention	Other interventions/ program features	Results	Sample size	Length/ follow-up	Population characteristics at baseline	Quality
Canuto et al, 2012 ⁹	Aboriginal and Torres Strait Islander Women's Fitness Program, Adelaide, South Australia	Pragmatic randomised controlled trial, Level III-1	Four nutrition workshops delivered by a dietitian (topics - food label reading, recipe modification, cooking demonstration) Fortnightly newsletters with healthy recipes and nutrition tips	Two 60-minute group cardiovascular and resistance training classes per week Incidental activity and walking Positive reinforcement and encouragement Pedometer and exercise diary Community consultation	Increase in weight of 2.5kg, ** BMI of 1.03kg/m ² , ** waist circumference of 1.5cm, # hip circumference of 1.97cm, # systolic blood pressure of 4.09mmHg, # diastolic blood pressure of 2.17mmHg# No difference between groups in fasting glucose, # fasting insulin, # HbA1c, # total cholesterol, # triglycerides, # LDL, # HDL#	n=100 (active group n=51, waitlist group n=49)	3 months/ 3 months	Metropolitan Female Mean age 41 years (waitlisted group), 40 years (active group) Mean BMI 34 (waitlisted group), 36 (active group) Mean HbA1c levels 6.5% (waitlisted group), 6.1% (active group) 26.7% (waitlisted group), 17.2% (active group) had type 2 diabetes	P
Grundy et al, 2001 ¹⁰	Laramba Diabetes Project, Northern Territory	Case series with pre-test/post-test outcomes, Level IV	Women's centre cooking demonstration Vegetable garden program Access to a nutritionist Five diabetes camps attended by nutritionists and diabetes educators Pictures depicting the number of teaspoons of fat and sugar in various foods were displayed in the store	Public health project officer/nutritionist Community-based workers Diabetes educators, specialist physician and podiatrist Two-way learning Steering committee of senior community members, health centre staff, public health project officer, community-based workers and other community members Changes in store practices Contract directing the store manager to stock healthy foods Sports days, hunting, disco	Increase in HbA1c at the end of the program compared with at the beginning of the program for seven people ^{#a} . Decrease in HbA1c at the end of the program compared with at the beginning of the program for three people ^{#a} . Remaining three did not have values from the beginning of the program available for comparison	n=13	2 years/ 2 years	Remote Aboriginal community Diagnosed with type 2 diabetes	N
Harris and Curtis, 2005 ⁷	Name not specified, Wollongong, New South Wales	Case series with pre-test/post-test outcomes, Level IV	Nutrition workshops	5-day camp Partners, family at camp Community involvement Diabetes resources Provision and training in glucometers, pedometers Aboriginal Health Workers Workshops on disease management, physical activity, stress management, relaxation training and smoking cessation	Decrease in cholesterol levels pre 5.29mmol/L ± 1.06 SD to six months post 5.1mmol/L ± 1.08 SD [#] Decrease in triglyceride levels pre 3.39mmol/L ± 1.69 SD to six months post 2.99mmol/L ± 1.76 SD [#] Decrease in HbA1c from pre 9.24mmol/mol ± 2.00 SD to six months post 8.6mmol/mol ± 1.86 SD**	n=19	5 days/ 6 months	Peri-urban Aboriginal community Male and female Mean age of 51 years Had type 2 diabetes Mean number of years living with diabetes was 6	N
Lee, 1993 ⁶	Minjilang Nutrition and Health Project, Northern Territory	Case series with pre-test/post-test outcomes, Level IV	Use of 'shelf-talkers' in the community store to aid recognition of 'target foods'	Screening of community members to raise awareness of health issues Direction of the project by community elders Employment of an Aboriginal research assistant Employment of community members Prompt return of individual and community results of clinical and dietary monitoring Provision and promotion of a wide variety of nutritious foods in the store Encouragement of increased exercise	Decrease in BMI after controlling for inter-individual variance, ***, systolic blood pressure (123mmHg ± 2.1 SEM in June 1989 to 115.2mmHg ± 1.9 SEM in June 1990 ^{***}), diastolic blood pressure (72.2mmHg ± 1.2 SEM in June 1989 to 61.4mmHg ± 1.2 SEM in June 1990 ^{***}), serum cholesterol (5.93mmol/L ± 0.15 SEM in June 1989 to 5.2mmol/L ± 0.15 SEM in June 1990 ^{***}), serum triglycerides in non-diabetics (1.79mmol/L ± 0.19 in June 1989 to 1.45mmol/L ± 0.14 in June 1990 ^{***}) No change in glucose, but decrease in 2-hour plasma glucose in women ≥35 years (n=13) ^{***} .	n=68	1 year/ 1 year	Remote Aboriginal community 10% had non-insulin-dependent diabetes mellitus 7% had impaired glucose tolerance Mean BMI of 23.3 ± 0.6	0

