The availability and affordability of nutrition

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The key function of the global food system is to deliver nutrition to the global population. Therefore, when we are considering the sustainability of current and future food systems, nutrition should be prioritised.

There are many aspects to ensuring global nutrition, but I will address two key questions here. Firsstly, are the foods that individuals need for adequate nutrition affordable, so that all individuals can meet their nutrient requirements with their income? Secondly, are the nutrients required by the global population delivered by the global food system?

The affordability of nutrition

A common approach to understanding whether nutrition is affordable in a given country is to establish the nutrient requirements of the population, the nutrient composition of the foods available and their retail cost, and then use mathematical modelling techniques to find the least cost nutrient adequate diet. This approach was taken by Chungchunlam *et al.* (2020) for the United States (US). Using US supermarket foods and prices, they found that the least cost daily diet that met the nutrient requirements of the average US adult had a retail cost of US$1.98. This diet contained 15 different food items, with milk, legumes and rice the greatest contributors by mass. Eggs and fish were also included in this diet.

The authors also wished to establish the least cost diet that consisted entirely of plant foods. They repeated the analysis with animal-sourced foods removed and found that the least cost nutrient adequate diet in this case had a retail cost of US$3.61, a substantial price increase over the previously mentioned diet. Soymilk, legumes, and red cabbage were the greatest contributors by mass in this instance.

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Finally, the authors investigated what degree of price increase would be necessary to various animal-sourced foods before they no longer featured in the original least cost nutrient adequate diet. An 8-fold increase was necessary in the price of milk before it no longer featured, while the increases for eggs (11.5-fold), fish (6.5-fold) and meat products (3 - 5.5-fold) were also substantial.

While this research applies to the US, other researchers have taken a similar approach globally. Taking nationally representative food retail costs from countries around the world, Bai *et al.* (2021) found that the least cost nutrient adequate diet had a global average retail price of US$1.35, varying between US$1.00 and US$1.89 depending on location. However, due to the great variation in household incomes around the world, the cost of these diets was between 1% and 77% of average household expenditure. The least cost nutrient adequate diets were least affordable in regions such as Central Africa and South East Asia (Figure 1).

There was also variation in the foods included in the least cost nutrient adequate diets in different countries. In countries with lower average household incomes, meat and seafood were included in the diet, whereas these were replaced by dairy and eggs in countries with higher average incomes. This reflects the differing relative prices of these foods in different parts of the world. However, what was constant throughout the diets was a need for nutrient dense foods – in this instance, those that deliver high quantities of essential nutrients relative to energy and at a low retail price.

The availability of nutrition

Is there enough food produced by the world to feed the world? More specifically, are the nutrients required by the global population available to the global population in food?

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Dr Smith is responsible for the continued development of the DELTA Model, a tool for investigating how global food production meets global nutritional requirements as part of a sustainable food system.

