2019

Perspective: The Evidence-Based Framework in Nutrition and Dietetics: Implementation, Challenges, and Future Directions

Elizabeth Neale
University of Wollongong, elizan@uow.edu.au

Linda C. Tapsell
University of Wollongong, ltapsell@uow.edu.au

Publication Details

Neale, E. P. & Tapsell, L. C. (2019). Perspective: The Evidence-Based Framework in Nutrition and Dietetics: Implementation, Challenges, and Future Directions. Advances in Nutrition, 10 (1), 1-8.

Perspective: The Evidence-Based Framework in Nutrition and Dietetics: Implementation, Challenges, and Future Directions

Abstract

Decision making in nutrition is based on current available scientific evidence. However, we are currently living in a time of highly accessible information, and with the increase in accessibility has come a concomitant increase in misinformation and pseudoscience relating to nutrition. This presents a challenge to the nutrition research community, practitioners, and consumers, and highlights a need to critically examine the current evidence-based framework in nutrition, and identify strategies for future improvements. This narrative review outlines the current evidence-based framework and approaches to evidence-based practice in the nutrition field, focusing on policy and guideline development. Within the framework, systematic reviews are an important tool for evidence-based practice, underpinning translation guidelines and other implementation documents. Recommendations for consumption of nutrients, foods, and whole diets are required to guide consumers and practitioners; however, these resources must be updated regularly to remain timely and accurate. In turn, clinical practice guidelines guide practitioners in how to implement the evidence base for patients and clients, supporting practitioners to be positioned as a key conduit between scientific evidence and the public. In contrast, health claims may support marketing of food products, but require consideration of the strength and quality of the evidence to support health claims, with external oversight required to ensure claims are appropriate. Collecting, synthesizing, and translating the evidence base in nutrition remains an ongoing challenge, particularly in the current context of increased information availability. To address growing challenges in combating pseudoscience, nutrition researchers, policy makers, and practitioners must work together, and the role of practitioners in translating the evidence base and personalizing it to individual patients must be emphasized. Continuing to address current challenges, including increasing the timeliness and consistency of the approach to the evidence base, is required to ensure informed and robust nutrition policy, research, and practice into the future.

Disciplines

Medicine and Health Sciences

Publication Details

Neale, E. P. & Tapsell, L. C. (2019). Perspective: The Evidence-Based Framework in Nutrition and Dietetics: Implementation, Challenges, and Future Directions. Advances in Nutrition, 10 (1), 1-8.

Published as:
Neale, E. P. & Tapsell, L. C. (2019). Perspective: The Evidence-Based Framework in Nutrition and Dietetics: Implementation, Challenges, and Future Directions. *Advances in Nutrition*, 10 (1), 1-8.

The evidence-based framework in nutrition and dietetics: implementation, challenges, and future directions

Elizabeth P Neale[1, 2]

Linda C Tapsell[1, 2]

[1]School of Medicine, Faculty of Science, Medicine and Health, University of Wollongong, New South Wales 2522, Australia

[2]Illawarra Health and Medical Research Institute, University of Wollongong, New South Wales 2522, Australia

Corresponding author:

Elizabeth P Neale

Address: University of Wollongong, NSW, 2522, Australia

Phone: +61 2 4221 5961

Email: elizan@uow.edu.au

Word count: 4051

Figures: 1

Tables: 1

Running title: The evidence-based framework in nutrition

Conflict of Interest and Funding Disclosure: The authors have no conflict of interest or funding to disclose. Prof Tapsell has been involved in the development of the Australian

Dietary Guidelines, the Nutrient Reference Values, and evidence-based review for the development of health claims. Dr Neale has been involved in the development of the Nutrient Reference Values and evidence-based review for the development of health claims.

Abbreviations:

AMSTAR: Assessment of Multiple Systematic Reviews

DRIs: Dietary Reference Intakes

EFSA: European Food Safety Authority

FSANZ: Food Standards Australia New Zealand

GRADE: Grading of Recommendations Assessment, Development and Evaluation

NRVs: Nutrient Reference Values

PEN: Practice-based Evidence in Nutrition

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-analyses

RCTs: Randomized Controlled Trials

SR: Systematic review

US: United States

WHO: World Health Organization

Abstract

Decision making in nutrition is based on current available scientific evidence. However, we are currently living in a time of highly accessible information, and with the increase in accessibility has come a concomitant increase in misinformation and pseudo-science relating to nutrition. This presents a challenge to the nutrition research community, practitioners, and consumers, and highlights a need to critically examine the current evidence-based framework in nutrition, and identify strategies for future improvements. This narrative review outlines the current evidence-based framework and approaches to evidence-based practice in the nutrition field, focusing on policy and guideline development. Within the framework, systematic reviews are an important tool for evidence-based practice, underpinning translation guidelines and other implementation documents. Recommendations for consumption of nutrients, foods, and whole diets are required to guide consumers and practitioners, however these resources must be updated regularly to remain timely and accurate. In turn, clinical practice guidelines guide practitioners in how to implement the evidence base for patients and clients, supporting practitioners to be positioned as a key conduit between scientific evidence and the public. In contrast, health claims may support marketing of food products, but require consideration of the strength and quality of the evidence to support health claims, with external oversight required to ensure claims are appropriate. Collecting, synthesizing, and translating the evidence base in nutrition remains an ongoing challenge, particularly in the current context of increased information availability. To address growing challenges in combating pseudo-science, nutrition researchers, policy makers and practitioners must work together, and the role of practitioners in translating the evidence base and personalizing it to individual patients must be emphasized. Continuing to address current challenges, including increasing the timeliness and consistency of the

68 approach to the evidence base, is required to ensure informed and robust nutrition policy,
69 research, and practice into the future.

