

# What do we know about the diets of Aboriginal and Torres Strait Islander peoples in Australia?

## A systematic literature review

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Despite health outcomes for Aboriginal and Torres Strait Islander peoples having improved in a number of key areas in recent years, these first Australians continue to experience greater health disadvantage.<sup>1</sup> In particular Aboriginal and Torres Strait Islander peoples suffer a disproportionately high burden of non-communicable diseases, with high rates of cardiovascular disease, diabetes and cancer.<sup>2</sup> Nutrition is an important determinant in the development and progression of these conditions, with dietary factors accounting for almost 10% of the total burden of disease.<sup>3</sup>

The colonisation of Aboriginal and Torres Strait Islander peoples saw a gradual shift from a traditional, varied and nutrient-dense diet, high in fibre and low in fat and refined carbohydrates, to an energy-dense westernised diet, high in fat and refined sugars.<sup>4-6</sup> The changes in lifestyle have been problematic for many Aboriginal and Torres Strait Islander peoples. Current inadequacies in nutritional intake are caused through a range of socioeconomic, environmental and geographic factors that influence the availability of healthy and affordable food.<sup>7</sup> Food and beverage items from remote community stores, regional and urban supermarkets and fast food outlets have replaced traditional foods almost completely in many contexts, and are made up of a high proportion of energy-dense, nutrient-poor (EDNP) items.<sup>6,8,9</sup>

### Abstract

**Objective:** To provide an overview of published research on the dietary intake of Aboriginal and Torres Strait Islander peoples.

**Methods:** Peer-reviewed literature from 1990 to October 2016 was searched to identify studies that measured the dietary intake of Australian Aboriginal and Torres Strait Islander populations. Study quality was assessed using a purposely devised quality appraisal tool. Meta-analysis was not possible due to the heterogeneity in dietary intake assessment methods. A narrative synthesis of study findings, where key themes were compared and contrasted was completed.

**Results:** Twenty-five articles from twenty studies with outcome measures related to dietary intake were included. Dietary intake was assessed by electronic store sales, store turnover method, 24-hour dietary recall, food frequency questionnaire and short questions. Consistent findings were low reported intakes of fruit and vegetables and high intakes of total sugar and energy-dense, nutrient-poor food and beverages.

**Conclusions:** While differences between studies and study quality limit the generalisability of the findings, most studies suggest that the diets of Aboriginal and Torres Strait Islander peoples are inadequate.

**Implications for public health:** A more concerted approach to understanding dietary patterns of Aboriginal and Torres Strait Islander peoples is required to inform policy and practice to improve diet and nutrition.

**Key words:** Aboriginal health, dietary intake, nutrition assessment

Government policy responses to date, which aim to specifically address the underlying determinants of poor nutrition such as food security, socioeconomic status and household infrastructure,<sup>7</sup> have never been fully implemented<sup>10</sup> and have been widely critiqued in relation to their limitations in addressing nutritional inequalities.<sup>11,12</sup> Community-led programs to improve the food environment have the potential to

benefit health but need to be scaled up to optimise impact.<sup>13</sup>

Accurate, quantitative dietary intake data are required to plan and evaluate both national policies and community-led intervention programs.<sup>6</sup> However, there are limitations in accurately assessing dietary intake<sup>6</sup> and there are additional methodological issues associated with measuring dietary intake in Aboriginal and Torres Strait Islander

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Submitted: March 2017; Revision requested: June 2017; Accepted: July 2017

The authors have stated they have no conflict of interest.

