Australian Academy of Science

DISCUSSION PAPER

Rethinking food and nutrition science

Critical evaluation of food and nutrition science—an Australian perspective

Theo Murphy High Flyers Think Tank

2017

2017 Theo Murphy High Flyers Think Tank discussion paper

Critical evaluation of food and nutrition science—An Australian perspective

Working group:

Associate Professor Eleanor Beck*, Dr Lucinda Black, Dr Lucy Carter, Dr Zoe Davidson, Dr Laura Downie, Dr Jenna Hollis, Dr Catherine Huggins*, Dr Nadeem Kaakoush, Dr Smriti Krishna, Professor Mark Lawrence, Dr Laurence Macia, Dr Lukar Thornton

*Group Leaders

Executive summary

The critical discussion that unfolded during the Theo Murphy High Flyers Think Tank, 'Rethinking food and nutrition science', was rich and covered a broad range of issues that affect food and nutrition science. This discussion paper considers the current state of food and nutrition science research. Opportunities for reform are proposed that will enable a flexible evaluation approach to create high quality research studies and subsequently outcomes that support the nutritional needs of the population. This paper identifies what is required for effective translation of research findings to overcome misinformation but also to gain the respect of the community we serve. The Think Tank participants determined that we need to critically consider the current paradigms and systems of nutrition science in order to achieve these outcomes.

A number of issues were considered key for rethinking food and nutrition science for Australia. Some of these issues were considered critically important and have been further developed by other working groups evolving from the Think Tank discussions. This highlights the integrated nature of our food and nutrition systems and that the critical review of nutrition science will be underpinned by monitoring and surveillance of food systems, governance and communication structures. The following outcomes are considered critical to rethinking nutrition science.

- **Scientific rigour** Food and nutrition science is a complex system with multiple levels, including important but potentially reductionist research at a nutrient level, studies on foods and meal systems, and extending to review of dietary patterns. All of these levels exist within a food and environment system which will affect outcomes associated with advice on nutrients, foods and dietary patterns. It is critical that nutrition science ensures rigour at all levels, which may include rethinking evidence frameworks, funding across the spectrum, and research and other systems that may have previously prioritised nutrient-only research. Therefore key outcomes of any decadal plan for nutrition must include:

    1. embedding implementation science into research planning and design, to assist in the translation of science into practice, and to ensure useful consumer messages and outcomes

2. working together in interdisciplinary teams from individual projects all the way to public health advocacy
3. challenging the current ideas of evidence, levels of evidence and our systems of classification, and ensure that this translates to funding and granting bodies to maximise opportunities (while ensuring the integrity of research funded/assisted by industry)
4. ensuring that nutrition monitoring and surveillance is prioritised, utilising defensible, financially sustainable methodologies. Data collection must be rigorous, regular and routine as well as accessible to maximise input into databasesand utilisation of the valuable resource.

- **Funding sources** To level the playing field from nutrients to food systems research, high level advocacy must include consideration of novel funding sources thereby ensuring equitable and substantive funding across the spectrum of research approaches, from nutrients to foods, meals, dietary patterns and food systems. This may include philanthropic considerations, careful research to identify the cost savings of preventative measures/research in comparison to tertiary care, or government policy to levy food industry to increase nutrition science research.
- **Regulation** is required to ensure food industry funding of research directly is regulated to maintain the integrity of nutrition science.
- **Communication and education** There must be communication of key messages in nutrition science, and measures to include translation and end users in research planning will assist. However, consideration should be given to the role of education in broadly improving food literacy. Professionals must be educated to train others in nutrition fundamentals, and this may include school education. Nutrition science communication must be a skill that is acquired by nutrition science professionals and this may be a requirement of nutrition science education programs.
- **Unity** Finally, in order to underpin all of these outcome, which require significant advocacy and potentially policy change, food and nutrition professionals must unify to ensure clear messages and a recognisable and trustworthy voice to advocate for improved nutrition outcomes for all. The governance of food and nutrition is important, and linkages between key organisations such as the Nutrition Society of Australia, Dietitians Association of Australia and the Australian Academy of Science are critical in advocacy.

Table of contents

Context and scope

Malnutrition, including under-nutrition, over-nutrition and imbalanced nutrition, is responsible for more deaths worldwide than any other modifiable factor. To what extent must the responsibility for this be borne by food and nutrition science? This question requires a critical evaluation of the responsibilities of the broad discipline of food and nutrition science, how well the field has met these, and where and how it can be improved and equipped to adapt to a rapidly changing future. Science is the generation of new knowledge and evidence, and is based on observation, experimentation and measurement that is assembled systematically. Science is about discovering answers to fundamental questions using the best available evidence at the time. This in turn, leads to more questions, and evolution of knowledge. Like all science, nutrition science is not static, and this challenges practitioners how to communicate evolving nutrition science to policy makers, professionals, industry and the public.

Participants in the Theo Murphy Think Tank on 'Rethinking food and nutrition science' set the overall goal of achieving food and nutrition security for all. Related goals, tools for change and stakeholders were mapped in a systems diagram to set the agenda for change. We are all stakeholders and end-users in the complex system of food and nutrition. Key stakeholder groups have influence and impact along the food chain, from food producer to table, and include primary producers, transporters, manufacturers, retailers, researchers, health professionals and consumers. Coordination and integration among stakeholders along the continuum to enable a high-functioning system is critical. This discussion paper specifically addresses the question of 'what is the role of food and nutrition scientists within Australia's food and nutrition system to achieve the goal of food and nutrition security for all?

