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Methodological challenges in translating nutrition evidence into the Australian Dietary Guidelines

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Abstract

Dietary guidelines shape public health by translating nutritional evidence into recommendations that support healthier eating and reduce chronic disease risk. The current revision of the Australian Dietary Guidelines (ADGs) provides an opportunity to integrate emerging scientific evidence and respond to contemporary dietary challenges. However, translating evidence from nutrition science into policy remains methodologically complex. Much of the available evidence is derived from observational studies, often synthesised in systematic reviews and meta-analyses. These syntheses may obscure contextual variation, residual confounding and heterogeneity in dietary assessment methods. Australia's cultural diversity, unique food systems and the distinct dietary practices of Aboriginal and Torres Strait Islander peoples underscore the need for high-quality, context-specific research to inform recommendations. Additional challenges also arise from the need to treat diet as a dynamic, multidimensional exposure, alongside variability in global evidence and inconsistencies in definitions of key constructs, including dietary patterns and ultra-processed foods (UPFs). While the ADG revision incorporates methodological improvements and prioritises key areas such as dietary patterns and UPFs, the strength and relevance of the resulting guidance will ultimately depend on the quality of underlying data. Strengthening investment in robust, culturally inclusive Australian nutrition research is essential to ensure credible and contextually relevant recommendations.

Dietary guidelines play a crucial role in shaping public health policy by providing evidence-based recommendations to promote healthier eating habits and prevent diet-related diseases[1]. They inform public health initiatives, education programmes and policy decisions, while also guiding healthcare professionals, educators and policymakers in promoting nutrition that supports long-term health[1,2]. By setting clear standards for nutrient intake, food variety and portion sizes, dietary guidelines influence individual dietary choices and the broader food environment, helping to establish benchmarks for a healthy diet that are accessible and adaptable to the needs of different populations.

The Australian Dietary Guidelines (ADGs)[3] are a cornerstone of the nation's public health framework. The guidelines provide essential recommendations for health promotion and chronic disease prevention. Currently, these guidelines are under revision[4], offering an opportunity to incorporate the latest scientific evidence and to adapt the recommendations according to changing dietary trends and emerging public health challenges. Given Australia's rising rates of diet-related chronic diseases[5,6], the updated guidelines have the potential to make a significant impact on population health. The decisions made during this revision will shape the dietary landscape of Australia for years to come. It is therefore essential that the guidelines reflect the local context while also drawing on the broader global evidence.

Conceptually, dietary guideline development can be understood within an evidence-informed decision-making continuum that links evidence generation, evidence synthesis, policy translation and implementation[7]. In this framework, dietary research feeds into evidence synthesis and guideline development, while policy translation and implementation require attention to context, equity, feasibility, acceptability and ongoing monitoring. Within this continuum, developing robust and context-specific dietary guidelines requires careful consideration of both the local context and the methodological limitations of the underlying evidence. This is particularly imperative when relying on observational studies synthesised through systematic reviews and meta-analyses. In this opinion piece, we discuss key methodological challenges in generating, synthesising and interpreting nutritional epidemiological evidence for dietary guideline development.

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Australian Dietary Guidelines revision

The current revision of the 2013 ADGs is being conducted using a prioritised, staged approach[4], with evidence updates focused on the highest-priority research questions, while other topics are considered using existing evidence where a full evidence update is not undertaken. The dietary components are generally evaluated based on beneficial and adverse health effects[8]. The evaluation also considers diet and sustainability, including evidence on accessible, affordable and equitable diets with minimal environmental impacts. In addition, the decision to integrate public consultation and prioritised evidence reviews[4] into the revised ADGs reflects a constructive approach to addressing both current evidence gaps and longer-term needs. The revision of ADGs outlines four key priority areas for consideration[4]: (1) dietary patterns, (2) nutritional needs across the life course, (3) protein-rich foods such as meats, poultry, fish, eggs, tofu, nuts, seeds and legumes/beans and (4) ultra-processed foods (UPFs).

