Recommendations to address the shortfalls of the EAT–*Lancet* planetary health diet from a plant-forward perspective

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Shifting to dietary patterns rich in plants and low in animal-source foods could substantially lower emissions from the food sector while reducing the global burden of non-communicable diseases. The EAT–*Lancet* Commission proposed the planetary health diet (PHD) to emphasise plant-forward diets and set global targets to guide an urgently needed food-system transformation. However, the PHD's meat-reduction approach has attracted criticism and prompted debate on the potential micronutrient shortfalls of the plant-forward dietary approach. Since the planet simply cannot sustain human diets defaulting towards animal-based solutions, the objective of this Viewpoint is to provide recommendations that address the shortfalls of the PHD, with an emphasis on plant-based sourcing of food. Using a socioecological approach, along with an Integrative Sustainability Framework to evaluate dietary guidelines, in this Viewpoint we recommend seven key thematic areas for further development of the PHD. These themes relate to the bioavailability of micronutrients from plant-based foods, the inclusion of indigenous foods and practices, fortification and supplementation, cultural inclusiveness, and gender-based differences, a broader perspective on processed foods, and strengthening the concept by integrating the One Health approach.

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Introduction

In 2019, the EAT–*Lancet* Commission published a set of global, scientific targets to guide an urgently needed transformation of the food system towards healthier and more sustainable diets.[1] The proposed reference diet—known as the planetary health diet (PHD)—emphasises a shift towards a more plant-based diet, comprised mostly of vegetables, fruits, nuts, whole grains, plant protein (ie, beans, lentils, and pulses), unsaturated plant oils, modest amounts of dairy, and small quantities of meat and fish. It is estimated that a widespread shift to the PHD would reduce global dietary emissions by 17% and potentially prevent approximately 11 million deaths a year.[1,2]

An evaluation in 2023 indicated that the PHD has had a pronounced effect on scientific discourse, gaining substantial support within the academic community.[3] However, the PHD has attracted criticism regarding the quantity of animal-source foods (ASF) it contains and the affordability of such a diet.[3–5] In early 2023, Beal and colleagues[4] raised concerns that the PHD does not meet the micronutrient requirements of certain populations, particularly women of reproductive age. The authors argued that plant-based dietary patterns would provide inadequate intake of vitamin B12, calcium, iron, and zinc, and pointed out that high phytate intake from plant-based foods could negatively affect micronutrient bioavailability. Consequently, they recommended that the PHD should reduce the recommended intake of whole grains, nuts, and legumes while increasing the recommended levels of ASF.[4]

In response, a Correspondence from Springmann, one of the original PHD authors, addressed these critiques,[6] warning that reducing plant-based foods and increasing ASF is not feasible within planetary boundaries.[6] Compared with the PHD, the proposed adjustments would result in an estimated one million additional diet-related deaths, along with 43–64% more greenhouse gas emissions, 26% more cropland being used, and a doubling of food costs in low-income countries (LICs).[6] Although Springmann's response highlights that people and the planet cannot afford to simply default towards animal-based solutions, Beal and colleagues raise legitimate criticisms that need to be taken into account when developing recommendations for healthy and sustainable plant-forward diets.

Plant-forward diets can be defined as dietary patterns with a high proportion of plant-based foods that do not necessarily exclude all ASF.[7] The word forward recognises the ongoing process of moving in this direction, which will look different depending on context. We argue that a global transition to a healthy, plant-forward diet, as guided by the PHD, is indeed possible.

A global reference diet provides a general direction but needs to remain flexible so that it can be adapted to the differing needs of countries, both in terms of cultural acceptance and diverse socioeconomic settings. This adaptability applies particularly to ASF recommendations, as ASF consumption typically increases with urbanisation and rising incomes.[8] Although high-income countries (HICs) might benefit from meat reduction messaging, low-income and middle-income countries (LMICs) could instead be encouraged to preserve traditional plant-forward dietary patterns and be given support on how to optimise them. In all contexts, a deeper understanding of a well-balanced and nutritionally adequate plant-based diet is essential. This understanding requires access to reliable information, adequate availability of healthy foods, and the skills to plan, prepare, and consume balanced meals that cover all nutritional requirements.

Efforts across research, policy, industry, and civil society should be focused on addressing these shortfalls rather

