

CONCEPTUALISING AND ASSESSING FOOD AFFORDABILITY



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Eric W Djimeu, Stella Nordhagen, Ty Beal, Heather Kelahan, and Saul S Morris

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The Global Alliance for Improved Nutrition (GAIN)
Rue de Varembé 7
1202 Geneva
Switzerland
T: +41 22 749 18 50
E: info@gainhealth.org

www.gainhealth.org

SUMMARY

Affordability is a key barrier to accessing nutritious foods, particularly for lower-income consumers. Several measures of food affordability have been proposed and used in the research literature. This paper reviews the concept of food affordability, discusses the limitations of existing measures, and makes recommendations for improvements. Food affordability measurement is typically based on income, social safety nets, or expenditures. However, multiple other factors can affect food affordability but are not incorporated in current metrics, including income variability and unpredictability, savings, reallocation of current spending, perceived values of foods, and access to financial services and transfers. Income-based measures should incorporate a portion of savings and include all income sources, such as seasonal income, remittances, and gifts. Expenditure-based measures of affordability should consider an amount spent on less healthy foods that could be reallocated to healthier foods within the same budget. We suggest the same type of allocation from expenses on non-essential items, such as cigarettes and alcohol. Finally, we call for a more comprehensive approach to improving the affordability of nutritious foods, which could integrate interventions to change consumers' perceptions of the values of different foods, reduce the scarcity mindset that affects self-control, and enhance access to financial institutions.

KEY MESSAGES

- A comprehensive measure of food affordability is critical to design interventions to increase access to safe and nutritious foods.
- We review how affordability is defined and measured in the context of food and nutrition and identify factors that could affect affordability.
- In general, in the context of food and nutrition, food affordability measurement is typically based on income, social safety nets, or expenditures.
- Other factors that can affect food affordability include income variability and unpredictability, savings, reallocation of current spending, perceived values of foods, and access to financial services and transfers.
- Other limitations of existing food affordability measurement include a lack of consideration of income seasonality, remittances, gifts, and saving.
- A more comprehensive perspective on measuring the affordability of nutritious foods would consider these factors and discuss affordability in the context of factors such as consumers' perceptions of the values of different foods, the scarcity mindset that affects self-control, and access to financial institutions.

BACKGROUND AND OBJECTIVE

Hawkes and Ruel (1) identify four dimensions of food access – availability, affordability, acceptability, and quality. There is greater clarity in the literature and consensus in the global community around the definition and operationalisation of two of these concepts, food availability and quality, than there is on food acceptability and affordability. This paper focuses on food affordability.

Research on food prices and affordability is vast, with the concept being studied by 18th century economists such as Adam Smith, David Ricardo, and Thomas Malthus. We focus our review in this paper on health science research on food affordability and specifically on papers that included a metric of food affordability. The concept of food affordability has been defined in many ways. For example, Hawkes and Ruel (1) define food affordability as the ability of at-risk households to afford available foods. Maestre et al (2) combine prices, which they consider to be the fundamental determinant of buying practices, with sufficient disposable income to purchase foods to illustrate the concept of affordability. Turner et al (3) provide a definition of food affordability in the context of the food environment: for them, prices interact with individual purchasing power to determine affordability within the ‘personal’ food environment. Herforth and Ahmed (4) discussed developments in food affordability measurements that consider the absolute, relative, and comparative cost of foods. Their definition considers the cost of food relative to individual or household purchasing power and aggregates food costs within a defined geographic area (5).

A lack of consensus on the definition of affordability in global nutrition and the heterogeneity of approaches used to measure it in empirical studies may constitute obstacles to the design of effective policies to increase access to nutritious foods, as affordability is a key determinant of food access. Interventions to improve food availability, acceptability, and quality will have limited impact on households if those households lack the funds to buy these foods. Thus, this paper has three objectives. The first is to review the concept of affordability; specifically, how it is defined and measured in the context of food and nutrition. The second is to review factors that could affect affordability. Many measures of affordability rely on income or expenditures averaged over time. Even though income is undoubtedly a key determinant of affordability, other factors are likely also at play, such as savings, predictability of income, and perceived value of foods. Building on these first two examinations, the third objective is to highlight the limitations of existing measures and to propose factors to consider in food affordability measurement going forward.

METHODOLOGY

We conducted a scoping review to identify studies that conceptualise and define food affordability and its measurement in nutrition in countries of all income levels. Complementing this search, we also conducted a literature review to identify studies that capture the perspectives of lower-income consumers in relation to affordability more broadly, to identify and discuss factors that may influence the perceived affordability of nutritious foods among poorer consumers.