70

71 **Keywords:** evidence-based framework, nutrition, systematic reviews, dietary guidelines,
72 health claims

73

74

75

76

77

78

79

80

81

82

83

84

85

86

Introduction

As is the case for healthcare policy and practice in general, decision making in nutrition is based on current available scientific evidence. It is reflected in policy related documents such as national dietary guidelines, food standards regulations, and clinical practice guidelines. An evidence-based approach is highlighted in international practitioner competency standards for dietitians (1). In general, nutrition related practice is underpinned by a framework of evidence-based guidelines and associated resources, which has an interdependent relationship with ongoing research.

Translating scientific evidence to practice involves a number of challenges. To begin with, we are currently living in a time of plentiful, but often inaccurate, information (2). As a result, a growing number of consumers access health and nutrition information from internet sources (3, 4) and this may be flawed. One study has already shown that the online weight loss information consumers were most likely to access tended to be of inferior quality (5). A recent review (6) highlighted the main challenges in communicating evidence-based nutrition, noting the plethora of non-scientific opinions and anecdotal evidence readily available. While misinformation is apparent in many health disciplines, the nutrition discipline experience is unique because everyone has firsthand experience in food and nutrition (6). This presents a challenge to the nutrition research community, practitioners, and consumers, and raises questions regarding how we collect, appraise, and translate evidence in nutrition. Thus, there is a need to critically examine the current evidence-based framework in nutrition, and identify strategies for improving the evidence-based framework into the future.

This narrative review outlines the current evidence-based framework that can be seen in the field of nutrition (Table 1). Global approaches to evidence-based practice prevalent in the scientific literature are described, and examples from Australia are considered in addressing

how an evidence-based framework can be implemented. Current approaches are critiqued, to identify gaps and further directions.

Current status of knowledge

Systematic reviews

Systematic reviews (SRs) of the literature can be seen as the cornerstone of evidence-based practice in nutrition. They provide a means to systematically collect, appraise, and synthesise the body of evidence on a specific research question. As such they serve as a form of research in their own right. SRs differ from narrative reviews due to the predefined methodological approach, which adheres to a particular design and subsequently reduces the risk of bias.

In recent years, improvements in SR methodology have occurred alongside quality assurance in other forms of research. For example, while drug, biological, and medical device clinical trials require protocol registration, registration is also encouraged for nutrition trials, setting standards for reporting requirements (for example ClinicalTrials.gov (7) and the Australian New Zealand Clinical Trials Registry (8)). In 2011 PROSPERO, an international database for the pre-registration of SR protocols, was launched (9). Pre-registering a review protocol reduces the risk of bias, while minimizing duplication in authors seeking to commence new reviews (10). A comparison between registered protocols and methods reported in submitted manuscripts also enables journal editors and reviewers to assess potential sources of bias and misreporting. A current limitation of PROSPERO is it is more structured toward SRs reporting health outcomes of relevance to human health. While this is likely to cover topics associated with nutritional care, related topics, such as workforce planning, health practitioner education, and methodological areas such as developing food composition databases and dietary assessment tools, are difficult to pre-register. Furthermore, while pre-registration of reviews with PROSPERO is required for a number of scientific journals, and

the number of registered SR protocols has increased exponentially since its launch (11), it still appears to be currently underused (12), and this may undermine its usefulness.

Guidelines for consistent reporting of clinical trials and cohort studies have been available for a number of years, in the form of CONSORT (13) and the STROBE statements (14), respectively. In 2009, Moher et al. (15), developed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA). The PRISMA checklist and flow-diagram (displayed in Figure 1) allow for consistent reporting in SRs, improving transparency and further reducing risk of bias. In addition, checklists such as the Assessment of Multiple Systematic Reviews (AMSTAR) checklist (16) are available to consider the quality of SRs as a whole, taking into account aspects such as duplicate study identification and data extraction, comprehensiveness and transparency of the search strategy, and potential conflicts of interest.

SR methodology is now a vital part of scientific evidence review in nutrition. The Nutrition Evidence Library of the USDA follows a defined methodology (17) to compile multiple SRs on current nutrition topics, in particular the relationships between dietary patterns and health outcomes which underpin dietary guidelines (18). Recommendations in guidelines developed by the World Health Organization (WHO) are also underpinned by SRs (19), which are used in health and nutrition policy internationally. Recently released WHO guidelines on nutrition topics including those on actions for improving adolescent nutrition (20) and integrated care for older people (21). While traditionally the domain of medicine, Cochrane reviews on nutrition topics are now regularly conducted, and a specific Cochrane Nutrition group was launched in 2016. ‘Living’ SRs, which are reviews that are continually updated and integrate new evidence when it becomes available (22), are now being piloted by the Cochrane Collaboration. Significantly, a living SR on interventions to increase fruit and vegetable

intake in children is one of only four living SRs published in the wider Cochrane Library (23).