The ADGs primarily rely on systematic reviews and meta-analyses as key sources of evidence for dietary recommendations[4]. Summarising and meta-analysing evidence can obscure important granularity and contextual differences. These challenges are particularly pronounced for dietary risks, which are more complex than many other types of exposures[9]. This is particularly important given that most studies included in such reviews are observational. For a complex, lifelong exposure like diet, there are unique challenges that extend beyond the usual biases associated with observational study designs[9,10]. The National Dietary Guidelines Expert Committee introduced a comprehensive framework for methodological reviews to enhance the transparency, reproducibility and validity of evidence evaluations informing the ADG revision[11]. This represents a significant and commendable step forward. To fully realise its potential, this methodological framework should be complemented by future targeted investment in high-quality, context-specific data on diet and health outcomes.

The challenge of 'local context' in Australia

The local context influences food availability and accessibility, shaping dietary habits, lifestyles, cultural practices and public health priorities relevant to the Australian population. The FAO recommends considering these variations when countries formulate dietary guidelines to meet the specific needs of a nation's population[1,12]. While global data can offer valuable insights, it should complement rather than replace local evidence, except in instances where national data are lacking or insufficient. Prioritising local evidence helps to ensure recommendations are contextually relevant and better support the health needs of the Australian population.

However, generating locally relevant evidence in a context such as Australia remains challenging. Australia is one of the most culturally diverse countries in the world, with people reporting more than 300 different ancestries[13]. Overall, nearly one-third of the population was born overseas (some areas up to 60 %), and it is likely that this translates into notable differences in dietary behaviour across the diverse ethnic groups. Capturing representative and generalisable evidence across the diverse population is inherently challenging and is likely to remain incomplete. The ADG revision strategic document[8] partially addresses this by stating that the evidence generated should reflect the Australian context and apply broadly to the general Australian population. However, it does not explicitly prioritise Australian-based evidence or address the underlying complexity. Dietary pattern approaches offer a way to capture cultural diversity. However, they also introduce further complexity because substantial intra-group heterogeneity exists within cultural and ethnic populations. This complicates the interpretation of findings and their translation into broadly applicable recommendations.

Geographic and demographic variations within Australia, including state-wide differences and urban–rural disparities, reflect diversity in climate, local food systems, cultural influences and health patterns. These variations can significantly influence dietary behaviours and, in turn, confound the effect of diet on health outcomes[14]. While well-established statistical methods are available to adjust for confounding, their effectiveness is inherently limited by the quality, scope and granularity of available data[15].

In particular, the dietary behaviours of Aboriginal and Torres Strait Islander peoples cannot be adequately represented by evidence from other Australian population groups, let alone from other countries, given their unique cultural and nutritional practices[16]. While many Aboriginal and Torres Strait Islander peoples have adopted aspects of a Western-style diet[17,18], traditional food practices remain culturally significant and are still practised to varying degrees[18,19]. For example, these practices may include hunting, fishing, gathering, preparing and sharing traditional foods such as fish, shellfish, game, bush foods and locally harvested plant foods. Such practices are closely linked to family, culture, community connection, Country and the intergenerational sharing of knowledge. They are also shaped by lived experiences of food access, affordability and the broader food system, rather than being solely a matter of individual dietary choice[18,20]. Where disaggregated data on dietary intakes are lacking, targeted investment in culturally inclusive data collection and community consultation should be recommended for future updates. Such approaches should be community-led where appropriate and embed equity considerations across evidence generation, guideline development, policy translation and implementation.

Synthesising international evidence

International evidence is valuable both when local evidence is lacking and for triangulating findings through cross-contextual comparisons. This is particularly important when sources of bias differ across settings. However, when biases arise from similar origins, such as residual confounding or selection bias, comparisons between evidence from different countries may provide limited additional insight[21]. Moreover, dietary behaviours differ substantially across geographical regions due to variations in culture, food availability and access. Estimating the health effects of dietary exposures across regions with distinct food environments, and subsequently pooling these estimates may therefore limit the applicability to dietary guidelines designed for a specific context[22].

