



Shaping Physical, Economic, and Policy Components of the Food Environment to Create Sustainable Healthy Diets

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Abstract

Background: Sustainable healthy diets are those dietary patterns that promote all dimensions of individuals' health and well-being; have low environmental pressure and impact; are accessible, affordable, safe, and equitable; and are culturally acceptable. The food environment, defined as the interface between the wider food system and consumer's food acquisition and consumption, is critical for ensuring equitable access to foods that are healthy, safe, affordable, and appealing.

Discussion: Current food environments are creating inequities, and sustainable healthy foods are generally more accessible for those of higher socioeconomic status. The physical, economic, and policy components of the food environment can all be acted on to promote sustainable healthy diets. Physical spaces can be modified to improve relative availability (ie, proximity) of food outlets that carry nutritious foods in low-income communities; to address economic access certain actions may improve affordability, such as fortification, preventing food loss through supply chain improvements; and commodity specific vouchers for fruits, vegetables, and legumes. Other policy actions that address accessibility to sustainable healthy foods are comprehensive marketing restrictions and easy-to-understand front-of-pack nutrition labels. While shaping food environments will require concerted action from all stakeholders, governments and private sector bear significant responsibility for ensuring equitable access to sustainable healthy diets.

Keywords

food environment, food affordability, food availability, sustainable healthy diets, food policy

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Introduction

Equitable access to sustainable healthy diets¹ can be achieved by acting on the food environment. The food environment is defined as the physical, economic, political, and sociocultural context in which consumers engage with the food system.² One conceptual definition divides food environments into *personal environments*, such as food accessibility, food affordability, convenience, and desirability; and *external environments*, such as food availability, prices, vendor, and product properties and marketing and regulation.³ The food environment concept can also be understood as the physical places, social spaces, and information exchange that influence consumers' food acquisition and consumption.

The global food supply shifted from staple grains to energy-dense, nutrient poor foods, whether in the form of ultra-processed foods, sugary drinks, or foods prepared with excessive fat, salt, or sugar.⁴ Therefore, the food energy supply has markedly increased over the last decades.⁵ These energy-dense, nutrient-poor foods are generally offered at a much lower cost compared to nutrient-rich foods.⁶ Low-cost calories have become the default for most of the global poor, leading to gross inequalities in access to healthy foods.

In this article, we discuss how the physical, economic, and policy components of food environments shape individual and population access to sustainable healthy diets. The section on physical food environments covers outlets where food is acquired or consumed, including marketing and product placement. The section on economic food environments addresses global and regional food prices, affordability, and convenience. The policy section covers key government actions to improve food environments, including examples of economic interventions.

Physical Food Environments

Measures

The physical food environment generally refers to the availability (ie, density per square kilometer) of food outlets, types of outlets (ie, grocery stores and restaurants), as well as the foods available inside the outlets. Studies on the food environment

in relation to dietary and health outcomes have benefited from Geographic Information Systems methods and tools, sometimes deployed alongside consumer surveys on measures of perceived food environments.⁷ The first generation of studies primarily defined food access in terms of distance between home and the nearest supermarket. Because people do not always shop at the nearest supermarket, attention shifted to the distance between home and the supermarket of choice. Proximity to food sources has little to do with diet quality, however, especially in North America where most of the food shopping trips are by car. By contrast, physical aspects of the food environment are important in pedestrian contexts or where access to transportation is scarce. Global Positioning System methods are now increasingly used to track exposure to food environments in space and time.⁸ There are few longitudinal studies, however, and less than 30% of studies reported reliability and validity of measures.⁹

Physical Food Environments in High-Income Countries and Food Choices

In general, the number of food outlets within a geographical area is associated with adults' dietary intake,^{10,11} but the evidence is mixed due to considerable variation in data collection methods.^{11,12} In the United States, associations were found between mobile produce markets and fruit and vegetable intake. Location of these mobile markets was the most cited factor of their use.¹³ Measures of perceived food availability more consistently show a relationship with dietary outcomes than objective measures.^{11,12,14}

In-store food environments may also influence food purchases. Shelf tags, taste testing, flyers, posters, or other signage were found to encourage healthy food purchases in grocery stores.¹⁵ Food placement in-store and prominence¹⁶⁻¹⁸ as well as in-store promotions¹⁴ have also been shown to influence food purchases.