Despite their central role in evidence-based health practice, SRs, (as well as the accompanying meta-analyses used to pool study results by statistical means), are not without their limitations. The large increase in published SRs and meta-analyses has been criticized in terms of both their accuracy and justification (12, 24). Indeed, it is important to note that SRs are susceptible to error, and that their strength is dependent on the quality of the studies included within them. Critical appraisal of the quality of included studies is a required component of SRs, and study quality can be considered when interpreting results (for example when conducting sensitivity analyses in meta-analyses). However, the presence of lower quality studies in a SR will impact on the accuracy of its conclusions. Even with small differences in search terms and inclusion criteria, it is possible for SRs and meta-analyses on very similar topics to reach differing conclusions. These problems can undermine the development of evidence-based practice and result in confusion for clinicians and consumers. While these issues do not detract from the value of SRs, they must be considered when using the findings of SRs to inform policy and practice.

Policy and guideline development

Recommendations for nutrient intakes

Recommendations for nutrient intakes take a number of forms, but they have in common reference levels of nutrients to meet physiological needs, minimize risk of adverse effects, and decrease the risk of chronic diseases. These recommendations or reference standards, are used in informing other policy documents (for example food-based dietary guidelines), and are linked to population health risk assessment, health research, the implementation of food standards and nutrition education or marketing.

The processes of developing these nutrient reference standards can differ around the globe. For example, the Dietary Reference Intakes (DRIs) in the United States (US) and Canada are developed by a Federal steering committee. Guiding principles to aid future DRI committees recommend steering committees identify target questions for SRs, and oversee their development exploring the relationship between the nutrient intakes and chronic disease endpoints (25).

In Australia and New Zealand significant changes have occurred in the development of methodology for deriving values since the last full update of the Nutrient Reference Values (NRVs) in 2006 (26). In the past a team of expert reviewers have examined the most recent Institute of Medicine DRIs to determine their applicability to the Australian and New Zealand populations (27), in conjunction with selected reviews. The new methodological framework outlined the use of SRs for the revision of the NRVs. It recommended the use of the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach to evaluate the quality of the body of evidence (28). The GRADE approach, which rates the quality of evidence based on a range of domains, was developed as a replacement for the multiple different quality assessment tools used by different bodies globally, with the goal of creating a more comparable and consistent evidence base in terms of guidelines and SRs (28).The methodological framework was implemented as a pilot in the review of three nutrients of public health importance: sodium, iodine, and fluoride, and revised guidelines were released in 2017 (fluoride (29)and sodium (30)). Ongoing revision of the NRVs is required to ensure they reflect the changing evidence base and guidelines remain dynamic.

Dietary Guidelines

While nutrient recommendations refer to food components, dietary guidelines refer to foods and dietary patterns. The development of food-based dietary guidelines informed by SRs of

the literature is used by countries around the world (31-35). The 2013 Australian Dietary Guidelines were based on a number of systematic reviews on targeted research questions (36), resulting in transparent and consistent method of implementation of the evidence base.

As with many dietary guidelines globally, the Australian dietary guidelines take a food-based approach, largely referring to whole foods and dietary patterns. In contrast, 'foods to limit' (also known as discretionary foods), are characterized by nutrients and food components (high in salt, added sugars, and saturated fat (31)) which in itself is subject to translation. Nevertheless, a food-based approach for dietary guidelines would have less ambiguity in adopting to practice, as we consume foods and whole diets, not individual nutrients. While much of the evidence has traditionally been derived in terms of nutrients, the synergistic role of multiple nutrients within whole foods and diets has been recognized and a shift in the evidence base directly relating to foods and dietary patterns has been seen in recent years (37, 38).

Because new studies are being published all the time, timeliness is an ongoing challenge for evidence based review. The current Australian dietary guidelines were released in 2013, but the systematic searches were conducted in 2009 (36). Unlike other countries such as the US where the US Congress mandates dietary guidelines for the healthy population are updated every five years (39), there is no set schedule for updating the Australian dietary guidelines. Maintaining up-to-date implementation of the evidence base is a valuable but labor intensive and costly process. In addition to the time required to search and synthesize the evidence, consultation with a range of stakeholders including consumers is also required to ensure guidelines remain relevant and appropriate. Efficient methods of updating guidelines when new evidence becomes available are needed, to ensure dietary guidelines remain relevant and accurate.

231 *Clinical practice guidelines*

232 Even in this age of excess information, practitioners remain an important link between the
233 evidence base and the patient, translating the scientific evidence and personalizing guidelines
234 to the individual. In contrast to nutrient reference values and dietary guidelines which focus
235 on *how much* or *what* consumers can do, clinical practice guidelines can focus on *how* to
236 implement the evidence base for patients and clients. They serve to translate the evidence
237 base for the management of clinical conditions (for example clinical practice guidelines for
238 the nutritional management of chronic kidney disease (40), and nutrition guidelines for cystic
239 fibrosis (41)). Within healthcare practice, nutrition care guidelines may be applied more
240 broadly by nurses and general practitioners, with dietitians supporting individualized
241 application of these guidelines. The delineation of these roles is also encapsulated within
242 some clinical practice guidelines, for example the Australian guidelines related to the
243 management of overweight and obesity (42), outline recommendations for nutritional
244 management conducted by different members of the multidisciplinary team.