A key challenge is the heterogeneity in dietary intake across countries. As an extreme example, average dairy product consumption in Australia (205 g/person/d) is nearly six times higher than in China, highlighting stark differences not only in specific food consumption but also in broader dietary patterns[23]. Pooling effect estimates from such disparate contexts risks misinforming guideline development due to differences in baseline diet, nutrient interactions and population-level exposures[24]. Although some broad diet–health associations may be directionally consistent across populations, their magnitude and interpretation can vary substantially by context. This may be because dietary components

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are rarely consumed in isolation. In addition, their estimated associations with health outcomes may depend on baseline intake, what they replace in the diet, preparation methods, food composition, nutrient interactions, affordability, food availability and broader dietary patterns.

A more appropriate strategy is to prioritise studies conducted in settings with comparable dietary environments and cultural contexts, and then synthesise findings from these settings. This approach was applied in our recent systematic review, which included twenty-five longitudinal studies examining associations between dietary patterns and adverse health outcomes in Australian adults[25]. However, many of these studies relied on a limited number of cohorts, reducing the overall diversity and generalisability of the evidence. While strong associations have been found for cardiovascular and metabolic outcomes, the evidence is more limited for areas such as cancer, reproductive and mental health. These gaps highlight the need for more diverse, high-quality longitudinal research within Australia to better inform dietary policy across a broader range of health outcomes. In the meantime, drawing on systematic reviews that include international studies (when appropriate) provides a practical and efficient approach.

Diet is a complex time-varying exposure

Most evidence in nutritional epidemiology comes from observational studies. This is because conducting randomised controlled trials to study the long-term effects of diet on health outcomes is costly, not always feasible and, in some cases, may be unethical[26]. Diet is a lifelong exposure that is dynamic over time and varies by season and geography[24]. However, most studies still rely on a single time point of dietary assessment. Although methods have been developed to treat diet as a time-varying exposure[27], collecting data that adequately capture changes in dietary patterns over time remains challenging. The current revision of the ADGs addresses age-specific considerations to some extent through conducting systematic reviews separately for children and adults[4]. However, most dietary exposures are still assessed as snapshots[25] rather than through repeated measures. Reliance on a single baseline dietary assessment limits the ability to account for changes in dietary patterns over time. While such studies can still contribute to systematic reviews and meta-analyses, the evidence they provide may be less reliable for drawing conclusions about long-term dietary effects[28].

Other major challenges in estimating the effect of diet on health arise from correlations among dietary components (i.e. multidimensionality in constituents of diet) and their co-variation with many psychosocial, behavioural and physical factors[24]. These complexities make it challenging to measure dietary intake consistently and accurately over long periods and to isolate the independent effects of interrelated dietary components[10]. Statistical approaches can help address the multidimensional nature of diet. For example, data reduction methods, such as cluster analysis, can help identify dietary patterns. However, isolating the effect of a single dietary component remains challenging. One proposed solution is the use of substitution models[29]. These models compare the health effects of replacing one dietary component with another. Examples include substituting whole grains for refined grains or plant-based proteins for red meat. These models offer a more realistic framework for understanding dietary choices. However, their value still depends heavily on the quality and granularity of available data. We welcome the ADG revision's[4] proposed focus on dietary patterns, which may remain relatively stable over time. While methodological challenges will remain, this may help address some issues related to dietary multidimensionality.

