

Review:

Retail consumer price data reveal gaps and opportunities to monitor food systems for nutrition

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[Food Prices for Nutrition](#) project working paper

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Key words: Food markets, food environments, consumer prices, consumer price index, diet quality, nutrition

Highlights

- Access to healthy diets depends on retail prices for diverse foods in local markets
- Consumer prices for retail items have different dynamics than commodity prices
- Retail prices are now collected and used to monitor inflation and food aid needs
- All countries have demonstrated ability to collect and report prices quickly
- Reporting item prices and indexes by nutritional food group could help guide policy

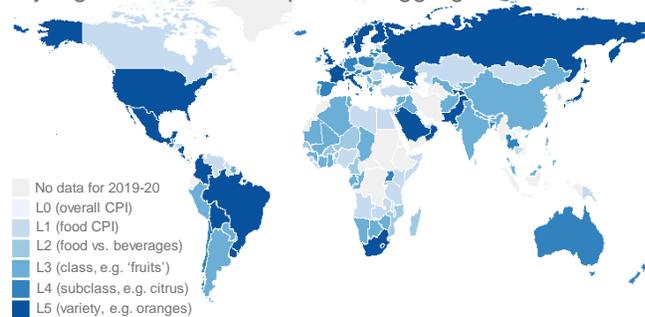
Graphical abstract



Review of global retail consumer food price data sources reveals gaps and ways to improve monitoring of global food systems

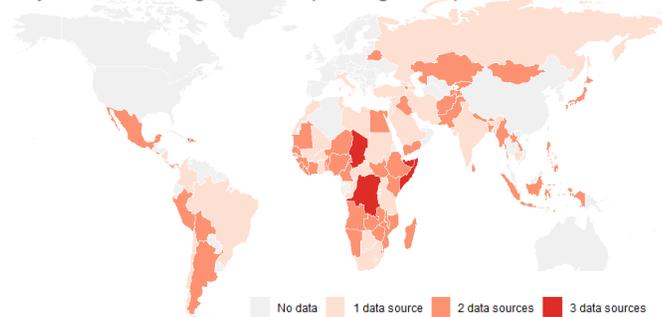
Improved data collection and reporting could show prices for nutritional food groups and healthy diet baskets, to guide policies and programs towards global development goals

National governments' consumer price indexes (CPI) by highest level of food price disaggregation in 2020



Note: Data shown are from the websites of 170 national statistical organizations around the world. Levels of disaggregation correspond to the COICOP system which does not always reflect nutritional values (e.g. 'fruits' includes tree nuts).

International market information and early warning systems (EWS) by number of agencies reporting food price data in 2020



Note: Data shown are from the Famine Early Warning Systems Network (FEWS NET), the FAO's Global Information and Early Warning System (GIEWS), and the WFP's Vulnerability Analysis and Mapping (VAM), covering 94 countries as of Nov. 2020.

Source: Bai, Y. et al. (2021), "Review: Retail consumer price data reveal gaps and opportunities to monitor food systems for nutrition", in *Food Policy*.

Review:

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Abstract

Policies and programs to improve global nutrition increasingly aim to improve diet quality through systemic change in food environments, often focusing on the availability and price of diverse food items. Almost all of the world's governments conduct nationally representative surveys of retail establishments every month and publish a consumer price index (CPI) to guide economic policy, but use of these data to improve food markets and nutrition has been limited. This study describes all of the publicly available monthly CPI data by food group, region and income level for every country of the world in 2019 and 2020. A total of 170 governments currently report overall food CPIs, of which 58 also report more disaggregated indexes for different types of foods, and 49 report price levels for at least some individual food items. To address gaps in coverage we compared these CPI data with prices from international agencies' Early Warning Systems (EWS) designed to help target agricultural assistance and food aid, which covered a total of 95 countries in 2019 and 2020. The EWS data include many lower-income countries that do not post their CPI data publicly, but often omit the diverse, perishable foods that would be needed to improve nutrition and health. We conclude that national governments and international agencies could help meet global development goals with more standardized and timely reporting about more diverse foods, for use in guiding new investments towards universal access to healthy diets at all times.

1. Introduction

Policies and programs to improve global nutrition are increasingly aimed at the availability and prices of nutritious foods in retail markets, seeking to improve diet quality through systemic change in consumers' food environments. The most recent edition of the United Nations (UN) system's flagship annual report "The State of Food Security and Nutrition in the World" (SOFI 2020), was subtitled "*Transforming food systems for affordable healthy diets*", and provided the first estimates of the number of people unable to afford least-cost diets that would meet a range of Food-Based Dietary Guidelines (FBDGs) (FAO, IFAD, UNICEF, WFP and WHO, 2020). The SOFI report and analyses of food prices and diet costs play an important role in many policy forums including the global Food Systems Summit of 2021 (United Nations, 2020). Although there is widespread interest in changing the prices of nutritious foods and diets, data on market prices actually paid by consumers is difficult to obtain.

To address affordability, policymakers are typically interested in the lowest-cost combination of foods allowing for substitution between items to meet dietary requirements. Interest in least-cost diets that meet nutrient requirements dates to the first set of Recommended Dietary Allowances (National Research Council, 1941; Stigler, 1945) and remains widespread (Allen, 2017; Bai et al., 2020a, 2020b; Bose et al., 2019; Schneider, 2020). The approach used in the SOFI 2020 report computes least-cost diets for all countries of the world at three levels of nutritional requirements, first for daily energy, then the most affordable mix of foods to meet all essential nutrient needs, and finally for an overall healthy diet in terms of food groups (Herforth et al., 2020). The food group approach, based on national dietary guidelines, has been used to track the cost of a healthy diet in a variety of settings (Dizon et al., 2019; Herforth et al., 2020; Hirvonen et al., 2020; Mahrt et al., 2019; Raghunathan et al., 2020), and has also been used to compare relative prices among food groups (Headey and Alderman, 2019) as well as the cost of dietary diversity (Masters et al., 2018). All of these methods concern the most affordable way to meet each nutritional criterion, and therefore depend on having prices for a sufficient variety of foods to include the least-cost items in each food category at each market location and time period of interest. Price indexes based on the least-cost items needed for a healthy diet, in quantities set by international standards, can now be computed and reported as easily as any other kind of average price level and could guide policies and programs towards making healthy diets affordable for all.

Prices used for the global analysis in the SOFI report are annual averages for each country in 2017, released in 2020, due to the absence of more recent and higher-frequency data with global coverage. The dataset is from the International Comparison Program (ICP) (World Bank, 2020), whose mandate is to compute purchasing power parity exchange rates by comparing price levels for the same items in multiple countries. Achieving that goal involves a multiyear delay in reporting. While the ICP dataset is currently the only comprehensive source of food price data across countries, it is not compiled frequently enough for timely monitoring of food prices to guide programs and policies in real time.

Beyond the prices reported through the ICP, each country's national statistical organization also collects a wide range of data for each country's consumer price index (CPI). A CPI is designed to show change over time in a basket of goods and services representing total expenditure in each country, and is reported as a unit-free index. Almost all countries report monthly or quarterly food CPI for all foods and non-alcoholic beverages, and some report sub-indexes for specific food groups. Agencies may also publish the complete list of item names and base year expenditure shares used to compute the index, but monthly item prices often remain confidential or are published for only a few products.