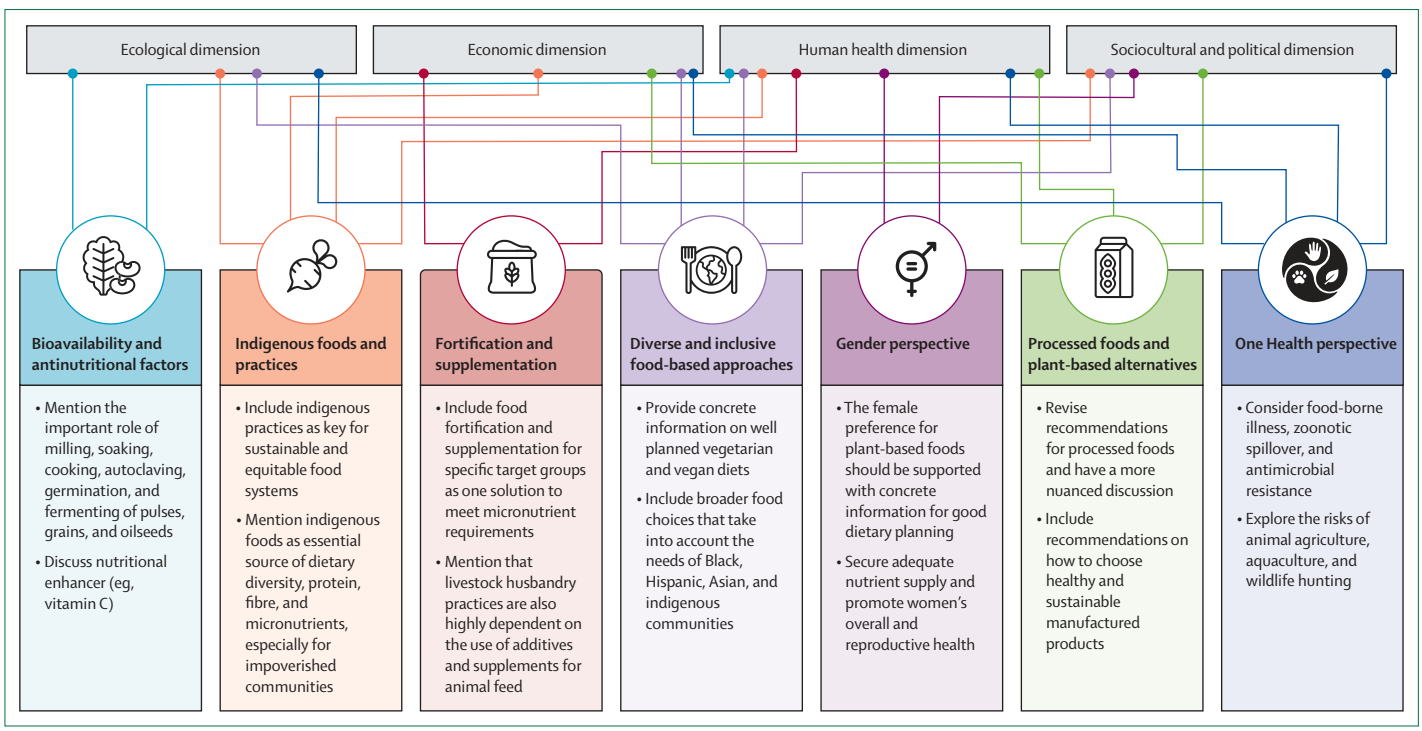

Figure: **Current shortfalls of the planetary health diet from a plant-forward perspective**
The four key dimensions of the Integrative Sustainability Framework[9,10] were used to identify potential shortfalls of the planetary health diet from a plant-forward perspective.

than proposing solutions that are not as viable. The objective of this Viewpoint is to contribute to the ongoing debate around the PHD and provide recommendations that address the shortfalls (figure) of the PHD from an inclusive and individual-centred perspective, while maintaining its strong plant-forward approach.[11] We have therefore established seven key thematic areas: the bioavailability of nutrients in plant-based foods and how to improve them, the inclusion of indigenous foods and practices, the options of fortification and supplementation, greater awareness of dietary inclusiveness, consideration of gender-based differences, a broader perspective on processed foods, and integrating the One Health approach, to promote health at the human–animal–environment interface.

Bioavailability and antinutritional factors

The first shortfall in the PHD that we identified is the absence of a discussion about bioavailability and antinutritional factors in plant-based foods. The PHD recommends dietary patterns with a high proportion of plant-based foods, so it is important to take the abosorption of nutrients into account to prevent potential micronutrient deficiencies in the general population. Appropriate absorption of micronutrients is particularly important in terms of the physiological requirement for iron in women of reproductive age. The bioavailability of certain nutrients in plant-based foods—such as iron, zinc, and calcium—can be lower than in ASF due to their forms (eg, haeme or non-haeme iron) and antinutrient content (eg, phytates, oxalic acid, and polyphenols).[12,13] However, there are proven methods to substantially increase the bioavailability of nutrients in plant-based foods. The Commission should prioritise these issues by incorporating a strategy in the PHD for reducing antinutritional factors and provide support in the form of food-related knowledge.[12–14] Specifically, in formulating the revised Commission, food processing and bioavailability, food combinations, the specifics of iron absorption, and the potential benefits of phytochemical compounds should be discussed.