To tackle this complex question, a paradigm shift in how nutrition scientists think about, plan for, measure and communicate impacts of food and nutrition science needs consideration. Capacity building may require assembling (and managing) highly integrated interdisciplinary and multidisciplinary teams. Interdisciplinary teams may currently exist in individual research studies, but academic institutions do not typically integrate nutrition science (if present at all) with medicine, biology, social science or health economics, for example, to map impacts, consider broader systems (other than just the biological or medical) and to ensure outcomes are both measurable and economically sustainable. Consideration of organisational processes and systems which support the integration of new ideas is an important step in the capacity building process.

The impact of clinical, community and health services nutrition intervention research is rarely sustained long term after the intervention ceases. Additionally, there are research-to-practice evidence gaps. The sustainability and implementation of interventions may be limited by a lack of planning at the beginning of projects that sets clear steps for how practice and policymakers will be influenced once the research evidence is available. There is often poor alignment between nutrition research and the organisational structures, knowledge needs, resources and implementation barriers faced by policymakers and end users such as health services, practitioners, schools and consumers. Cost-effective interventions that could feasibly be scaled-up, delivered and sustained in the real world (and provide greater return for research investment) are needed. Approaches such as leadership, training and prompts must be identified to support end users to build capacity and implement nutrition initiatives at scale.

Focus of the paper

This paper aims to consider the key issues impacting on nutrition science through discussion of the key challenges and opportunities for change at both national and international levels. The discussion is guided by the follow themes:

1. Governance and professionalism in nutrition science
2. Nutrients to foods and meals, dietary patterns and food systems
3. Defining frameworks to grade the quality of evidence in the food and nutrition sciences
4. Challenges associated with current funding systems
5. The role of food industries
6. Ensuring rigorous data collection
7. Communication of nutrition science to everyone
8. Nutrition education/knowledge transfer from scientist to consumer

Some of these themes also impact on the broader food and nutrition context in Australia and are the focus of separate discussion papers (theme 1 relates to the discussion paper on Effective Governance*;* theme 6 relates to the discussion paper on Knowledge Hub; and theme 7 to the discussion paper on Empowering Food Choices).

1. Governance and professionalism in nutrition science

The Theo Murphy Think Tank of the Australian Academy of Science brought together an interdisciplinary group of PhD-trained people in their early- to mid-career phase, interested in the science of nutrition. While transiently united by the Academy, the individuals were not members of one single nutrition organisation but included members of many professional organisations such as the Dietitians Association of Australia, the Nutrition Society of Australia and other scientific associations and/or affiliations. The discussions that follow in this paper recognise a need for advocacy to government and government agencies such as the National Health and Medical Research Council (NHMRC), and review of research funding within government and non-government agencies as well as representation to seek funding from other groups such as philanthropists or even the food industry. The danger of misinformation and the need for improved nutrition education at all levels to assist in combating this, together with nutrition scientists' obligation to consider implementation and communication of messaging within their research, is critical.

In order to achieve these goals it is recognised that nutrition science does not have a united, credible voice and an independent body that serves as a point of contact to both community and government. An independent body may assist in promoting these goals of nutrition scientists and ultimately improved nutrition outcomes. Such a group would not supersede existing organisations, and respect and collegiality for all credentials is considered paramount. This is important as often, when groups join together, they must work at the lowest common denominator.Redefined or new leadership, to work in the complexity of the food and nutrition environment with an international perspective, would be a considerable advancement for nutrition science in Australia. This would

encourage our talented workforces to work across disciplines and may provide new opportunities for nutrition science. Establishment of an overarching governance structure to support health and environmental outcomes through the consideration of the seven themes discussed below, could facilitate and expedite reform. The independent body would be a first point of contact to advocate to government on issues specific to nutrition science, and also be a point of contact for media to combat misinformation, avoiding any industry links. It would not be required to support any professions or credentialing processes and would therefore be able to focus on nutrition science. This area of discussion was raised in a number of working groups for the Think Tank and has been prioritised as a key working area for a future decadal plan and an outcome of such a plan.

2. Nutrients to foods and meals, dietary patterns and food systems

A systems perspective is needed to understand and manage the vast and complex role of food and nutrition in society. Many dietary components, including nutrients and non-nutrient chemicals, combine and interact across several levels in a hierarchy of mixtures that includes foods, dishes, meals, diets and dietary patterns. The impacts of these individual and combined components on health are very challenging, as the physiological effects are at multiple levels impacting general health, metabolism, immunity and many more systems. Food and nutrition science must be interdisciplinary to tackle the complex question 'how does nutrition impact health?'. In addition, dietary patterns are strongly associated with broader implications of food systems, including cultural norms, socio-economic considerations and environmental sustainability.