The ICP and CPI collect item prices for the purpose of measuring overall inflation and living standards, with no mandate to disclose individual item prices or nutritionally relevant food groups and healthy diet baskets. Meanwhile, market information and early warning systems (EWS) are explicitly focused on high-frequency reporting of prices for individual foods, to guide agricultural interventions and nutrition assistance by international agencies such as the World Food Program (WFP). Geographically, EWS data include price collection from more rural areas and small towns which account for a larger share of the population in those countries, whereas CPI data aim to represent total expenditure which is concentrated in urban markets. By definition, EWS data are item prices for individual foods, showing an average cost per kilogram, liter or other unit at each point in time. Item prices can be used to compute diet costs when the product description is sufficiently specific for matching to a food composition database showing the edible portion and nutrient content of the item. Matching item descriptions to data about its nutritional content may be quite accurate for uniform commodities such as soybean oil, but estimates of edible portions and nutrient composition may be only approximate for items such as

a whole chicken or different types of fish. Food price datasets may also include some items of unknown composition such as street foods.

This study analyzes the universe of monthly food price data now being collected and reported by national governments and international agencies around the world, to assess the degree to which prices are available for diverse items in each nutritionally relevant food group or healthy diet basket. We focus on the continuously updated monthly price indexes and item prices published for CPI and EWS purposes because these organizations have longstanding taxpayer-funded mandates for price data collection and public dissemination to guide policy choices. We also identify the types of food for which monthly price indexes or individual item prices are available as of November 2020 for the previous two years (2019 and 2020), from either CPI or EWS sources, thereby exploring the potential for retail price data to guide food policy and monitor food systems around the world. Other kinds of food price data available for specific locations from private organizations and household surveys are addressed at the end of this paper in the discussion section.

The data we describe have not previously been assembled and analyzed because they are published in diverse formats by different agencies to reach their own audiences. Historically, from 1924 to the 2000s, the International Labor Organization (ILO) assembled and published a subset of food prices collected for countries' monthly CPIs in the annual *ILO October Inquiry* (Dupré, 2005). For that report, the ILO sent a questionnaire to each national statistical agency requesting the previous 12 months of local currency prices for a list of foods that was expanded in 1985 to cover 96 distinct items. The resulting data from 1985 through 2008 was used occasionally for studies of real wages and poverty (Moatsos, 2016; Zwart et al., 2014). To our knowledge the ILO data were never used to compare relative prices of different food groups, because their sole purpose was to compute average price levels and hence real wages for low-income workers. By the 2000s, the World Bank and IMF had improved their use of price levels for poverty measurement and annual reporting of item prices to the ILO was discontinued, in favor of a more standardized approach to collecting prices for the same items in multiple countries through the ICP global office in the World Bank, and month-to-month reporting of countries' overall food CPI as part of inflation monitoring through the International Monetary Fund (IMF). Monthly variation in overall food CPIs is monitored primarily by the Food and Agricultural Organization to track food markets (FAO, 2021a), and by the IMF to track general

economic conditions (Reinsdorf, 2020), while the ILO also reports and uses these data to monitor the cost of living (Stoevska, 2020). All of these analyses use only the aggregate index, rather than prices for individual foods or averages by food group that can be calculated from item-level data (Bai and Masters, 2020).

The limited availability of comparable data across countries and over time has led previous studies of retail food prices to focus on a few higher-income countries (Rao et al., 2013; Darmon and Drewnowski, 2015; Christensen and Bronchetti, 2020), while research on food prices in lower-income countries often focused on a small number of generic items, typically just starchy staples (Brinkman et al., 2010) or bulk commodities in international trade (e.g. Swinnen and Squicciarini, 2012). This paper aims to reveal the extent to which price data are available for diverse food groups across geographic regions and by national income level, and thereby draw conclusions regarding how existing food price data can or cannot be used to monitor the cost and affordability of items from all food groups needed for a healthy diet.

2. Methods and data sources

2.1. Inclusion criteria and search procedures

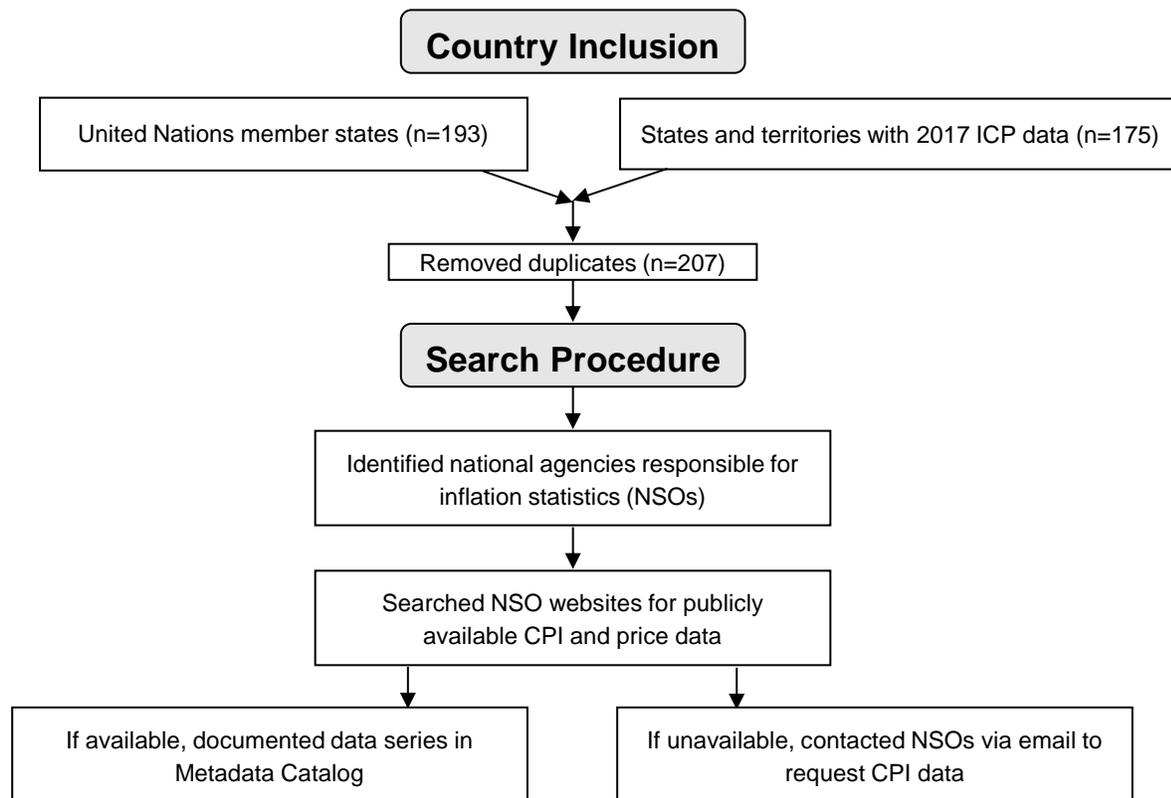
Locations represented in our dataset include all United Nations member states, plus any other countries and territories for which 2017 prices were reported through the ICP. The result is a universe of 207 locations for which nationally representative consumer prices might potentially be available. For each place we sought all publicly available CPI data for 2019 and 2020, and also downloaded all available EWS data for 2019 and 2020 as explained below (Figure 1).

To determine what CPI data is reported by each government, we identified the agency in each country that is responsible for inflation statistics and searched their online portals for downloadable data or regularly published bulletins. Our searches were conducted in waves between June and November 2020, using a combination of terms including the name of the country, “consumer price index”, “ministry of statistics”, “bureau of statistics”, “national statistical office”, “central bank”, and keywords such as “food price”, “food items”, and “food lists”, or equivalent terms in other languages. If that failed, we located the primary government website for each country and navigated through its links to locate the agency responsible for tracking inflation. Once we found that agency, if their website lacked downloadable food price indexes or item prices, we emailed enquiries to the contact information on that website asking

whether they had data they could send directly. Email enquiries of this type yielded data for Saudi Arabia and Palestine, and incomplete or no response from agencies in the seven other countries or territories for which no 2019 or 2020 data had been published as of our last visits to their websites in November 2020. The countries for which we have no data at all are Central African Republic, Eritrea, Lichtenstein, Monaco, Turkmenistan, North Korea, and Andorra.