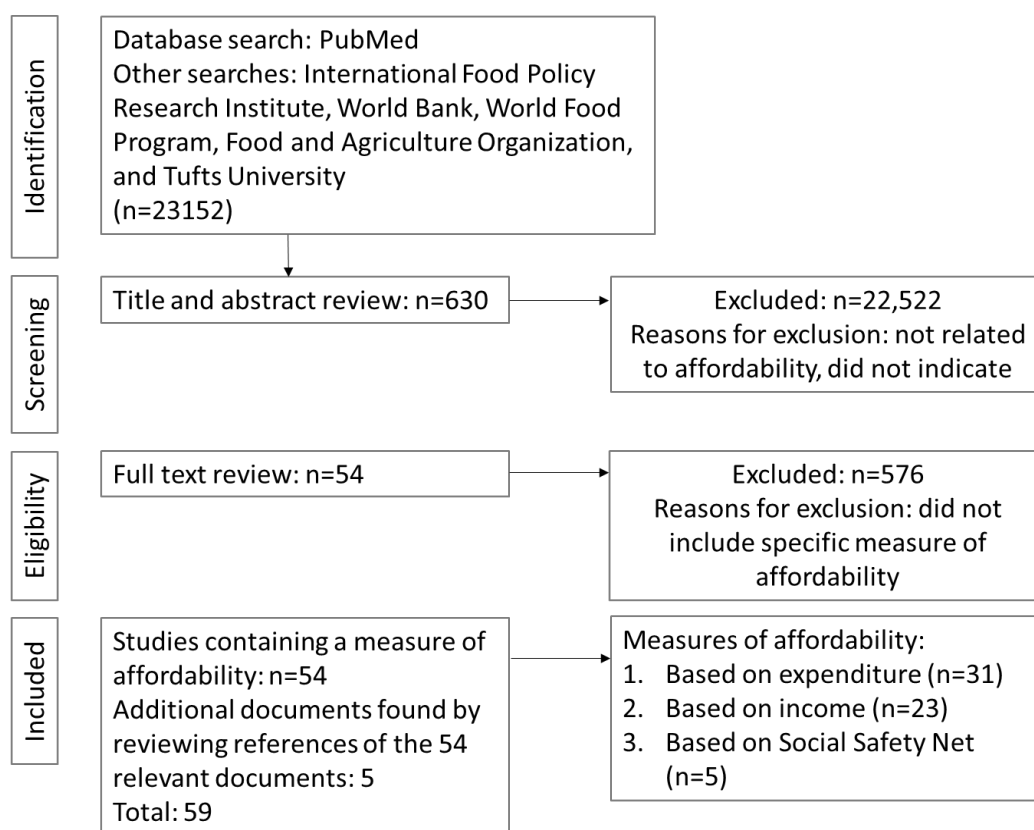
Scoping review selection criteria

To be included in the food affordability scoping review, studies needed to contain a specific measure of affordability of diets, foods, or nutrients. Studies needed to capture the cost of a diet, food, or nutrient and compare it to a benchmark measure (or multiple measures) of

affordability. Only studies published in English between January 2000 and March 2020 were considered.

SEARCH METHODS AND IDENTIFICATION OF STUDIES ON FOOD AFFORDABILITY AND ITS MEASUREMENT

We used advanced search on PubMed and keyword searches on relevant websites (Figure 1). We searched the title and abstract fields using the following words: ("afford" OR "affordability" OR "affordable" OR "purchasing power" OR "price" OR "food prices" OR "cost" OR "costs" OR "fill the nutrient gap") AND ("diet" OR "diets" OR "food" OR "foods" OR "nutrient intake" OR "nutrient intakes" OR "nutrient adequacy"). Titles and abstracts were screened for mentioning an aspect of food affordability, and full texts were included if they used an approach to measure food affordability. A total of 20,849 titles were reviewed from PubMed and 2,303 from other sources including the International Food Policy Research Institute, World Bank, World Food Program, Food and Agriculture Organization, and Tufts University. After screening and reviewing titles, abstracts, and full texts, 54 studies were found to be relevant, and another five documents were found by reviewing the references of these 54 documents. We classified the 59 studies into three categories based on the measures they used to benchmark affordability: expenditure, income, or social safety nets.



We also did an additional search in Google Scholar of relevant terms for understanding how those living with financial constraints think about the affordability. Additionally, we reviewed documents cited by the book *Portfolios of the Poor: How the World's Poor Live on \$2 a Day* (6), as well as all documents listed on Google Scholar as having cited the book (1,883 total). Finally, we reviewed the 630 papers identified via the search illustrated in Fig. 1, searching for the words "poor", "budget", "coping", "afford", and "qualitative". From these approaches, we identified 149 papers, 49 of which were included in the full-text review.

RESULTS

THE CONCEPT OF AFFORDABILITY AND ITS MEASUREMENT IN NUTRITION

Measuring affordability based on income

Twenty-three studies included a measure of affordability based on comparing food cost to household or individual income (Table 1). Most studies measured food costs and household or individual income, calculated food cost as a share of income, and assessed absolute affordability by comparing this metric against some pre-determined affordability threshold or assessed relative affordability by comparing the cost of foods or diets with one another. Studies varied in the food groups or diets assessed, how foods were characterised, and the households or individuals they included. They also varied in their measurement of costs and income and the cut-off values they used to define affordability.

Most studies characterised foods using national-level guidelines for a healthy diet or recommended food baskets (7–9). Other studies reviewed only the affordability of meeting the national recommendations for fruit and vegetable consumption or total calorie needs (10–12). Most studies assessed commonly consumed foods or the lowest-cost foods that could meet dietary guidelines, but some studies also considered environmental sustainability (13,14). Cost data were predominantly captured through first-hand data collection at local retail outlets (15,16). Some studies used cost data from national-level income and expenditure surveys (17), national pricing data (10), or the World Bank’s International Comparison Program (18).

Many studies used household income data collected from surveys. Income was also often defined as the level provided by government income assistance (19) or welfare programs (20). This enabled studies to assess whether the current income level provided by these social protection programmes was adequate for people to afford nationally recommended nutritious diets or food baskets (21,22). This is also true for studies that used an income level equivalent to the government-mandated minimum wage (23) or the cash wage of unskilled laborers (7). Other studies used a country’s mean or median per capita household income (8,13). Most studies assessed gross income, but some compared food cost to disposable income by subtracting out estimated essential expenses (22,24).