Nutrition research is disproportionately focused on the nutrient–physiology interface, and there is a tendency to consider the effects of nutrients separately rather than as components of complex mixtures. This disproportionate focus on a reductionist approach to nutrition research has contributed to food and nutrition policies and interventions focused predominantly on individual nutrients. This may, in part, be due to the history of nutrition science, and entrenched by many factors including research cultures, training approaches and funding models, including economically-motivated involvement by the food industry.

Historically, nutrition science stemmed from considering the prevention of deficiency-associated diseases. It was critical to isolate individual nutrients and consider the effects of withdrawal or excessive intake of a particular nutrient. Food supplies were variable and potentially unreliable. Understanding nutrient sources, their role in maintaining health and even the effects of excessive intake underpinned our knowledge of the food supply and formed the basis of early dietary messages and public health initiatives. This early work established a paradigm in nutrition science of reductionism (consistent with the basic science paradigm) that has prevailed in some sectors, including funding sectors, and in the community, which may seek a single nutrient or single food solution to a complex nutritional concern. Particularly in a time of plenty (in developed countries), we need now to consider how to incorporate 'optimal' nutrition in the form of whole diets and dietary patterns, and how these sit in both a cultural context and also at each level of production, supply and consumption from 'farm to fork'.

These considerations underpin fundamental questions in relation to research experimental design. What limitations of our experiments have been exacerbated by reductionism in nutrition science? It may be easier to change a single nutrient or food, to investigate its effect in a randomised control trial (RCT), than to consider entire dietary patterns. However, where the broader patterns of food

intake and the systems which create these patterns are ignored, there can be excessive inference made from single component (i.e. nutrient, ingredient or food) studies. Examining a simple substitution potentially requires less complex analysis and interpretation with greater likelihood of unambiguous results. The positive results in this simple substitution are more likely to allow for extension of research as these results provide impetus for more funding. There is therefore a skew of the funding towards these types of studies, which have defined endpoints and are designed as randomised control trials (RCTs) using traditional research paradigms including the basic science and clinical research paradigms. This may have impacted on the evolution of more complex experimental methodologies, specific to nutrition science, to explore more complex and intertwined factors.

At a global level, there are a much larger number of studies that are nutrition specific (nutrient level) compared to those that are nutrition sensitive (Lawrence et al. 2016a).

There are examples where dietary supplements have been made commercially available based on the reported benefits of certain nutrients derived from dietary sources, as identified through epidemiological studies (Downie and Keller 2014). In many cases, RCTs using these supplements have failed to reproduce the results seen in the larger studies investigating foods and dietary patterns, yet the supplements are commercially available. Due to differences in the regulatory requirements for dietary supplements compared with therapeutic agents, supplements do not need to necessarily demonstrate efficacy but need to be shown to be safe. Yet, some food additives such as emulsifiers are commonly added to processed food while preclinical research suggests that they may not be totally safe.

With the rise of non-communicable diseases linked to Western lifestyles, it becomes urgent to strictly regulate what can and what should not be present on consumers' plates. Generally speaking, even clinicians struggle to deliver clear messages due to the lack of consistency, knowledge and research in the field. It could be said that most consumers may prefer a reductionist approach, where consuming a single nutrient (or sometimes a single food) provides them with an opportunity to think they are doing something to improve their health, regardless of outcome.

It is generally not considered that analysing broader dietary patterns will provide far better direction to combat nutrition-related chronic diseases (Hu 2002) and that foods act within the body differently to nutrients. That is, the sum of foods is greater than individual components (Jacobs et al. 2011). This approach necessitates research that does not make simple nutrient substitutions or even that of single foods, but rather considers how a whole diet approach must be taken over a significant period of time. Furthermore, if dietary advice is generated from such work, it can never be oversimplified to a 'one size fits all' message, because different populations may have different requirements or inherent physiology altering their response to food; individuals may not be able to adopt different dietary patterns based on cultural norms or even availability of foods; and even systems external to our food supply system may influence health such as socioeconomic status, transport systems and food regulation.

3. Defining frameworks of evidence in nutrition science

In the context of nutrition science there are synergies between nutrients and between foods, and there are cultural issues and potentially greater differences between individual groups and populations that impact on research design and implementation. Neither the traditional basic

science research paradigm nor the clinical research paradigm easily accommodate this diverse set of factors found in nutrition science. Solutions may include a new research paradigm for nutrition science, and recognition by funding agencies, governments and scientific advisors that the breadth of nutrition challenges necessitates research from a range of methodologies. To facilitate this the existing evidence-level framework may need to be adapted.

Specific issues with RCTs may occur where there is high variability in response across a population and the signal may be swamped in a system with a reliance to consider differences between means. In such a model, reviewing the variation in response in individuals and benefits to those responders may be more relevant. If the same model was applied to a susceptible population then there may be much better results. Critically, we may not always know what to control for within an RCT.

Much of the evidence on dietary patterns has also been developed from population studies that may provide a snapshot of various disease markers or health outcomes based on dietary intake data that is not necessarily ideal for the purpose it is being used. For example, food frequency data may fail to collect details of fortification or food preparation, yet these may be critical in understanding effects of diet.

