



Position Paper

Challenges of Nutrition Sciences

How PAN Addresses the Issues Emerging from Nutrition Research and Communication

As a medical association that communicates evidence-based nutritional knowledge, PAN is constantly facing multiple challenges that come with nutrition science. What exactly are these challenges, and how does PAN handle them?

Nutrition science seems to be in a crisis. The general public, among them patients that could benefit from dietary changes, does not seem to trust the science anymore. This leads to an impeded approach to current and future patients, threatening public health.

Nutrition science no longer puts its primary focus on nutritional deficiencies. In the pre-industrial area, most diet-related diseases, such as scurvy, pellagra, or goiter were caused by some sort of deficiency in the diet (Bhatt 2010), so these diseases were discovered and cured through nutrition research.

Now, nutrition science no longer deals mainly with deficiencies (at least in the developed countries) but faces larger issues, such as preventing non-communicable diseases and gaining healthy life years of individuals and communities. They cannot be cured by simply eating a single ingredient or by adding a certain kind of supplement. With this new focus, new questions have to be asked, and new methods have to be applied. These methods, however, face several difficulties.

What is the status quo of people's diets?

As stated by the EAT-Lancet Commission, millions of people consume a diet that contributes to premature death and morbidity. Non-communicable diseases, among them cardiovascular diseases, cancer, respiratory diseases, diabetes and dementia, are responsible for 65% of global deaths. They are caused by four major risk factors: poor diet, smoking, alcohol consumption, and lack of exercise. Among them, poor diet even outweighs the role of tobacco, alcohol, and physical inactivity combined (Lancet 2014). People are



still eating too much red and processed meat, salt, sugar, and sweetened beverages and not enough fruits, vegetables, whole grains, legumes, and nuts and seeds. In 2017, 11 million global deaths could have been prevented by minimizing dietary risk factors (Lancet 2019).

Why are people's diets so unhealthy, that is, disease promoting?

This issue arises partially because of several problems nutrition science is facing. We want to address and discuss the three major problems here and provide potential solutions, hoping to contribute to healthier diets.

Problem #1: Contradictory Study Results

Research findings in nutrition science seem to be vastly inconclusive. Newly published studies often contradict each other, sometimes even leading to drastic paradigm shifts.

For example, the traditional paradigm concerning diet and heart health is that the consumption of dietary cholesterol is associated with cardiovascular disease (CVD) and mortality, which had been shown by observational evidence (Shekelle & Stamler 1989; Kushi et al. 1985). These results are consistent with early animal studies confirming an induction of atherosclerotic plaques in the aortas of rabbits when fed a high-cholesterol diet (Finking & Hanke 1997). Similar results were found for the association between dietary saturated fat, serum cholesterol, and risk of mortality from coronary artery disease (Keys 1980) that was confirmed by studies showing that the replacement of saturated fats with polyunsaturated fats leads to a reduction of serum cholesterol and coronary heart disease events (Hodson et al. 2001; Hu et al. 2001; Mozaffarian et al. 2010).

However, this "cholesterol/saturated fat" paradigm has been questioned due to the publication of several studies failing to show a role of dietary cholesterol in the development of CVD (Berger et al. 2015), resulting in a removal of the recommendation to restrict dietary cholesterol to 300 mg/day in the 2015-2020 Dietary Guidelines for Americans (Soliman 2018). The recent PURE study that was published in Lancet (Dehghan et al. 2017) challenged this paradigm even more, stating that a saturated fat intake is not associated with CVD mortality, but does even reduce the risk of stroke.

Then again, just recently another study seemed to re-confirm the traditional paradigm, showing that a higher consumption of dietary cholesterol or eggs is significantly associated with higher risk of incident CVD and all-cause mortality (Zhong et al. 2019).