The majority of studies assessed affordability based on the share of income needed to meet the recommended number of servings of a specific food group or the total recommended diet for the individual or household (10). Several studies did not set a threshold for what percent of income a diet could cost and be considered affordable or unaffordable (10,12,12,14,15,21,25–27). Studies that did set a threshold for affordability did so for different reasons. One study used a threshold of less than 20% of household income per household member required to purchase two servings of fruits and three servings of vegetables per day for every household member. The authors selected this threshold because they found that few households in high-income countries used more than 20% of their income for the purchase of the recommended number of servings (11). Other studies used thresholds ranging from 20% to 30% of income as the ‘international standard’ (14,28), compared to the percent spent in the United States or Canada (22), or set a threshold equal to the amount found to be acceptable in an opinion paper (29). Studies that compared food cost to net income tended to implicitly use a threshold of 100% by assessing whether the cost of meeting nutritional guidelines would exceed household resources after other needs were met (16,24).

Table 1: Summary of results of studies measuring affordability based on income

Study	Setting	Affordability calculation details
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		Cost of the food group (numerator)	Income level of the household or individual (denominator)	Cut-off value (if absolute affordability was measured) [affordability outcomes]
(17)	Mexican households	Cost per 1000 kcal of 222 foods and beverages	Household income from National Income and Expenditure Surveys	Amount households must spend to acquire 1000 Kcal between 1996 and 2016 [0.013 pesos of their income in 1996 to buy 1000 kcal of food and beverages and 0.050 pesos in 2016]
(10)	Ethiopian households	Cost of two servings of fruits and three servings of vegetables per household member per day (based on international recommendations)	Household income from an expenditure survey	11% of household income [11% of household income to meet the international recommendation of two servings of fruits and three servings of vegetables per person per day]
(11)	Households in 18 countries	Cost for two servings of fruits and three servings of vegetables per household member per day	Household income from the Prospective Urban Rural Epidemiology (PURE) study	20% of household income [57.42% of individuals in LMICs could not afford the recommended daily intake]
(7)	Indian households	Cost of a recommended diet, based on India's Food Based Dietary Guideline	Cash wage of unskilled labour, adult (male and female)	cost of recommended diet [45-64% of the rural poor cannot afford a nutritious diet]
(24)	Three household types relying on income assistance in Canada	Cost of the National Nutritious Food Basket (NNFB)	Monthly gross income, net of essential monthly expenses	100% of net income [For a family of four relying on income assistance who purchased the NNFB in 2002, they would have experienced a monthly deficit of \$116.55. In 2010, this deficit would have increased to \$473.57]
(8)	Rural households in the United States of America (U.S.)	The average individual's food expenditures	Weekly income per household	The cost of the lowest-cost basket of food items meeting USDA nutritional requirements [Missouri households spend an average of 17.451% of their income on food; this ranged from 9.99% in St. Charles County (urban) to 30.26% in Carter County (rural)]
(20)	Australian households	The cost of different Australian healthy food baskets	Disposable income for employed and welfare payments for unemployed	No cut-off value – relative affordability only [Families on welfare payments and low incomes spend 28–34% of their income to be able to afford a healthy food basket whereas the average Australian family expenditure on food is 17%]
(16)	household types relying on minimum wage in Canada	The cost of The NNFB	Minimum wage, net essential expenses	100% of minimum wage [A family of four in 2002 will have a deficit of \$342.10 to have access to a basic nutritious diet. With the 2006 increase in the minimum wage, the deficit will be \$295.89]
(26)	A household of four New Zealand	The cost of diets meeting the New Zealand and Activity Guidelines food group recommendations using common foods	1) Median disposable income; 2) Income support; 3) Minimum wage	25% of income [For households on the minimum wage, the diets required 27% to 34% of household income, and if receiving income support, required 41–52% of household income]
(27)	A household of four in Australia	The cost of a healthy food basket in metropolitan Adelaide	Household income	No cut-off value – relative affordability only [Low-income families would have to spend approximately 28.3% of household income on eating healthily, compared to the 17% average expenditure on food by Australian households]