To expand the evidence base with studies using a food systems approach, and for such studies to gain recognition as important in evidence grading, the existing framework requires amendment. For example, environmental sustainability is an issue of significance in the food supply, yet contemporary issues such as sustainability are not considered in the framework of clinical trials. There is a role for nutrition experts to educate decision makers that there is not always going to be RCT evidence and it may not be even scientifically (or ethically) sound to consider this model to address some questions. So while nutrition scientists may understand research design relevant to the factor being considered, there is a role for advocacy for scientific design to encompass food patterns and especially food systems, including their interaction with the environment.

There are numerous problems with existing models of evidence and hierarchies of value of this evidence—especially in relation to complex dietary systems. Nutrition science needs to consider multicomponent models including nutritional ecology with a greater implementation of interdisciplinary science. It is for these reasons that Cochrane has published a call to action to reshape the synthesis and translation of evidence use for nutrition (Lawrence et al. 2016b). Most critically, any review of models of grading of nutrition science need to consider that:

- the existing framework (based on 1999 clinical guidelines) tends to be more suited to a reductionist view, where one nutrient at a time is investigated (or even some individual foods), and is largely based on basic science and clinical research paradigms
- the existing framework does not suit public health guidelines or even a dietary patterns approach but is still necessary to consider in the contexts of avoiding nutrient deficiencies and in some specific disease conditions
- a new framework needs to be fit for purpose
- a new framework could be used by an NHMRC panel specific to nutrition and this would have flow-on effects to assist equity in funding across the spectrum from nutrients to food systems

- in the context of food regulation it is critical to guard against the excessive inference from reductionism.

4. Challenges in funding systems

As described, there is a potential bias towards nutrient studies producing unambiguous results within a single trial—even if over time there are mixed messages when studies are contradictory. A recent example of the challenge of nutrient-based studies is that from the PURE studies (Dehghan et al. 2017; Miller et al. 2017), where the findings are often not interpreted with consideration to the broader dietary patterns within which these nutrients are consumed. Performance of any individual nutrient (macro or micro) may change within a food depending on a range of factors, including processing, which is highly relevant in the modern food supply. This results in a bias in funding towards a reductionist approach to nutrition and leads to a self-perpetuation of reductionist research where phenomena without mechanisms are not funded, but mechanisms without phenomena are funded.

Decreasing research funding aimed at investigating single nutrients, ingredients or foods is unlikely to be beneficial. However, working towards an equal spread of funding across the continuum, from nutrients to food systems, would seem a positive goal. An obvious example is the extreme healthcare costs associated with treatment of obesity and critically the metabolic conditions associated with overweight and obesity (Wang et al. 2011). There is a tendency to medicalise conditions to presume that the causes and treatments are only biological. This is an individualised and expensive approach to treatment that includes drug treatment. However, in many parts of the developed world, there is no longer a food environment restriction. Food is ubiquitous and relatively inexpensive. There is, however, an environmental and possibly social restriction on physical activity. The systems-based approach to prevention of obesity, in particular, is underfunded in comparison to the treatment costs of individualised care, yet there is a critical need to design experiments from individual nutrients all the way to a level where we attempt to understand how people interact with food in their environment (Lawrence *et al.* 2016b).

Lifting the investment in a systems/diet-based approach to research is not simple and cannot be considered only at a national level. As food is part of an international marketplace (even though cultural variations may limit the scope of relevance across populations), an obvious source of funding may be the food industry. The incentives for the food industry to fund research into individual foods or nutrients is obvious. However, industry—from a business perspective—has no incentive to fund systems-based research opportunities. An option for funding may be to levy the food industry and use this funding to initiate and sustain a broader spectrum of nutrition research. Such a system would certainly require government management, and understanding the cost of doing nothing in nutrition science food systems may provide specific leverage to encourage investment. That is, government needs to be encouraged to consider the economic potential to improve health (less tertiary care) as an impetus for greater funding of nutrition research at the dietary patterns and especially the food systems end of the continuum. It is also possible, with a modified evidence framework and implementation of rigorous standards, that nutrition research at a larger, systems level could be more attractive to philanthropic donors. Embracing the concept that prevention is better than cure is a longer-term financial model. Ensuring health economists are part of nutrition science research is a key consideration to achieve these kind of outcomes.

5. The role of the food industry

There is no question that the food industry provides a current and potentially increased avenue for funding of nutrition research. Projects include research at all levels from farm to fork, from agricultural enhancement to researching claims of specific functionality attached to foods by the food industry or others. Historically, food industry research and development centres worked to make new products. Subsequently there was a shift to focus on sensory properties, especially palatability, and a focus on nutraceuticals or nutritional properties, especially where there is an opportunity to make a nutritional claim related to an ingredient or food. These opportunities capitalised on by industry are contentious to some researchers and generally promote a one size fits all approach to nutrition. In particular, ultraprocessed foods in this category are likely to be discretionary foods, not core foods, and are marketed with nutrition and health claims based on specific nutrient additives. They tend to undermine the broader philosophy of the dietary guidelines and in some cases may present a public health risk, especially if consumed regularly. Conversely, there may be instances where certain products developed and processed by industry may not be intrinsically detrimental and actually may provide value. A specific example is where waste streams are utilised for supplementing foods, such as those from tuna processing providing omega 3 to add to other foods. Furthermore, the nutritional quality of a food may be maintained through modern processing; shelf life is extended; nutrition value of low nutrient foods is improved; or palatability is improved for consumers. There are benefits of our modern food industry and these must be balanced with potentially negative outcomes.