From the universe of all available CPI publications, we assembled metadata summarizing the available indexes and item prices by geographic region. Many countries post multiple price datasets. Each dataset was assigned a unique identifier based on characteristics including the base year for item weights, the price indexes or item prices reported, the market locations or subnational regions for which data were reported, the temporal frequency of the data and its start and end date. For each CPI the base year is particularly important, since it defines the list of items and their expenditure weights used to compute index values each month. Our metadata also tracks dataset characteristics including the name of the reporting government agency, links to the website from which data are accessible, whether or not item and group weights are reported, which (if any) item prices are reported, totals or ranges for number of food items included in the CPI calculation, and other unique notes as relevant to each individual country.

Figure 1. Country inclusion and search procedure.



To complement national CPI data, we also downloaded all EWS food price data published for 2019 and 2020 by international agencies to guide their policy and program interventions. These EWS data are collected and published by three organizations with different mandates: the Global Information and Early Warning System (GIEWS) is managed by the Food and Agriculture Organization of the UN to monitor markets for farm products, the Famine Early Warning System Network (FEWS NET) is funded by USAID to predict humanitarian emergencies, and the Vulnerability Analysis and Mapping (VAM) system is used by the World Food Programme (WFP) to guide their food and nutrition assistance activities. Each of these international efforts collects and publishes price data from a mix of sources in collaboration with national governments. The datasets differ in scale and focus: as their names imply, FEWS NET targets locations most at risk of extreme scarcity, while FAO GIEWS focuses on agricultural commodities and includes data from wholesale markets as well as retail outlets, and the WFP VAM aims to inform ongoing food and nutrition support for all of the world's people at risk of undernutrition. Like CPI data, the published EWS data are likely to be a subset of all the prices

ever collected by agency staff, reflecting only the information that they have chosen to publish in pursuit of the agency's mission.

All of the EWS data are downloadable in machine-readable form. GIEWS data are currently not available as a bulk file download, but can be obtained through the FAO's Food Price Monitoring and Analysis website that allows users to download up to 10 comparable price series at a time in table format. This interface also provides options to download charts and summary statistics for selected series, but for statistical analysis of the entire dataset users must request an Application Programming Interface (API) key from the FAO GIEWS team. The API allows for unlimited download of GIEWS data via a statistical software such as RStudio. VAM and FEWS NET data are separately downloaded from the Humanitarian Data Exchange and the FEWS NET website.

While EWS are published quickly in machine-readable form, most of the world's CPI information is disseminated in monthly or quarterly statistical bulletins with tables of data designed for human readers of printed reports. In some cases CPI data can be downloaded in bulk, but most of the data reported here were extracted from pages that may be difficult to find on the individual country's statistical organization website. For this effort we employed a multilingual team of six graduate students specialized in food policy who were trained in the diverse terminology used to describe food items and price indexes, each of whom devoted an average of about 300 hours over six months to assemble and analyze the data.

2.2. Price indexes and classification of food items

To identify the level of disaggregation at which price indexes are reported by each country, we use terminology adapted from the UN Classification of Individual Consumption by Purpose (COICOP) (United Nations, 2018). A large and growing fraction of national statistical agencies use the COICOP system in their CPI reporting. In COICOP, food and beverage items for which prices might be available would be assigned a numerical code corresponding to a sequence of nested, mutually exclusive categories described in Table 1 below. Each item, if included in a price index, has an associated weight corresponding to its share of national consumer expenditure.

Table 1: Levels of food price index disaggregation

Index Level	Aggregation	Description and example
L0	CPI	All goods and services
L1	Division	Food and non-alcoholic beverages ^a
L2	Sub-division	Food; Non-alcoholic beverages
L3	Class	Food groups (e.g. Fruits within Food)
L4	Sub-class ^b	Food types (e.g. Citrus within Fruits)
L5	Variety	Food species or varieties (e.g. Oranges within Citrus)

^a Typically excludes food away from home; however, some countries such as Japan include food away from home as a subdivision. Also may include stimulants and tobacco, spices and noncaloric items such as bottled water.

^b Some countries that publish L4 indexes also publish a small number of L5 item indexes; countries are listed as L5 only if indexes for all items in their food list are published.

As shown in Table 1, the first level of possible disaggregation separates out food and non-alcoholic beverages from the universe of all consumer expenditure. The L2 or “sub-division” indexes separate foods from beverages, then L3 separates out each “class” of items, which often corresponds to food groups such as all fruits. An L4 index shows unit-free changes in the prices for a “sub-class” or type of item, such as all citrus fruits. The most granular data is L5, showing a “variety” such as oranges. The 2018 revision of COICOP introduced a total of 269 unique six-digit codes for L5 disaggregation (United Nations, 2018). By design, these are categories without units of measure, and items with the same COICOP code may be quite diverse. For example, the six-digit code for fresh oranges is 011623, but those could be large, sweet oranges or small bitter ones, and prices could be quoted for many different quantities. Not all countries report by COICOP categories, or at all index levels. For example, Pakistan reports L0, L1, L3, and L5 indexes, but does not report separate L2 or L4 indexes.

In a catalog of metadata provided in the Supplement, we characterized the level, frequency, and public availability of CPI and CPI price reporting by country. The catalog documents data series characteristics such as data source, number of indexes or prices, date ranges, base years, highest index level published, and publication frequency. Other characteristics are included as available, such as the approximate number of items included in the underlying index calculation, number of markets included in price collection, and whether item

names were reported. Additional notes are also included in some cases, but metadata are not standardized and key information such as item descriptions are not typically published.

The first column of Figure 2 shows the L3 COICOP system of price index classification, which is explicitly or implicitly used in food price reporting for most countries around the world. This categorization is designed for national income accounting, and is not well suited to classification of foods for nutritional purposes. For example, the COICOP category of “vegetables” includes starchy roots and tubers and “fruits” include plantains, all of which are most often nutritionally classified as starchy staples alongside cereal grains. Similarly, the COICOP vegetables category also includes beans and legumes, and the COICOP fruit category includes nuts and seeds; legumes, nuts and seeds are nutritionally important categories of their own or sub-categories of protein-rich foods in most dietary guidelines. The second column of Figure 2 shows the most granular disaggregation of food groups needed to construct the various dietary pattern recommendations made in a range of national Food-Based Dietary Guidelines (FBDGs) published by national governments (Herforth et al., 2019). Columns three to five provide a comparison to three other classifications commonly used in nutrition research and dietary quality monitoring and analysis. The third column shows the groupings used in the reference diet developed by the EAT-*Lancet* Commission (Willett et al., 2019), and the fourth shows the categorization used for the Household Dietary Diversity Score (HDDS) to evaluate food security through household consumption of diverse food groups (Swindale and Bilinsky, 2006). Finally, the Minimum Dietary Diversity for Women of Reproductive Age (MDD-W) is a score corresponding to micronutrient adequacy in low- and middle-income settings, including ten food groups with separate groupings for dark green leafy vegetables (DGLVs) and vitamin A-rich fruits and vegetables (Arimond et al., 2016).

The right-most column of Figure 2 shows the seven food groups used in this report to classify the items for which prices are available. This seven-category food price grouping overcomes the main limitations of COICOP categories for nutrition purposes, using a small number of groups suited for data visualization. These food groups are similar to those that appear in many dietary guidelines and reference diets which were used in the construction of least-cost nutritious diets (Herforth et al. 2020, Hirvonen et al. 2020, Masters et al. 2018).