The described discrepancies give rise to the public assumption that the recommendations derived from these research findings are arbitrary and might be changed fundamentally in just a matter of time, provoking indifference towards any dietary advice. To put it concisely, people find it hard to follow dietary instructions because food that is said to be healthy today could be said to be unhealthy tomorrow. This might induce the assumption that everything a person eats is unhealthy anyway. Hence, many people either



choose to not pay attention to any dietary advice at all, or they do want to obtain nutritional information but end up confused by contradictory statements and don't know what to do. Of course, this doesn't apply to everybody, but it is, in fact, a very common issue.

Regarding health professionals, especially doctors, the situation is not too different. Due to various causes, among them a lack of nutrition classes in most medical schools¹, physicians don't pay much attention to nutrition research, not to mention the fact that most of them do not have the time to thoroughly evaluate the available inconclusive evidence. As a consequence, they rely on standard (drug) treatment that is covered by unambiguous and conclusive guidelines based on research and expert opinions. To be precise here, it is not the case that the pharmacological evidence is conclusive, and nutritional evidence is not. The problem, rather, is that drug treatment is clearly regulated because there are task forces that evaluate the evidence and define clear guidelines, while no or very few of such guidelines exist for nutrition treatment, and in the case of existing nutrition guidelines, our health care systems don't allow for implementation of these guidelines into practice.

What is the reason research findings of nutrition science often seem inconclusive?

One major reason is that nutrition science relies mainly on study types that are not considered as the gold standard for evidence. Drug trials usually are designed as randomized controlled trials (RCTs), in which participants are assigned randomly to one of two groups. The subjects of one group are getting the treatment; the other ones get a placebo. This study design enables researchers to establish a causal role between the treatment and a symptom or a disease because the only thing that was different between these two groups was the treatment, keeping all other parameters stable. In fact, this study design was the one James Lind used to find out that citrus fruits have an impact on the development of scurvy (Bhatt 2010). However, with the larger issues nutrition science is addressing now, this study design is not feasible. It would be enormously expensive and time-consuming, and sometimes there could also be an ethical barrier, for example, if subjects had to consume nutrients that are strongly believed to be disease-promoting.

If researchers wanted to answer the question whether or not a Mediterranean diet prevents coronary artery disease by conducting a randomized controlled trial, the researchers would have to assign subjects to this diet (and a control diet) over several years or even decades to see an effect on the development of this slow-emerging disease. Most people, however, are not willing to stick to a precise diet plan over the course of several years, so this study would be doomed to failure.

To bring up a specific example, The Women's Health Initiative conducted a large nutrition study, assigning women randomly to two groups, one eating a regular diet, the other eating a low-fat diet. Even though the participants were demanded to follow the dietary regimen for years, the subjects did not. Billions of dollars were spent on this project, with no results because of skewed data (WHI I-III).

¹ That is why it is PAN's aim to reform the syllabus of medical schools, making nutrition a key part of medical training.



Of course, randomized controlled trials are possible for very defined questions, for example, if a vegan diet followed for eight weeks can lower LDL-cholesterol when compared to a “Western” diet high in meat and dairy products. However, to address the “big” questions, such as the prevention and treatment of complex diseases, nutrition science has to rely on observational studies. Observational studies either ask study subjects with a certain disease or disease factor about their diets during a certain amount of time in the past, or they track people for years, monitor their diet, and observe which diseases are developing. There are several problems that come along with these study designs. First, a causal relationship between dietary habits and disease cannot be established because the participants are not randomly assigned to two groups, keeping all parameters constant apart from diet. This is why the researchers need to control for so-called “confounding factors” that might be the actual cause of a certain impact on the disease. However, controlling for confounders does not exclude the possibility that the researchers miss an important one that is the actual cause. Second, since these study types are not interventional, they have to use food surveys to track the subjects’ diets. This leads to a problem called “recall bias.” People tend to forget about the things they eat, or they (most often unintentionally) “whitewash” their dietary habits and, for example, only indicate a piece of chocolate per day although they ate much more.

For example, a review by Archer and colleagues (2015) comes to the conclusion that memory-based dietary assessment methods, such as interviews and surveys, are “fundamentally and fatally flawed,” and hence, “these data are pseudoscientific and inadmissible in scientific research.”