Heterogeneity in research questions and statistical approaches

Even when studies investigate the same exposure and outcome, differences in the underlying research questions can limit the interpretability and appropriateness of pooling effect estimates[24]. In such cases, systematic reviews that critically evaluate individual studies, without statistically combining results, may be more appropriate than formal meta-analyses. For example, studies examining the association between egg consumption and CVD often report divergent findings, partly because of differences in research questions and study designs[30]. FFQ may primarily capture the number of eggs consumed as discrete items, whereas 24-h recalls and food diaries may better capture total egg intake. In these cases, the estimates will depend heavily on the recipes used in the underlying food composition databases. Furthermore, some studies assess baseline egg consumption and examine the association with outcomes over different follow-up periods (e.g. 5-year *v.* 10-year follow-up). Others use substitution models to estimate the health effects of replacing eggs with alternative foods (e.g. fish or plant-based proteins)[31]. These distinctions are important because they shape how effect estimates are interpreted, particularly when substitution foods, comparator groups and background dietary patterns are not clearly defined[24]. Indeed, effect estimates can vary substantially depending on how foods are modelled, particularly whether the analysis specifies what the target food (e.g. eggs) is replacing or being replaced by in the diet.

As highlighted by Stern *et al.*[24], dietary exposures are inherently complex. Without a clearly articulated causal question, estimated effects may lack internal validity or may not be generalisable across populations. This issue is compounded by variation in confounder adjustment across studies[32]. These methodological and conceptual differences contribute to heterogeneity in study findings and highlight the need for careful appraisal of study design, exposure definition and population context in systematic reviews. Such appraisal can improve the coherence of evidence synthesis and strengthen the policy relevance of findings. The ADG revision strategy[4] explicitly recommends such structured appraisals, which balance methodological rigour with the practical constraints of evidence availability.

Focusing on dietary patterns

A major and commendable advancement in the current revision of the ADGs is the incorporation of evidence from studies that examine broader dietary patterns[8]. This approach provides an opportunity to gain more comprehensive insights into dietary differences than would be possible by focusing on single food groups alone[33]. In addition, dietary patterns capture both the nutrient profile of the diet and the types, variety and combinations of foods consumed, making them a more policy-relevant exposure for dietary guideline development. However, it is sometimes argued that the concept of 'dietary patterns' can be misleading because it represents an ill-defined exposure[24]. This approach also requires careful methodological consideration, as dietary patterns are defined and operationalised differently across studies and

populations. For example, although the Mediterranean diet is widely recognised for its beneficial health associations, it is not a single, uniform diet. Variations exist even within the Mediterranean region itself, and the adaptation to other cultural settings may differ according to food availability, affordability and other contextual factors. As a result, findings from one context may not directly apply to another[34].

The development and application of guideline-based dietary pattern measures have been demonstrated in Australian empirical research. For example, the ADG Index was developed[35,36] to assess adherence to the guidelines and showed that diet quality varied by sociodemographic factors, health behaviours and BMI. It has also been used to examine associations between adherence to the ADGs and health outcomes, including all-cause and CVD mortality[37]. These examples show how dietary guidelines can be operationalised in research, while highlighting the need for clear definitions and consistent scoring across studies.

In the USA, adherence to the American Dietary Guidelines has been operationalised through the Healthy Eating Index (HEI)[38]. While the HEI provides limited direct guidance for designing interventions or public messaging, it remains a valuable tool for assessing diet–health associations. It can also capture aspects of dietary diversity and alignment with food- and nutrient-based recommendations. Interpretation of diet quality indices, however, still depends on how dietary components are defined, weighted and operationalised across populations. Although contextual variations are expected and data synthesis requires careful consideration, dietary patterns can still provide a useful basis for health communication strategies.

Particular challenges arise with dietary patterns identified through data reduction approaches, such as principal component analysis. Because these patterns are derived from sample-specific distributions, rather than absolute intakes, findings from one context are unlikely to directly apply to another. This also makes evidence synthesis challenging and, in some cases, inappropriate.