Physical Food Environments in Low- and Middle-Income Countries and Food Choices

Food environments are changing rapidly in low- and middle-income countries (LMIC). There is an

exponential increase of supermarkets,¹⁹ fewer produce markets in some countries,²⁰ and an increase in supply of ultra-processed foods, sugary drinks, snacks, and an increase in establishments for eating away from home.^{4,21-23} While studies measuring food environments in LMIC have increased in the last decade, evidence on the relationship between food environments and health is scarce, and standardized methods and metrics are needed.¹⁹

Food environments in LMIC include both market- as well as nonmarket-based food sources (own production, wild harvested foods, and transfers/gifts).³ Among rural communities, market access, typically measured as distance (km) to the nearest market, modifies the relationship between production and dietary diversity. A pooled analysis of data from Ethiopia, Malawi, Kenya, and Indonesia showed that market access had stronger effects on dietary diversity than did production diversity.²⁴

In LMIC, of great concern is the excessive exposure to low-cost, unhealthy foods. A mixed methods study in Mexico showed that food access was influenced by 4 factors: the density of food outlet type, the availability of food inside the outlets (eg, variety, quantity, quality, pricing), the promotion of different foods, and perceptions of exposure to unhealthy and healthy foods.²⁵ In Brazil, fruit and vegetable availability in São Paulo neighborhoods was significantly associated with regular fruit and vegetable consumption among adults (≥ 5 times/week). Regular consumption was significantly lower among lower-income individuals living in neighborhoods with fewer supermarkets and produce markets.²⁶ Fast-food restaurants were more likely and supermarkets were less likely to be located in low socioeconomic status neighborhoods.²⁷

The role of street food in LMIC in influencing food access is an emerging topic of research.^{28,29} The percentage daily energy intake from street foods in adults in LMIC ranged from 13% to 50% and in children from 13% to 40%.³⁰ A study in Delhi found high levels of saturated and trans fats in snacks sold by street food vendors.³¹

A study in Accra, Ghana, investigated the characteristics of the local food environment in an urban poor setting and the associated risk of

obesity,³² and found a 0.2 kg/m² increase in body mass index (BMI) for every additional convenience store and a 0.1 kg/m² reduction in BMI for every food vending location in the study area, after controlling for individual sociodemographic characteristics, lifestyle behaviors, and community characteristics. The ready-to-eat vending locations offered both healthy and unhealthy options, while convenience stores mostly sold processed foods with high caloric value.³²

Inequalities in Food Access

The distribution of outlets may also differ by the neighborhood composition and purchasing power.³³ Low-income neighborhoods generally have a disproportionate share of low-cost, unhealthy foods^{33,34} and in some,³³ but not all,³⁵ cases lower access to supermarkets. It is the lower-income groups with least resources that are disproportionately affected by the poor quality of their local food environment.³⁶ A population-based cohort study in the United Kingdom found that high fast-food outlet exposure amplified differences in fast-food consumption across levels of education.³⁷ Another United Kingdom study demonstrated independent associations of neighborhood fast-food outlet exposure and household income with diet and obesity.³⁸ In general, the association between food environment exposure and dietary behaviors may vary by socioeconomic position.³⁹

The Economic Food Environment: Food Prices, Affordability, and Convenience

People generally eat what they can afford. Whereas calories in the global food supply have become cheap, nutrient-rich foods remain more expensive. While lower-income groups worldwide may have adequate (or even excessive) energy intakes, they are at risk for nutrient deficiencies. Further, transient or permanent food insecurity tends to shift household food purchases toward securing adequate energy intakes and away from nutrient-dense foods.^{40,41}

The Price of Nutritious Food

Retail food prices reflect global commodity prices and/or local supply demand.⁴² About two-thirds of rural households and the majority of urban household in LMIC are net buyers of food,^{43,44} so food price fluctuations can affect both rural and urban groups. In Bangladesh, a lower price of rice was associated with a lower prevalence of underweight.⁴⁵ In Indonesia, the combination of high food prices and reduced incomes during the economic crisis in the late 1990's led to an increase in child anemia.⁴⁶