(31)	Households earning minimum wage in Canada	The cost of the NNFB	Household income net from deducting essential living expenses	100% of net income [The household of four, lone mother with three children, would face monthly deficits of \$496.77 in 2012 if they were to purchase a nutritiously sufficient diet]
(32)	Three types of hypothetical households in Ontario	The costs in Toronto of the Ontario Nutritious Food Basket	Ontario Works Benefits (welfare income)	No cut-off value – relative affordability only [comparing welfare incomes to costs in the Toronto of the Ontario Nutritious Food Basket and other essential expenditures for three household types; cost of food basket and essentials is \$858.71, \$1,367.65, and \$1,754.53 for one-person household, single-parent household, and two-parent household respectively]
(14)	Hypothetical reference households in Australia, divided into income quintiles	The costs of 1) the typical basket of food and 2) a hypothetical healthy and sustainable food basket	Average national weekly disposable household income	30% of income (for low-income households) [Households in the lowest income quintile would have to spend up to 48% of their weekly income to buy the healthy and sustainable basket]
(29)	Welfare-dependent families in Australia	The total cost of a seven-day meal plan, based on Australian public health recommendations	Average weekly disposable household income	No cut-off value – relative affordability only [The welfare-dependent couple-family would spend nearly half, 44% (38% with generic brands), of their total weekly income to buy the meal plan]
(22)	A reference family of five in Australia	The cost of the Illawarra Healthy Food Basket	Average weekly earnings and welfare	No cut-off value – relative affordability only [affordability has remained relatively constant between 2000-2009 and at around 30% of average household incomes]
(21)	Six hypothetical households in Cyprus	The cost of food baskets based on Cypriot national food-based dietary guidelines	Guaranteed minimum income	No cut-off value – relative affordability only [For low-income families, the proportion of income that needs to be spent on the healthy food for physical needs and food basket for physical and non-physical needs ranged from around 39 to 72% and 47 to 81%, respectively]
(33)	Four hypothetical senior households in urban Nova Scotia, Canada	Cost of foods to meet requirement of Canada's NNFB	Net income from the Canada Pension Plan and the Old Age Security Program	100% of net income [In each household scenario, the potential monthly deficits increased from 2002 to 2010, ranging from \$112 in 2002 for a lone mother with three children to \$523 in 2010 for a lone male]
(34)	Individuals in 159 Countries	The cost of the lowest-cost EAT–Lancet reference diet (diet capable of sustained health and protecting the planet)	Daily household income	No cut-off value – relative affordability only [buying the cheapest EAT–Lancet diet would take 90% of daily household income in low-income countries]
(15)	Four different household types in Australia	The cost of the Victorian Healthy Food Basket	Average fortnightly income required for food basket from census data	No cut-off value – relative affordability only [Families in the inner city use less of their income on the food basket (15%) compared to middle and outer suburbs families (19%)]

Measuring affordability based on social safety net value

We found five studies (exclusively from the United States) that used social safety net assistance as a comparator to assess affordability (Table 2). All five studies assessed affordability by determining whether diets meeting United States Department of Agriculture (USDA) guidelines could be purchased using only safety net benefits for food (food stamps or

benefits from the Supplemental Nutrition Assistance Program (SNAP)). Most focused on guidelines an entire healthy diet, but Stewart et al (35) focused on fruit and vegetable guidelines for only.¹ Several studies stratified analyses by neighbourhood and/or retail store type ((36);(37)). Most studies focused on affordability at the household level, but Mulik et al (38) also assessed individual-level affordability for different age groups and genders.

Table 2: Summary of results of studies measuring affordability based on social safety net assistance

Study	Setting	Cost of the food group (numerator)	Affordability calculation details	
			Social safety net assistance (denominator)	Cut-off value (if absolute affordability was measured) [affordability outcomes]
(36)	A family of four in the U.S.	Average market prices for a diet meeting minimum daily requirements from food lists representing variations of the USDA's Thrifty Food Plan (TFP), by store size and neighbourhood income level	USDA's TFP price	Equal to the TFP price ² [The average market basket price in a low-income neighbourhood is 2.1% above the TFP price; The average market basket price in small/ medium/stores is 17% above the TFP price]
(39)	Individuals (children, male adults, female adults, seniors) and households (a family of four) in the U.S.	The monthly cost of USDA's MyPlate diet (guidelines based on age, gender, and retail price data), plus the cost of labour in food preparation	The monthly SNAP allowance	100% [a family of 4 with 2 adults (aged 31–50 years) and 2 children (one aged 8–11 years, one aged 12–17 years) were the most financially vulnerable to covering the cost of USDA's MyPlate diet. This type of family would need to incur an additional cost of \$627/mo. to eat a nutritionally sound diet]
(40)	A family of four in the U.S.	The monthly cost of less expensive fruits and vegetables that comply with USDA's MyPyramid fruit and vegetable recommendations	The monthly SNAP allowance	100% [With a SNAP allowance of \$23.43 for fruit per week, a four-person household consisting of a 40-year-old male, a 40-year-old-female, an 11-year-old boy, and an 8-year-old girl could have afforded to pay no more than 42% and 47% of the cost to satisfy MyPyramid recommendations for fruit and vegetables, respectively]
(37)	Two types of four-person families in the city of Central Falls, U.S.	Costs of a market basket of 58 food items that complies with USDA's TFP guidelines	The monetary value of food stamps received per household	100% [Central Falls residents have limited access to TFP items; when healthy foods are available within the city, residents of Central Falls must pay more than the average American for a healthy diet. the cost of the market basket across all Central Falls retailers was approximately 41% higher than the national average]
(41)	A family of four in Philadelphia, U.S.	The monthly cost of a market basket of food items that complies with USDA's TFP guidelines	The monthly maximum SNAP allotment	100% [A family of four who receives the maximum SNAP benefit would need to spend an additional \$2,352 per year on average to purchase the Thrifty Food Plan market basket items]

Notes:

SNAP (Supplemental Nutrition Assistance Program) is a federal food assistance programme (formerly known as food stamps) that assists low-income families (at or below 130 percent of federal poverty guidelines) in affording a nutritious diet.

The USDA's TFP (Thrifty Food Plan) is the national standard for a 'nutritious diet at a minimal cost', in theory lifting families into food security. It is used to determine national poverty thresholds and serves as the basis for the maximum SNAP allotment.

MyPyramid, released by the USDA Center for Nutrition Policy and Promotion in 2005, updated the older American food guide pyramid. It was replaced with MyPlate in 2011.

Measuring affordability based on household expenditure

¹ MyPyramid, released by the USDA Center for Nutrition Policy and Promotion in 2005, updated the older American food guide pyramid. It was replaced with MyPlate in 2011.