However, the bottom line in the food industry needs to include profit and sustainability. While the food industry can reformulate foods to improve their nutritive value, research on processing and ultraprocessed foods provides evidence that promotion of highly processed foods above less processed foods may not be promoting ideal nutritional intake. It is unrealistic to expect that individuals will not eat foods that may have advantages (perceived or real) in preparation, cost or palatability, and will not be attracted to purchase these foods before core foods.

A subtlety that may be unclear to those not working with industry are the differences between a consultancy project, where the food industry owns the intellectual property and potential outcomes, and a university- or other research-driven project where results are published irrespective of outcomes. The latter may include competitive linkage grants with industry or where a researcher seeks assistance from industry to provide foodstuffs for research. It is difficult to communicate subtle differences and to potentially defend differences in public forums. There is also little doubt that a review of studies indicates a bias of publishing with industry funding, demonstrating use of industry funding in a negative way to promote specific outcomes (Lesser et al. 2007; Bes-Rastrollo et al. 2013). While registration of trials is becoming the norm, there is still a positive publishing bias and evidence that industry reviews are more likely to be favourable toward the intervention. Both the funding source (inclusive of but not limited to industry) and the investigators' biases can potentially influence the publication of results. There is a greater need for transparency with regard to funding agreements to ensure all publicly and privately funded studies are published irrespective of the findings. It is particularly important for industry to adopt such practices to ensure greater confidence in research findings generated using industry funds.

It would seem prudent that in future planning in nutrition research, the inclusion of a risk management strategy for engagement with industry is critical. Steps to mitigate risk which should be included in planning include compulsory registration of trials with the food industry, development of clear guidelines for acceptance of funding from industry, and contractual arrangements allowing publishing of all studies. Guidelines exist in individual organisations (e.g. CSIRO, some universities) and there are published guidelines (Mozaffarian 2017) but inclusion of guidelines or reference to accepted guidelines in a nutrition decadal plan is critical. Engagement with certain food industry sectors can provide an opportunity to broaden the funding for nutrition research, but caveats are necessary. Failure to engage would be an opportunity lost but the key risks of poor management of such processes are research bias, flawed evidence generation and the further loss of credibility in the eyes of the public. Conversely, close and ethical collaborations between nutrition scientists and the food industry can result in improving the nutritional quality of processed food products; the food industry could then be considered a major vehicle for delivering high-quality foods that meet some nutritional needs of different age groups and can form part of a balanced diet.

6. Ensuring rigorous data collection

Within Australia, nutrition surveillance has no consistent history, is limited in scope, and doesn't include a large prospective cohort study that includes nutritional and dietary intake data. Dietary intake studies representative of Australians is sporadic at best, with intake studies in 1995 and 2011–12 and no definitive schedule for this to be repeated. There is no government agency responsible for food and nutrition, from agriculture to consumer, and government priorities appear to favour commercialisation irrespective of nutritive worth (this topic has been discussed in more detail in the 'Effective governance for food and nutrition science in Australia' Think Tank discussion paper). How do we achieve a shift in priorities? What are the tools for change needed to ensure that we get reliable, accurate and up-to-date data? How do we ensure change is relevant to the bigger picture of food and nutrition security for all?

Issues relating to the collection of data in nutrition science include the variety of methods employed to collect intake data in all studies across the continuum, from nutrients to systems, and the inherent limitations of each of the methodologies. Even rigorous methods in studies with intensive collection of data from individuals may suffer from issues related to a reliance on self reporting from participants (Ahluwalia et al. 2016, Dwyer et al. 2003). Large-scale studies similarly rely on self reporting but with added limitations of tools such as food frequency questionnaires. In order to standardise big data, agreement would be required on a minimum standard for experimentation or food surveillance protocols and a framework could include the minimum data set that should be collected. In that way, it is more likely that results can be combined, collated and interpreted in systematic reviews and meta-analyses in the longer term. This also includes a move to utilise more open data systems, linked to a new framework for grading of evidence.

Tools that may be required include an accessible, fit-for-purpose tool for data collection to measure what people are eating and what the outcomes are related to this intake. A broad, open repository for nutrition data is a large undertaking but likely to result in significantly improved peer review, standards, and collation of data to answer questions related to multiple population groups. In considering such a task, we need to identify how data that already exists can be coded and accessed. For example, large amounts of biomedical data are collected daily in hospitals and identifiers in

these systems could be unified. Victoria also has unique school identifiers that follow individuals throughout their education, and these or similar systems may also provide opportunities for tracking health outcomes. If fit-for-purpose tools were readily available, then nutrition components could also be included in many more studies to assist in gaining greater quantities of data of standardised quality. Data could be analysed by standardised food composition databases, which would need to be maintained to ensure their currency with the food supply.