Food processing and bioavailability

Techniques such as milling, soaking, cooking, autoclaving, germination, and fermenting are effective in improving nutrient bioavailability in pulses, grains, and oilseeds, and reducing antinutritional factors.[12,13,15] For example, the concentration of phytic acid in legumes can be substantially reduced through soaking and cooking.[12,16] Similarly, fermentation—widely practised in Africa—can significantly increase the nutritional value of grains via the liberation of soluble iron, zinc, and calcium.[17] This method can also increase the content of essential amino acids in grains and legumes.[12,17] Knowledge and information about these traditional and indigenous methods of food preparation need to be re-established and widely disseminated—for both consumers and food producers.

For plant-based sources of calcium, oxalic acid is considered a particularly relevant antinutritional factor, since it binds calcium, reducing its absorption.[13,18] Although foods such as spinach and rhubarb have low calcium absorption rates (~5%) due to the presence of oxalic acid, the calcium absorption rate of certain other green leafy vegetables, such as turnip greens, kale, and bok choy, is even higher (>50%) than that of cow's milk and dairy products (~30%), and these are therefore good sources of calcium.[14,19] In addition, calcium-rich mineral waters, and calcium-fortified plant-based milks and tofu, are also considered good sources of calcium.[18,20] Another factor affecting calcium bioavailability is the effect of sodium and protein intake, as high levels of these nutrients can increase urinary calcium excretion, potentially reducing calcium availability. Whereas tofu can be considered rich in protein, dairy products tend to have high concentrations of both protein and sodium, potentially reducing calcium availability.[19] We therefore encourage the Commission to provide a balanced recommendation on calcium sources, taking into account the bioavailability from a range of foods.

Food combinations: vitamin C to increase iron absorption

Combining different plant-based foods can help increase bioavailability, which is a particularly important aspect when it comes to the absorption of dietary iron. Haeme iron, which is primarily found in animal flesh, has a higher bioavailability (approximately 15–40%) than non-haeme iron, which is found in plant foods (bioavailability approximately 1–15%).[21] However, vitamin C (ascorbic acid) is a powerful enhancer of the absorption of non-haeme iron. As such, iron-rich plant-based foods, such as pulses and grains, should be consumed in combination with sources of vitamin C.[14] A 2017 systematic review and meta-analysis by Heffernan and colleagues[22] concluded that increasing vitamin C intake remains a practical approach to generally lower the risk of iron deficiency and minimise the occurrence of iron-deficiency anaemia.

The specifics of iron absorption

Further to food combinations, an aspect that needs to be considered when discussing adequate iron intake is the inverse relationship between iron absorption and serum ferritin concentrations.[21] People who follow a mostly plant-based diet usually have lower serum ferritin concentrations, and people with low serum ferritin concentrations are able to absorb non-haeme iron much better than people with high concentrations of serum ferritin. In other words, the more plant-based a person's long-term diet is, the better their body is able to absorb non-haeme iron.[21]

In 2023, van Wonderen and colleagues[18] investigated the estimated absorbable iron content of omnivorous, vegetarian, and vegan diets in women of reproductive age, using four different methods. They found that estimates of absorbable iron by diet-dependent equations are highly dependent on the model and parameters used. Of all the input parameters, serum ferritin concentration affected the models most. Currently there is no common standard on which serum ferritin concentrations should be used to assess dietary requirements.[18] Thus, the estimate of absorbable iron needed to meet recommended daily allowances was highly dependent on how high or low the researchers set the assumed serum ferritin concentration. This finding suggests that estimates of iron absorption need to be interpreted relatively to have broad applicability.[18]

The potential benefits of phytochemical compounds

So far we have discussed the antinutrient properties of phytochemical compounds; however, some of these compounds also have potentially beneficial effects. For example, phytic acid and phenolic compounds are considered natural antioxidants, and their anti-inflammatory and anticarcinogenic properties have been documented.[12,23] It is therefore crucial to take into account the effect of both potential dietary enhancers and inhibitors in seeking to reduce nutritional shortfalls and optimise health. Pulses and grains are affordable and nutrient-dense sources of protein, iron, and zinc, and constitute the main dietary source of human energy, worldwide,[24,25] and pulses have a key role to play in sustainable agriculture.[26]

Indigenous foods and practices

The second shortfall that we identified in the PHD is the absence of an acknowledgement of the importance of indigenous foods. Indigenous foods are re-emerging as a key factor in developing sustainable and equitable food systems around the world. These indigenous foods are species or varieties that occur naturally in particular geographical areas.[27] The role of indigenous foods in resilient and diverse food systems is not included in the PHD; as such, we recommend that they be incorporated and promoted for their environmental, nutritional, cultural, and socioeconomic benefits.

