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POLICY FORUM

What Lies Behind the Transition From Plant-Based to Animal Protein?

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Abstract

Dietary changes that occur in response to economic development are collectively known as the *nutrition transition*. More specifically, diets built around staple cereals and tubers give way to diets with more animal products and more added sugars and fats. Although the proportion of dietary protein stays constant, plant proteins are replaced by animal proteins but in ways that are dependent on regional cultural, religious, and ethical concerns. The *protein transition*, viewed here as a subset of the broader nutrition transition, illustrates how dietary patterns in low- and middle-income countries (LMICs) are shaped by societal as well as by economic forces. The complexity of food decisions justifies the need to integrate nutrition with the social sciences in the study of evolving food systems.

The Nutrition and Protein Transitions

Economic development in low- and middle-income countries (LMICs) is accompanied by a *nutrition transition*.[1] Traditional diets built around staple starchy crops, such as cassava or rice, are gradually being replaced by more varied diets containing more animal products, more vegetables and fruit, and more processed foods containing added sugars and fats.[2,3] The modernization of traditional food patterns is accompanied by longer food supply chains, changes in food retail, and more frequent eating away from home.[2]

Dietary intake data from LMICs undergoing nutrition transition show that the consumption of vegetable oils, animal fats, and added sugars rises sharply while the consumption of starchy staples declines.[1] In general, starchy staples are less palatable, less appealing—and often less nutritious—than the more varied dietary options that become newly available to the more affluent consumer. The nutrition transition to more varied food patterns with a higher proportion of processed foods has long been considered to be an economic phenomenon and a natural, if sometimes regrettable, consequence of economic development.[1]

While dietary sugars and fats rise sharply, the proportion of protein in the diet remains virtually constant.[1] Although there is a general shift from plant to animal proteins, the choice of animal protein appears to be strongly dependent on geography, religion, and

culture. The *protein transition*, viewed here as a subset of the nutrition transition, illustrates how the drivers of food choice may not be purely economic in nature. Cases in point are the sharp regional differences within Asia in the consumption of beef and pork or of milk, yogurt, and cheese, which may not be a part of local customs or the local food culture.[4,5] These foods' incorporation into local food patterns can engage deeper societal, cultural, and ethical concerns.

Economic Drivers of the Nutrition Transition

To what extent the adoption of "modern" diets within LMICs is a direct economic consequence of higher household incomes remains unclear. Based on studies of global dietary trends, the proportion of energy from animal fats is a direct function of gross domestic product (GDP), whereas the proportion of added sugars in the diet is linked to both GDP and urbanization.[1] The advent of inexpensive vegetable oils and added sugars has weakened past links between the consumption of fat and sugar calories and country GDP. Even low-income countries can now afford inexpensive if empty calories, mostly from added sugars and vegetable fats.[1,3]

These shifts in dietary patterns, associated with the nutrition transition, follow two classic laws of economics. Engel's Law states that the proportion of the household budget spent on food diminishes as incomes rise.[6] Whereas populations in high-income countries (HICs) spend a negligible amount of disposable income on food, the food budget can reach 50% or more of income in LMICs.[7] The concept of what foods are "affordable" is thus relative, depending on absolute food prices in relation to local incomes.

The Food and Agriculture Organization of the United Nations (FAO) has recommended the use of a food price-per-calorie metric in evaluating food and agriculture policies for LMICs,[8] and the World Bank has defined the poverty line in food and nutrition terms by estimating the cost of basic food needs, including both calories and essential nutrients.[9] Working in India, Subramanian and Deaton[10] calculated the cost of food commodities in rupees per 1 000 kcal, showing that cereals and sugar provided calories at far lower cost than did meat, dairy, or vegetables and fruit.[11] The same structure of food prices has been observed in HICs, including the US, France, and the United Kingdom (UK).[12,13] A similar pattern of prices was observed in Mexico where tortillas and lard provided more calories and lower-cost calories than did vegetables and fruit.[14] Not surprisingly, low-cost cereals remain the staple energy source of many global poor.[15]

Bennett's Law states that the proportion of the budget spent on staple grain crops diminishes as incomes rise.[16] In general, grain calories are cheap, whereas most nutrient-rich foods are not. Indian consumers switched from low-cost cereal calories to more expensive calories as their living standards rose.[11] In other countries, likewise, the more affluent consumers do not consume more dietary energy, but their diets are more varied

and their calories cost more.[15] One way to measure food affordability at the local level is to express food prices not in absolute amounts but as a percentage of disposable income for the population of interest. Comparing food prices to diet costs is another promising approach, as foods viewed as affordable by the middle class may not seem affordable to groups with lower income, especially in LMICs.[15]

The hidden health cost of inexpensive global diets is now coming into view. Public health agencies are increasingly concerned about the dual burden of malnutrition that is characterized by the persistence of nutrient deficiencies and stunting among children and by increased body weight among adults.[3] Both forms of malnutrition can be traced to poor quality of the habitual diet, especially among the urban poor. LMICs bear the burden of the nutrition transition,[17] as it has become possible to have diets more than adequate in calories but deficient in key nutrients. The key issue in planning dietary interventions for LMICs is not the provision of additional empty calories but improving the nutrient-to-energy ratio. There are different ways of achieving this aim.