There is an opportunity for innovation design, particularly in big data collection. Engaging design thinkers in the process of developing data collection tools will bring prototypes to the fore. The end users who would need to be considered and consulted in the design phase would range from researchers 'on the ground', to policy makers, to individuals who would be providing the data. Key considerations would include accessibility of the data (e.g. from remote Australia to expatriates overseas). Purposeful data collection (surveillance and monitoring) will be most useful if guidelines for a minimum level of data are developed and implemented. An initial consensus exercise with leading experts may be useful for prepare these guidelines for broader consultations. This topic was recommended at the Think Tank as a key outcome area and discussion group for a decadal plan in nutrition, and is covered in depth in the 'Australian Food and nutrition knowledge hub' discussion paper.

It remains to be determined if having the right tools will be sufficient to support lobbying for routine nutrition monitoring and surveillance. Researchers and users of nutrition data should be encouraged to embed implementation planning into their project designs to demonstrate the added value of such data collection, and to help investors realise the value of regular monitoring and surveillance. Consideration should also be given to whether there is value in investing in improving access to existing data and how the data should be coded, linked and stored.

7. Communication of nutrition science to everyone

The complexity of nutrition makes communicating simple, accurate messages to the general public difficult. However, nutrition scientists should be reassured that there is broad demand for reliable information that supports better health. Nutrition science has an obligation to effectively and consistently communicate with and engage members of the public on relevant messages. Communication is essential to moving nutrition science forward, and must be included in a nutrition science decadal plan.

One measure which may assist is the embedding of implementation information in study planning and design. That is, stakeholders should be consulted at all levels of study design to ensure research is relevant to end users, and to ensure that researchers have considered how findings can be communicated effectively. There is often excessive inference made from individual studies, where for example a nutrient finding in an animal species is communicated as a breakthrough for health outcomes in populations. The original research may be a breakthrough, but consideration early on as to how messages could be communicated to ensure clarity and caveats on their reach, would assist with limiting misinterpretations and possibly also misinformation.

It is also important to consider why unqualified individuals claiming a 'quick fix' are successful in their communication to the public. Firstly, they may not feel bound by the ethics of scientific research or a health profession. Secondly, they tell a story that focuses on improvement to move to

a state of wellbeing. Nutrition science cannot deny that an original reductionist approach of avoiding nutrient deficiency does not sound as good as consuming a greater quantity of a nutrient or 'superfood' to gain some health advantage. Similarly, promoting the Australian Dietary Guidelines to avoid lifestyle disease seems far less attractive than a 'diet' that will make one feel better, enjoy life and look great. Nutrition science needs to compete in an environment where everyone who eats, or claims to have had individual success in modifying their diet, is automatically an expert. The public may actually know that a food is not a 'superfood', but by purchasing and consuming the food individuals feel empowered that they are at least doing something to improve their health.

The difficulty is that there is not always a single message that nutrition scientists would wish or need to promote. The use of 'fast' media, including social media, may be better used as a forum to balance sensationalism rather than necessarily promoting a single piece of science. Social media is freely used by charlatans to build a following, and nutrition scientists could provide uniform messages of proper information to take back this space. To do this they need to understand audience needs, engage actively, and utilise social media appropriately where 'tone and inference' are crucial to messaging. Groups of experts, in all areas of nutrition, could be united around single positive nutrition messages using discussion forums including Twitter accounts to promote science or by creating official facebook pages. From social media, mainstream media links can be established and fostered.

Most critically, all communication should remember who the message is for and what the perspectives are of those who will be affected. The NHMRC has a statement on consumer and community involvement in health and medical research (2016). This could support researchers to consider the end user at all stages of the research process from planning to implementation and communication/dissemination. If this is not 'fit for purpose' for nutrition research and engagement, a new framework should be developed. This may also need to be considered for industry-based research and product development so that consumers have a greater say in how health claims are used to support healthy choices. Consumers are often unwittingly persuaded (through marketing) to buy a product presumed to be healthy because of the addition of a particular nutrient. By promoting greater engagement with consumers in research and development, the communication flow and consistency of messages should facilitate greater understanding of nutrition and health relationships.

8. Nutrition education/knowledge transfer from scientist to consumer

The typical avenues to careers in nutrition science commence with a three-year science-based degree. Typically, degrees include biochemistry and physiology and background in nutrients and broad nutrition science techniques. Some degrees may have more food science while others may include a variety of subjects around socialisation of food and community and public health nutrition. Dietetics is a specialty course in nutrition science that trains people not only in fundamental science but also how to translate this and/or provide therapy as a health professional. Other training is the traditional pathway of honours, masters and doctorate. In addition to these more traditional pathways, many scientists cross from other disciplines (e.g. exercise, broader physiology or biochemistry, genetics, ecology, social science) to engage in nutrition science research. Ideally, this inter- and intra-disciplinary history adds value to any nutrition science to create a range of expertise from social to pure science and dietetics and other nutrition groups.

There are a number of considerations that impact on the core structure in our current training models:

1. Accreditation of professional degrees: while this is critical to ensure science (and other standards) are maintained, it may also constrain what new content could be rapidly included within degrees.
2. Some food and nutrition science programs may lack higher level physiology (for example) while some pure science degrees may lack any teaching of the social and environmental aspects of food and nutrition.
3. There are difficulties in teaching students multidisciplinary approaches to research when current academics might not have this background and these additional subject areas might typically be taught in different schools, faculties or campuses.
4. Food and nutrition is a broad area and it is unrealistic to expect new graduates to be across all aspects, especially population health and food systems. Modern competency-based learning describes the creation of life-long learners and this is critical in science where best evidence will evolve and change over time.
5. As described, nutrition communicators are critical. There is some need for 'go to' people. Is it unrealistic to include the teaching and assessment of nutrition communication in all nutrition (or even human biology science) degrees?