Figure 2. Example food groupings used for price indexes and nutritional purposes

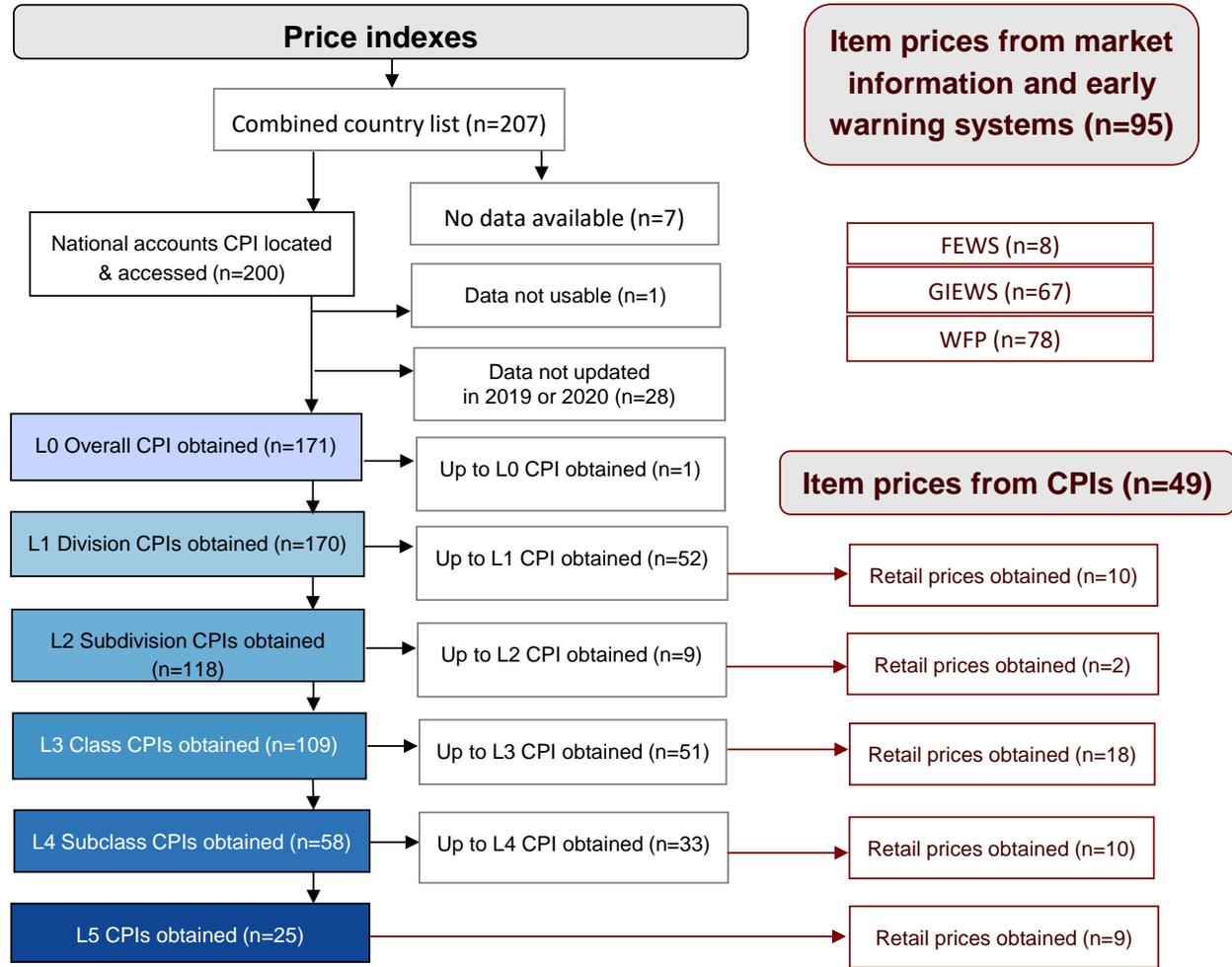
COICOP (code)	FBDGs	EAT-Lancet	HDDS	MDD-W	Diet cost categories
Bread and Cereals (01.1.1)	Roots and tubers	Roots and tubers	White roots and tubers	Starchy staples (cereals, white roots & tubers)	Starchy staples (cereals, white roots & tubers)
	Cereals	Whole grains	Cereals		
Vegetables (incl roots and tubers) (01.1.7)	Legumes	Legumes	Legumes and nuts	Legumes	Legumes, nuts and seeds
	Nuts / Seeds	Nuts		Nuts / Seeds	
	DGLV	Vegetables	Vegetables	DGLV	Fruits and vegetables (incl. orange roots & tubers)
	Other veg			Other veg	
Red/orange veg	Vit. A-rich fruits and vegetables				
Fruits (incl nuts / seeds) (01.1.6)	Fruits	Fruits	Fruits	Other fruits	
Fish and seafood (01.1.3)	Fish and seafood	Fish and seafood	Fish and seafood	Meat, fish and seafood	Meat, fish and seafood
Meat (01.1.2)	Poultry	Poultry	Meat		
	Red meat	Red meat			
	Processed meat				
Dairy and eggs (01.1.4)	Eggs	Eggs	Eggs	Eggs	Dairy and eggs
	Dairy	Dairy	Dairy		
Oils and fats (01.1.5)	Oils and fats	Unsat oils	Oils and fats		Oils and fats
		Saturated oils			
Confectionery (01.1.8)	Discretionary foods	Added sugars	Sweets		Other, n.e.c
Non-alcoholic beverages (incl fruit and veg juices) (01.2)			Other, n.e.c		
Other, n.e.c (01.1.9)					

Note: Column 1 shows L3 COICOP classes and the corresponding codes, mapped in column 2 to the most granular sub-classifications applied within 10 national food-based dietary guidelines (FBDGs) from diverse regions used to measure the cost of healthy diets in SOFI 2020, followed by the categories used in the EAT-Lancet Commission Report (Willett et al., 2019), the Household Dietary Diversity Score (HDDS) (Kennedy et al., 2011) and Minimum Dietary Diversity for Women (MDD-W) (Martin-Prevel et al., 2017). Food group names have been adjusted for uniformity across classification systems. For example, HDDS includes the food groups “Meat, poultry, and offal,” which we simplify to “Meat,” while MDD-W includes the food group “Grains, white roots and tubers, and plantains,” which we simplify to “Starchy Staples.” The last column shows the main food price categories used in this study, adjusting COICOP to reflect the nutritional attributes of foods.

3. Results

A complete enumeration of all countries and territories for which data could be obtained is shown in Figure 3, including both national CPI and international EWS data.

Figure 3. Countries reporting each level of disaggregation for price indexes and item prices



Note: The early warning system (EWS) data are collected and published by three organizations with different mandates: the Global Information and Early Warning System (GIEWS) is managed by the FAO of the UN to monitor markets for farm products, the Famine Early Warning System Network (FEWS) is funded by USAID to predict humanitarian emergencies, and the Vulnerability Analysis and Mapping (VAM) system is used by the World Food Programme (WFP) to guide their food and nutrition assistance activities. Countries with EWS data may also report CPI data. The International Comparison Program (ICP) collect global prices to compute purchasing power parity exchange rates.

Starting with item prices on the right side of Figure 3, we found that the international agencies provide EWS data for a total of 95 countries and territories around the world. The VAM system offers the broadest range of data, spanning 78 countries with a total of 443 distinct food items, while GIEWS spans 67 countries which report a total of 142 items. FEWS NET is the most targeted, focusing on 8 countries and 84 different items. In contrast, the number of statistical agencies that provide at least some item prices from their CPI is 49, of which two (Saudi Arabia and Palestine) did so by email request.