² For example, if the average market basket price for small stores in Study X was \$116 and the TFP price at that time was \$102 then the affordability is measured by $(((116/102) - 1) * 100 = 13.7)$, meaning the average market basket price in small stores in Study X is 13.7% above the TFP price.

We found 21 studies—exclusively from low- and middle-income countries (LMICs)—that use a variant of household expenditure to analyse food affordability (Table 3). Eighteen of these studies are from a World Food Programme (WFP) project called Fill the Nutrition Gap (FNG) (42). Expenditure-based affordability studies were often similar to the income-based studies in Table 1.

Most studies consider a theoretical diet that satisfies all energy and nutrient requirements of a family (43), and the FNG studies also require that this diet be accessible through locally available foods (42). Jones and Charlton (44) consider only one type of food: the recommended 400 grams of local, non-starchy fruits and vegetables (NSFV) per person, per day (45). Finally, one study considers locally available foods that meet all known requirements for essential nutrients and dietary energy requirements for a woman of reproductive age (46).

The cost of the food group or diet was captured mainly through market price survey data collection at a given point in time, in the area for which the type and characteristics of the food group or diet is calculated. The minimum cost of a theoretical diet satisfying a family's nutrient requirements at the lowest possible cost, based on availability, price, and nutrient content of local foods, is obtained with the Cost of the Diet (CoD) tool, developed by Save the Children UK in 2006. This approach was considered in a series of FNG studies (42). Other studies—including that of Jones and Charlton (44), which calculates affordability for a recommended amount of a type of food—collect prices per kilogram of common commodities from major supermarkets and central produce markets.

Most studies assessed food affordability by comparing costs to both household food expenditures and total household (food and non-food) expenditures (42,43), but one study considered food expenditures only Jones and Charlton (44), while another considered only total household expenditures (46). Data on expenditures are generally obtained through secondary sources. For example, the FNG studies used household food expenditure data from Living Standards surveys or Household Socioeconomic surveys (42). In some cases, as in Jones and Charlton (44), household food expenditures are obtained from primary data collection conducted by national statistics offices. Finally, Bai et al. (46) estimate household expenditures from national accounts.

In FNG studies, affordability is assessed by calculating the proportion of households able to afford the cost of a nutritious diet given their current level of total food expenditures and/or a proportion of their total food expenditure or the total expenditure. To determine the affordability of 400 grams of NSFV, Jones and Charlton (44) calculate the proportion of a household's total and food budget required to purchase 400 grams of local NSFV for all household members using the Household Income and Expenditure Survey. Finally, Bai et al (46) use retail prices and food composition data to compute the affordability of the lowest-cost nutritionally adequate diet using different variants of costs and total household expenditures. The authors used the ratio of the cost of nutrient adequacy to total household expenditures as the indicator of affordability.

Table 3: Summary of results of studies measuring affordability based on household expenditure

Study	The unit of analysis Country	Cost of the food group (numerator)	Affordability calculation details	
			Expenditure (denominator)	Cut-off value (if absolute affordability was measured) [Statistic on affordability outcome]
(43)	A family of four in Indonesia	The cost of a theoretical diet satisfying a family's nutrient requirements at the lowest possible cost, based on availability, price, and nutrient content of local foods	1) Household food expenditures; 2) Total household (food and non-food) expenditures)	1) 100% of food expenditures 2) 70% of total expenditures (food and non-food) expenditures) [in Timor Tengah Selatan, only 25% of households could afford to meet the nutrient requirements, whereas in urban Surabaya, 80% could]
(42) and other FNG studies	Families in several countries (El Salvador, Ghana, Madagascar, Pakistan, Lao PDR, Philippines, Cambodia, Mozambique, Niger, Ghana, Timor-Leste, Sri Lanka, Tajikistan, Indonesia, Rwanda, Uganda, Uganda (Refugee Analysis), Lesotho. Household characteristics vary based on country-specific demography	The cost of a theoretical diet satisfying a family's nutrient requirements at the lowest possible cost, based on availability, price, and nutrient content of local foods	Household food expenditures	100% [Timor-Leste: The nutritious diet is affordable for 15-37% of households by region; Ghana: regional unaffordability of the lowest cost locally available diet ranged from 10% (Greater Accra) to 78% (Northern Region), Lesotho: Non-affordability of a nutritious diet is particularly high in the mountainous regions (above 70%)]
(44)	Households in Vanuatu	The minimum monthly cost of purchasing 400 mg of local NSFV per person, after accounting for wastage	Household food expenditures	100% [The poorest households would need to allocate 40.9% (SD 34.3%) of their total food budget to NSFV to purchase recommended amounts of these foods. Twenty-one percent of households recorded sufficient NSFV expenditure while 23.4% recorded less than 10% of the expenditure required to meet the NSFV recommendations]
(46)	Women of reproductive age in 159 countries	The minimum cost of locally available foods that meet all known requirements for essential nutrients and dietary energy requirements for a woman of reproductive age	Total household expenditure (on all goods and services)	100% [Diet costs vary less than income, and the cost of nutrient adequacy (CoNA) ranges by a factor of ten from just 3% of household expenditure in high-income countries to 36% in low-income countries. Looking across regions, there is considerable variation in the premium for nutrients, with the highest observed in South Asia [3.50 (0.97)] and the lowest in Middle East and North Africa [1.69 (0.42)]. Nutrients were least affordable in [CoNA to household expenditure ratio of 0.32 (0.16)] and cheapest in North America [0.02 (0.00)]]

Notes: This table has fewer than 21 studies because many studies are FNG studies, which are reported in one line.