A variety of pathways lead to expertise in nutrition science. Competency standards may be a useful way to separate the different experts in nutrition, however some core competencies, including science communication, seem necessary across all nutrition education courses. Review of common skills could fall under the remit of a joint governance group. This would not work as a regulatory body, but rather to advocate minimum standards in a nutrition workforce, based on education programs. Workforce development and defining career pathways needs to work towards a food and nutrition workforce that is agile, responsive and multidisciplinary, and that addresses priorities. These could be identified by an overarching group. One of these priorities is a workforce that can build population food and nutrition (health) literacy.

A strategy to improve nutrition education across a much wider range of individuals is involvement in school education, with the aim of building the health and food literacy of the entire population over time. Empowering food choices through appropriate skills and information requires consistent messaging which could be delivered in a formal education setting. Promoting food literacy works to create and harness a healthy food culture and combat misinformation. However, nutrition science needs to ensure that there is a workforce to deliver this education and it may be that the path to 'nutrition educator' has been overlooked as a career option due to the lack of infrastructure to sustain such a workforce. Advocacy to government to highlight the need for a framework for this education training seems prudent. There are also opportunities in universities to offer broad nutrition content to students across faculties. First-year elective subjects may provide additional opportunities to educate large groups of individuals, empowering food choices and tackling misinformation.

Conclusion

The Critical Review of Nutrition Science Think Tank group identified a range of concerns within the fundamental aspects of science, but also a range of problems that can be utilised as specific topics in a decadal plan. Firstly, nutrition scientists need to consider all the systems that affect food intake (for example, environment, socioeconomic, cultural) to fully achieve food security for all. While research on nutrients, foods and meals will always be important, a future focus must include dietary patterns and food systems. Secondly, in order to consider this, a funding system must be developed to ensure that the range of research methods required receive funding to manage bias or overfocus on mechanisms rather than phenomena. This may include considered engagement with the food industry as a key stakeholder, but with caveats to minimise bias and ensure rigorous standards associated with this engagement. Finally, when we consider research from nutrients all the way to food systems, a framework of evidence specific to food and nutrition that is fit for purpose must be considered.

The other key issues requiring further consideration include:

- formation of an overarching governance group that advocates to government and other stakeholders on nutritional care and advice
- development of minimum data collection and sharing standards
- provision of nutrition scientists with communication skills on at least some level, support of nutrition scientists to act as educators, and the expansion of nutrition education through broad-based education in schools and universities (non-nutritionists).

References

Ahluwalia, N., Dwyer, J., Terry, A., Moshfegh, A. & Johnson, C. 2016. Update on NHANES Dietary Data: Focus on Collection, Release, Analytical Considerations, and Uses to Inform Public Policy. *Advances in Nutrition: An International Review Journal,* 7**,** 121-134.

Allender S, Owen B, Kuhlberg J, Lowe J, Nagorcka-Smith P, Whelan J et al. 2015 A Community Based Systems Diagram of Obesity Causes. *PLoS One*. 10(7): e0129683.

Bes-Rastrollo M, Schulze MB, Ruiz-Canela M, Martinez-Gonzalez MA. 2013. Financial Conflicts of Interest and Reporting Bias Regarding the Association between Sugar-Sweetened Beverages and Weight Gain: A Systematic Review of Systematic Reviews. *PLoS Medicine.* 10(12): e1001578.

Dehghan M, Mente A, Zhang X, Swaminathan S, Li W, Mohan V, Iqbal R, Kumar R, Wentzel-Viljoen E, Rosengren A, Amma LI, Avezum A, Chifamba J, Diaz R, Khatib R, Lear S, Lopez-Jaramillo P, Liu X, Gupta R, Mohammadifard N, Gao N, Oguz A, Ramli AS, Seron P, Sun Y, Szuba A, Tsolekile L, Wielgosz A, Yusuf R, Hussein Yusufali A, Teo KK, Rangarajan S, Dagenais G, Bangdiwala SI, Islam S, Anand SS, Yusuf S; Prospective Urban Rural Epidemiology (PURE) study investigators. 2017. Associations of fats and carbohydrate intake with cardiovascular disease and mortality in 18 countries from five continents (PURE): a prospective cohort study. *Lancet*. Aug 28. pii: S0140-6736(17)32252-3. doi: 10.1016/S0140-6736(17)32252-3.

Downie, L. E. & Keller, P. R. 2014. Nutrition and age-related macular degeneration: research evidence in practice. *Optom Vis Sci*. 91, 821-31.

Dwyer, J., Picciano, M. F. & Raiten, D. J. 2003. Collection of food and dietary supplement intake data: What We Eat in America-NHANES. *J Nutr,* 133**,** 590s-600s.