Turning to price indexes in the middle of Figure 3, of the world's 207 countries and territories that might have CPI data, we find that seven publish no data at all, one (Iran) had only unusable data, and 28 did not publish data updated into 2019 and 2020 as of our last visit to their websites in November 2020. Of the remaining 171 countries and territories, one provides only their overall CPI for all goods and services (L0), 52 provide indexes up to their overall food CPI (L1) and 118 provide separate subdivision indexes for food and for non-alcoholic beverages (L2) of which 109 also provide indexes at the "class" level of large food categories (L3). A total of 58 countries provide food price indexes at the nutritionally relevant "sub-class" level (L4), and 25 countries provide price indexes at the most granular "variety" level (L5). Twenty of the countries that publish L5 indexes also provide subindexes from L0 to L4, while the remaining five have idiosyncratic approaches and publish only a subset of these indexes. For example, Georgia publishes L0 and L5; Pakistan publishes L0, L1, L4, and L5; and Bolivia publishes L0, L1, L3, and L5.

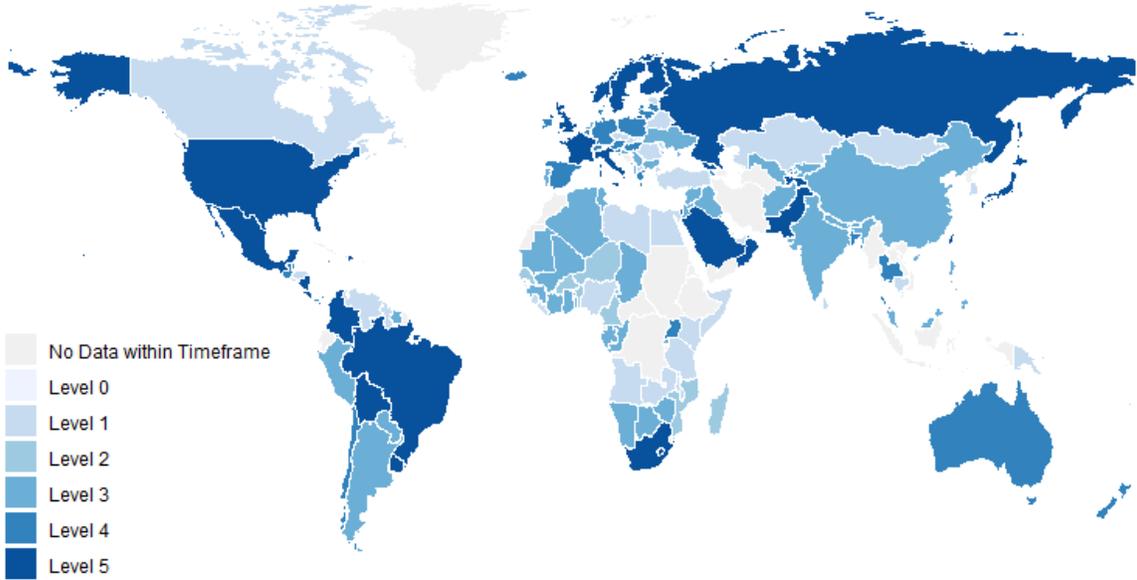
The geographic location of countries with each level of price index reporting and disclosure of individual item prices is shown in Figure 4. Panel A reveals that countries with greater disaggregation are primarily in North and South America and Northern Europe. However, there are numerous exceptions, and many countries in Africa, Asia, Central America, and Southeast Europe recently updated publications at the class level (L3). This kind of data is substantially more useful for food policy and nutrition purposes than L1 and L2 indexes, although less useful than prices or indexes at the level of subclasses (L4) and varieties (L5). Panel B reveals that the 49 countries which disclose item prices for at least a subset (11-241 items) of their CPI food list are widely spread around the world.

A principal objective of our analysis is to characterize the nutritional quality of items for which item prices are published, using nutritionally relevant food groupings. Results are shown

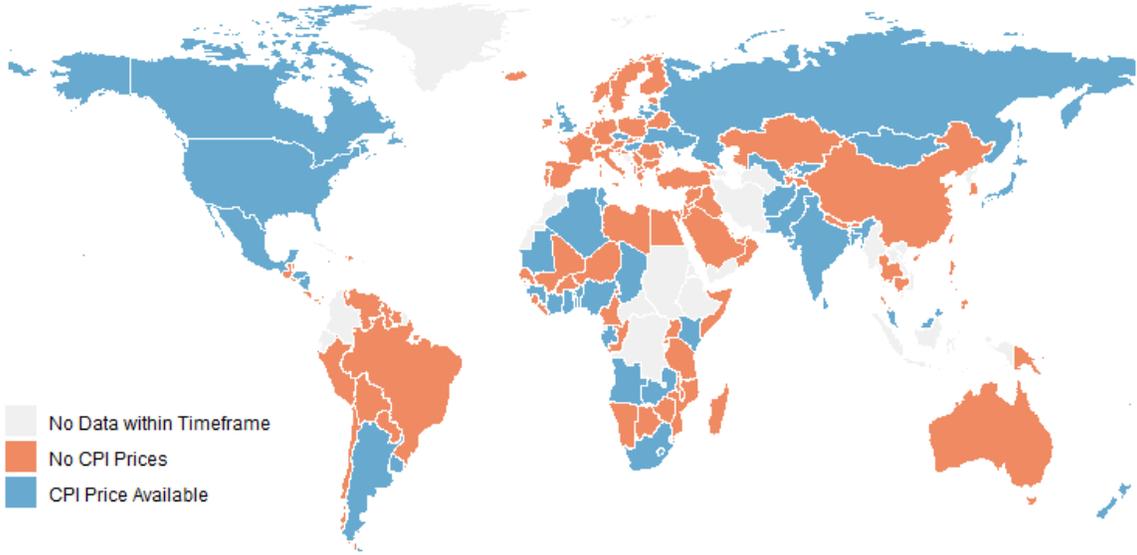
in Figure 5, where Panel A shows the number of prices in each of the seven large categories suggested in Figure 2, and Panel B shows the breakdown of fruits and vegetables into more granular categories.

Figure 4: Food price data from national sources available for 2019 and 2020.

Panel A. Food price indexes by the highest level of disaggregation in product categories.



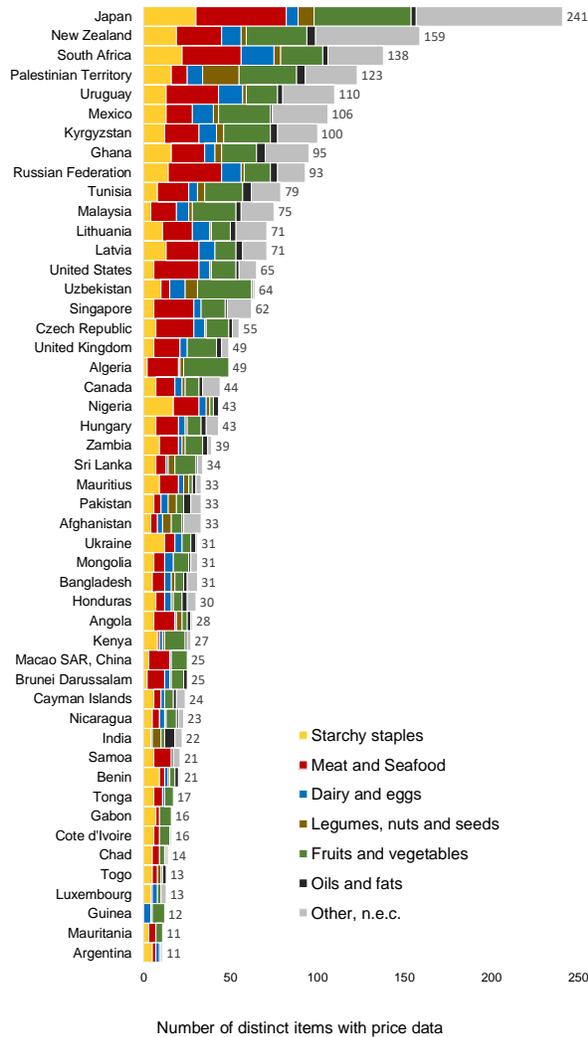
Panel B. Availability of any food prices for individual items.