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*Aust NZ J Public Health.* 2017; 41:579-84; doi: 10.1111/1753-6405.12721

populations.<sup>6,7,14</sup> The most recent National Aboriginal and Torres Strait Islander Nutrition and Physical Activity Survey (NATSINPAS) 2012-13 is the only nationally representative study reporting on remote and non-remote areas across Australia, but it wasn't designed to accurately capture dietary patterns of different regions or groups.<sup>15</sup> Without high quality data, it is impossible to understand where best to intervene to achieve dietary improvement and measure the impact of government policy on diet and nutrition.<sup>16</sup>

The objective of this review is to provide an overview of the published research on the dietary intake of Aboriginal and Torres Strait Islander peoples in Australia. This is with a view to identifying what further studies are needed to ensure that policies to improve the diets of Aboriginal and Torres Strait Islander groups are based on robust, culturally appropriate assessments of current dietary patterns.

## Methods

### Search strategy

The review methodology was registered with PROSPERO (ID number CRD42016032683). A

three-step strategy was employed to identify peer-reviewed literature published in English from 1990 to October 2016.

1) Electronic databases were searched: PubMed, HealthInfoNet and PsycInfo. Search terms included: Aboriginal and Torres Strait Islander, Australia and dietary intake. Key words used in combination were: Indigen\* OR Aborigin\* OR Torres Strait Islander AND Australia\* AND diet\* OR nutrit\* OR food consum\* OR eat\* NOT virus OR bacteria OR infect\* NOT genom\* NOT plant\* OR tree\*. The search results were imported into Endnote (Thomson Reuters) where duplicate records were removed.

2) Titles and abstracts were assessed by two independent reviewers (SW and SF) against the inclusion criteria. To be included, studies needed to focus on Aboriginal or Torres Strait Islander peoples in Australia, of any age and living in any region of Australia, and include a baseline measurement of dietary intake.

3) Where eligibility was unclear, studies were further discussed or a third independent reviewer (JB) was consulted. Electronic searches were supplemented by manual cross checking of the reference lists of publications.

### Data extraction

Data were extracted using a standardised table designed and tested for this review including: 1) population characteristics; 2) sample size; 3) study design; 4) measurement method; 5) primary outcome measure; and 6) main findings.

### Quality assessment

Study quality was assessed using a purposely devised quality appraisal tool (Supplementary Table 1) developed from two existing tools.<sup>17,18</sup> Additional domains added related to the involvement of Aboriginal and Torres Strait Islander peoples in the design and implementation of the studies.<sup>19</sup> One reviewer (SW) had primary responsibility for quality assessment. For the first three studies, two reviewers (SW and SF) jointly completed quality assessment and the remaining extraction was completed by the first reviewer and checked by the second reviewer. Disagreements were resolved through discussion or a third independent reviewer (JB) was consulted until consensus was reached.