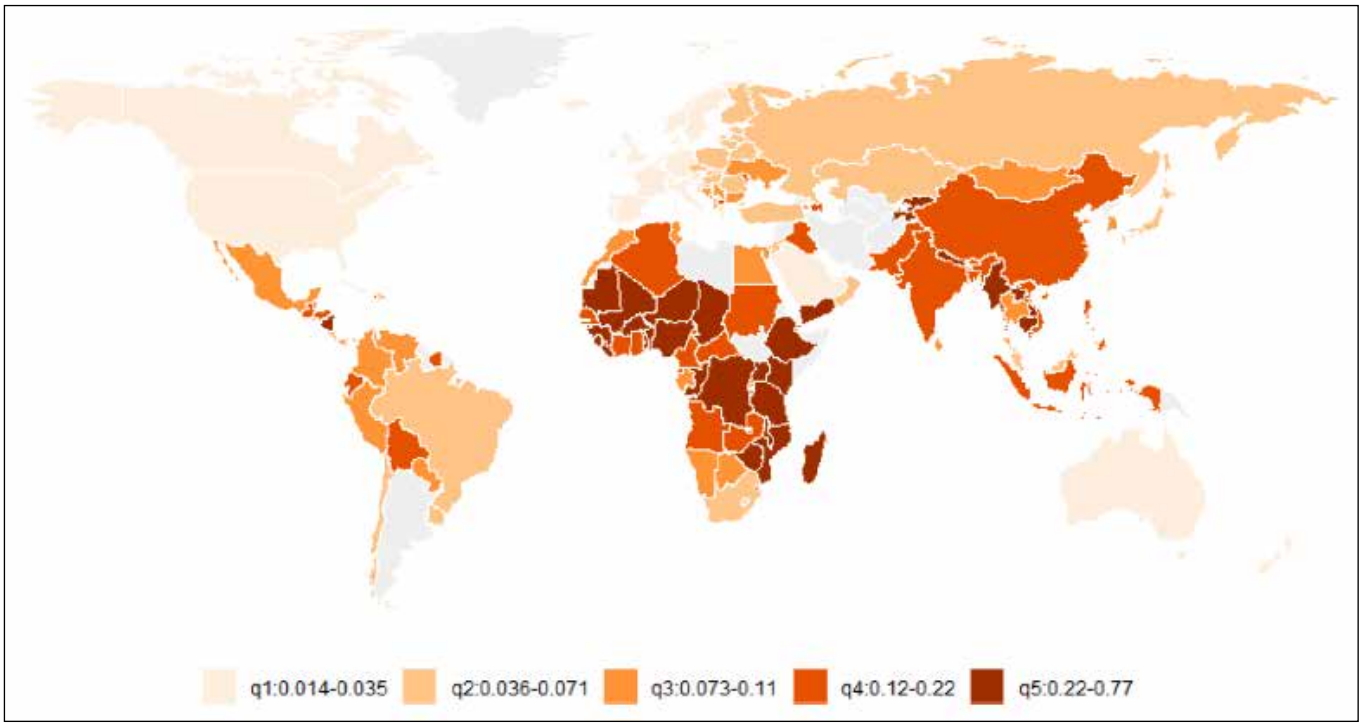

Figure 1. Cost of nutrient adequacy as a proportion of mean household expenditure. Reproduced from Bai *et al*. (2021).

The Sustainable Nutrition Initiative™ at the Riddet Institute has addressed this question using the DELTA Model (Smith *et al*., 2021). This model captures data for global food production, distribution, waste, and end uses, coupled with food composition and nutrient bioavailability data to produce a total quantity of globally bioavailable nutrients. This is then compared to age- and gender-weighted global nutrient requirements for 29 nutrients, to establish whether global availability matches up to requirement.

The DELTA Model has found that, in 2018, sufficient macronutrients were produced globally to meet the requirements of the population. The same was not true for micronutrients, with calcium and vitamin E supply insufficient to meet global requirement. Other micronutrients, such as iron, potassium, zinc, riboflavin, vitamin A, and vitamin B12 were all less than 10% above global requirement, indicating vulnerability. These gaps will grow in size and number in the future without positive changes to the food system to ensure nutrition for all (Smith *et al*., 2021).

A limitation of the DELTA Model's global perspective is that it does not capture the inequitable distribution of food and nutrients around the world. In a step towards this, the same