LIMITATIONS OF EXISTING APPROACHES TO AFFORDABILITY MEASUREMENT IN NUTRITION

In this section, we discuss the limitations of each approach presented above. A main limitation of the income-based approach is that estimates of, or proxies for, household income may not accurately reflect household resources for food. For example, some studies measure income only as formal income, but many households in LMICs rely on informal income. Other studies proxied income based on government income assistance or welfare programmes (20,47), which might not be available for many poor households in LMICs. Also, as lower-income consumers are likely to have different sources of income, relying on income assistance or welfare programmes may not provide an accurate indication of their disposable resources available to purchase food. Other income-based studies used an income level equivalent to the government mandated minimum wage. In LMICs, where most of the lowest-income households live, the minimum wage may not be enforced. The income of lower-income workers is also highly variable and unpredictable. Only a few studies analysed expenditure based on disposable income and calculated the average of disposable income over time, which could capture this variability. Income-based studies are also limited in their ability to assess affordability in absolute terms. Many did not set a threshold for affordability, and for those that did, the choice was not always fully discussed by the authors.

One of the main limitations of studies that assessed affordability based on social safety net assistance is that social safety net food support is much more common in high-income countries than in LMICs. Indeed, the studies reviewed in this category were exclusively from the United States. In addition, most of these studies consider only the amount of the social safety net assistance to assess affordability of following recommended dietary guidelines. Even though recipient households must meet specific criteria, one of them being low levels of income, it is possible that recipients have other resources for food. It is also possible that some households that could qualify for social safety net assistance do not receive it or do not receive the full amount (e.g., because they have not completed necessary paperwork or due to processing errors). Thus, the measure of affordability based on social safety net levels is more for hypothetical scenarios than for estimating the number of people able to afford a healthy diet; it can assist the government in adjusting the monetary value of social safety nets, but it cannot be used, for instance, to estimate the proportion of individuals or households unable to afford a healthy diet. Furthermore, this measure of affordability focuses only on the segment of the population that benefits from the social safety net and might not be informative for the broader population, some of whom may not be eligible for food assistance but still cannot afford a healthy diet.

Affordability based on household expenditure—the most common approach, especially in LMICs—presents several limitations. This measure implicitly assumes that actual food expenditures are the maximum that households or individuals can afford, given other financial constraints. However, actual expenditures on food could differ from potential resources that could be spent on foods. Expenditure-based studies also do not consider the allocation of spending across different types of food, the amount spent on unhealthy foods that could be allocated to more nutritious foods within the same level of spending, or the amount spent on alcohol, cigarettes or other items/ activities that could be reallocated to increase the amount spent on nutritious foods. Another limitation is related to estimating the cost of foods consumed from home production. It is not always clear from affordability studies whether consumption from own production of food producers is valued at the market price when estimating their food expenditure. Measures of food affordability should include the cost of own production valued at the market price to not underestimate the food expenditure of food producers and thus create a bias when estimating the affordability of nutritious foods for this population, which includes many people in LMICs (mostly rural) who are food producers. Furthermore, the valuation of the cost of own production might be

biased because of the quality of the market price data. It is plausible that a price survey including 30 items will estimate a higher dietary cost than a price survey with 180 items. Prices in household expenditure surveys are often implicitly derived from household-level consumption and expenditure data, which might be questionable because of issues such as recall errors. Official consumer price surveys (for calculating CPI) are often biased towards urban areas.

Finally, another limitation of affordability based on household expenditure is that the indicator used to assess affordability is a simple prevalence (proportion of the population below a threshold) and does not consider the severity of food unaffordability. Future affordability analyses could be expanded to other measures such as the affordability gap or affordability severity index.

OTHER FACTORS THAT MAY INFLUENCE AFFORDABILITY OF NUTRITIOUS FOODS AMONG POOR CONSUMERS

Current measures of affordability rely on a limited set of determinants such as (an implicitly time-invariant measure of) income/expenditures and prices. However, other factors can influence the affordability of nutritious foods among poor consumers, such as income variability and unpredictability, inter-temporal trade-offs, rationality in decision making (including 'self-control'), savings, reallocation of current spending, perceived values of different foods and willingness to make substitutes, methods of buying food, and access to credit and other financial services. We group these factors and discuss how they affect the affordability of nutritious foods among lower-income consumers.

Income unpredictability, income variability, and inter-temporal trade-offs

Income variability and unpredictability are important issues for the affordability of nutritious foods, especially among poor consumers in LMICs (6). For lower-income households in LMICs, income can be highly unpredictable because they often hold multiple and uncertain occupations (6). Income unpredictability is compounded by shocks (e.g., health issues, loss of jobs), which substantially reduce disposable income. Furthermore, many low-income people work in the agricultural sector, and the bulk of their annual income is earned just after the harvest. For instance, 65% of the rural poor in Guatemala get some income from self-employment in agriculture, 86% work as laborers outside agriculture, and 24% are self-employed outside agriculture. In Indonesia, 34% of rural, extremely poor households work as laborers outside of agriculture and 37% earn income from self-employment outside of agriculture (48). High variability of income leads to high variability of consumption, as demonstrated in several countries (49–51). In income- and expenditure-based food affordability studies, variability and unpredictability are rarely considered. A few studies average income over time, but the authors do not discuss how this is done. Because of income variability, a food might not be equally affordable at different points in time, even for households with the same average income level. Thus, affordability is linked to liquidity constraints, often caused by limited access to savings or credit in many LMICs because of imperfections in capital markets. Orhun and Palazzolo (51) investigate the extent to which liquidity constraints inhibit low-income households' ability to use inter-temporal money-saving strategies. Exploiting recurring variation in household liquidity, the authors shows that when low-income households have more liquidity, they partially catch up to higher-income households' ability to use inter-temporal savings strategies. In short, in the presence of liquidity constraints and with limited access to savings or credit, poor consumers may not be able to smooth their consumption and afford some foods at certain time points that their average income over time might make it possible for them to afford.