245 Within the evidence-based framework in nutrition, there are also strategies for addressing
246 practice-based problems. For example Practice-based Evidence in Nutrition (PEN) (43),
247 developed by Dietitians of Canada and now managed by a partnership between Dietitians of
248 Canada, the British Dietetic Association, and the Dietitians Association of Australia, serves
249 as a repository of evidence summaries related to practice-specific questions. Evidence is
250 organized into knowledge pathways, with practice questions designed by practitioners and
251 researchers working in the area. Practitioners and researchers with expertise in an area may
252 contribute to PEN, differentiating it from other implementation strategies such as dietary
253 guidelines and nutrient recommendations, which tend to be developed by expert working
254 groups alone. Nutrition guidelines and resources from other organizations are also available
255 via PEN. These strategies allow PEN to remain user-focused and relevant to end-users, as

256 well as offering a practical solution to costs associated with maintaining expert working
257 groups. In comparison to other implementation strategies, this approach could however create
258 problems in ensuring consistency in the collection, synthesis, and translation of the evidence
259 base.

260 *Food standards and health claims*

261 In addition to the development of guidelines, the evidence base may also be used to inform
262 regulated health claims, which provide an opportunity for the food industry to translate health
263 benefits associated with foods and products (44). While an effective method of
264 communicating product benefits, health claims are used as a marketing strategy, and as a
265 result, require an evidence-based approach to ensure the accuracy of the claims (45). In the
266 European Union, the European Food Safety Authority (EFSA) regulates health claims. In
267 2006, regulations were adopted in the European Union that required nutrition or health claims
268 made on food labels to be substantiated by scientific evidence (46). The role of EFSA thus
269 includes evaluating submissions for nutrition and health claims to determine whether claims
270 can be substantiated. Similarly, health claims made in the US and Canada are reviewed for
271 pre-market approval by the US Food and Drug Administration (47) and Health Canada (48),
272 respectively.

273 In Australia, Food Standards Australia New Zealand (FSANZ) are responsible for developing
274 the Food Standards Code, which sets out the nutrient and health claims that can be made on
275 food and beverage labelling and advertising (49). Standard 1.2.7, which outlines the
276 requirements around these claims, was gazetted in 2013 after a 10 year period of consultation
277 and revision (50). The standard includes provisions for content claims, and general and high
278 level health claims. High level claims which relate to risk of disease have been set based on a
279 process of SR, managed by an expert panel. In contrast, general level health claims, which

relate to structure and function, may be pre-approved (based on existing claims available through bodies such as EFSA), or self-substantiated. Claims may be self-substantiated through a process which requires a SR (51). Although the use of SRs to substantiate health claims allows for flexibility in the claims made and encourages an evidence-based approach, there are some limitations in this system. At present, the process for self-substantiation involves the food business notifying FSANZ of the food-health relationship they have substantiated, which includes a formal acknowledgement that they have followed the required methods (50). The notified food-health relationship is then reported on the FSANZ website, and the food company may make the claim. Unlike the processes implemented in other locations such the US, Canada, and the European Union, SRs used for health claim self-substantiation in Australia are currently not reviewed for compliance or accuracy prior to their use. The SRs may be reviewed at a later time by a State or Territory Food Authority, or in the case that a complaint is made. Food companies may also voluntarily request the SR be assessed by a State or Territory Food Authority prior to being notified to FSANZ. The onus of conducting the SR appropriately and ensuring the claim is scientifically substantiated is currently thus largely placed on the food company, with limited quality control, which leaves the current system susceptible to misuse.

Challenges and future directions

There are a number of challenges which face the current evidence-based framework in nutrition, particularly in the context of the current environment of highly accessible information, which is often of dubious quality.

In its current form, the evidence-based framework continues to be based on the medical model of research, which prioritizes randomized controlled trials (RCTs) as the highest level of evidence (52). It should be acknowledged that RCTs provide high quality research,

particularly in terms of providing insights into causal relationships, which observational studies are much less able to explore. However, nutrition research faces substantial problems when trying to fit this paradigm. Tenets of RCT design such as blinding of participants and investigators, and use of appropriate controls are highly problematic in the context of nutrition, particularly studies testing whole foods or diets, when it is not possible to adequately blind participants and investigators to the intervention used (53). Similarly, choice of a control is also an issue, with nutrition studies lacking the type of placebo used in drug trials. Changing one element of the diet can have an impact on other dietary characteristics such as macronutrient profiles caused by substituting one food for another, making it difficult to isolate the food or dietary component responsible for effects. Furthermore, the outcomes of interest in nutrition research are often those which require long periods of study to identify, such as the development of cardiovascular disease. In addition, these outcomes are often not feasible to study in an RCT due to the higher cost associated with this study design (53). While there are exceptions to this (such as the PREDIMED study, a whole diet-based study RCT ran for 4.8 years and involved over 7000 participants (54)), RCTs on long-term conditions are usually not practical in nutrition.

Although cohort studies may be limited by challenges related to dietary assessment and the impact of confounding variables (55), the nature of nutrition outlined above means it may be more appropriate to put greater emphasis on cohort studies. Cohort studies however continue to be considered to provide a lower quality of evidence compared with RCTs (52). Although this issue is taken into account in some areas, such as the development of the Australian Dietary Guidelines, a reliance on cohort studies can result in challenges when determining the strength of the body of evidence on the topic. The issue is reflected in methodological tools such as GRADE. By default, GRADE classifies evidence from RCTs as ‘high’ quality, whereas evidence from observational studies is classified as ‘low’ quality (28). Although

GRADE does allow upgrading of evidence from observational studies on the basis of dose-dependent relationships and large effect sizes, it may still represent a disadvantage for nutrition related questions which may be more suited to observational designs. An amended version of GRADE specifically designed for nutrition research, NutriGRADE (56), was recently proposed. NutriGRADE differs from GRADE in its consideration of use of validated dietary assessment tools, adjusting for confounders, and the impact of funding source. However this approach has been criticized for creating an additional system (when the goal of GRADE was to create a common system to reduce redundancy and conflicts between tools), and for its reliance on numerical evaluation, which is not recommended when assessing the quality of the evidence base (57, 58).