## Results

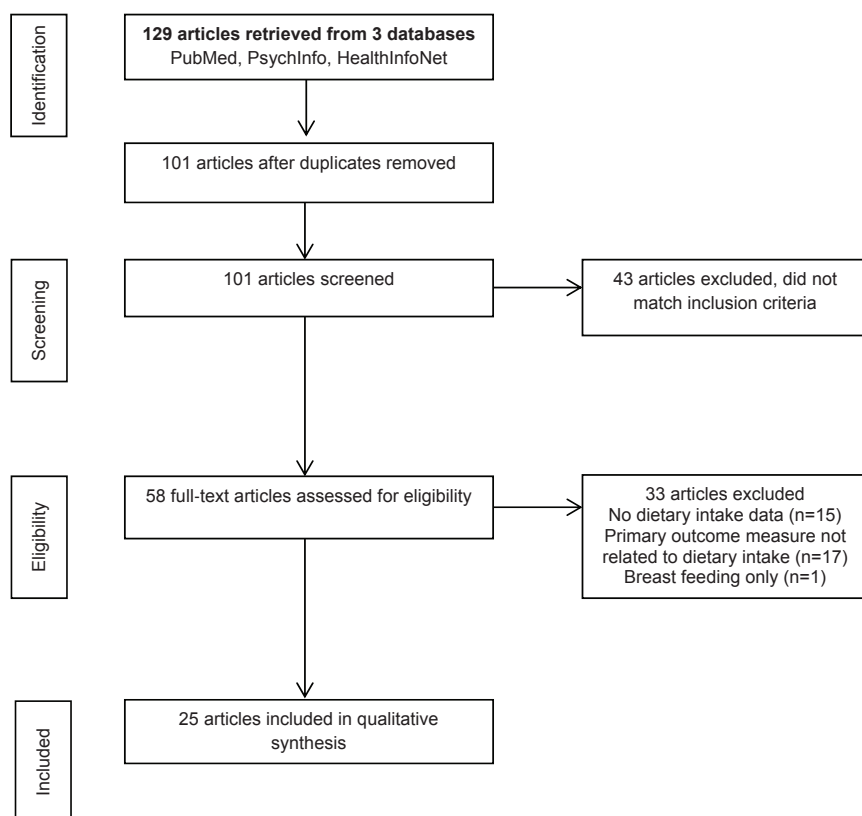
### Search results

The search strategy identified 129 articles (Figure 1). Following elimination of duplicates, initial assessment of titles and abstracts, and evaluation of retrieved articles against the inclusion criteria, twenty-five articles from twenty studies were identified for quality assessment and included in the review. Included studies were conducted between 1991 and 2016, but most studies were conducted in the early 1990s (n=5 studies) or after 2007 (n=14).

### Description of studies

Twenty independent studies were included in the analysis but there was a total of twenty-five articles, as several used the same raw data but analysed for different purposes.<sup>9,20-25</sup> The most common dietary intake assessment methods used were: electronic store sales data (n=6 studies) and store turnover method (n=3) to measure population-level intake; and 24-hour dietary recalls (n=4), food frequency questionnaire (n=4) and short questions (n=3) to measure individual intake. Fifteen were observational studies and five were intervention studies (Supplementary Table 2).

Figure 1: Flow diagram of article identification retrieval and inclusion for the systematic review.



**Location and study population**

Most studies were conducted in a remote setting (n=12 studies), with less in rural (n=4) or urban settings (n=4).<sup>26</sup> The studies were located in the Northern Territory (NT), n=5 studies; Western Australia (WA), n=4; New South Wales (NSW), n=4; Queensland (QLD), n=2; South Australia (SA) n=2; and Victoria (VIC), n=2. One study included three states and one territory<sup>27</sup> (Supplementary Figure 1). For population estimates using electronic store sales and the store turnover method, participant numbers ranged from one to six stores servicing approximately 149 to 5,000 residents. In studies assessing self-reported intake at an individual level, participant numbers ranged from 25 to 2,524 participants.

**Quality assessment**

Studies were most likely to be rated as low quality based on validity of dietary assessment measure (n=8 studies), participation rate (n=8) and representativeness of the study sample (n=5). 'Involvement of Aboriginal and Torres Strait Islander peoples throughout the study process' was not reported in nine out of 20 studies. Of the 10 studies that used a food composition table to link foods to nutrient

intakes, five studies did not report having a second person check over the food-nutrient linking (Table 1).

**Dietary intake**

All studies reported on several outcomes including: nutrient profile relative to requirement (n=12 articles), major food sources of nutrients (n=7), intake of fruit and vegetables (n=7) and traditional foods (n=2). Estimated per capita energy intakes varied widely depending on study type, sample population and location. Population measures ranged from 9,608kJ/person/day using electronic store sales data collected from stores and purchasing data collected for other food outlets and services in three communities in the NT from 2010 to 2011<sup>24,25</sup> to 14,720kJ/person/day from electronic store sales data in five community stores in SA in 2012.<sup>13</sup> Estimates from dietary recall ranged from 7,570kJ/person/day for children in three urban communities in NSW from 2008 to 2009<sup>28</sup> to 8,353.5kJ/person/day in girls and 9,689.2kJ/person/day in boys aged 10–12 years residing in three disadvantaged rural communities in NSW in 2012.<sup>9</sup> The recent National Aboriginal and Torres Strait Islander Nutrition and Physical Activity Survey 2012–13 (NATSINPAS) estimated average energy

intake as 7,261kJ/person/day for females and 9,175kJ/person/day for males.<sup>15</sup>