Huang TT, Drewnosksi A, Kumanyika S, Glass TA. 2009. A systems-oriented multilevel framework for addressing obesity in the 21st century. *Prev Chronic Dis*.6(3):A82

Hu FB. 2002. Dietary pattern analysis: a new direction in nutritional epidemiology. *Curr Opin Lipidol* 13:3-9

Jacobs DRJ, Tapsell LC, Temple NJ. 2011. Food synergy: the key to balancing the nutrition research effort. *Public Health Rev*. 33:507-29

Lawrence, M., et al. 2016a Evidence Synthesis and Translation for Nutrition Interventions to Combat Micronutrient Deficiencies with Particular Focus on Food Fortification. *Nutrients.* 8(9): 555.

Lawrence, M., Naude C, Armstrong R, Bero L, Covic N, Durao S, *et al.*, 2016b. A call to action to reshape evidence synthesis and use for nutrition policy[editorial]. *Cochrane Database of Systematic Reviews* (11): 10.1002/14651858.ED000118

Lesser, L., et al. 2007. Relationship between Funding Source and Conclusion among Nutrition-Related Scientific Articles. *PLoS Medicine* 4(1): e5.

Miller V, Mente A, Dehghan M, Rangarajan S, Zhang X, Swaminathan S, Dagenais G, Gupta R, Mohan V, Lear S, Bangdiwala SI, Schutte AE, Wentzel-Viljoen E, Avezum A, Altuntas Y, Yusoff K, Ismail N, Peer N, Chifamba J, Diaz R, Rahman O, Mohammadifard N, Lana F, Zatonska K, Wielgosz A, Yusufali A, Iqbal R, Lopez-Jaramillo P, Khatib R, Rosengren A, Kutty VR, Li W, Liu J, Liu X, Yin L, Teo K, Anand S, Yusuf S; Prospective Urban Rural Epidemiology (PURE) study investigators. 2017 Fruit, vegetable, and legume intake, and cardiovascular disease and deaths in 18 countries (PURE): a prospective cohort study. *Lancet*. Aug 28. pii: S0140-6736(17)32253-5. doi: 10.1016/S0140-6736(17)32253-5.

Mozaffarian D. 2017. Conflict of Interest and the Role of the Food Industry in Nutrition Research. *JAMA*. May 2;317(17):1755-1756.

Orellana L, Strugnell C, Hayward J, Millar L, Swinburn B, Allender S. 2016. Worlds Apart: Active (opt-in) consent underestimates the prevalence of obesity in a school-based survey. Evidence from the Healthy Together Victoria and Childhood Obesity (HTVCO) study. 13th International Congress on Obesity; April, 2016; Vancouver, Canada: *Obesity Reviews*. p. 121-2.

National Health and Medical Research Council 2016. Statement on Consumer and Community involvement in Health and Medical Research, Consumers Health Forum of Australia. Available: https://www.nhmrc.gov.au/guidelines-publications/s01. [Accessed October 2017].

Vandenbroeck I, Goossens J, Clemens M. 2007. Tackling Obesities: Future Choices - Building the Obesity System Map2007: Available: www.foresight.gov.uk/Obesity/12.pdf. [Accessed October 2017]

Wang YC, McPherson K, Marsh T, Gortmaker SL, Brown M. 2011. Health and economic burden of the projected obesity trends in the USA and the UK. *Lancet*; 378(9793): 815-25.

About the 2017 Theo Murphy High Flyers Think Tank: Rethinking food and nutrition science

The Australian Academy of Science has been hosting annual High Flyers Think Tanks on nationally important topics since 2002. These two-day events bring together outstanding early- and mid-career researchers with expertise in a broad range of disciplines to discuss novel applications of science and technology, and to identify gaps in knowledge that need to be addressed.

The 2017 Think Tank, *Rethinking food and nutrition science,* was held in Perth on 26-28 July with participants examining the field from four perspectives:

- Critical evaluation of nutrition science
- Key control points for healthy, equitable and sustainable food and nutrition
- Essential goals for achieving effective solutions
- Tools for change

Following the event, participants continued to work together to develop a series of discussion papers, of which this is one. The discussion papers are designed to create a productive dialogue and contribute to the consultation process during the development of a decadal plan for the discipline of nutrition.

The 2017 Think Tank was generously supported by the Theo Murphy (Australia) Fund, which is administered by the UK Royal Society.

The Think Tank and the subsequent drafting of discussion papers was overseen by the National Committee for Nutrition, The Theo Murphy High Flyers Think Tank Steering Committee and the following experts:

Professor Jennie Brand-Miller AM, University of Sydney
Professor Frank Dunshea, University of Melbourne
Professor Mike Gidley, Centre for Nutrition and Food Sciences, University of Queensland
Professor Paul Griffiths, University of Sydney
Professor Anne-Marie Grisogono, Flinders University
Dr Brooke Harcourt, Murdoch Childrens Research Institute
Professor Ian Hume AO FAA, University of Sydney
Professor David Le Couteur, University of Sydney
Professor Amanda Lee, Australian Prevention Partnership Centre, Sax Institute
Professor Manny Noakes, CSIRO
Professor David Raubenheimer, Charles Perkins Centre, University of Sydney
Dr Gyorgy Scrinis, University of Melbourne
Professor Stephen Simpson AC FAA FRS, Charles Perkins Centre, University of Sydney
Professor Helen Truby, Monash University