Finally, the focus of nutrition research is an issue that needs to be addressed for evidence based systems to be more fully functional. To date what has been classically recognized as nutrition research is highly reductionist, focusing on individual nutrients and dietary components. It has been suggested that this trend may in part be related to funding which prioritizes research focusing on single nutrients (59). While this approach still has relevance in identifying mechanisms responsible for effects seen with dietary change, and is also essential for some evidence-based analyses (such as the development of DRIs and the Nutrient Reference Values) it has limited value for food based recommendations. Research that focuses only on individual food components creates problems for translating evidence for dietary guidelines, and overlooks the synergistic benefits which may be obtained from whole foods and dietary patterns (37, 38, 53). A reductionist approach to research and translation may also have unexpected consequences on population health, such as those seen following consumption of some vitamin and mineral supplements (60). More recently there has been a paradigm shift with a greater focus on dietary patterns and whole foods (37, 53), but further research targeted in this way is required to support a robust evidence base in nutrition.

In order for the evidence-based framework in nutrition to remain relevant and effective, it needs to be regularly updated to ensure it reflects the current body of evidence. This presents a substantial challenge due to the labor-intensive nature of SRs, reflected in the long delays in updates to implementation resources observed in the Australian context. This challenge presents a number of opportunities to strengthen evidence-based practice in nutrition. Broader adoption of living SRs provides a potential solution to this challenge, however dedicated funding allocations would be required for this strategy to be sustainable. With advances in technology and machine based learning facilitating improvements in SRs (61) (for example abstract screening via the online tool Abstrackr (62)), there may also be opportunities to automate elements of the process and improve efficiency.

If researchers and clinicians wish to continue to build evidence-based practice in nutrition, it is important that opportunities for capacity building and resource sharing are taken up. This could include continuing to build critical thinking and analysis skills in tertiary nutrition students, and improving collaborations between domains to share skills and resources. For example, partnerships between food regulatory bodies, researchers, and food industry could facilitate assessment of self-substantiated health claims to assure the accuracy of health claims used in nutrition marketing.

Conclusion

The evidence base in nutrition is a constantly growing and evolving space, operating in the context of more widely available information than ever before. While this increases the ease by which consumers may access information, the quality of this information is often flawed (2). To address growing challenges in combating pseudo-science, nutrition researchers, policy makers and practitioners must work together to ensure timely, efficient, and relevant

collection, synthesis, and implementation of the evidence base. The role of practitioners in translating the evidence base and personalizing it to individual patients must also be acknowledged. A key component is embracing and communicating the changing nature of the evidence. It is important to show that with a growing evidence base, the conclusions from the past may differ to those in the future. This includes improving the timeliness and consistency of the approach in developing the evidence base. The challenges outlined in this review will always need to be addressed to ensure informed and robust nutrition policy, research, and practice into the future.

Acknowledgments

All authors (EPN, LCT) have read and approved the final manuscript.

Figure legend: Figure 1: PRISMA flow diagram for documenting the process of study retrieval, screening, and inclusion in a systematic review (15)

References

1. International Confederation of Dietetic Associations. International Competency Standards for Dietitian-Nutritionists. 2016.
2. Collier R. Containing health myths in the age of viral misinformation. Canadian Medical Association Journal 2018;190(19):E578.
3. Pollard CM, Pulker CE, Meng X, Kerr DA, Scott JA. Who uses the internet as a source of nutrition and dietary information? An Australian population perspective. Journal of medical Internet research 2015;17(8).
4. Le L, Finn A. Evaluating Credibility of Online Nutrition Information: A Content Analysis on Current Nutrition-Related Blogs. Journal of the Academy of Nutrition and Dietetics 2016;116(9):A79.
5. Modave F, Shokar NK, Peñaranda E, Nguyen N. Analysis of the accuracy of weight loss information search engine results on the internet. American journal of public health 2014;104(10):1971-8.
6. Mozaffarian D, Forouhi NG. Dietary guidelines and health—is nutrition science up to the task? Bmj 2018;360:k822.
7. U.S. National Library of Medicine. Internet: https://www.clinicaltrials.gov/ (accessed 2018 June 1st.
8. . Internet: http://www.anzctr.org.au/ (accessed 2018 June 31st.
9. University of York Center for Reviews and Dissemination. Internet: https://www.crd.york.ac.uk/prospero/ (accessed 2018 June 1st.
10. Booth A, Clarke M, Dooley G, Ghersi D, Moher D, Petticrew M, Stewart L. The nuts and bolts of PROSPERO: an international prospective register of systematic reviews. Systematic Reviews 2012;1(1):2. doi: 10.1186/2046-4053-1-2.
11. Page MJ, Shamseer L, Tricco AC. Registration of systematic reviews in PROSPERO: 30,000 records and counting. Systematic Reviews 2018;7(1):32. doi: 10.1186/s13643-018-0699-4.
12. Ioannidis J. The mass production of redundant, misleading, and conflicted systematic reviews and meta□analyses. The Milbank Quarterly 2016;94(3):485-514.
13. Schulz KF, Altman DG, Moher D. CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials. BMJ 2010;340. doi: 10.1136/bmj.c332.
14. Von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, Initiative S. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. PLoS medicine 2007;4(10):e296.
15. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS medicine 2009;6(7):e1000097.
16. Shea BJ, Grimshaw JM, Wells GA, Boers M, Andersson N, Hamel C, Porter AC, Tugwell P, Moher D, Bouter LM. Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. BMC Medical Research Methodology 2007;7(1):10. doi: 10.1186/1471-2288-7-10.
17. Handu D, Moloney L, Wolfram T, Ziegler P, Acosta A, Steiber A. Academy of Nutrition and Dietetics Methodology for Conducting Systematic Reviews for the Evidence Analysis Library. Journal of the Academy of Nutrition and Dietetics 2016;116(2):311-8. doi: 10.1016/j.jand.2015.11.008.
18. United States Department of Agriculture. Internet: https://www.cnpp.usda.gov/nutritionevidencelibrary (accessed 2018 June 4th.