In general, staple foods (wheat, maize, rice, vegetable oil) are cheaper per 100 calories than fresh, nutrient-dense foods (vegetables, fruits, nuts, animal-source foods, beans, pulses).⁴⁷⁻⁴⁹ Food prices and diet costs need to be compared to disposable incomes, in accordance with Engels Law. American households in the highest income quintile only spend 8.2% of disposable income on food, while households in the lowest quintile spend 35% of their income on food.⁵⁰ By contrast, the poorest households in LMIC spend 50% to 80% of their total expenditure on food, with most purchases directed toward staple grains, some condiments, vegetables, and affordable sources of animal protein such as dried fish.⁵¹ Such a diet can put the population at high risk of micronutrient deficiencies.^{52,53}

In high-income countries, diet quality is predicted by social class and income.⁵⁴ In 2006, families in France living below EUR 2.5 per person/d were unable to afford a nutritious diet, priced at EUR 3.5 per person/d.⁵⁵ In the United States, severe food insecurity was linked to lower intakes of fruit and vegetables, larger proportion of calories from cereal-based meals, high-fat protein food, and sweetened beverages.⁴⁰ In New Zealand, the cost of healthy household diets were on average 14% more expensive than the average current diet.⁵⁶

Measuring Food Affordability

Estimating the cost of a 2000 kcal/d diet is a standard method to measure affordability of diets across countries or population groups.^{57,58} In general, higher quality diets are associated with

higher per 2000 kcal diet costs.⁵⁹ Fewer studies have looked at the relative cost of nutrient adequacy. In the United States, the most affordable sources of calcium, vitamin C, and fiber were milk, orange juice, and beans, respectively.⁶⁰ In a review of school lunches in the United States, vegetables and fruits, beans, and white potatoes were found to provide most nutrients per penny.⁶¹ In Mexico, the lowest-cost diets were those with traditional energy-dense foods (tortillas and tamales), consumed more by the rural low-income people, and vegetables and fruit were more expensive.⁴⁹

Another way to assess food affordability is by comparing the price of a food relative to staples (mostly cereals; relative caloric prices [RCP]).⁶² In LMIC, higher RCP for milk was associated with higher prevalence of stunting, whereas lower RCP for soft drinks was associated with more overweight.⁶² An alternative way is to calculate the cost of delivering 2000 kcal/d or daily value of a nutrient (protein, calcium) from specific foods or food groups. Such metrics, sometimes expressed as calories or nutrients per penny,⁵⁷ can also be used to assess the environmental cost of producing nutrient-dense foods or nutrient-rich diets.⁵⁸

Several affordability measures are used.⁶³ The Cost of the Diet linear programming software⁶⁴ has been used to estimate the cost of a food list that meets both energy and nutrient needs for diverse households at the lowest cost possible, while respecting current eating habits. Affordability was assessed by comparing the generated cost to a population's food expenditure (Supplementary Figure 1).

Cost of Nutritious Meals and Diets in LMIC

The cost of a basic meal and a healthy diet in many LMIC is staggering. An analysis by the World Food Program compared the price of a basic plate of food (staple + legume stew) in 34 different countries to the average per capita income in each country.⁶⁵ The proportion of daily income that people in LMIC would have to spend for one 600 kcal meal ranged from 2.7% to 13% across different countries in Asia, and 7% to 45% across nonconflict affected countries in Africa, to

155% in South Sudan. Expressed as a proportion of daily income in the United States, a meal's price was USD 94.43 in Malawi, USD 61.93 in Mozambique, USD 9.34 in the Philippines, and USD 8.27 in Guatemala. For 3 meals per day, the estimated proportion of income that would have to be spent increases to 9% to 50% across Asia and 25% to 158% for nonconflict affected countries in Africa.⁶⁵

