

Challenges and opportunities for better nutrition science

The path to conducting better nutrition science entails recognising previous and inherent limitations and challenges and building on recent developments and opportunities, say **Tim Spector** and **Christopher Gardner**

No other scientific field is so influenced by self-proclaimed “experts” as nutrition science. This is likely because of an intense focus on nutrition in the media and the fact that food is part of everyone’s daily life. Any new nutrition study that emerges, regardless of its size or quality, attracts unparalleled public interest.

Attempts to oversimplify complex science when constructing guidelines based on limited scientific evidence have largely failed. For example, simplified low fat recommendations have caused confusion by omitting details about types of fat or which foods should be promoted or avoided. The result is a confused public that looks to the latest fad or food guru for advice and disregards much of the uncontentious sensible advice on offer.

Against this backdrop the Food for Thought nutrition meeting in 2018, which was convened by *The BMJ* and Swiss Re, brought together scientists, health practitioners, and journalists to discuss controversies and consensus in nutrition and health. The overarching intention of the meeting was to bring together differing voices, working out what is and isn’t known, and try to find a way forward.¹

Traditional academic researchers representing the establishment and guideline committees mixed with critics of the system, including advocates of low carb/high fat diets and anti-sugar lobbyists. Many of these conflicting voices had worked together to produce reviews on the most controversial issues in nutrition.¹ Listening to the discussions that followed was a watershed moment. The traditional nutrition academic community were admitting some mistakes and that the system of assessing the benefits or harms of foods was imperfect.

Much of the discussion focused on overnutrition rather than undernutrition. Traditional harmful associations in high income Western countries, such as

saturated fats in the US, are not being replicated in low and middle income countries.² The benefits of fibre, vegetables, and fruits and the need to reduce sugar and ultra-processed foods had clear agreement. However, there was far less consensus on other issues, especially dietary advice for patients with diabetes, the benefits of keto diets, and the role of meat, saturated fats, and salt restriction.

Everyone agreed that improving our diet was the most important and cost effective health measure we have at our disposal. Based on discussions from the 2018 Food for Thought meeting, we propose key challenges for the field and new opportunities to improve both human and planetary health.

Power of “big food”

The food and drink industry has gone from mid-size companies in the 1970s to global multinationals with immense power, money, and influence. The top 10 companies control over 70% of what we eat and drink and have annual sales larger than the gross domestic product of many countries. They are producing greater amounts of more affordable and accessible food for our expanding population, but at the cost of our health.¹ As White and colleagues note, “the commercial food system has the potential to show leadership and support for dietary public health, but systemic change is needed first and this is likely to require governmental action.”³

Much of the funding of many academic nutrition departments is from the food industry or its intermediaries, which helps drive research agendas.⁴ The medical world learnt the hard lessons on influence from the tobacco and pharmaceutical industries, but it has yet to recognise fully the influence of food and drink companies, which have far greater impact on our health. This influence has indirectly ensured that it took 40 years for the first quality randomised controlled trial of the effects of junk food in humans.⁵

Industry fills a void that scientific funding agencies have left, and it is hard to blame academics who have few funding options to keep their teams going, even if the outputs are conflicted. Greater transparency of funding sources, compliance with preregistration of all trials, and increasing the publishing rate of null findings would help to improve the science generated by funding from big food.

Funding

The percentage of funding directed towards obesity and nutrition research globally is tiny compared with other fields such as HIV or cancer. Pharmaceutical companies invest almost a billion dollars on average to bring to the market drugs that show marginal benefits over competitors. But obtaining a mere \$2m–\$4m (£1.6m–£3m; €1.8m–€3.6m) for a nutrition study is a lifetime aspiration for most nutrition scientists. We balk at the idea of paying a fraction of the budget of drug trials to test the health benefits or safety of foods we eat every day. Governments and health agencies need to re-examine their priorities for funding, as should philanthropic individuals and organisations, to help fund better studies. For years food companies have said they lack the funds to do proper long term research on the health and safety of their foods, but this is no longer true.

Even experts don’t always agree

Expert scientists frequently assemble to create or update dietary guidelines, both nationally and globally. Guidelines have become more evidence based and often include an evaluation of scientific quality and corresponding statements of impact on strengths of recommendations. However, many notable areas of disagreement exist, particularly for dairy, meats, and beverages.