19. World Health Organization. WHO handbook for guideline development. 2nd ed. Geneva: WHO Press, 2014.
20. Organization WH. Implementing effective actions for improving adolescent nutrition. Geneva: World Health Organization, 2018.
21. World Health Organization. Integrated care for older people: guidelines on community-level interventions to manage declines in intrinsic capacity. Geneva: World Health Organization, 2017.
22. Elliott JH, Turner T, Clavisi O, Thomas J, Higgins JPT, Mavergames C, Gruen RL. Living Systematic Reviews: An Emerging Opportunity to Narrow the Evidence-Practice Gap. PLOS Medicine 2014;11(2):e1001603. doi: 10.1371/journal.pmed.1001603.
23. Hodder RK, O'Brien KM, Stacey FG, Wyse RJ, Clinton-McHarg T, Tzelepis F, James EL, Bartlem KM, Nathan NK, Sutherland R, et al. Interventions for increasing fruit and vegetable consumption in children aged five years and under. Cochrane Database of Systematic Reviews 2018(5). doi: 10.1002/14651858.CD008552.pub5.
24. Barnard ND, Willett WC, Ding EL. The misuse of meta-analysis in nutrition research. JAMA 2017;318(15):1435-6. doi: 10.1001/jama.2017.12083.
25. National Academies of Sciences Engineering Medicine. Guiding Principles for Developing Dietary Reference Intakes Based on Chronic Disease. Washington, DC: The National Academies Press, 2017.
26. Department of Health and Ageing. Methodological framework for the review of Nutrient Reference Values. 2013.
27. National Health and Medical Research Council, New Zealand Ministry of Health. Nutrient Reference Values for Australia and New Zealand including recommended dietary intakes. 2006.
28. Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, Schünemann HJ. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. BMJ 2008;336(7650):924-6. doi: 10.1136/bmj.39489.470347.AD.
29. Australian Government Department of Health, New Zealand Ministry of Health. 2017 Update: Fluoride. In: National Health and Medical Research Council, ed., 2017.
30. Australian Government Department of Health, New Zealand Ministry of Health. 2017 Update: Sodium. In: National Health and Medical Research Council, ed., 2017.
31. Department of Health and Ageing, National Health and Medical Research Council. Australian Dietary Guidelines. In: Department of Health and Ageing, National Health and Medical Research Council, eds. Canberra, Australia, 2013.
32. Kromhout D, Spaaij C, de Goede J, Weggemans R. The 2015 Dutch food-based dietary guidelines. Eur J Clin Nutr 2016;70(8):869-78.
33. Ministry of Health. Eating and Activity Guidelines for New Zealand Adults. In: Ministry of Health, ed. Wellington, New Zealand, 2015.
34. US Department of Health and Human Services, US Department of Agriculture. 2015 – 2020 Dietary Guidelines for Americans. In: US Department of Health and Human Services, US Department of Agriculture, eds. 8th Edition ed. Washington DC, United States of America, 2015.
35. Nordic Council of Ministers. Nordic Nutrition Recommendations 2012. In: Nordic Council of Ministers, ed. 5th Edition ed. Copenhagen, Denmark, 2014.
36. Department of Health and Ageing, National Health and Medical Research Council. A review of the evidence to address targeted questions to inform the revision of the Australian Dietary Guidelines In: Department of Health and Ageing, National Health and Medical Research Council, eds. Canberra, Australia, 2011.