As a result, nutritional research findings might turn out inconclusive because the outcome might not reflect actual causal connections but rather results from the flaws and limitations that are inherent in the design of observational studies.

Additionally, not only observational studies but also randomized controlled trials might be flawed by the wrong choice of control diet. A vegan interventional group compared to a control group that is eating large amounts of sugar and saturated fat might prove effective in terms of heart-healthy blood results. However, would it look the same if the vegan diet was compared to an omnivorous diet that includes animal-derived food groups in moderation? It depends on the thorough evaluation and interpretation of study results by academics and the media as to how the results are communicated to the public, leaving room for potential inconsistencies.

Another major reason for contradictory findings is the issue of conflict of interest. Nutrition trials are underfunded by governments, which opens the door for the food industry to sponsor studies of interest. This, on the one hand, threatens the credibility of nutrition science. On the other hand, it might influence study results, leading to heterogenous evidence. An opinion piece by nutrition and food policy researcher Marion Nestle, published in JAMA (Nestle 2016), reported that a collection of 76 industry-funded studies in nutrition research contained only 6 studies that found results contrary to its funder’s interest, which is consistent with the results of systematic analyses of industry sponsorships, seen for example in the case of sugar-sweetened beverages in obesity (Lesser et al. 2007). According to Nestle, “(...) independently funded



studies find correlations between sugary drinks and poor health, whereas those supported by the soda industry do not."

Research funded by industry is not necessarily flawed. However, funding has an impact on the initiation of certain studies and their hypotheses that are put to the test. Also, the results have to be interpreted with caution because of the potential risk of bias. Finally, funding influences the way the results are processed and presented by the media. If a company producing chocolate bars sponsors a study proving a beneficial effect of cacao flavonoids on endothelial function, and promotes the results, the media might react by producing the headline that chocolate is healthy, neglecting potential harmful effects of sugar or fat. Researchers might be biased not only by industrial funding, but also by their own opinions on certain foods or diets concerning ethical, environmental, or cultural beliefs. Religion might also play a role in nutrition, as most of the major religions have dietary guidelines, such as fasting, dietary exclusion of food groups (such as pork), or particular handling of food (Jewish kosher laws). Personal opinions or faith might lead to an interpretation of research results that are consistent with this belief system, and hence, to so-called confirmation bias that is contributing to inconclusive results.

Another huge fallacy in the area of nutrition science is the equation of single nutrients with the food or even diets containing them. The addition of fiber to a chocolate bar consisting of sugar and hydrogenated fat does not make this chocolate bar healthy in terms of obesity prevention because the fiber probably loses its satiating effect in the matrix of the other ingredients. Food is more than the sum of its nutrients.

The nutrient "vitamin C" might exert completely different effects whether it is consumed via supplementation or fruit.

Additionally, the effect of single foods cannot be equated with the effect of the food groups they belong to: fermented milk might have a blood pressure lowering effect, while total dairy consumption might not.

Finally, certain foods might act differently when consumed within different dietary patterns. An egg might have a different impact on health when eaten in the framework of a typical "Western" diet or a Mediterranean diet.

This so-called fallacy of composition contributes to the perceived inconsistent nutritional evidence because it is not recognized as the actual cause of contradicting studies looking at single nutrients and whole foods containing these nutrients, or single foods and dietary patterns containing these foods, respectively.

How does PAN deal with this major challenge when it comes to communicating nutritional research findings?

First of all, PAN tries to give a transparent overall picture of the available evidence and does not base its recommendations on single studies. PAN takes into consideration both observational and interventional studies, looks at research examining pathophysiological mechanisms, and especially focuses on systematic reviews and meta-analyses, constituting the highest grade of evidence. If there is a corresponding trend among these different types of studies that points in the same direction, PAN considers this as a hint to a link between a particular diet and a disease that is worth mentioning and worth a practical try. PAN also



takes a thorough look at the conflicts of interest study authors declare, and PAN interprets results yielded by these studies with caution. Whenever there is new research available, PAN views it in the light of the available evidence, rather adding to and not overturning previous statements. Finally, PAN does not presume to provide exact diet plans to follow, but rather to outline dietary patterns that are promising in preventing and treating non-communicable diseases.