The recent studies in SA and NT using electronic store sales data showed protein, carbohydrate and fat (including saturated fat) were in or almost within the recommended ranges.<sup>13,24,25,27</sup> In contrast, these three studies showed that total sugar provided 22–33.4% of total energy intake,<sup>13,24,25,27</sup> which is two to three times that recommended by the World Health Organization (WHO).<sup>29</sup> The two NT studies<sup>24,25,27</sup> that used electronic store sales data also showed sodium intakes greatly exceeded recommendations,<sup>30</sup> while calcium, magnesium, potassium and fibre fell below the population recommended levels.<sup>30</sup> Similarly, the children's dietary survey in rural NSW showed 74% of participants exceeded the upper limit for sodium, while a high proportion of participants did not meet the adequate intake for dietary fibre (77%), potassium (62%) or calcium (65%).<sup>9</sup> The NATSINPAS also reported that, on average, the estimated sugar intake provided 21% of total energy intake and sodium intake was 2,379mg,<sup>15</sup> which exceeds recommended limits.<sup>30</sup> Likewise, the estimated dietary fibre intake of 18 grams and calcium intake of 734mg (males) and 611 mg (females)<sup>15</sup> was below recommendations.<sup>30</sup>

**Table 1: Quality assessment of studies, summarised.**

Quality criteria	Ashman A, et al 2016	Wycherley T, et al 2016 & Brimblecombe J, et al 2013	Lee A, et al 2015	Russell S, et al 2015	Scelza B, et al 2014	Black A, et al 2013	Maxwell S, et al 2013	Brimblecombe J, et al 2012	Chun Yu Louise J, et al 2012 & Gwynn J, et al 2012	D'Onise K, et al 2012 & LIM, et al 2012 & McDermott R, et al 2009	Valery P, et al 2012	Butler R, et al 2011	Hamada A, et al 2011	Hodge A, et al 2011	Rowley K, et al 2001	Lee A, et al 1995 & Lee A, Bailey A, et al 1994	Lee A, O'Dea K, et al 1994	Rowse T, et al 1994	Guest C, et al 1993	Wahlqvist M, et al 1991
1. Inclusion and involvement of Aboriginal and Torres Strait Islander people throughout study process	L	U	L	L	U	L	U	U	L	L	L	L	U	L	L	U	U	U	U	U
2. Sample is representative of the underlying population	H	L	L	L	L	L	H	L	L	L	H	L	H	L	L	L	L	L	L	H
3. Participation rate is greater than 50% or attempt to quantify characteristics of non-responders	H	L	L	H	U	L	U	L	H	H	H	L	H	H	L	L	L	L	U	H
4. Reliable and valid dietary assessment measures used	L	L	L	H	H	L	H	L	L	U	L	H	H	H	L	L	L	L	H	H
5. Meets criteria for quality of the dietary assessment measure	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L
6. Appropriate food composition tables used and second person has checked linking of foods	L*	L	L*	NA	NA	L	NA	L	L*	NA	NA	NA	NA	NA	H*	U	L*	NA	NA	H
7. Results appear in enough detail to permit checking for accuracy	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
8. Study limitations have been commented on and taken into consideration in results	H	L	L	H	H	L	L	L	L	H	L	L	L	L	L	H	L	H	L	H