The consumption of local indigenous foods plays an important role in nutrition and food security, especially in LMICs and regions.[28–30] Indigenous fruits, vegetables, legumes, and grains often form the staple ingredients of rural diets. In Botswana, for example, there are an estimated 150 edible wild and semi-wild plant species, including leafy vegetables and indigenous fruits, that are integrated into diets.[28] The resilient nature of these foods, along with their availability during periods of drought and environmental stress, contribute substantially to food security.[28,29]

Indigenous plant-based foods have considerable nutritional value, often with higher levels of micronutrients than non-indigenous options.[29,31] Indigenous and traditional foods are an essential source of

micronutrients, protein, and fibre, and enhance dietary diversity, especially for vulnerable communities. One serving of pigweed and cowpea leaves, for example, provides more than 75% of the daily vitamin A requirement.[30]

However, widespread consumption of indigenous foods is often restricted by a number of factors, including social stigma due to their association with rurality and lower socioeconomic status. In LICs undergoing a nutrition transition away from traditional foods and towards westernised convenience-food products, indigenous foods are often perceived as being inferior, despite their often superior nutritional profile.[32] The PHD should include indigenous foods and acknowledge the multidimensional benefits of indigenous foods that are nutrient-rich, climate-resilient, economically affordable, and locally available.[33]

Nowadays, large supermarkets rarely provide access to indigenous plant-based foods, rather prioritising fruits and vegetables that can be mass-produced by commercial farmers. Indigenous varieties of foods are mainly found in markets or informal stalls. In these settings, however, the shortage of cold storage, and the lack of hygiene standards requirements can compromise their quality.[34] Dietary guidelines around the world should constitute the foundational source of education on how to consume these indigenous and traditional foods safely and optimally; Brazil and Canada are two examples of countries that have integrated indigenous foods into their national food-based dietary guidelines.[27] Despite high variability across countries, future iterations of the PHD should identify the role of plant-based indigenous foods as a lever for food and nutrition security, particularly in LMICs.

Fortification and supplementation

The third shortfall concerns fortification and supplementation, which is limited to a side note in the current iteration of the PHD.[1] To exclude this option in dietary recommendations ignores the evidence that food fortification and supplementation can address vitamin and mineral deficiencies in populations cost-effectively and sustainably.[35–38]

Food fortification is the process of adding vitamins and minerals to staple foods. This approach has, in fact, been used for several decades as a safe and effective policy strategy for preventing micronutrient deficiencies in populations and improving diet quality.[39] For example, in Costa Rica, rice is fortified with various nutrients, including vitamin E, selenium, and zinc; in the USA, flour is fortified with iron and vitamin B12; and, in Israel, cereal-grain products are fortified with folic acid.[39,40] Also, the widespread practice of fortifying salt with iodine has successfully addressed iodine deficiency worldwide, reducing the number of countries considered to have iodine-deficient populations from 110 to 19 since 1993.[38,39] Despite these widespread successes, the effectiveness of these public health interventions should be measured regularly so that the evidence is strengthened and updated.

A 2019 systematic review and meta-analysis found that the large-scale fortification of staple foods has improved the micronutrient and health status of women and children in LMICs.[35] Additionally, WHO also encourages large-scale food fortification as an impactful evidence-informed and cost-effective intervention to combat vitamin and mineral deficiencies, including iodine-deficiency disorders, anaemia, and iron deficiency, among others.[41] Although fortification often requires a further processing step, according to the NOVA classification, fortified staple foods still belong to Group 1 (minimally processed foods) or Group 2 (processed culinary ingredients).[42] The extent to which ultra-processed foods can contribute to the nutrient supply of a healthy and sustainable diet is discussed in the Processed foods and plant-based alternatives section.

Current barriers to large-scale food fortification include low levels of political motivation, low levels of funding, poor industry compliance with standards and regulations, the high costs of fortification ingredients, a lack of accessibility and equity for consumers, insufficient coverage of the population, and resistance from interest groups.[35,37,39,40] Although these barriers are neither scientific nor technical in nature, they present challenges that are relevant to national policy implementation.

When considering the reasons for and against the use of large-scale fortification, it is often forgotten that livestock husbandry practices are already highly dependent on the use of additives and supplements for animal feed. Additives are widely used in animal feed to improve the health of animals and the quality of ASF. For example, the need for cobalt supplementation in ruminants to allow for adequate vitamin B12 synthesis has been documented for decades in many regions of the world,[43] and is now a widespread practice in beef and dairy production.[44,45] Without the common practice of feed fortification, ASF would not contain adequate amounts of vitamin B12 and other micronutrients.[44–47] This practice indicates that, regardless of whether diets are animal based or plant based, addressing certain micronutrient shortfalls can be difficult without the use of fortification or additives.