37. Jacobs DR, Tapsell LC. Food, not nutrients, is the fundamental unit in nutrition. Nutrition reviews 2007;65(10):439-50.
38. Tapsell LC, Neale EP, Satija A, Hu FB. Foods, nutrients, and dietary patterns: interconnections and implications for dietary guidelines. Advances in Nutrition 2016;7(3):445-54.
39. US Department of Agriculture, US Department of Health & Human Services. Scientific Report of the 2015 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health & Human Services and the Secretary of Agriculture. In: US Department of Agriculture, US Department of Health & Human Services, eds. Washington DC, United States of America, 2015.
40. Ash S, Campbell K, MacLaughlin H, McCoy E, Chan M, Anderson K, Corke K, Dumont R, Lloyd L, Meade A, et al. Evidence based practice guidelines for the nutritional management of chronic kidney disease. Nutrition & Dietetics 2006;63(s2):S33-S45. doi: doi:10.1111/j.1747-0080.2006.00100.x.
41. Saxby N, Painter C, Kench A, King S, Crowder T, van der Haak N, Australian and New Zealand Cystic Fibrosis Nutrition Guideline Authorship Group. Nutrition Guidelines for Cystic Fibrosis in Australia and New Zealand. Thoracic Society of Australia and New Zealand, 2017.
42. National Health and Medical Research Council. Clinical practice guidelines for the management of overweight and obesity in adults, adolescents and children in Australia. National Health and Medical Research Council, 2013.
43. Dietitians of Canada. Internet: http://www.pennutrition.com/home.aspx (accessed 2018 30th June.
44. Tapsell LC. Evidence for Health Claims: A Perspective from the Australia–New Zealand Region. The Journal of Nutrition 2008;138(6):1206S-9S. doi: 10.1093/jn/138.6.1206S.
45. Kaur A, Scarborough P, Rayner M. A systematic review, and meta-analyses, of the impact of health-related claims on dietary choices. International Journal of Behavioral Nutrition and Physical Activity 2017;14(1):93. doi: 10.1186/s12966-017-0548-1.
46. Regulation (EC) No. 1924/2006 of the European Parliament and of the Council of 20 December 2006 on nutrition and health claims made on foods. Official Journal of the European Union 2007;OJ L12:3–18.
47. US Food and Drug Administration. Guidance for Industry: Evidence-Based Review System for the Scientific Evaluation of Health Claims. In: Office of Nutrition Labeling and Dietary Supplements, ed., 2009.
48. Health Canada. Guidance Document for Preparing a Submission for Food Health Claims. In: Bureau of Nutritional Sciences, ed., 2009.
49. Food Standards Australia New Zealand. Internet: http://www.foodstandards.gov.au/code/Pages/default.aspx (accessed 2018 June 31st.
50. Food Standards Australia New Zealand. Australia New Zealand Food Standards Code: Standard 1.2.7 -Nutrition, health and related claims. 2017.
51. Food Standards Australia New Zealand. Information on establishing food-health relationships for general level health claims. 2016.
52. Merlin T, Weston A, Tooher R. Extending an evidence hierarchy to include topics other than treatment: revising the Australian 'levels of evidence'. BMC Medical Research Methodology 2009;9(1):34. doi: 10.1186/1471-2288-9-34.
53. Jacobs DR, Tapsell LC, Temple NJ. Food synergy: the key to balancing the nutrition research effort. Public Health Reviews 2011;33(2):507.

54. Estruch R, Ros E, Salas-Salvadó J, Covas M-I, Corella D, Arós F, Gómez-Gracia E, Ruiz-Gutiérrez V, Fiol M, Lapetra J. Primary prevention of cardiovascular disease with a Mediterranean diet. New England Journal of Medicine 2013;368(14):1279-90.
55. Trepanowski JF, Ioannidis JPA. Perspective: Limiting Dependence on Nonrandomized Studies and Improving Randomized Trials in Human Nutrition Research: Why and How. Advances in Nutrition 2018;9(4):367-77. doi: 10.1093/advances/nmy014.
56. Schwingshackl L, Knüppel S, Schwedhelm C, Hoffmann G, Missbach B, Stelmach-Mardas M, Dietrich S, Eichelmann F, Kontopanteils E, Iqbal K. Perspective: NutriGrade: A Scoring System to Assess and Judge the Meta-Evidence of Randomized Controlled Trials and Cohort Studies in Nutrition Research–. Advances in Nutrition 2016;7(6):994-1004.
57. Higgins JPT, Green S. Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration. 2011.
58. Meerpohl JJ, Naude CE, Garner P, Mustafa RA, Schünemann HJ. Comment on "Perspective: NutriGrade: A Scoring System to Assess and Judge the Meta-Evidence of Randomized Controlled Trials and Cohort Studies in Nutrition Research". Advances in Nutrition 2017;8(5):789-90.
59. Fabbri A, Chartres N, Scrinis G, Bero LA. Study sponsorship and the nutrition research agenda: analysis of randomized controlled trials included in systematic reviews of nutrition interventions to address obesity. Public health nutrition 2017;20(7):1306-13.
60. Jenkins DJA, Spence JD, Giovannucci EL, Kim Y-i, Josse R, Vieth R, Blanco Mejia S, Viguiliouk E, Nishi S, Sahye-Pudaruth S, et al. Supplemental Vitamins and Minerals for CVD Prevention and Treatment. Journal of the American College of Cardiology 2018;71(22):2570-84. doi: https://doi.org/10.1016/j.jacc.2018.04.020.
61. Beller E, Clark J, Tsafnat G, Adams C, Diehl H, Lund H, Ouzzani M, Thayer K, Thomas J, Turner T, et al. Making progress with the automation of systematic reviews: principles of the International Collaboration for the Automation of Systematic Reviews (ICASR). Systematic Reviews 2018;7(1):77. doi: 10.1186/s13643-018-0740-7.
62. Wallace BC, Small K, Brodley CE, Lau J, Trikalinos TA. Deploying an interactive machine learning system in an evidence-based practice center: abstrackr. Proceedings of the 2nd ACM SIGHIT International Health Informatics Symposium: ACM, 2012:819-24.