A nutritious diet is estimated to cost 2 to 7 times more than a diet that meets only energy needs,^{64,66} and a nutritious diet is not affordable for many households (Supplemental Figure 2). In low-income, nonconflicted countries in Africa, such as Mozambique and Niger, nutrient-rich diets were generally not affordable in rural and urban areas. In Indonesia, nutritious diets were affordable for 90% of households in Surabaya (second largest city), but only for 20% of households in West Timor.⁶⁷ Purchasing power is needed to deploy education interventions and to influence consumer choice.⁶⁶

Convenience: Time, Fuel, and Water

The concept of convenience (note 1) relates to the time costs and effort costs spent in purchasing, preparing, and cooking.⁶⁸ That time and effort spent on food preparation and cleaning up are borne primarily by women. Time costs are both objective (hours spent on task) and perceived (being rushed or feeling time constrained).⁶⁹ In the United States, higher fruit and vegetable consumption was associated with >2 hours per day spent in preparing, cooking, and cleaning up.⁷⁰ Individuals who spent <2 hours per day on such tasks were 70% more likely to eat at fast-food restaurants.⁷⁰ American families with time constraints were more likely to eat snacks and use ready-to-eat meals or eat at restaurants.⁶⁹ Among families in the United Kingdom, convenience strategies for cooking included combining natural ingredients with either packaged ingredients, such as bread, tortilla flour, pasta, or ready-to-eat meals and snacks.⁶⁸

In many LMIC, obtaining fuel and water increases the time, effort, and cost of food preparation among lower-income groups. In Malawi, women spent 6 to 10 hours/week gathering

fuelwood.⁷¹ Women respond to fuelwood shortage by cooking cereals and beans less often.⁷² In South Africa, there is a shift toward rice because it requires less time to cook.⁷³ In India, urban-dwelling families who owned a pressure cooker were protected against severe food insecurity, even after controlling for household socioeconomic factors.⁷⁴ Water insecurity forces some women to prepare fewer water-intense meals⁷⁵; others decide to buy water, which increases the cost of meals.

Policy Options to Create Healthy Food Environments

Governments are encouraged to implement comprehensive policies to shape food environments. Policies that can address both sustainability and health⁷⁶ are more likely to garner wide support. The NOURISHING framework^{77,78} identifies 6 types of policies to create healthy food environments. Food environment policies have been shown to have equal or greater benefit to lower socioeconomic groups.⁷⁹ We present some policy examples in this section.

Labeling is one example of policy at point-of-sale. The existing mandatory or voluntary schemes for front-of-package labels include traffic lights, warning labels, and summary rating schemes such as the Health Star Ratings and Nutriscore.⁸⁰ There is some evidence that some types of front-of-package labels help consumers make healthier choices^{59,81} and encourage industry to product reformulation.⁸² Labeling schemes could further consider environmental measures such as animal welfare, water, land use, and greenhouse gas emissions.⁸³

Restriction of marketing and advertising to children is another policy option. In Chile, warning labels for products high in energy, sugar, sodium, and saturated fats⁸⁴ have been an entry point to restrict marketing (eg, event sponsorship, advertising) of food carrying at least one of these warnings to children aged 14 years and younger. Foods with a warning label are not allowed in schools. Another frontier for policy action is social media influencing,⁸⁵ as there is evidence that social-media influencer marketing may

increase intake of unhealthy foods among children.⁸⁶

Governments have also used zoning restrictions and incentives to address food availability. South Korea has established “Green Food Zones” around schools, banning the sale of fast food and soda within 200 meters of schools.⁸⁷ Singapore has implemented the Healthier Hawker Program to incentivize healthier recipes (eg, healthier oil, reduced sodium salt, whole-grain noodles, and brown rice) by offering competitive pricing for ingredients through shared distribution and marketing services.⁸⁸

Policy instruments to improve affordability of nutritious foods have often included income transfers, whether as cash, vouchers, or in-kind.⁸⁹ Vouchers have been particularly effective in increasing the uptake of nutritious food items.^{90,91} While nutritious foods should be available, and consumers should desire to buy them, provision of commodity-specific vouchers can ensure better uptake of sustainable, nutritious food items.