In addition to population-level fortification, individually taken supplements can also address the micronutrient requirements of specific target groups.[14,48,49] For example, WHO recommends iron and folic-acid supplementation for all pregnant women, regardless of their iron status.[48] WHO also recommends iron and folic-acid supplementation for all women of reproductive age in regions where the prevalence of anaemia is more than 20%.[49] A 2023 systematic review and meta-analysis found that iron supplementation can help improve the markers of iron deficiency anaemia among women of reproductive age in LMICs.[50] However,

	Criteria	Score for PHD (total maximum score 58)	BFCI maximum score* (total maximum score 100)
1	Has no food group with only animal-based meat, fish, or eggs	18	18
2	Has no food group with only dairy	0	18
3	Mentions plant food sources for five critical nutrients of plant-based diets (3 points per nutrient): protein; iron; calcium; zinc; omega-3 fatty acids	3; 0; 0; 0; 3	3; 3; 3; 3; 3
4	Recommends obtaining vitamin B12 without animal-based foods	5	5
5	Mentions plant-based alternatives to meat in text (3 points) and food graphic (3 points)	3	6
6	Mentions plant-based alternatives to milk in text (3 points) and food graphic (3 points)	0	6
7	Mentions plant-based alternatives to dairy in text (3 points) and food graphic (3 points)	0	6
8	Gives recommendations on vegetarian (including vegan) diets	12	12
9	Mentions health benefits of vegetarian diets	9	9
10	Mentions sustainability benefits of vegetarian diets, plant-based foods, or both	5	5

BCFI=Balanced Food Choice Index. PHD=planetary health diet. *Full points if yes, zero points if no.

Table: **The PHD evaluated using BFCI criteria**

more research is needed on micronutrient supplementation, with higher-quality data and more accurate assessments of individual and geographical variances. For example, iron absorption can be affected by malaria, which is obviously particularly relevant for regions with high prevalences of malaria.[48,50] Since absorption from supplements follows the same principles as absorption from food, there needs to be an increase in the awareness among women of reproductive age of the importance of enhancers and inhibitors.[50]

In summary, regardless of whether we choose a plant-forward diet or increase our consumption of ASF, fortification, supplementation, and additives can play a key role in improving health outcomes in both individuals and populations. These options should not be discarded, but should rather be evaluated in terms of the human costs and benefits while acknowledging the limits of planetary boundaries.

Diverse and inclusive food-based approaches

The PHD's recommendations for the consumption of ASF are indicated in terms of a range that starts at zero.[1] This range allows for inclusive individual dietary choices, including vegetarian and vegan diets, which is especially important for people who eat little or no ASF for ethical, ecological, religious, economic, or other reasons. However, to cater for diets that contain little or no ASF, concrete information on what constitutes well-planned vegetarian and vegan diets is needed.[14,51] This lack of proper information is the fourth shortfall that we identified in the PHD.

In their global analysis of national dietary guidelines, Klapp and colleagues[51] developed the Balanced Food Choice Index (BFCI) to measure the extent to which food-based dietary guidelines provide recommendations that cover the broad spectrum of plant-based diets, with might include some or no ASF. The overall scores are calculated on the basis of 10 indicators and 17 variables, with points awarded according to the level of nutritional information provided by a food-based dietary guideline. According to the BFCI, a food-based guideline is classified as balanced if it allows for inclusive food groups (ie, there is no food group comprised only of ASFs), if it provides nutrition information about the crucial nutrients of plant-based diets (ie, protein, iron, calcium, zinc, omega-3 fatty acids, and vitamin B12), if it gives recommendations on vegetarian (including vegan) diets, and if it mentions plant-based alternatives to ASF as well as the health and sustainability benefits of vegetarian diets, plant-based foods, or both.[51]

When using the indicators from the BFCI for evaluation, the PHD scored 58 out of a possible 100 points (table). Although the PHD allows for a variety of plant-based protein sources, enabling easy substitution of meat, the same level of information is not available for the substitution of cow's milk. The PHD also has no information about meeting calcium requirements with plant-based foods, a micronutrient that is found in dairy products and is often cited as a reason for consuming dairy. The PHD thus fails to adequately represent the informational needs of the broad spectrum of people who follow plant-based diets, and those who are lactose intolerant. 70% of the global population face difficulties in fully digesting lactose, with a higher observed prevalence in Black, Hispanic, Asian, and indigenous communities, and in LMICs.[51,52] Additionally, milk allergy is the most life-time prevalent allergy in Europe, as reported by 6·0% of people (followed by wheat [3·6%] and eggs [2·5%]).[53]

To be more inclusive and acknowledge the broad spectrum of plant-based diets, we recommend that the Commission either include unsweetened calcium-fortified plant milk in the dairy group, or include dairy in the protein group and mention plant-based foods such as green leafy vegetables as a source of calcium. Existing examples can be found in the dietary guidelines of countries such as Canada, Namibia, the Netherlands, and Qatar.[51]

Gender perspectives

Another shortfall already identified by Beal and colleagues is that the specific iron needs of women of reproductive age might not be sufficiently met by the current PHD.[4] However, it is our view that Beal and colleagues' recommendation to resolve the nutritional challenges faced by women simply through eating more meat is highly problematic and fails to consider gendered dietary patterns.

Individuals who menstruate, become pregnant, and give birth have higher and more variable iron requirements, and it is necessary to be aware of this when devising standardised dietary recommendations. Specific recommendations for improving iron intake in plant-forward diets can be found in other sections of this Viewpoint.