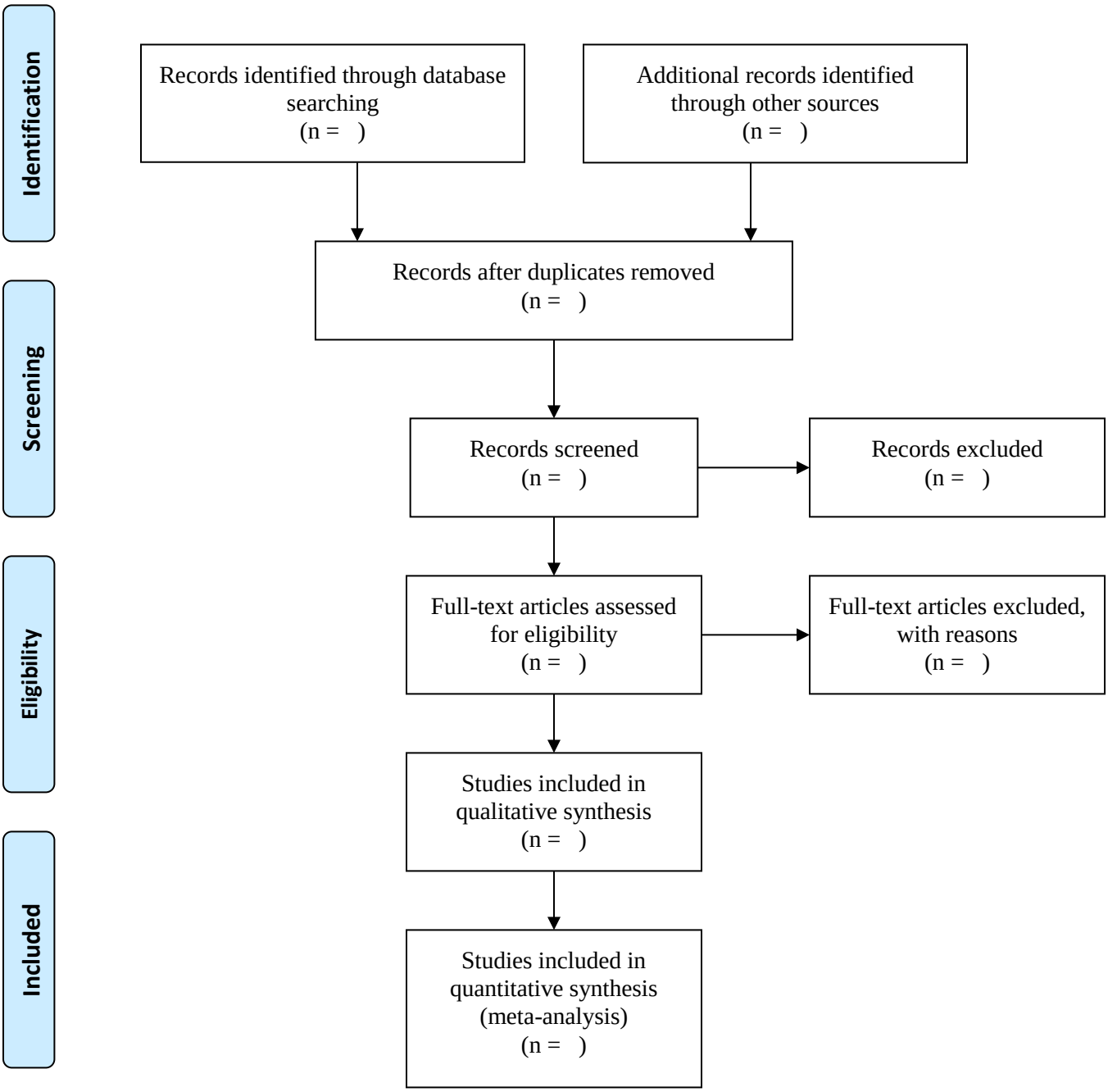
581 **Table 1:** Overview of approaches to evidence-based practice in nutrition, and challenges associated with each of these approaches

582

	Features	Challenges
Systematic reviews	• Systematically collect, appraise, and synthesise body of evidence on a research question • Follow a defined methodology • May be pre-registered to reduce bias • Underpin other components of the evidence-based framework in nutrition, including policy and guidelines	• Quality of the systematic review is dependent on the quality of the included articles • Variation in search terms and inclusion criteria may result in different conclusions • Labor-intensive and require a large time commitment to complete
Nutrient intake recommendations and dietary guidelines	• *Nutrient intake recommendations:* outline reference levels of nutrients to meet needs, reduce risk of adverse effects and chronic diseases • *Dietary guidelines:* outline types and amounts of foods and diets to be consumed to meet nutrient needs and reduce the risk of chronic disease	• Must be regularly updated to ensure they continue to reflect the current evidence base
Clinical practice guidelines	• Translate the evidence base for the management of clinical conditions for use by practitioners	• As with guidelines targeted at consumers, clinical practice guidelines require regularly updating to ensure they are current • In the absence of a single administering body, there may be substantial variation between the development and reporting of different practice guidelines
Food standards and health claims	• Allow the translation of health benefits of food products by the food industry • May be used as a method of marketing food products	• Requires external oversight to ensure health claims are accurate and supported by the evidence base. In the absence of this oversight, there is increased risk claims may be inaccurate

		or misused

583


Identification
Screening
Eligibility
Included
Records identified through database searching (n =)
Additional records identified through other sources (n =)
Records after duplicates removed (n =)
Records screened (n =)
Records excluded (n =)
Full-text articles assessed for eligibility (n =)
Full-text articles excluded, with reasons (n =)
Studies included in qualitative synthesis (n =)
Studies included in quantitative synthesis (meta-analysis) (n =)