For example, a dietary pattern classified as high in Ca in a Chinese sample (where much of the nutrient is obtained through plant-based foods) may not be classified in the same way in Australia, where dairy products are a major source[23]. One potential way to address some of these challenges is through metabolic signatures that reflect dietary patterns[39]. These may provide biologically grounded and objective indicators of intake, improve cross-population comparability and reduce reliance on self-reported data. However, further work is needed to establish reproducible signatures that adequately reflect differences in diet and health across populations.

Ultra-processed foods

One significant addition to the current ADG revision is the prioritisation of UPFs[8]. UPFs are commonly defined as industrial formulations made with few or no whole foods and often containing additives such as flavours, colours, emulsifiers and other substances not typically used in home cooking. Over the past decade, a growing body of evidence has documented the detrimental health impacts of UPFs[40]. While this recognition marks important progress, several methodological challenges remain.

In 2009, a widely used classification system called NOVA (*not an acronym*) was introduced[41]. It categorises foods into four groups based on the extent and purpose of industrial processing: (1) unprocessed or minimally processed foods, (2) processed culinary ingredients, (3) processed foods and (4) UPFs.

UPFs represent the highest level of processing. A key concern with the NOVA classification is its broad and imprecise nature, which may limit accurate assessment of UPF-related health outcomes, particularly across diverse food practices and cultural contexts[42]. However, NOVA classification is only one approach to identifying foods that may warrant limitation in dietary guidelines. Dietary guidance has traditionally focused on limiting foods high in added sugars, Na, saturated fat and discretionary energy, reflecting well-established links between these dietary components and adverse health outcomes[3]. NOVA adds a processing-based dimension by highlighting formulation and product characteristics that may not be fully captured by nutrient profiling alone[41]. Therefore, nutrient-based and processing-based approaches should be viewed as complementary when considering 'foods to limit' in the ADG review.

While UPF classification draws attention to industrial processing as a potential dimension of diet-related risk, differences in food systems, product formulation, classification methods and consumption patterns complicate cross-study comparisons and evidence synthesis. For instance, there is considerable overlap between the HEI and UPF classifications. A proof-of-concept study examined whether a menu high in UPFs, defined as NOVA category 4, could align with the 2020 Dietary Guidelines for Americans. The researchers developed a menu in which 91 % of total energy came from UPFs, yet the menu achieved a high HEI-2015 score of 86 out of 100[43].

This overlap raises questions about how well existing metrics capture the health impacts of UPF consumption. However, it does not necessarily indicate a limitation of the NOVA framework. Rather, it highlights that NOVA and diet quality indices capture different dimensions of diet. For instance, the HEI reflects alignment with nutrient- and food-group-based dietary recommendations, whereas NOVA classifies foods according to the extent and purpose of industrial processing. Therefore, some UPFs may contribute favourably to nutrient-based diet quality scores while still raising concerns related to additives, packaging-related chemicals, altered food structure, palatability, snacking behaviours and increased total energy intake.

In Australia, findings from a nationally representative study showed that higher UPF intake was inversely associated ($\beta = -0{\cdot}5$; 95 % CI −0·5, −0·4) with overall diet quality, as assessed by Dietary Guideline Index (compliance with the 2013 ADGs)[44]. These findings suggest that combining estimates of the health effects of UPFs from the USA with Australian data may be problematic, given substantial differences in baseline diets, food systems and the classification and consumption patterns of UPF across populations. Although some multinational food products may use harmonised recipes, differences in consumption frequency, portion sizes and overall dietary context can still lead to varying health impacts across countries[45].