In addition to consideration of varying nutritional requirements, it is equally important to take gender-specific dietary patterns into account. These differentiated dietary patterns are the products of socialisation, based on socially constructed norms of masculinity and femininity.

Data analysis in social science research has repeatedly shown that meat consumption is associated with masculinity, and that those who identify as female generally consume less meat and more plant-based foods.[32,54–56] Various studies have also shown that women tend to be more connected to animal welfare and environmental protection, which could explain why they tend towards plant-forward diets and are substantially more likely to be vegetarian or vegan.[54,56–59] Other factors such as sexism, socioeconomic conditions, cultural reasons, and beliefs also affect gender-specific food choices.

One might expect that the gender gap in meat consumption would decrease as economies develop and the opportunities available to women expand. However, a growing body of research suggests the opposite.[60–62] For example, a recently published cross-cultural analysis of more than 20 000 individuals in 23 countries across four continents found that, in all the countries analysed, women tended to consume less meat than men, with this difference increasing significantly in countries with higher human development and gender equality.[60] This finding suggests that, as wealth and gender equality increases around the world, plant-forward diets are likely to become even more relevant for women.

Regardless of the reason for doing so, following a plant-forward diet offers numerous benefits for overall health. The positive health benefits identified by the EAT-*Lancet* Commission include lower rates of obesity and overweight, coronary heart disease, stroke, and type 2 diabetes than in those whose diets are high in meat.[1] In addition, there is growing evidence of health benefits from plant-forward diets that are specific to women, adolescent girls, and people who menstruate; for example, a 2023 review suggests that meat consumption is associated with a higher risk of developing endometriosis.[63] Moreover, adherence to a healthy plant-rich diet that is high in fruits, vegetables, whole grains, and legumes, and low in salt, sugar, saturated fats, and red and processed meats, might reduce the risk of breast cancer.[64–66] Furthermore, several meta-analyses conclude that the regular consumption of soya and soya products, which are often used as meat and dairy substitutes,[67] are associated with reduced risk of breast cancer and overall cancer incidence.[68–70] Regular consumption of soya products might also reduce breast cancer recurrence and improve survival.[71]

Varying physiological requirements and dietary preferences should inform solutions that ensure an adequate nutrient supply across all stages of life, specifically including reproductive age. Making increased meat consumption the default recommendation is neither sustainable nor realistic. Academics and government institutions should avoid being presumptuously paternalistic about people's food choices, and instead provide education on how to follow a well-planned plant-forward diet that covers all macronutrient and micronutrient requirements, while also promoting overall and reproductive health.

Processed foods and plant-based alternatives

The sixth identified shortfall relates to the discussion of processed foods. The EAT–*Lancet* Commission discourages the consumption of highly processed foods.[1] Although it is evident to most that biscuits and chips should not be consumed in excess, there are other highly processed foods, such as wholegrain bread or calcium-fortified soya milk, that can play an important role in healthy, sustainable diets.[72,73] According to widely used food classification systems, such as NOVA, all of these foods are categorised as highly processed;[42] however, assuming that a food is unhealthy and unsustainable simply because it is highly processed is inaccurate and potentially misleading.[72,74] To address this misconception, the EAT–*Lancet* Commission update should provide clearer guidance on how to select healthier processed foods instead of broadly discouraging the whole category.

The Commission uses the term highly processed foods generically, without any reference to any specific food classification system.[1] There are several classification systems that categorise foods according to their level of processing. The most relevant are the Food Standards Australia New Zealand, International Agency for Research on Cancer, International Food Information Council, International Food Policy Research Institute, and NOVA.[75] These systems differ in many aspects, including the types of ingredients and the number of processing steps needed to classify foods as highly processed. Despite the differences, the proponents of these systems all share the idea that the more processed a food is, the more unhealthy it is, regardless of the nutrient content of the final product. Although these

systems and ideas have been widely adopted by leading food and health organisations, they have been also widely criticised by others.[42,72,74]

The idea that a food product is unhealthy and unsustainable just because it is manufactured or processed lacks biological plausibility and confuses consumers.[72,74,76] A 2023 simulation study showed that it is possible to consume a diet with a high nutritional quality that is compliant with US dietary guidelines, even with over 90% of calories from foods classified as ultra-processed.[73] Low-income populations in both LICs and HICs often live in so-called food deserts, where fresh produce (such as fruit and vegetables) is not easily accessible.[77] Highly processed foods such as pre-prepared frozen vegetables and packaged wholemeal bread, could improve the diet quality of these communities. These manufactured foods also play an important role in reducing the work-related burden of women. Apart from routinely spending more time than men on household chores, women typically also do the shopping, planning, and cooking of almost all meals for their families.[78–80] Relying on some manufactured staples without having to cook healthy meals from scratch reduces the time that women spend on unpaid care work, another reason why it is important to provide guidance on which highly processed products can be part of a healthy, sustainable diet, rather than imposing a blanket restriction on all highly processed foods.