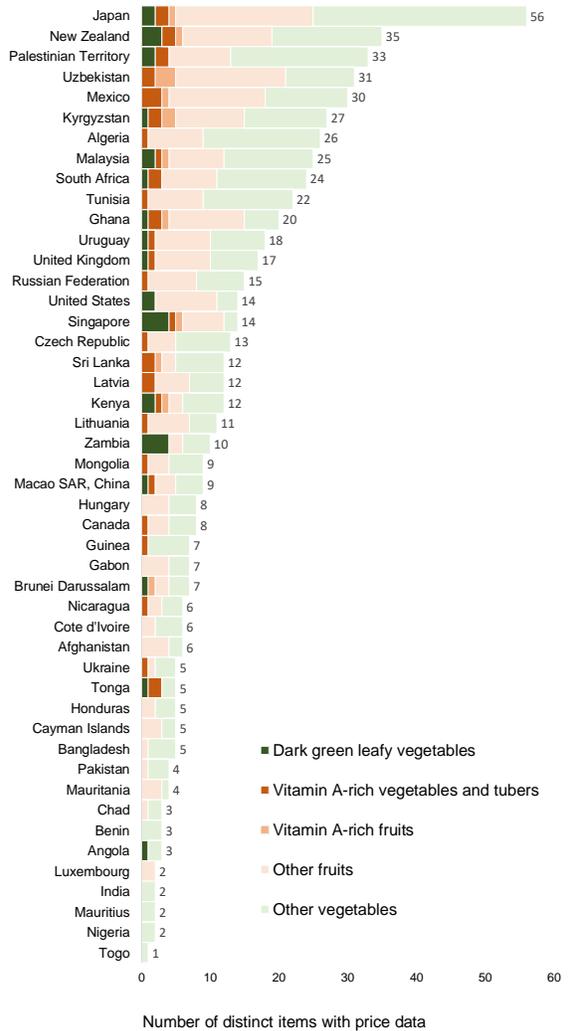
Note: Data shown are from national statistical agency websites, visited June – November 2020. Panel A displays the aggregation levels of indexes. Panel B displays countries with any available food retail prices, which is often just a subset of the items included in national CPI calculations.

Figure 5. Number of food items with prices published by national statistical agencies

Panel A. Major food groups



Panel B. Fruit and vegetable items



Notes: analyses include 49 countries that published CPI prices for their selected items in either 2019 or 2020. Panel B includes 47 countries, which excludes Argentina and Samoa because no fruit or vegetable prices were reported.

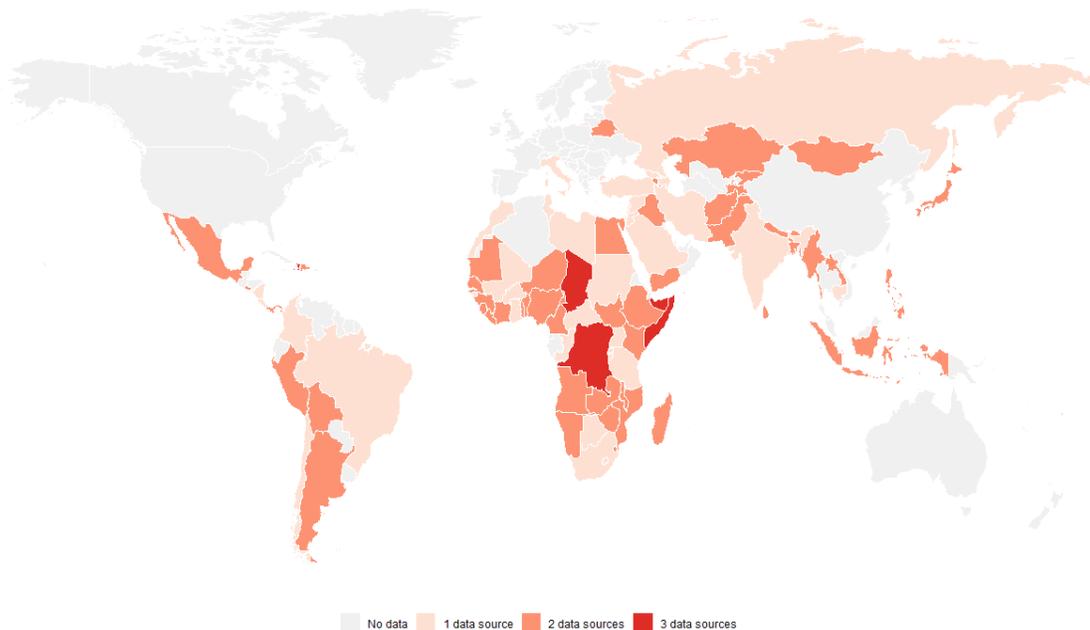
The number of items in the underlying CPI food list and the number of item prices posted vary widely (Figure 5), and the items included may vary seasonally and from month to month. Multiple starchy staples are included in all 49 countries, and animal-sourced foods are also relatively well represented, with the exception of dairy and eggs which are not reported at all in several low-income countries including Mauritania, Gabon, Côte d’Ivoire, Chad, and Togo. The “meat and seafood” grouping is mostly meat with fewer seafood prices. There are notable gaps in data for legumes, nuts and seeds; most countries include few or none of them. Among the food groups collectively classified as “other,” sweets and sugary snacks were the predominant food group, typically including at least either sugar or honey. Most countries that report prices for sugary foods such as biscuits, chocolates, and ice cream also had the most detailed item lists overall, with exceptions such as Mongolia and Samoa that post prices for multiple sugary foods despite publishing prices for relatively few items in other food groups.

Fruit and vegetable item prices are published in all countries except Samoa and Argentina, but there is great variation in the total number and composition of these items. As shown in Panel B of Figure 5, more nutritious items such as dark green leafy vegetables and vitamin A-rich fruits and vegetables are missing from many countries. A total of 16 countries omit both of these categories from the item prices that they publish, including Gabon, Côte d’Ivoire, Mauritania, Chad, Benin, Nigeria and Togo in Africa, and Bangladesh, Pakistan, and India in South Asia.

Item prices from the EWS are geographically concentrated in regions that report few CPI prices, and many of those countries actually have prices from more than one of the data sources. Figure 6 shows the location of EWS reporting.