Problem #2: Inconsistencies Around the Concept of Health

When people talk about diet, they wonder whether certain foods or diets are “healthy.” Diet cannot be thought about without the concept of health. However, it is, in fact, remarkable that in most discussions, the concept of health usually is not defined beforehand. If people have different concepts of what it means for a diet or food to be healthy or unhealthy, then it becomes comprehensible that inconsistent beliefs about what to eat or not coexist.

The concept of health needs to be viewed in the light of at least four different contexts:

1. A food or diet can be healthy/unhealthy with regards to a specific person with peculiar genetics, environment and diseases, or with regards to a certain kind of community, versus “statistical health” investigated in studies.
2. A food or diet can be healthy/unhealthy with regards to a specific (physical or mental) disease.
3. A food or diet can be healthy/unhealthy with regards to mortality risk or longevity.
4. A food or diet can be healthy/unhealthy with regards to an individual goal.

The following discussion illustrates these contexts with examples.

Concerning the first point, we always have to keep in mind that what might be healthy for one person might be unhealthy for another one, “healthy” being understood here as disease preventing. Every individual comes with his or her own genetics, epigenetics, microbiome, and so on, influencing the way he or she reacts react to his or her environment, ergo, the food he or she eats. For example, white bread usually is considered to be “unhealthy” because it is supposed to promote blood sugar spikes, and by this, eventually, diabetes and obesity. Whole-grain bread made with traditional sourdough, on the other hand, is consumed by long-lived people and centenarians in the so-called Blue Zones, representing an ideal food item for satiety, weight control, and nutrients. Researchers around Korem (Korem et al. 2017) conducted an RCT with a crossover design, assigning subjects to two groups that either ate one quarter of daily calories from industrially produced white bread or whole-wheat bread made with sourdough. Interestingly, opposed to the expectations, in more than half of the subjects eating the sourdough bread, blood sugar levels spiked higher than when the same subjects ate the white bread, which could be explained by the fact that their microbiome was different from the participants who could deal better with whole-wheat bread (Zeevi et al. 2015). These results suggest that white bread might actually be healthier for some people in terms of blood



sugar levels and potential diabetes prevention. Also, statistically, there were no differences between both groups, which would mean that both white and whole-wheat bread are equally healthy or unhealthy. However, this “statistical health” is not valid on the individual level because the study subjects had quite different individual reactions to both types of bread. However, the “averaging method” that is applied in every study is not able to reflect these individual effects that have to be taken into account when individual health is meant to be the focal point.

This study directly leads us to point number two:

White bread might be healthy for some people in terms of blood sugar spikes and potential diabetes prevention (this would have to be investigated further), but it might be unhealthy in terms of colon cancer prevention because the fiber is missing that constitutes the substrate for anti-proliferative short fatty acids (Scharlau et al. 2009). Health does not only have to be defined in terms of an individual person or statistical value; it also has to be viewed in regard to a specific disease, or, naming point 3, to general mortality risk. Is white bread considered healthy if it prevents diabetes but promotes colon cancer? Certainly not. Is it healthy if it prevents diabetes and promotes colon cancer, but reduces general mortality risk (hypothetically spoken)? The answer is tricky.

This point illustrates the problem that arises when the label “healthy” is put onto single foods or diets. By labeling foods or diets, the relatedness to single individuals, to specific diseases, or to mortality risk gets lost. This issue contributes significantly to the perceived inconsistencies of nutrition science and its communication.

Another use of reference that is less relevant to PAN, but still widely confused by the media, is the use of “healthy” in terms of a specific personal or cultural goal, for example, growing, weight loss, building muscle, or increasing mental performance. A diet high in dairy is supposed to make children grow big and strong, but is this healthy for them in terms of disease prevention? Of course, it would be healthy if “health” is equal to the state of being “big and strong.” The excessive supplementation of whey shakes might be “healthy” for a bodybuilder whose goal it is to build muscle. Training with a permanent protein deficit could be considered as “unhealthy” in this case, even though the bodybuilder could profit from it in terms of longevity.