Table 1 continued: Summary of included studies.

Author/year	Program Name/ Location	Study design/ NHMRC level of evidence ¹⁸	Nutrition education intervention	Other interventions/ program features	Results	Sample size	Length/ follow-up	Population characteristics at baseline	Quality
Longstreet et al, 2008 ⁸	Walkabout Together Program, ²⁰ Townsville, Queensland	Case series with pre-test/post-test outcomes, Level IV	Nutrition advice in line with the Australian Guide to Healthy Eating	Multidisciplinary primary health care approach, including information sheets; monthly newsletters and recalls Weekly support groups Physical activity advice Pedometer and log book Indigenous health worker	Decrease in weight from 99.7 kg + 1.6SEM to 97.8kg + 1.6 SEM, # waist circumference from 113cm + 1.2SEM to 111cm + 1.1SEM#	n=100	12 months/ 12 months	Urban Aboriginal community 18-69 years old (mean age 44.3±1.3SEM) Male and female Mean BMI of 36.6 ± 0.65 SEM	0
Rowley et al, 2000 ⁵	Looma Health Lifestyle Program, Western Australia	Comparative study with concurrent controls; Level III-2	Formal and informal education sessions Cooking classes Store tours	Diabetes Nurse Educator Aboriginal Health Workers Community members as diabetes workers Weekly weight and glucose checks Community member as store manager Improved quality and quantity of fresh produce in the store and increased availability of healthier food choices Promotion of physical activity Appointment of sport and recreation officer Regular physical activity groups, including hunting trips, walking and sporting teams	Decrease in BMI at six months* and 12 months.* ²¹ Interaction between change in plasma glucose and fasting insulin in intervention/ non-intervention group were not statistically significant# Decrease in 2-hour plasma glucose from baseline to 24 months (mean change [95% CI] = -0.9 [-1.9-0.2] mmol/L for the interventions group, 1.5 [-0.8-3.7] mmol/L for the non-intervention group* Decrease in triglycerides from baseline to 24 months (mean change [95% CI] = -0.27 [-0.73-0.20] mmol/L for the intervention group, 0.85 [-0.22-1.91] mmol/L for the non-intervention group*	n=49 (32 intervention, 17 control)	2 years/ 4 years	Remote Aboriginal community 82% were overweight or obese Age 39-52 years Men and women Approximately 1/3 had impaired glucose tolerance Approximately half of participants had diabetes Approximately 3% of participants were classified as having sedentary physical activity levels The majority of participants were not attempting dietary change	P

*p<0.1 (This was the standard set for statistical significance by Rowley et al.⁵ due to low numbers and limited statistical power).

**p≤0.05

#p>0.05.

^Exact p value reported, so assumed to be statistically insignificant

#No p value reported, so assumed to be statistically insignificant

^Exact values of change were not reported.