Another strategy to improve affordability is to make existing staple food more nutritious. Interventions such as biofortification of cereals and legumes or (mandatory) postharvest fortification of cereal flours, rice, salt, and/or oil enhance the nutrient profile of the food supply.⁵² Fortification is cost-effective to improve nutrient intakes⁹² when the food supply is predominantly plant-based, staple foods.⁵³

Food affordability may also be addressed through improved food availability. Globally, 30% to 50% of the food is lost before reaching the market.⁹³ In LMIC, supply chain improvements (ie, improving transport to market, cold storage)⁹³ would help prevent food loss. Agricultural and food subsidies and taxes might also address affordability. In LMIC, most agricultural subsidies are for staple crops and oil seeds, instead of fruit and vegetable or other perishable livestock products low in greenhouse gas emissions.⁹⁴ Subsidies on staple crops may release household budget for other foods, while taxes may disincentivize the purchase of cheap, energy-dense foods.⁹⁵ In particular, taxes on sugar-sweetened beverages have shown to reduce consumer purchases.⁹⁶ The merits and drawbacks

of subsidies have been analyzed and debated by others.^{97,98}

Strong lobby by food and beverage corporations has hampered progress on implementation of some policies in many countries. The Lancet Global Syndemic Commission recently proposed triple-duty actions that tackle obesity, undernutrition, and climate change. The underlying premise is that policies that address more than one issue can garner stronger, wide-ranging support from civil society, which may drive bolder commitments by responsible government agencies, encourage stronger compliance, and hold industry accountable.⁷⁶ Examples of triple-duty actions include reducing red meat consumption through taxation, labeling or other regulations, sustainable dietary guidelines, right-to-well-being legislation, and restricting commercial influences on policy development.

Platforms to Support Evidence-Based Policy Action

The type of policy used to create access to sustainable healthy diets will depend on the prevailing public health nutrition issue(s). In some low-income countries, undernutrition and micronutrient deficiencies dominate; in middle-income countries, the double burden of malnutrition is the prevailing issue; while in high-income countries addressing obesity and noncommunicable diseases (NCDs) is the priority. We highlight 2 platforms, the International Network for Food and Obesity/Noncommunicable Diseases Research, Monitoring and Action Support (INFORMAS) and Fill the Nutrient Gap (FNG), that support collaborative, evidence-based decision-making for food and nutrition policy in different contexts. The FNG is used in countries where affordability of nutritious diets is a cause of undernutrition and micronutrient deficiencies. The FNG addresses the inadequate (physical and economic) access to nutritious foods and examines how different institutions (social protection, health, agriculture) may address the inadequate access. The INFORMAS platform, on the other hand, is used to assess food environments, with the aim to reduce the prevalence of obesity and NCDs.

The INFORMAS Healthy Food Environment Policy Index

The INFORMAS⁹⁹ developed a Healthy Food Environment Policy Index (Food-EPI) to assess the implementation of food environment policies compared to international best practice and to derive concrete priority actions to fill implementation gaps.⁷⁸ Research groups and/or nongovernmental organization (NGOs) in all countries can join the INFORMAS network to access the protocols and tools. The INFORMAS supports the utilization of the Food-EPI through training country teams. The Food-EPI examines indicators on food composition, labeling, promotion, provision, retail, food prices and food trade and investment, leadership and governance, monitoring, funding, platforms for interactions, and health-related policies.⁷⁸

The Food-EPI process at the country level (Supplement Figure 2) invites a national Expert Panel (public health experts, NGOs, and medical associations) to rate the extent of implementation of food environment policies compared to international best practice. The ratings are informed by comprehensive evidence of implementation, verified by government officials and international benchmarks. Evidence is compiled from publicly available information, direct communication with government, and/or through freedom of or access to information requests. Government stakeholders are involved as observers during the rating process. Experts then propose concrete actions to address the implementation gaps and then prioritize those actions according to importance and achievability criteria.