How does PAN deal with the inconsistencies around the concept of health when it comes to communicating nutritional research findings?

First of all, PAN doesn't label foods or diets as healthy or unhealthy per se. By reporting research findings from a disease-orientated angle, PAN defines “healthy” in terms of disease-preventing or -modifying. PAN also looks at “the bigger picture,” that is, putting food groups or diets into the context of mortality risk. When PAN talks of health aspects of single foods or dietary patterns, PAN always looks at a broad variety of health effects and consequences. As a physicians' association, PAN considers a diet to be “healthy” if it promotes the state defined by the World Health Organization: “(...) a state of complete physical, mental and social



well-being and not merely the absence of disease or infirmity.” (<https://www.who.int/about/who-we-are/constitution>; last access: April 25, 2019)

As PAN provides information for many readers and viewers, it cannot take into account each individual's health. Thus, PAN entrusts personalized dietary advice to well-educated health professionals who are in contact with patients or interested individuals, providing them with evidence-based information that is based on statistics. Whenever studies indicate that certain food groups or diets yield heterogenic results among individuals, PAN points that out to leave room for customized advice. As explained before, what is “healthy” (or viable) for one individual might be “unhealthy” (or impractical) for another, resulting from their unique profile of (epi)genetics, microbiota, environmental factors, possibilities and attitudes.

Last, PAN encourages a deflationary usage of the concept of health in the context of nutrition science, as PAN endorses a clear description of the effects of diet on health and disease parameters, ergo, study results.

Problem #3: Entangling Nutrition Facts with Cultural, Ecological, and Ethical Aspects

Even though nutrition science represents a single research area just like, for example, nuclear physics, it can never be detached from cultural, ecological, or ethical aspects. This fact creates a problem for nutrition science because it challenges its scientific credibility.

Why is nutrition science entangled with these aspects? Science, like nuclear physics, usually is a descriptive discipline, trying to make statements about reality. While nuclear physics describes reality with formulas like this, for example, ${}^{235}_{92}\text{U} + {}^1_0\text{n} \rightarrow {}^{140}_{54}\text{Ba} + {}^{93}_{36}\text{Kr} + 3{}^1_0\text{n}$, nutrition science usually makes statements like “Concerning coronary heart disease risk, highest versus lowest consumption of whole grains is associated with a relative risk of 0.83.” This statement is per se also descriptive, but it is characterized by one important difference: It includes health. As soon as a scientific discipline is about single human individuals, their goals or their health (as presumably the most important goal), it cannot be considered a purely descriptive discipline anymore. Of course, nutrition studies justifiably aspire to describe entirely objective facts, but when it comes to interpreting and communicating these facts, they have to be viewed with regard to certain individual or community-related goals, putting these facts into a normative context. The concept of health established by the WHO does not only include mere absence from certain diseases, but also that mental and social well-being, political, cultural, religious, social, ecological, and ethical considerations might play a role in communicating nutrition science, too. Thus, as soon as food is discussed in the context of disease prevention, it can never be detached from the multilevel consequences that result from its production and consumption, because these consequences eventually affect human health at some point.



As all of those aspects are viewed differently from country to country, region to region, PAN International entrusts every single PAN branch to choose from and cover those aspects that are considered important in a specific community at its discretion in a highly scientific and descriptive manner.

For example, when it comes to recommendations for action, ethical or moral considerations might become necessary, encountering the ancient conflict between morals and facts, the gap between humanities and natural sciences. Referring to the abovementioned example of nuclear physics, if ethical considerations of the researchers had played a (preventative) role in the development of the atomic bomb that became scientifically possible by discovering physical laws, human history probably would look different. However, unlike nutrition science, nuclear physics does not put its major research focus on humans, their individual goals and their health, but on inanimate matter. This differentiates this scientific discipline from nutrition science, because the former does not necessarily evoke normative deliberations, resulting from a completely different research focus.