Each item was rated as L=low bias, H=high bias, U=unclear, NA= not applicable

\*Second person not checking linking of foods

The main contributors to dietary intake were similar both between the studies and over time. Two NT studies in the 1990s that used the store turnover method of dietary assessment identified white sugar, meat and meat products, white flour and bread as the four main foods contributing to available energy.<sup>6,31,32</sup> More recent studies in SA<sup>13</sup> and NT<sup>24,25,27</sup> using electronic store sales data also found that white sugar, meat and meat products, and bread were the primary contributors to energy. A striking finding from these recent studies was the high expenditure on beverages and corresponding high intake of sugar-sweetened beverages.<sup>13,24,25,27</sup> The intake of energy-dense, nutrient-poor foods and beverages also appears to be high in children and youth, contributing as much as 40–50% of total energy intake.<sup>9,33</sup> The NATSINPAS also reported a high intake of these foods where just over two-fifths (41%) of total daily energy intake was from discretionary foods and beverages, with almost two in five (37%) people reporting daily consumption of soft drinks and flavoured mineral water.<sup>15</sup>

All four individual-level dietary assessment studies reported that few participants were meeting the recommended two serves of fruit and five serves of vegetables per day.<sup>21–23,28,33,34</sup> Similarly, the NATSINPAS<sup>15</sup> showed that just over half (54%) of the participants met the recommended serves of fruit and only one in 12 (8%) participants met the recommended number of serves of vegetables per day.<sup>30</sup> Two studies (one in a remote community in WA and the other in three remote communities in the NT) both reported that fruit and vegetables made up the smallest portions of food and beverage purchasing in community stores, while beverages, particularly soft drink and juice, made up the largest percentage of money spent.<sup>24,25,35</sup>

Only two studies provided data on the intake of traditional foods. One study in rural Southern Gumbaynggir Country, NSW, found 96% of the households surveyed regularly consumed food resources from the Nambucca River Estuary, particularly during periods of financial hardship.<sup>36</sup> An ethnographic survey undertaken in a remote community in WA in 2006 found 22.8% of households had at least one member participating in a hunt each day.<sup>35</sup> Traditional foods were not a feature of rural children's diet in the study of 10–12 year olds in NSW.<sup>9</sup>

## Discussion

This is the first comprehensive overview of the evidence about the diets of Aboriginal and Torres Strait Islander groups in Australia. The relatively low number of studies and varying quality means it is not possible to use the findings to make generalisations about the diets of Aboriginal and Torres Strait Islander peoples in Australia other than those provided from the NATSINPAS. However, a number of important observations can be made to help inform future policy development.

### Study populations

The studies were conducted in a variety of locations across Australia. Most studies have been undertaken in remote environments. Few studies have assessed dietary intake among Aboriginal and Torres Strait Islander peoples in urban areas despite one-third (233,100 people) of the total Aboriginal and Torres Strait Islander population in Australia living in this setting.<sup>37</sup> As a consequence, the wide variety of dietary practices of the different cultural groups that make up Indigenous Australia may not have been captured.

### Dietary assessment methods

Around half of the studies included used electronic store sales data or store turnover method to assess population intake. Previous research has shown that these methods have less potential for bias compared to the weighed food record, 24-hour dietary recall, food frequency questionnaire and diet history, and are more acceptable to community members.<sup>27,38</sup> In a rural or remote context the community store is a good setting from which to obtain a 'community dietary quality profile' or monitor the impact of dietary interventions,<sup>6,27</sup> as this is where the majority of food is purchased.<sup>24,25</sup> However, these approaches yield average per capita consumption estimates rather than taking into account differences relating to gender or age, or other variations of dietary intake patterns.<sup>39</sup>

While dietary assessment methods such as 24-hour dietary recalls and food frequency questionnaires (FFQ) are much more useful for assessing variation between individuals, they also have their limitations. With self-reported data obtained from either 24-hour dietary recall or a FFQ, participants tend to under- or over-report their food intake.<sup>39</sup>

While the FFQ can be used to assess dietary intake over periods of more than 24 hours, the development of an appropriate list of food items is crucial to the validity of this method and participants can have difficulty remembering their frequency of consumption of different foods and beverages.<sup>39</sup> These methods are further limited when used in the Aboriginal and Torres Strait Islander population.<sup>38</sup> Accurate assessments of diet require 24-hour recalls to be repeated several times. However, the resources required to do this, particularly in remote areas, means it is often not practical. While the recent NATSINPAS used a multiple-pass 24-hour dietary recall, it was decided that repeat surveys would not be performed in remote locations due to the costs involved.<sup>15</sup> In such cases, a trade-off between accuracy and practicality often has to be made to ensure that adequate data is obtained in the most cost-effective way.