Protein Quality

The current consensus in the US is that human health is best served by plant-based diets that are rich in whole grains and contain a variety of vegetables and fruits, pulses, and legumes.[18] Americans are currently advised to replace red meat and meat products with more beans, legumes, lentils, fish, poultry, seafood, or lean meat.[18] It is something of a paradox, then, that the current plant-based food consumption patterns of groups with lower incomes in Southeast Asia, where rice is the primary food source, tend to be deficient in calcium, iron, and zinc.[19] Some of these deficiencies can be remedied by the addition of small amounts of animal foods to the diet. A 2004 report by the World Health Organization stressed the need to diversify diets built around cassava, rice, corn, wheat, or potatoes largely because of protein quality and amino acid imbalance, particularly lysine deficiency.[20] Dietary guidelines issued by regional governments have stressed the need to diversify largely plant-based diets by including some animal proteins. For example, dietary guidelines developed for Vietnam by the FAO stress the need to consume protein-rich foods from "a good balance of vegetable and animal sources," including seafood as well as beans and peas.[21] The National Institute of Nutrition has also advocated increased consumption of dairy products to remedy prevalent calcium deficiencies and promote bone growth.[22]

The tradeoff between the impact of foods on population and planetary health is complex. One view, originating from meat-eating countries, is that plant-based diets are healthier for people and better for the planet.[23] Another position is that the high-nutrient density of animal foods needs to be balanced against their higher cost and greater impact on the environment.[24] Economic and ethical tradeoffs may need to be made. Modeling studies suggest that the environmental impact of dietary patterns in HICs can be substantially reduced without eliminating meat or dairy products altogether.[25] One problem, however,

is that low-cost foods with low environmental impact are not necessarily the most nutrient dense and do not necessarily provide high-quality protein.[24]

The Cultural and Ethical Drivers of the Protein Transition

Some aspects of the nutrition transition seem to occur regardless of cultural or religious factors, food traditions, or local agricultural production patterns. These include more dietary energy from diverse sources and replacement of starchy staples (eg, cereals, roots, and tubers) with more animal products, including meat, poultry, fish, and milk and other dairy products, as well as more vegetables and fruit. These aspects of the nutrition transition seem to occur regardless of cultural or religious factors, food traditions, or local agricultural production patterns. As animal and vegetable fats and added sugars increase, however, the protein content of the diet in LMICs stays virtually constant at 12%-14% of energy.[1] The protein transition, defined by the replacement of plant proteins by (high-quality) animal proteins, is a poorly characterized component of the nutrition transition. The income-dependent shift from plant-based protein to animal protein tends to be country specific. The choice and the quality of the protein appear to be driven not only by economic factors but also by geography, religion, and culture.[4] Depending on geographic location and local habits, plant proteins from staple grains can be replaced by meat (beef, pork, poultry), by fish, or by milk and other dairy products, including yogurt and cheese.

The Drivers of Food Choice competitive grants program, supported by the Bill and Melinda Gates Foundation and the UK government,[26] stresses that food choice is integral to "social and economic expression of identities, preferences, and cultural meanings and ultimately influences nutrient intake and health."[27] While processed foods, added sugars, and fats in the diets of LMICs have received much research attention,[3] the social and cultural drivers of the protein transition have not. Regional differences have consequences for trade and the local food supply. Some countries in Southeast Asia have shown rapid growth in the consumption of poultry and fish but not dairy; the growth in consumption of animal protein in East Asia was driven by rapidly rising pork consumption in China. By contrast, the growth in consumption of animal protein in South Asia (India) was driven by the consumption of milk and dairy foods.[2] These regional differences suggest that drivers of protein food choice are not purely economic but include cultural factors such as religion, shared traditions, individual attitudes, motivations, and beliefs.

Understanding the drivers of food choice requires the study of multiple biological, psychological, economic, social, cultural, and political factors. For example, in past studies,[4] Malaysian food consumption patterns have been linked to the 3 main ethnic groups (Malay, Chinese, and Indians) and a few minority groups. Each group has its own food culture with its typical dishes and ingredients, dietary taboos and restrictions, dining rituals, form and structure of meals, and symbolic dimensions of food. Studies of

why people choose the dietary protein that they do lend themselves to a mixed-methods approach blending qualitative interviews or focus groups with quantitative surveys, which is currently missing from most observational studies in nutritional epidemiology. Social sciences can serve to describe local food habits and food cultures in different dimensions: from actual practices, to social representations and beliefs, to social norms. Focusing on what people eat and would like to eat under a variety of conditions adds a motivational or cultural component to standard nutritional or economic surveys.

Conclusion

The nutrition transition in the rapidly developing and urbanizing countries of South Asia and Southeast Asia involves a context-specific shift from plant to animal protein sources. The drivers of protein choice go beyond economics and involve ethics, religion, and culture. The inclusion of social sciences in the study of the protein transition complements existing work in nutritional epidemiology.

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