However, entangling descriptive nutrition study results with aspects from other scientific disciplines or even humanities threatens the credibility of nutrition science itself whenever these results are communicated in the context of these aspects, especially when it comes to recommendations.

How does PAN deal with this issue when it comes to communicating nutritional research findings?

As PAN is a medical association, it not only provides scientific information, but also gives practical recommendations. However, PAN is determined to separate the scientific evidence from ethical considerations. This is why PAN takes a descriptive approach first when it comes to gathering the recent evidence. Similar to a systematic review, PAN takes into account all the available studies relevant for a single topic and values their statements according to their scientific quality and their grade of evidence. PAN does not focus on single research areas, such as plant-based diets, but reviews the evidence in the framework of the question of which diet is best for preventing or treating a particular disease in terms of effectiveness. In terms of restoring the credibility of nutrition science and nutrition doctors, this comprehensive evidence-based approach is absolutely vital.

As a hypothetical example, if a high-quality meta-analysis with no industrial funding showed that a diet including three beef steaks a day versus no steaks significantly prevents Alzheimer's, PAN would report this result.

If the consumption of three beef steaks a day should be recommended to everyone is a different question that is much more difficult to answer. However, it certainly cannot be answered by distorting the evidence in a way that leads to a clear recommendation.

The answer indeed depends on multiple factors. First of all, it was already mentioned that it is difficult to label food groups or diets per se. In this example, three steaks a day could prevent Alzheimer's but might



lead to cardiovascular disease or cancer. That is why PAN puts study results into the bigger picture of health issues. Second, beef production raises enormous environmental issues that affect human health, as illustrated above. Third, farming cattle in terms of meat production raises important ethical issues.

Eventually, every recommendation PAN gives has to be applied to a single individual person. That is why PAN performs a stringent analysis of the current scientific evidence but does not ignore other aspects when it comes to discussing nutrition, pointing to potential cultural, ecological, or ethical impacts of the results. By choosing this strategy, PAN hopes to reclaim scientific credibility for nutrition science and provide helpful dietary recommendations that can be implemented by individuals at the same time.

Will PAN's Strategies Solve the Global Issue of Poor Diets?

In this essay, we have seen PAN's strategies to tackle the major problems with communicating nutrition science.

By comprehensively evaluating the current evidence on dietary factors and diseases, we try to elucidate the perceived inconclusiveness and make clear statements about study results and their limitations. By naming the explicit framework, PAN works with a transparent concept of "health," avoiding inconsistencies due to that cause. Finally, PAN is committed to science and to separate scientific facts from ethical issues, even though PAN acknowledges these issues in its recommendations.

However, it would be naïve of PAN to think that this strategy alone will restore faith in nutrition science and improve people's diets, but it certainly is a necessary first step into the right direction.

This way, health professionals and also the general public might start to trust nutrition research again, and a transparent presentation of dietary guidelines leaves room for self-determined diets that suit any individual person.

There still is a long way to go to really improve global nutritional status.

Information and practical recommendations will not suffice to change dietary behavior. There are many factors involved from perceiving the information to actually realizing it practically and keeping the new behavior in the long term.

This is yet another major problem the area of nutrition, in particular nutrition communication and counselling, has to face. It is remarkable that drugs are usually considered to be effective even though they do not work in some patients and even have side effects (skeptics of conventional medicine excluded). With nutrition, however, things look different. Even though diet has proven to be effective with regard to many diseases, it is quickly labeled to be useless when symptoms do not change right away, or it is even discarded as ineffective in the first place.



Additionally, many people are not willing to invest the needed time and effort to change their dietary habits, or they are lacking the mental strategies to put themselves through this behavioral modification and lose motivation.

Informing people about the great power of nutrition and giving them practical guidelines is helping with motivation, but it might not reach everybody.

So, instead of taking only so-called “downstream” actions, we also need “upstream” policy interventions promoting a health care system that supports close monitoring and coaching of patients, acknowledging the huge role of psychological factors in implementing dietary modifications.



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