### Quality assessment

The reliability and validity of dietary assessment methods, representativeness of the study population, and lack of comment on the inclusion and involvement of Aboriginal and Torres Strait Islander peoples throughout the study process were the main issues relating to study quality.

Several of the studies used assessment methods not specifically validated for Aboriginal and Torres Strait Islander populations. Validation studies are not always feasible as they tend to be large and costly. However, studies should acknowledge the limitations of the dietary assessment used and state in which populations the tool they are using has been validated. There have been only a small number of tools validated for the Aboriginal and Torres Strait Islander population, including the store turnover method<sup>32</sup> and a food frequency questionnaire.<sup>40</sup> Ideally, studies should draw from existing validated tools, or questionnaires should be adapted or modified to suit the population being sampled.

None of the identified studies were based on a nationally representative sample of the population, other than the NATSINPAS. That said, Aboriginal and Torres Strait Islander groups are not all the same and there is sometimes a trade-off between aiming for representative population-wide samples and obtaining accurate data on specific groups. More often the studies in

this review aimed to assess dietary intake in a particular community or a specific target population, or to assess the impact of a nutrition intervention on the participants involved in a study. In such cases, it is important not to generalise the results from the sample to the whole Aboriginal and Torres Strait Islander population. With the recent NATSINPAS, some discrete Aboriginal and Torres Strait Islander communities with a small number of Aboriginal and Torres Strait Islander households were excluded in order to manage enumeration costs. The final sample was weighted to population benchmarks to account for these exclusions.<sup>15</sup> This national level survey provides us with estimates at the population level, but it is difficult to generalise across different contexts such as very remote vs. remote, therefore it is important to have both nationally representative surveys and targeted studies to get more in-depth information.

The quality of research about Aboriginal and Torres Strait Islander peoples can be improved through the participation of Aboriginal and Torres Strait Islander peoples in the design and implementation of the research programs.<sup>41</sup> Only half of the studies included in this review stated if or how Aboriginal and Torres Strait Islander peoples were involved in the study design or throughout the study process. While word limits for peer-review journals limit what can be reported, it would be helpful for community engagement processes to be better described to facilitate quality assessment of future studies.

### Dietary intake

Overall, these studies suggest a diet of generally poor quality for Aboriginal and Torres Strait Islander peoples. In particular, total sugar intake has been remarkably high since the early 1990s, while fruit and vegetable intake is well below the recommendations. These findings are consistent with the recent National Aboriginal and Torres Strait Islander Nutrition and Physical Activity Survey, which identified that Aboriginal and Torres Strait Islanders in general consume too little of the five major food groups and too much sugar and other discretionary foods.<sup>15</sup>

Total sugar intake as a contribution to energy intake in studies included in this review consistently exceeded the WHO recommendation of  $\leq 10\%$  of total energy intake<sup>29</sup> by up to three times.<sup>6,9,13,24,25,27,32</sup>

Total sugar intake was also high at an average of 19.5% of total energy intake in the non-Indigenous population in the Australian National Nutrition and Physical Activity Survey (NNPAS) 2011-12.<sup>42</sup> Total sugar intake was found to be higher in the Aboriginal and Torres Strait Islander population living in non-remote areas in the NATSINPAS<sup>15</sup> compared to remote areas. Approximately two-thirds (67%) of all free sugars consumed by Aboriginal and Torres Strait Islander peoples came from beverages including sugars added to beverages, i.e. tea and coffee, alcoholic beverages and milk beverages.<sup>15</sup> This is consistent with results from studies using the store turnover method and electronic store sales data to estimate diet, which identified high expenditure on beverages and corresponding high intake of sugar-sweetened beverages.<sup>13,24,25,27,35</sup>