To address this misconception around highly processed foods is particularly relevant for plant-based alternative products. Crucially, plant-based alternatives to popular ASF can play an important role for people transitioning to a more plant-based diet, since these products often closely resemble the familiar taste and texture of foods that people are used to and like.[51] Numerous studies show that, compared with their animal-sourced counterparts, plant-based alternatives can have several health benefits and are often more environmentally sustainable.[81–83] But, according to the NOVA classification, plant-based alternatives such as oat milk, tofu, and plant-based burgers are considered ultra-processed.[84,85]

Decades of nutritional research have shown that lower amounts of salt, saturated fat, and free sugars, along with higher amounts of dietary fibre, are the most important determinants of the healthiness of both individual foods and diets as a whole.[1] Evidence suggests that, compared with the ASF they intend to replace, plant-based meat alternatives can have lower levels of total and saturated fat, salt, and calories, and contain more dietary fibre.[84,86–88]

Since one can find both healthier and less healthy products within the same category, the PHD should promote better product reformulation and encourage consumers to choose products that comply with recognised nutrient standards, whenever possible. An example of this can be found in the Netherlands, where the government-financed Nutrition Centre published macronutrient and micronutrient standards for products intended to replace meat and dairy.[87] From a consumer's perspective, the PHD should encourage the selection of healthier plant-based alternatives, which can be achieved by promoting (where available) products that feature more favourable front-of-pack labelling. These front-of-pack labelling systems are based on nutrient criteria established by national governments—Nutriscore in Europe, and the black warning labels in South America, are some examples.[88]

In addition to their potential nutritional benefits, plant-based alternatives can be substantially more environmentally sustainable than ASF, and should be integrated into the PHD for this reason.[81–83] A recent review indicates that, compared with ASF, production of plant-based alternatives generates 70% less greenhouse gas emissions and requires 70% less land and water.[81] Almond milk was the only exception because its production requires more water than cow's milk.[86] However, more research is needed on the environmental effects of different types of highly processed foods, and how to optimise processing and packaging.[89]

In HICs in particular, plant-based alternatives represent a food category with promising potential to substantially reduce ASF consumption, with people increasingly choosing them over meat and dairy. A prospective cohort study,[90] based on the EPIC cohort, and involving more than 266 000 participants showed that higher levels of consumption of ultra-processed ASF and sugar-sweetened beverages were associated with an increased risk of multimorbidity from cancer and cardiometabolic diseases. However, they also found that other subgroups of foods, such as ultra-processed breads and cereals, as well as plant-based alternatives, were not associated with this risk.[90] Rather than maintaining an ambiguous stance on these products, the Commission should offer clear recommendations on how to select healthier options within the context of plant-forward diets.

One Health perspective

The seventh and final shortfall we identified is the missing integration of the One Health approach. Although the PHD's current recommendations for reduced consumption of ASF are theoretically already in line with One Health, the PHD would be strengthened by integrating an approach that promotes health at the human–animal–environment interface. Whereas the notion of planetary health explores human health and its interrelatedness to the natural environment, the One Health approach takes human and environmental concerns into account and adds a third dimension—animal health.[91] As food systems reach into all three of these disciplines, any analysis of food systems should also take cognisance of the most commonly researched One Health topics, including wildlife conservation, the transmission of foodborne illnesses, zoonotic spillover, and antimicrobial resistance.[91–93]

To meet the global demand for ASF in a world with a growing population, livestock farming will need to be further intensified or increased. However, farmed animals are already the leading consumers of antibiotics worldwide, which constitutes a high global risk from the One Health perspective.[94,91] When antibiotics are used excessively or inappropriately, there is a risk of pathogens becoming resistant in both animals and humans,[92] which leads to antimicrobial resistance, one of the world's ten leading global health threats.[95] In 2019, an estimated 4·95 million deaths worldwide were associated with bacterial antimicrobial resistance, with the majority of these deaths occurring in western sub-Saharan Africa. Since Africa is the smallest consumer of veterinary antibiotics worldwide, this statistic further emphasises that the worst effects of global health threats, such as climate and biodiversity change, zoonotic spillover, and antimicrobial resistance, are felt by populations who are not themselves driving the problem.[92]

The exchange of infectious diseases between the environment, animals, and humans frequently occurs due to contaminated and unsafe foods. Foodborne illnesses affect 600 million people every year, causing 420 000 annual deaths and economic losses of US$110 billion.[96] Food-producing animals, such as cattle, chickens, pigs, and turkeys, serve as the primary reservoirs for many foodborne pathogens, including *Campylobacter* species, non-Typhi serotypes of *Salmonella enterica*, Shiga toxin-producing strains of *Escherichia coli*, and *Listeria* monocytogenes.[92] Foodborne pathogens are thus mostly present in meat, dairy, fish, and eggs. So far, no effective intervention has been able to eliminate foodborne pathogens from animals. Although plant-based foods can also trigger foodborne diseases, the respective fruits and vegetables are often contaminated with waste from infected animals.[92]