Some of this disagreement is due to the wide range of food products in these categories and our tendency to oversimplify, making a single recommen-

dation across a broad health spectrum problematic. However, many scientists sitting on expert panels have conflicts as their research is often paid for by the food industry. Another problem is political interference influenced by industry lobbying that can shape national dietary guidelines. When even the experts don't seem to agree, the general public is less likely to consider nutrition recommendations as credible.

Study quality

Most of our nutritional evidence has come from large observational studies started many decades ago. These have been supplemented with small, short term human trials, usually of low quality, plus animal experiments. These large observational studies tend to maximise generalisability but are subject to inherent biases. In contrast, short term and often reductionist human trials tend to maximise rigor but lack generalisability. Some critics argue that all observational studies should be disregarded, primarily because they can study only association, not causation. We believe this is flawed thinking; the power of using both approaches is to maximise the combination of generalisability and rigour.⁶ However, improved nutrition assessment methods would benefit both.

The traditional subjective methods that rely on memory and honesty, such as the food frequency questionnaire and 24 hour recall, have inherent limitations. These can now be supplemented with digital devices, food logging diaries on mobile phones, and emerging blood, stool, and saliva tests of metabolites that more objectively reflect eating habits, although all need further validation. In studying nutrition, we need to embrace and improve the quality of long term observational studies for generalisability and short term studies for rigour in metabolic controlled conditions. The power lies in having both.

Context and reductionism

The recurring mantra needed for every nutrition study should be, "Instead of what"? Many discrepancies among studies could be due to the context in which an ingredient or meal is eaten and the alternative foods that are available. For example, observational studies of the health effects of saturated fats vary between the US, Europe, and Asia. Reducing meat may provide health benefit only if it is replaced by extra pulses or vegetables, rather than by refined or high glycaemic carbs such as rice or white bread. The concept makes

studying large populations more complex, but it is crucial if we are to understand the effect of whole meals and meal patterns on health. Context is key for any nutrition changes.

The last five decades have seen arguments over the ideal ratios of macronutrients (fat, carbs, and protein) we should consume. All categories have a range of healthy and unhealthy subtypes and many different ratios that seem healthy. This simplistic view is increasingly considered to be flawed and ignoring the hundreds of chemicals that differ within each food. The food we eat is estimated to contain at least 26 000 unique chemicals, and many of the components have been overlooked.⁷

At the 2018 meeting, many participants shared this view and supported moving towards studying food groups and patterns, rather than macronutrients or individual items in isolation. Our past focus on specific macronutrients has allowed ultra-processed foods to be marketed as healthy by using broad brush categories, such as low in fat or sugar.

Demoting the calorie

We need urgently to overturn calorie counting as the mainstay of nutritional advice and prevention of obesity. There is growing consensus that it lacks value as a practical tool in weight management. It is impossible to measure intake accurately, and too many variables influence calorie expenditure to make calorie counting useful. New research in humans suggests our bodies and metabolic rates can behave differently when given identical calories in different contexts.

Although many countries have introduced compulsory or voluntary calorie counts on food labels and in restaurants and fast food outlets, their effectiveness long term is not agreed. This suggests we need different sustainable public health approaches that focus on food quality, not just quantity. Not enough attention is being paid to the sustainability of diets that may be effective in the short term but hard to maintain, such as ketogenic high fat diets. Sustained behavioural change is the key to any long term nutritional benefit. While portion size and portion control can still be a component of sustained change, it's time for calorie counting to go.

Microbiome

A major change in nutrition in the past decade has been the discovery of the gut microbiome, which is more than a passing fad. The trillions of microbes contain 100-

fold more genes than humans and behave like a virtual organ, producing thousands of chemicals, including key metabolites and essential vitamins. Our microbiomes are highly variable; even identical twins share only about one third of their microbial families.

Gut microbes alter the metabolism of most ingested drugs, such as cancer immunotherapy. They also influence how food is processed and how nutrients and energy are extracted. Our different glycaemic responses to carbohydrates are under microbial influence,⁸ but lipaemic responses may be even more closely linked.⁹

Assessment of the gut microbiome is cheap enough to become a routine requirement in clinical studies and all food safety experiments. Manipulating the microbiome through diet is one of the major challenges of the next decade and is more complex than it seems. Studies have shown that simply adding fibre supplements such as inulin or single microbe probiotics may not be enough for many individuals.¹⁰ Understanding the composition, function, and diversity of the microbiome needs to be incorporated into nutritional education at all levels and inevitably means that future nutritional advice will be more personalised.