UPF consumption can be measured and operationalised in several ways. This makes it challenging to isolate the specific components responsible for adverse health effects and contributes to inconsistent findings across studies[40]. Most studies use quantile-based measures of UPF intake, but the cut-off points vary widely between countries[46,47], reflecting differences in baseline diets and consumption patterns[48]. This variation can introduce bias when results are pooled across populations. Moreover, using proportions as a measure of UPF intake is problematic, as they may reflect changes in UPF consumption, total food intake or both[48]. This limits their utility for consumer guidance. Alternative metrics, such as absolute units (e.g. grams or servings), may provide more

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accurate and comparable assessments across populations. We acknowledge the challenge of data standardisation in UPF research and support the ADGs' prioritisation of new reviews[8] specifically addressing UPF consumption and health outcomes in the Australian population. This will help ensure that recommendations are grounded in context-relevant evidence.

Added chemicals and pesticides

Although related to UPF and food processing, added chemicals, pesticide residues and food contact chemicals also represent broader food system and food safety issues[49]. The health effects of diet may be shaped not only by nutrient composition and food processing, but also by contaminants and chemicals introduced through agricultural production, packaging, storage and processing[50]. These exposures can vary across countries because of differences in agricultural practices, food regulation, monitoring systems and supply chains[50].

Modern agriculture increasingly relies on synthetic chemicals, including agricultural pesticides and food additives, which contribute to environmental contamination and may pose risks to human health[50,51]. These chemicals are also linked to food contamination, with studies reporting the presence of pesticides, persistent organic pollutants and microplastics in various foods and their association with chronic diseases[50,52,53]. Moreover, food contact chemicals, including phthalates, bisphenols and per- and polyfluoroalkyl substances, can migrate into food from packaging, processing equipment and storage containers[50]. The concentrations and types of these chemicals vary widely across countries, influenced by national regulations on chemical usage and monitoring standards[45,51,54]. For example, pesticide levels in fruits and vegetables can differ significantly between the USA and Australia due to variations in regulatory standards[55,56].

Ultimately, the quality of food is only as good as its source and how it is handled[50]. As such, the health impact of dietary exposure is shaped not only by nutrient intake, but also by the burden of chemical contaminants. Prioritising local evidence[45] on the health effects of diet, where adequate studies are available, can therefore provide more robust input for the ADGs. Where high-quality local data on dietary chemical exposures are not available, this should be identified as an evidence gap. Exploratory scoping reviews or stakeholder consultations may then help guide research priorities. Data and standards from food regulatory authorities, including Food Standards Australia New Zealand, provide important local sources for understanding these issues. They should therefore be considered when assessing the relevance of international evidence to the ADGs[57,58].

Decision-making under uncertainty

Dietary guideline committees often need to make public health recommendations when the evidence base is subject to bias. This highlights the importance of transparent and structured decision-making[7]. Structured approaches such as GRADE (Grading of Recommendations Assessment, Development, and Evaluation)[59] or NutriGrade[60] can support the appraisal of evidence certainty by considering study design, risk of bias, inconsistency, imprecision, indirectness and publication bias. In the context of the ADGs, this is particularly relevant because much of the available nutritional evidence is observational. Where evidence is uncertain, guideline developers should clearly distinguish between what is well supported, what is inferred and what remains unresolved[61,62]. Clearly communicating the basis and limitations of recommendations can strengthen the transparency and trustworthiness of the guideline process[7,61].

Conclusion

The current revision of the ADGs represents a critical opportunity to improve population health through evidence-informed and culturally responsive dietary recommendations. However, as outlined in this perspective and by others[22,63], significant methodological challenges remain. These include the limitations of observational dietary data, complexities in dietary exposure measurement and the difficulties in translating global findings into the local context. Australia's demographic diversity, dynamic food systems and regional variation further complicate the development of representative and actionable nutrition guidance. Recent advancements, including the focus on dietary patterns and UPFs, reflect a more sophisticated evidence review framework. However, their utility ultimately depends on the availability and quality of underlying data. To ensure the ADGs remain credible and impactful, ongoing investment in high-quality, local and inclusive dietary research is critical. We recommend that the ADG committee formally document the evidence gaps identified during the current revision and use them as a standing research agenda for the next cycle. At the same time, international evidence remains valuable, particularly when local evidence is limited.

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