Moreover, zoonotic spillover—in which pathogens cross the animal–human species barrier—accounts for 60% of emerging or new infectious diseases in humans.[97] Although the origins of future spillover events are impossible to predict, an increase in the demand for ASF and the required intensification of animal agriculture and aquaculture substantially increases their likelihood. The increased risk of spillover events is based on a complex set of factors related to food systems, including biodiversity loss through land-use change, infringement on natural habitats, high livestock density, agricultural inputs, and wildlife hunting.[98] Although wildlife hunting can be a vital source of nutrients, food sovereignty, and security, as well as a source of perceived wealth, in many communities around the world,[93] the fact that the majority of emerging diseases come from wildlife cannot be ignored and requires context-specific measures.[97,98]

In the absence of intervention, meat consumption could continue to rise globally, further driving the use of antibiotics and increasing the risk of zoonotic spillover. The potential for the associated threats to immobilise our global health system requires urgent further attention and increased awareness. The above scenarios emphasise the need for the One Health approach to form a core evaluative component of a true cost–benefit analysis of our food choices.

Conclusion

While recognising that the PHD is an important tool for understanding healthy and sustainable food choices, the objective of this Viewpoint is to provide recommendations that address current shortfalls from a plant-forward diet perspective. The seven key topics we have identified include the bioavailability of plant-based foods and how to improve them; the inclusion of indigenous foods that are nutrient-rich, climate-resilient, economically affordable, and locally available; the options of fortification and supplementation; greater awareness of dietary inclusiveness and gender-based differences; a broader perspective on highly processed foods; and the need for an alignment with a holistic approach, such as One Health, which

Search strategy and selection criteria

The content of this Viewpoint was conceptualised in preparation for a consultation that took place in June, 2023, as part of the process of formulating an update to the original planetary health diet (PHD). Concepts that support a deeper understanding of balanced plant-forward diets were identified. Beginning with a socioecological framework similar to that used by other food system analyses, we further narrowed down the framework by using the Integrative Sustainability Framework (developed by Ahmed and colleagues, 2019) for evaluating national and regional dietary guidelines). The Integrative Sustainability Framework looks at four key dimensions of sustainability (ecological, economic, human health, and sociocultural and political). These key dimensions were used to identify potential shortfalls of the PHD from a plant-forward perspective (figure). In this context, a shortfall refers to specific areas that need to be improved and expanded upon in future iterations of the PHD.

To provide an empirical grounding for this Viewpoint, we conducted a review of both the academic and grey literature (in English), with the aim of providing an overview of findings from peer-reviewed articles and relevant reports, and documents from the databases of UN agencies and intergovernmental and non-governmental organisations. We searched PubMed and Google Scholar, between March 10 and Aug 31, 2023, for references (with any publication date) that use the following terms (which align with the key dimensions of the Integrative Sustainability Framework): "antimicrobial resistance", "anti-nutritional factors", "bioavailability and plant-based foods", "breast cancer and plant-based diet", "dietary guidelines and plant-based diets", "feed additives", "food security", "food-borne illness", "fortified foods", "gender and animal welfare", "gender and environmental protection", "gender and vegetarian diet", "gender equality and diet", "gendered dietary patterns", "gendered food choices", "indigenous foods", "iron bioavailability", "lactose malabsorption", "large-scale fortification", "micronutrients", "nutrient quality", "nutrition transition", "One Health", "planetary health diet", "plant-based alternatives", "plant-based diets", "plant-based sources and calcium", "supplementation micronutrients", "supplements animal feed", and "women health and plant-based diet". Articles were screened by title and abstract to identify relevant full-text reports, and were considered relevant if the scope of the article was in English, within the defined concept of the Integrative Sustainability Framework, and the study population was adults; systematic reviews and meta-analyses were chosen with priority.

promotes the health of humans, animals, and the environment.

The evidence clearly shows that people and the planet cannot afford to simply default towards animal-based diet solutions. But it is also clear that we need a holistic view of the opportunities and challenges associated with a plant-forward approach to diets. Sometimes that means looking back and recognising traditional knowledge, and sometimes that means breaking with tradition and being open to new technologies. The EAT–*Lancet* Commission update should take these recommendations into account to increase the uptake of healthy, plant-forward diets around the world.

Contributors

A-LK contributed to the conceptualisation, methodology, formal analysis, visualisation, writing of the original draft, and editing. NW contributed to the conceptualisation, formal analysis, writing of the original draft, and editing. RA, AP-C, and CN contributed to the writing of the original draft, reviewing, and editing. AR contributed to the reviewing and editing of the Viewpoint.

Declaration of interests

A-LK is an employee of ProVeg International and a PhD student at the University of Göttingen. NW and RA are employees of the Physicians Association for Nutrition. All opinions presented in this article belong to the authors alone, and not to any organisation with which they are or were affiliated. CN, AP-C, and AR declare no competing interests.

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