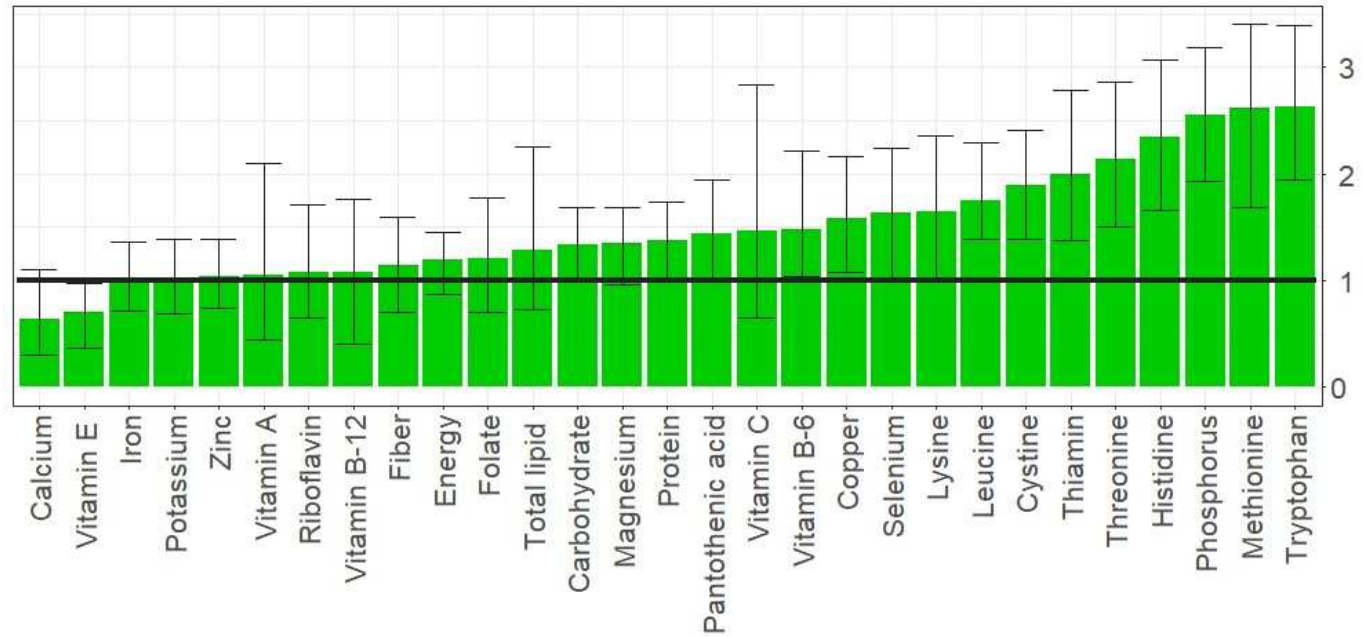

Figure 2. Variability in the availability of nutrients in different countries. The availability of individual nutrients is plotted against global requirement. The black horizontal line at 1 indicates the global requirement for each nutrient. The coloured bars show global availability of each nutrient. The range bars show the range in availability of each nutrient between the 10th and 90th percentiles of the global population, based on national averages. Source: the DELTA Model, version 1.3 (Sustainable Nutrition Initiative, 2021).

framework has been applied at a national level for the world's countries. Taking New Zealand (NZ) as an example, the model tells us that in 2015 there was sufficient macronutrient availability in NZ to meet the requirements of the NZ population. However, once again there were gaps for micronutrients. In this case, there was insufficient calcium, fibre, iron, potassium, folate and vitamins C and E available to meet requirements. This is despite the fact that NZ produces between 1.5 and 6 times the amount of all of these nutrients needed by our own population, with the exception of our low vitamin E production.

Applying this same approach to all the world's countries allows us to see the extent of inequitable nutrient distribution. Figure 2 shows that, while at the global average level almost all nutrients are available in excess of requirement, the list of nutrient gaps in individual countries is far longer. Distribution of food and nutrients should be addressed alongside increasing production.

However, the global and national perspectives above do not capture the variation in nutrient availability and consumption at the individual level. NZ nutrition survey data paint a similar picture to the national view from the DELTA Model. The last NZ adult nutrition survey found that 59% of adults had inadequate calcium intakes (particularly women), 6% had inadequate iron intakes (34% of adolescent females), and 2% had inadequate vitamin C intakes (particularly men) (University of Otago and Ministry of Health, 2011). For almost all nutrients, there were individuals found by the survey who had inadequate intakes.

These results highlight the differences between the global, national, and individual perspectives on nutrient availability and intakes. However, if there is insufficient global availability of a nutrient to meet global requirements, there cannot be sufficient availability at the national level for all countries. Similarly, if there is insufficient national availability of a nutrient, there cannot be sufficient availability for all individuals. Thus, all three perspectives are valuable and complementary.

Conclusion

The affordability and availability of nutrition must be a central consideration when discussing changes to global or national food systems. Research has shown that affordable nutritious diets contain diverse foods of both plant and animal origin, and that nutrient dense foods are critical. The need for nutrient density also applies to the question of availability of nutrition: nutrient dense foods (particularly micronutrient dense) are important for ensuring sufficient availability of all nutrients to a growing global and national population.

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