Figure 6. Availability of EWS food price data by number of data sources

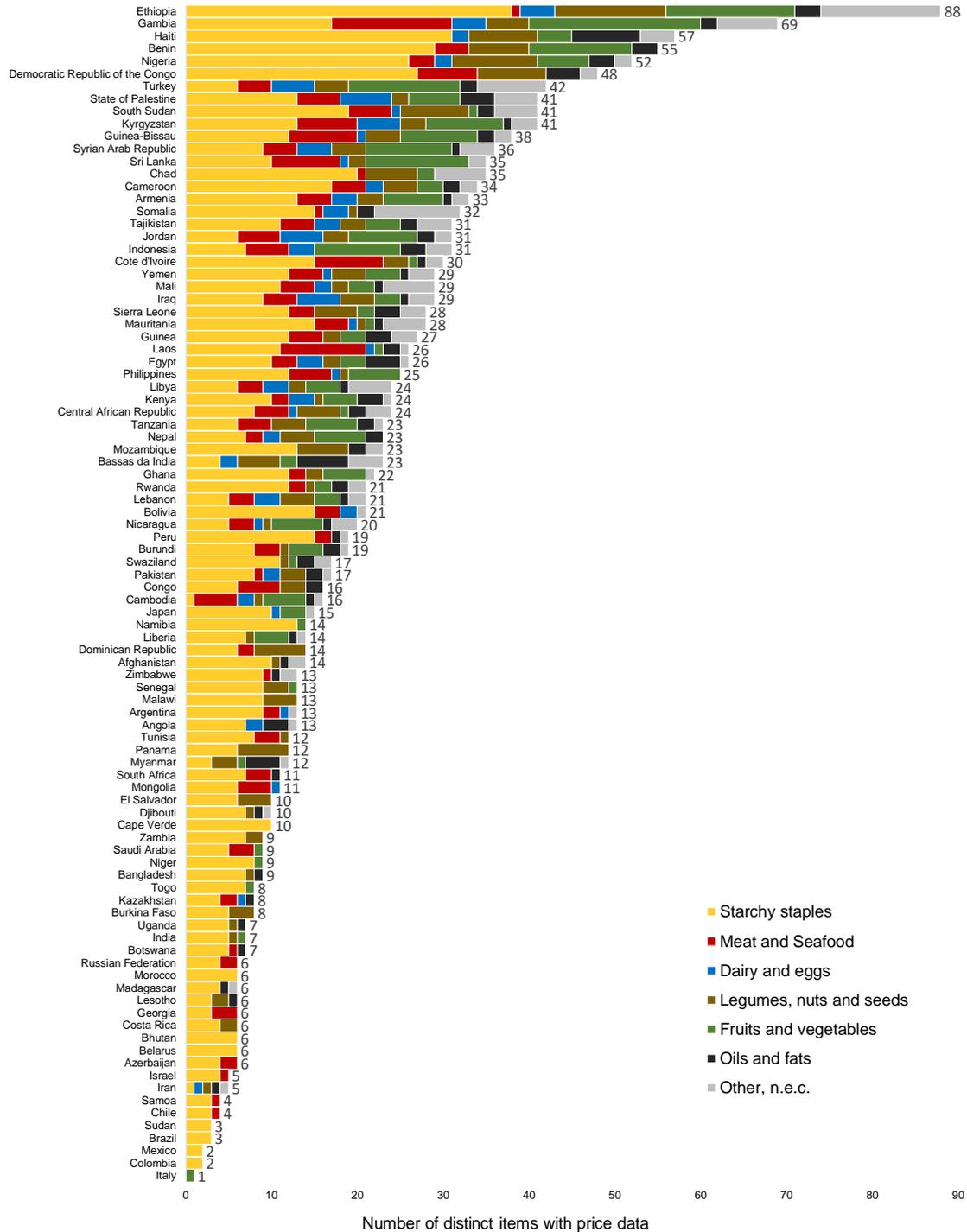
Data availability from EWS sources



Note: Data shown are from the Famine Early Warning Systems (FEWS) Network, the FAO’s Global Information and Early Warning System (GIEWS), and the World Food Programme (WFP)’s Vulnerability Analysis and Mapping (VAM) tool, all updated in November 2020. There are in total of 94 countries in the compiled data base. 39 countries are included in 1 data set, 51 in 2 data sets, and 4 countries are included in all three data sets (Chad, Democratic Republic of the Congo, Haiti, and Somalia).

Figure 7 below shows the number and food-group composition of prices available in the EWS datasets. Most countries have less than 50 items, except Benin, Ethiopia, Haiti, and The Gambia and Nigeria. Since the EWS were developed to monitor foods consumed by very low-income people they focus primarily on starchy staples. Over time the three international agencies have expanded their food lists to include more diverse foods. But as of 2019 and 2020, starchy staples still constitute the majority of price observations for all countries regardless of the total number of foods reported. Countries with very few foods typically report only starchy staples, which may be consumer-oriented foods such as tortillas in Mexico, or important agricultural commodities such as the two types of rice reported for Colombia. A focus on starchy staples also applies to countries reporting relatively long food lists, such as Ethiopia, Haiti, and DRC.

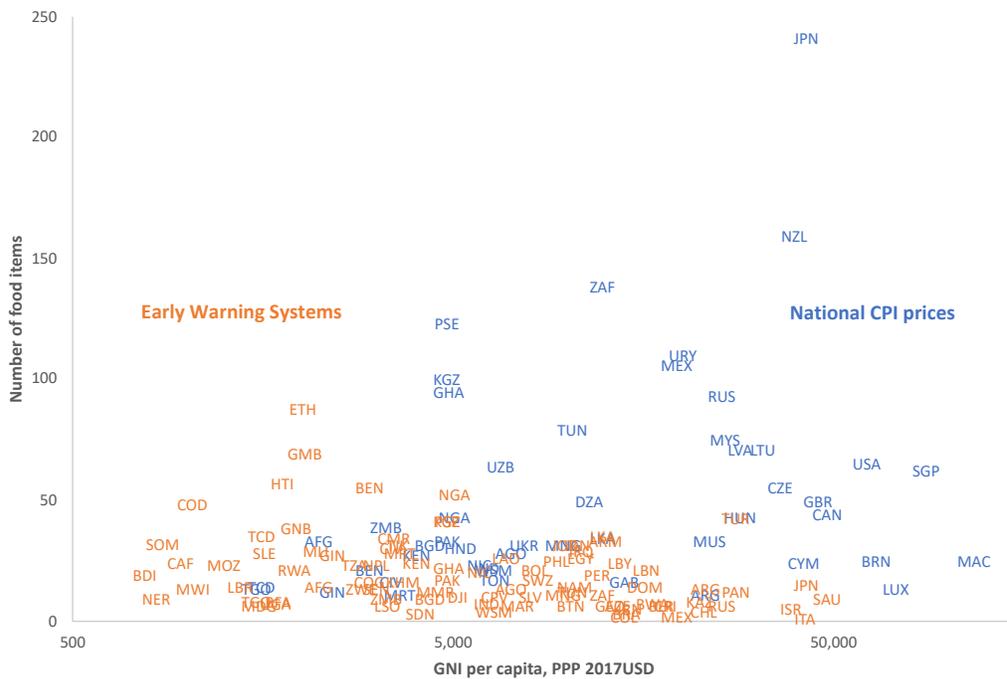
Figure 7. Number of food items with prices published in EWS datasets



Note: Data shown are from the Famine Early Warning Systems (FEWS) Network, the FAO’s Global Information and Early Warning System (GIEWS), and the World Food Programme (WFP)’s Vulnerability Analysis and Mapping (VAM) tool, all updated in November 2020. There are in total 94 countries covered by the three datasets.

The CPI and EWS data assembled for this study are shown in Figure 8 below, which plots the number of published item prices in each kind of price data by level of per-capita income. The number of item prices varies widely at every income level. EWS are more likely to collect data in lower income countries, and higher income countries are more likely to publish CPI item prices and often post prices for a larger number of items. For countries with both national and EWS food price data, CPI tends to include more food items across more food categories while EWS data often covers more regions and markets. For example, through its national reporting Zambia publishes about twice as many item prices as are available from EWS sources and these data span all 7 food categories compared to only 2 captured in EWS data. CPI data are only available, however, at a national average while EWS sources cover 72 distinct markets. India, Russia, Japan, and Mexico are notable exceptions to this trend as each CPI food price dataset has excellent regional coverage. More detailed analysis of differences and similarities in prices reported by alternative sources is an important frontier for future work.