Personalised nutrition

A combination of recent large scale population studies using artificial intelligence mixed with digital technologies and the microbiome have clearly shown wide variation in our metabolic response to foods.^{9 10} Large scale trials (eg, DIETFITS) have shown no differences in mean results between high and low fat healthy diets but large inter-individual differences regardless of allocated diet.¹¹

Population health could be improved by promoting diet changes for which there is broad consensus—eating more vegetables, fibre, and whole foods and avoiding ultra-processed foods. However, individual advice based purely on average responses is of little use, as most individuals do not resemble "the average." Personalised nutrition, based on genetic tests, was thought inevitable, but with few exceptions (eg, response to caffeine in coffee, and alcohol or lactose intolerance) this promise hasn't been fulfilled. Recent studies in twins have shown that genes have only a minor role in metabolic postprandial responses to fats and carbohydrates.⁹ Artificial intelligence methods using large data sets generated from digital wearables

(eg, glucose, sleep, and exercise monitors) and metabolomics are leading to tools to help inform individual food choices, and even how and when to eat—that is, the new field of restricted time eating.¹² Both the nutrition community and industry will have to deal with this emerging field, which will have a major impact on population based “one size fits all” advice on our eating habits.

Saving the planet

The real fears of global warming by 1.5°C with its consequences have become mainstream for all countries. The estimated 15–20% of the total warming effect related to food production should not be ignored, as much of this is potentially modifiable by our food choices.¹³ The 2019 Eat-Lancet report advocated a global shift in our eating patterns to reduce emissions—notably, a major shift from meat and dairy production to increasing plant sources of protein such as pulses that have low carbon imprints. The findings and estimates for each country were based on multiple assumptions and, as expected, were widely criticised by lobby groups and others. Nevertheless, most experts agree that eating less meat, especially beef, and to a lesser extent dairy, may be one of the most important climate actions individuals can take. Current health recommendations that endorse daily cow’s milk or two to three portions of fish, for example, may not be sustainable for the planet. Convincing countries like China to reduce meat and dairy consumption while other developed countries such as the US still eat fourfold to fivefold more of these foods per head will be another major challenge. More positively, linking an individual’s behavioural diet change to a national or global environmental goal could increase its chances of sustained success by aligning personal values with external, societal issues.

Education and training

The final pieces of the puzzle needed to make progress in nutrition include dissemination and education on areas of agreement as well as the new challenges and solutions. Academic nutrition departments need to embrace multidisciplinary approaches to improve the range and quality of nutrition research and improve understanding of new fields. Governments need to understand that a larger slice of the funding pie is required for nutrition research and that direct independent fund-

ing is necessary for major trials of food patterns.

The training of medics and health professionals and their ongoing lack of skill in offering dietary advice is an international disgrace.¹⁴ In most countries, students spend more time learning about scurvy, which they may never see a case of, than obesity. Many medical interns in diabetes still learn little about diet and lifestyle approaches yet are experts on rare side effects of drugs. Nutrition and obesity have few medically qualified specialists, and so we lack role models for aspiring clinicians.

The past few years have seen unprecedented changes in the nutrition problems facing us, but also major advances in our understanding. The field of nutrition will continue to grow in importance for our global health and wealth over the next decade. We have many of the tools needed to improve nutrition research. However, it remains to be seen if we have the flexibility and mindset to adapt to the considerable challenges that lie ahead, and whether this can be translated into substantive dietary change to improve population health.

Contributors and sources: Tim Spector and Christopher Gardner have both been publishing observational epidemiological and randomised controlled trial results in the area of nutrition science for more than 25 years. The essay draws on their collective experience and insights from their own studies, from collaborations with a wide range of colleagues, and from serving on multiple national and international scientific committees and organisations.

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Tim D Spector, professor¹

Christopher D Gardner, professor²

¹King’s College, London, UK

²Stanford University, Palo Alto, CA, USA

Correspondence to: T D Spector
tim.spector@kcl.ac.uk



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