The main outputs from Food-EPI are an evidence document summarizing the current implementation, the scorecard, which compares current action to international best practice, and the recommended actions.^{100,101} The Food-EPI process takes about 1 year to complete, of which 6 months are needed to document the current status of implementation and create a comprehensive evidence document. The Food-EPI complements World Health Organization progress monitoring indicators and provides an in-depth analysis on broader nutrition policies and infrastructure

support systems to achieve a healthy food environment.

The Food-EPI has been implemented in 11 countries with 12 others in process.¹⁰² Policies most frequently prioritized are taxes on unhealthy foods, restricting unhealthy food promotion, front-of-pack labeling, processed food composition targets, and healthy school food policies.

This tool is comprehensive but adaptable to country context while still maintaining comparability. The tool encourages a collaborative policy process, priority setting, and capacity building for policy-makers on food environment and international best practices.

Fill the Nutrient Gap Analysis

The FNG is a systems-focused nutrition situation analysis and decision-making process, using collaborative engagement of stakeholders from different sectors.¹⁰³ The aim is to identify and prioritize strategies to increase availability, affordability, and choice of nutritious foods to ultimately improve nutrient intake and prevent malnutrition. The framework was developed by the World Food Program, with technical input from several institutions.

The analysis contributes to better understanding of the nutrition situation because it: (1) focuses on examining the drivers of dietary intake; (2) uses linear programming to characterize the availability, cost, and affordability constraints of nutritious diets for households and target groups with higher nutritional needs and to model potential interventions to improve them; and (3) facilitates multisectoral discussion on barriers to nutrient intake and enables a prioritization of nutrition-specific and -sensitive strategies across food, health, and social protection systems.

Fill the Nutrient Gap is a facilitated process. The FNG team offers governments and stakeholders a comprehensive review of secondary data to identify the barriers and possible solutions to improve access to nutritious foods and improve nutrient intakes (ie, situation analysis). These solutions are presented to key stakeholders and solutions that are feasible and of interest to policy-makers are listed for modeling with the Cost of the Diet tool, with the aim of making a

nutritious diet more affordable. Some of the common interventions that are modelled are (1) improving availability of nutritious foods (eg, expanding production, strengthening the value chain to limit food loss, or reduce transport costs), (2) lowering prices (ie, lower production cost or subsidies), or (3) provision of nutritious foods to a specific target audience. It is also possible to model the impact of cash transfers or income generation activities on the affordability of nutritious diets. The modeling activity enables a comparison of a wide range of interventions aimed at improving nutrient intakes. These strategies are discussed by the stakeholders from different sectors, and each sector then prioritizes actions to support improved nutrient intakes.

Conclusion

The food environment is critical for ensuring access to sustainable healthy diets. Gross inequities in access currently exist; sustainable healthy foods are generally less available and affordable than less sustainable and less healthy foods. Sustainable healthy diets are likely to be more accessible to those with higher incomes, those with the time to cook and clean up, and those with reliable access to water and fuel. Government policies must assess how existing social class inequalities will be exacerbated and identify relevant actions to reduce them. In LMIC, there is a pressing need to offset the price of sustainable, healthy foods, with policy action on biofortification, large-scale staple-food fortification, and commodity-specific food vouchers (ie, fruits, vegetables, legumes, etc).

Food environments may constraint and enhance sustainable healthy choices. Countries seeking to improve food environments should implement comprehensive policies to make healthy sustainable foods the easy, affordable, and preferred choice. These include vouchers for sustainable healthy foods, taxes on junk food and marketing restrictions for junk food, improving availability (through various means), and easy-to-understand front-of-pack labeling, among others. Hardly any country is implementing a series of consistent and coherent policies to create healthy food environments, except Chile. Several tools and processes have been developed to

support policy-makers to design a policy mix for better access to sustainable healthy diets. These tools support policy assessment, analysis, and stakeholder engagement needed for building commitment and legitimacy. Concerted action from government, private sector, and civil society is needed so that food environments deliver equitable access to sustainable healthy diets.

Authors' Note

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Supplemental Material

Supplemental material for this article is available online.

Note

1. Convenience foods “encompass a wide variety of processed and semi-processed food, frequently contrasted with ‘fresh’ foods using raw ingredients, cooked from scratch.”⁶⁸

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