Saving, reallocating current spending, perceived values of different foods, and rationality in decision making

As Turner et al. (3) state, “no matter where we looked, we found that most of the households, even those living on less than one dollar a day per person, rarely consume every penny of income as soon as it is earned, they seek, instead, to manage their money by saving when they can and borrowing when they need to” (p. 3). In fact, in contrast to the general perception that lower-income households consume every penny they earn mostly on foods, they both save and spend a non-negligible portion of their income on non-food expense items. Using data collected from income-poor Indians, Banerjee (48) found that nearly all those who earned saved (97%) but only about half (46%) had access to formal savings; more than half (51%) saved informally, and a few (3%) could not save. Bai et al. (45) observe a similar situation in Uganda. Further, in India, South Africa, and Bangladesh, Turner et al. found that lower-income families often borrow even when they have savings sufficient to cover the loan, reflecting a strong desire to save (3). Savings is not considered in different affordability measures because it does not directly affect income. Analyses could find greater food affordability if they assume that lower-income households could use a part of their savings to access food.

An analysis of spending patterns of lower-income households shows they save and spend more on food than on non-food expenses. Banerjee et al. (48) analysed the spending patterns of lower-income households in 13 different countries and showed that food typically comprises 56–76% of consumption among households, while alcohol and tobacco comprise 5–8.1% of consumption. Spending on festivals is an important part of the budget for many extremely poor households. In Udaipur, India for instance, more than 99% of extremely poor households spent money on a wedding, funeral, or religious festival over the course of a year. The median household spent 10% of its annual budget on such celebrations. In South Africa, 90% of households living on less than \$1 per day spent money on festivals. Without suggesting that all spending devoted to festivals should be saved or spent on foods, it may be feasible for households to redirect a portion of that spending to more nutritious foods. The authors find that the typical poor household in Udaipur could, for example, spend up to 30% more on food, based on what these households spend on alcohol, tobacco, and festivals.

Perceived values of different types of foods ultimately affect what people spend. Many studies use food expenditures as a reference for assessing the affordability of nutritious foods. However, learning what foods the poor currently purchase and consume could be informative in food affordability analyses. Deaton and Subramanian (52) note that among grains, in terms of calories per rupee, millets are clearly the best buy. Yet in their data, only about 52.1% of the total spending on grains is on these grains, while another 28% is on rice, which costs more than twice as much per calorie, and a further 13.75% or so is spent on wheat, which is a 70% more expensive way to get calories. In addition, the poor spend almost 7% of their total budget on sugar, which is not only more expensive than grains as a source of calories but also bereft of other nutritional value. Banerjee et al. (48) similarly find that the poor in Udaipur spend almost 10% of their food budget on sugar, salt, and other processed foods. The authors find that even for the extremely poor, for every 1% increase in food expenditure, about half goes into purchasing cheaper food high in calories and half goes into purchasing more expensive food high in calories. These studies show that the perceived value and desirability of foods influences their perceived affordability.

It has been demonstrated that scarcity forces the poor to constantly focus on urgent unmet goals, and that affects self-control, which underlies planning. Scarcity also affects fluid intelligence—the ability to think and reason abstractly and solve problems (53). In the context of extreme poverty, the assumption that people will follow rational decision-making

processes may be unrealistic. Because self-control contributes to reduced impulse behaviours, a reduction of self-control due to poverty could affect the capacity to decide to buy foods based solely on their affordability. In other words, assessment of food affordability may be impeded for people living in poverty, because poverty can deplete self-control, reduce intellectual resources that support decisions to buy foods based on affordability, and thus compromise choices. Scarcity that affects self-control has a direct impact on food choices, regardless of affordability.

How people in poverty buy foods and access financial services and transfers

The way foods are purchased can influence food affordability. In general, bulk buying is cheaper than buying small quantities. Bulk buying constitutes an inter-temporal savings strategy, consisting of accelerating purchase timing to take advantage of a good deal that provides long-term savings in exchange for an increase in immediate spending or long-term quantity purchased. Dillon et al. (54) test whether bulk purchasing allows households to spend less without reducing quantities they purchase. Using transaction diaries from households in Tanzania, the authors find that the average household could spend 8.7% less through bulk purchasing without reducing quantities purchased. Furthermore, there was little indication that liquidity constraints prevent poorer households in the sample from buying in bulk, possibly because the bulk quantities under examination were not very large.

The importance of access to financial institutions in facilitating consumption smoothing has been demonstrated in many settings (55). Because a steady income is an important factor in food affordability, access to microfinance and other financial services improves food affordability for the poor. Islam and Maitra (56) document how microcredit in Bangladesh facilitates consumption smoothing; Kinnan et al. (57) provide comparable evidence for formal and informal credit transactions in Thailand; and Jack and Suri (58) show that the development of mobile banking helps households weather income shocks.