P=positive, N=negative, 0=neutral

suggesting that community ownership may also contribute to program longevity.⁵

Interestingly, all three studies in remote settings involved community members in both design and implementation of the programs,^{5,6,10} whereas only one of the studies in an urban setting used this community development approach.⁷ This could be attributed to the proposed higher level of social cohesion in rural communities when compared with their urban counterparts.²² It has been suggested that low population density, isolation and limited public services, characteristic of rural areas, may lead to increased connectedness and cooperation within the community.²² Facilitators of nutrition education programs in urban Aboriginal communities may need to consider strategies for galvanising community ownership. Cooking skills workshops were a component of the nutrition education intervention that influenced the decrease in BMI. There is little evidence demonstrating the sole effect of cooking skills workshops on nutrition-related health outcomes. However, a qualitative study conducted with Aboriginal Australians reported that cooking classes improved nutrition knowledge and cooking skills.²³ This may, in turn, facilitate a change in nutritional intake, leading to improved health outcomes. Participants attributed much of this program's perceived success to its social nature – the program was conducted in small groups and each session was followed by a group dinner.²³ This is synonymous with a review of effective components of nutrition education interventions, which found that participatory interventions had a significant positive effect on dietary change.²⁴

Changes to the food environment, such as improved quality and quantity of fresh produce in the community store and increased availability of healthier food choices, also contributed to the positive effect on BMI. Given that community stores provide about 95% of the dietary intake of the population in remote Indigenous Australian communities,²⁵ this is not surprising. Programs providing nutrition education are unlikely to be successful if healthy choices are not available for purchase. The influence of the community store on the health of the community has previously been demonstrated.²⁵ The appointment of a community store manager as reported by Rowley et al.⁵ may have contributed to the program's success.

Overall, group education settings yielded a wider variety of positive results than

individual education settings. There is a gap in the literature surrounding the effectiveness of group versus individual nutrition education in Aboriginal and Torres Strait Islander populations. A randomised controlled trial with Caucasian adults in an urban setting in Minnesota, US, suggested that group education for type 2 diabetes is slightly more effective than individual education at improving HbA1c levels.²⁶ This may be due to the shared learning experiences and increased support for behaviour change among peers.²⁷ Behaviour change models encompassing a combination of individual, social and environmental change have been found to underpin successful nutrition education interventions.⁴ A systematic review of nutrition education emphasised the importance of active participation, social support, empowerment and carefully targeting the audience.⁴ These findings are congruent with those of this review.

There were several limitations to the studies included in this review. Most notably, four of the six studies were rated as moderate to weak quality. This was mainly attributed to lack of blinding within study designs and lack of or inadequate statistical analysis. Randomised controlled trials may not be an appropriate framework for evaluating the effect of nutrition education interventions in a community setting.²⁸ However, efforts should be made to reduce the risk of bias in studies, and stringent statistical analyses should be conducted so that program efficacy can be more accurately assessed. The authors also acknowledge the value of qualitative evaluation in measuring benefits achieved in nutrition education in Aboriginal and Torres Strait Islander communities.²⁹ The focus of this review was on the health impact of nutrition education and its benefit as a health promotion strategy given its widespread use.

All studies included in this review consisted of multifaceted interventions, which are recommended for health promotion.³⁰ However, this makes it difficult to isolate the effect of the nutrition education component alone. Poor attendance and lack of compliance with interventions contributed to the moderate to high risk of bias seen in four of the six studies. Consequently, the effectiveness of interventions may have been underestimated if unexposed participants were included as part of the treatment group.³¹ This review included only published studies or evaluations; therefore, as is typical of systematic reviews, there is publication bias. The short duration

and follow-up of included studies is also a limitation. Practitioners involved in delivering nutrition education programs should be supported and encouraged to appropriately evaluate and disseminate their work to build the body of evidence to support change in practice.

Conclusion

This systematic literature review found that nutrition education interventions had some effect on reducing biochemical and anthropometrical risk factors for chronic disease in Indigenous Australians. Of the evidence available, programs with community support, as well as those including group education sessions, cooking skills workshops and store interventions, were most effective. This review hopes to inform the practices of those working to improve the health of Indigenous Australians.

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