In contrast, few Aboriginal and Torres Strait Islander participants met the recommended two serves of fruit or five serves of vegetables a day.<sup>21-23,28,33,34</sup> According to the NNPAS, a lower proportion of Aboriginal and Torres Strait Islander adults 19 years and older met the recommendations for vegetable intake compared with non-Indigenous adults (4.4% compared with 6.8%).<sup>42</sup> The proportions of participants meeting the recommendations for fruit intake were identical between Aboriginal and Torres Strait Islander adults and non-Indigenous adults (54% for both).<sup>42</sup> The intake of fruit and vegetables was consistently low in studies undertaken in all regions: urban, rural and remote. The NATSINPAS found Aboriginal and Torres Strait Islander peoples living in remote areas were less likely than those in non-remote areas to have consumed fruit products and dishes (35% compared with 49%) or vegetable products and dishes (55% compared with 67%).<sup>15</sup> In some very remote places, everyday access to affordable and quality fruit and vegetables is variable.<sup>43</sup> Remote store products were reported to be 60% more expensive than Darwin supermarket prices and 68% more expensive than Adelaide supermarket prices in a cross-sectional survey.<sup>43</sup>

Energy-dense, nutrient poor foods tend to be convenient and easily accessed, and provide the cheapest options to satisfy hunger,<sup>44</sup> particularly in a remote context, while healthy foods can be in limited supply and at relatively high costs.<sup>43</sup> This energy-cost differential helps explain the

persistently poor dietary patterns reported in this population.<sup>43</sup> Despite this, research suggests that community dietary patterns can be improved through improved food supply and stock management in community stores.<sup>45,46</sup> Consequently, the focus of Aboriginal and Torres Strait Islander nutrition-based initiatives has broadened to include improving food quality and access to healthy food in remote communities,<sup>45,46</sup> rather than a sole focus on nutrition education.

### Strengths and limitations of study

A limitation of this review was that it excluded grey literature that did not meet peer-review standards and academic publication quality. However, key policy documents, in particular the most recent NATSINPAS, have been considered throughout. While the search strategy was limited to three main databases, additional cross-checking was performed with the reference lists of studies included in this review; therefore, it is unlikely that studies have been missed from this review. Limited reporting of community engagement methods in the studies also meant it was challenging to assess the quality of the studies in relation to this domain. It would be helpful if future studies could more clearly identify such processes.

### Conclusion

This is the first systematic review to collate and critique the quality of available data on the dietary intake of the Aboriginal and Torres Strait Islander peoples in Australia, and it has highlighted the varying quality of studies and limited generalisability of sample populations. Although caution is advised in interpreting the outcomes of these studies, consistent findings were low reported intakes of fruit and vegetables and high intakes of total sugar and energy-dense, -nutrient-poor food and beverages.

### Implications for public health

The review demonstrates a clear need for policy and community interventions to improve dietary quality for Aboriginal and Torres Strait Islander peoples. However, the limited number of studies, variable quality and lack of diversity of communities involved could be a barrier to effective policy making and should be addressed.

## Acknowledgements

SW had primary responsibility for writing the paper and final content. JB and JW were equal senior authors who contributed to the conceptualisation and development of the review. SW, LV, JB and JW made contributions to the development of the review protocol and search strategy. SW and SF were involved in study selection, data extraction and quality assessment. SW prepared the manuscript with review from SF, LV, JG, ML, KT, JB and JW. JB is supported by a National Heart Foundation (NHF) Future Leader Fellowship (ID:100085). JW is supported by a joint National Health and Medical Research Council/ National Heart Foundation Career Development Fellowship (App:1082924).

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## Supporting Information

Additional supporting information may be found in the online version of this article:

**Supplementary Table 1:** Quality appraisal tool.

**Supplementary Table 2:** Summary of included studies.

**Supplementary Figure 1:** Map of study locations.