Furthermore, remittances, cash transfers, and other social programmes can affect food affordability, as they add financial resources. However, evidence on the relationship between remittances and access to food is limited and, in general, weak (59). In contrast, there is strong evidence linking access to cash transfers (via cash or vouchers) and access to food. Cash transfers usually result in the purchase and consumption of more diverse foods, when compared to food aid (60–62).

DISCUSSION: A NEW PERSPECTIVE ON MEASURING THE AFFORDABILITY OF NUTRITIOUS FOODS AMONG THE POOR

In summary, many factors influence the affordability of nutritious foods, and not all are considered in the current affordability literature. In this section, we first discuss which of these factors could be included in affordability measurement and how this could be done. We then discuss other factors that cannot be included in the practical measurement of affordability but can be integrated into broader efforts to improve food affordability. We focus on improvements that could be made to studies that assess affordability based on either income or expenditures, as methods that base affordability on safety net support are less feasible in LMICs and have not been applied in these settings to date.

Income-based affordability studies

The literature indicates that people do save. Thus, in income-based affordability studies, savings should be included as a potential resource to access nutritious foods. Furthermore, in LMICs, and especially among the poor, formal income may not capture all the resources individuals or households have at their disposal. Thus, we suggest that the calculation of

income include all sources—formal wages, seasonal income, remittances, cash gifts, and so on.

Expenditure-based affordability studies

Analysis of the whole portfolio of expenditures should be considered when measuring affordability based on expenditures, rather than focusing on food expenditures exclusively. For instance, spending on cigarettes, alcohol, and similar non-essential goods could be reallocated to more nutritious foods. Expenditure-based studies should consider spending on non-essential items that could be reallocated and discuss how this affects food affordability.

Furthermore, it is also important to consider what types of foods are currently being purchased. For example, households may be spending a substantial portion of expenditures on non-essential less healthy foods, such as sweets. Practically speaking, measurement of affordability based on expenditures should calculate and discuss the amount spent on less-healthy foods that could be reduced and reallocated to healthy foods, within the same budget.

Other factors

While difficult to incorporate savings and access to financial institutions in affordability estimates, these factors should be considered in interventions to improve food affordability. Interventions that encourage households to save could ultimately improve food affordability. Interventions aiming to enhance access to financial institutions, especially credit and savings institutions, could help improve food affordability by reducing income barriers and smoothing consumption.

With the exception of one recent study that systematically considered time use to cook nutritious foods (63), time used to cook nutritious foods is not always considered in existing studies on affordability of nutritious foods. Time use can be a constraint and should be factored in when measuring the actual cost of nutritious foods. One way to do that is to estimate the opportunity cost of time used to cook and add this cost to the overall cost of food. Moreover, existing studies on affordability of nutritious foods do not always consider seasonality. Most studies rely on cross-sectional surveys collected at specific months of the year. Affordability at those specific months of the year may be different than in other months of the year (64–69). Addressing seasonal variations in affordability should be considered and will require data collection in all seasons, which is costly. Finally, except the World Food Programme and Save the Children method that factor in food preferences when estimating least-cost healthy diets that are more consistent with existing food preferences by excluding foods that are not locally consumed, existing studies on affordability of nutritious foods do not fully consider food preferences, which are strongly related to a food culture and customs. Food preferences should be considered in studies on affordability. For example, Mahrt et al. (9) incorporate preferences by calculating the cost of the recommended diet using expenditure shares of the poor to represent their preferences, which inflates the diet cost.

LIMITATIONS OF THE PAPER

The paper has certain limitations. First, we did not use a systematic review approach for our search strategy but instead used ad hoc approach adapted to our goals. This ad hoc approach implies that our search strategy, and more generally the article selection process, may not be replicable and may have affected the choice of the studies included in the paper, resulting in a selection bias that could limit the validity of some of our conclusions. Second, the paper's search focused on the health and nutrition literature and may have not fully integrated the contribution of other disciplines and especially the contribution of economics,

which partly developed around the study of the food affordability in the 18th and 19th centuries. Better including other social science disciplines would have helped to provide a more comprehensive perspective on the current state of research related to food affordability, enabling us to better highlight the existing gaps and how to overcome them.

Finally, and related to the above points, some recommendations made here are beginning to be addressed in previous work on food affordability. In particular, more recent studies on food affordability consider the composition and nutrient requirements. For example, Allen (69) uses the linear programming to compute least-cost nutrient adequate diets at each place and time for which consumer prices are reported. This study and others (70,71) show that new approaches to calculate food affordability consider how healthy and unhealthy foods differ across income levels and continents. The field of food affordability research is a rich and growing one, and we look forward to seeing additional research continue to address some of the gaps in the early work on the topic that we have considered here.

CONCLUSION

Access to and consumption of nutritious and safe foods will not be possible for much of the world's lowest-income households without improved affordability. To assess how far we are from that aim and identify appropriate interventions, we must use measures of food affordability that can feasibly and accurately assess the extent to which lower-income consumers can afford nutritious and safe foods. In this paper, we have examined and critiqued existing measures of affordability—which rely mainly on income, expenditures, and social safety nets—to propose a more comprehensive approach to measuring food affordability. We propose integrating factors beyond formal income and market basket surveys and building on the literature on the perspectives of the world's poor to consider other factors when interpreting affordability. Such factors include income variability, income unpredictability, inter-temporal trade-offs, savings and savings practices, reallocation of current spending, perceived values of different foods, rationality in decision making, and access to financial services and transfers—all of which can affect food affordability. With these new dimensions added, as they are already beginning to be, future research on food affordability should help paint a more accurate—and actionable—picture on which to base programmatic and policy interventions.

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