Figure 8. Number of items with published food price data by source and GNI per capita



Notes: The EWS data shown are from datasets of the Famine Early Warning Systems (FEWS) Network, the FAO’s Global Information and Early Warning System (GIEWS), and the WFP’s Vulnerability Analysis and Mapping (VAM) tool, updated in November 2020, covering 94 countries. The national CPI data include 49 countries that published CPI prices for their selected items in either 2019 or 2020.

4. Discussion and conclusion

4.1 Transparency and standardization in food price data collection and publication

National CPI data typically includes a diverse range of food and non-alcoholic beverage items, because the purpose of CPI data is to track inflation over all expenditures in the economy as a whole. We find that most governments publish only aggregate averages designed to track overall inflation, rather than nutritionally relevant food groups or individual item prices. Choices about what to publish appears driven by the political and economic implications of inflation data, rather than technical difficulty or personnel requirements, because the collection of market prices and dissemination of overall CPI data is done routinely even under conditions of extreme scarcity in very low income countries, and is sustained during periods of extreme stress such as natural disasters or the COVID pandemic (Bai et al., 2021). Several low- and lower-middle countries are among the few governments that already post item prices and food group averages, clearly demonstrating the technical and budgetary feasibility of more granular reporting.

Adoption of internationally standardized procedures for publishing average prices by food group and for a healthy diet basket would allow data that are already being published in other forms to be used to improve food environments for nutrition and health. A standardized approach to food price monitoring could also help governments increase the diversity and improve the speed with which food price data are reported. At present, the median number of item prices reported to the public is zero, as a majority of countries make no item-level price data publicly available. Of those 49 countries that do report some item-level prices, most report an insufficient diversity of items to be able to calculate least-cost nutritious diets such as the Cost of Healthy Diet metric used in the SOFI 2020. It is understandable that the complete set of individual item prices used for CPI calculations be kept confidential, so national and global tracking of access to healthy diets will require the publication of nationally representative averages for nutritionally relevant food baskets and food groups. Publishing food price indexes and diet costs that reflect a healthy diet, in contrast to the food CPI that reflects what is currently consumed, could be done on a quarterly or monthly basis using the exact same prices as the existing CPI, and help guide policy and programs to make healthy diets affordable for all.

Beyond standardized reporting of average prices for nutritionally relevant food groups and healthy food baskets, other improvements in how data are compiled and published could enhance their usefulness. The most fundamental step is to publish data in machine-readable

form, with complete metadata regarding units of measure, item descriptions and the location and timing of price data collection. At present, many countries that disseminate their food price data online do so using formats developed for print publications, using nonstandard terminology and disparate reporting periods that make it difficult to obtain and clean the data to analyze price trends and diet costs.

Efforts to harmonize data reporting could use regional or global platforms such as Eurostat for countries in European Union, and ASEANstats for countries in the Association of South East Asian Nations, the IMF, the World Bank and other organizations. These platforms serve primarily to compile data furnished to them by national governments' official statistical agencies. They offer the potential for more standardized, available data, such as requiring reporting CPIs by food group such as the L4 categories in COICOP, and ensuring that item descriptions and expenditure weights in the CPI are listed in the metadata. Reporting average prices for internationally standardized food groups and healthy diet baskets could also accelerate and simplify reporting, because the item weights would be based on uniform nutritional criteria rather than the constantly changing expenditure weights needed for measuring overall inflation, or the complex calculations behind purchasing power parity data from the ICP whose standardization process takes several years to complete. The technical feasibility of nearly real-time reporting of food price has already been demonstrated by market information and early warning systems, whereby price data flow from field observations to data processing and posting online in a few days or weeks, as well as the monthly reporting of overall CPI data to the IMF and other international agencies.

4.2. Making retail price data more relevant for nutrition

Any efforts to standardize price data for food system monitoring should ensure that aggregate average prices represent items and categories that are relevant for nutrition and health. The individual item prices or food-group averages needed for a healthy diet could potentially be reported monthly, as a nationally-representative total and for subnational regions or market locations. Countries could achieve this aim using COICOP price indexes for each L4 subclass of foods, or each L5 variety within the subclass, since those correspond to foods with identifiable nutritional characteristics. The higher-level categories used for COICOP are designed for national accounts to measure economic activity, rather than healthfulness, so they do not quite

align with nutritional food groups used in dietary guidelines. For example, the L3 class of foods designed to capture horticulture includes tree nuts such as almonds along with fruits in a single category, and the class designed to capture bulky vegetables includes starchy roots and tubers alongside nutrient-rich items like tomatoes (Figure 2). Nutritionally relevant price indexes could readily be constructed from average prices and expenditure weights for the more granular L4 subclasses, and average prices for L5 varieties or individual items would allow identification of the most affordable foods to meet nutritional needs at each time and place.

The items selected for national food CPI data tend to be more diverse than prices currently selected by international agencies for EWS data, but both kinds of food lists could be made more relevant for food policy and nutrition if item selection deliberately sought to include prices for items that have the greatest potential impact on health. The set of price indexes and item prices that are available for 2019 and 2020 often omit nutritionally important food groups that may be insufficiently consumed under current conditions, especially dark green leafy vegetables and vitamin-A rich fruits and vegetables. Furthermore, even when nutrient-rich food groups are represented, only the most internationally-known varieties such as carrots, broccoli, and spinach are often selected, omitting less common vegetables that may be locally important for populations at risk of malnutrition, such as okra or pumpkin leaves.

Reporting prices for foods of potential nutritional importance is important to capture substitution possibilities within and between food groups, for example regarding seasonal availability of fruits and vegetables, or displacement of nutrient-rich items by other foods. Widely consumed items in categories such as sweets and sugary snacks, salty snacks, mixed dishes, sugar-sweetened beverages, other caloric beverages and foods consumed away from home are already included in CPI data, with expenditure weights that reflect national average consumption patterns, but expanded reporting of price data for such items could help governments compare the cost of healthy diet baskets to a variety of unhealthy options, and tailor their policies and programs accordingly.

Beyond the CPI and EWS data analyzed in this study, many other sources compile market prices that could potentially be used for research on food policy, nutrition and health. For example, cost-of-living comparisons are provided by Numbeo using prices crowdsourced from online contributors (Adamovic, 2021) which can be used to provide near real-time estimates of price changes (FAO, 2021b). Near real-time price data can also be scraped from online retailers

as done by the Billion Prices Project and the commercial PriceStats service in selected countries (Cavallo, 2021). Other data providers use proprietary surveys of retail outlets to achieve high levels of standardization in their cost-of-living comparisons (Abbey, 2020; Economist Intelligence Unit, 2021), or combine data sources to monitor and forecast agricultural commodity markets (Gro Intelligence, 2021), report on industry and consumer trends (Euromonitor, 2021), provide item-specific “scanner” data about individual transactions (National Academies of Sciences, Engineering, and Medicine, 2020), or provide contract services about prices at specific marketplaces (Esoko, 2021). All of these complement longstanding efforts to infer market prices from household surveys (Deaton, 1988) for use in estimating consumer response to policy change in low income countries (Capéau and Dercon, 2006; Ecker and Qaim, 2011; McCullough et al., 2020), as well as newer efforts to expand price data collection to address multiple forms of malnutrition worldwide (Lee et al., 2013). These diverse sources of food price data can be extremely useful for research purposes, but their institutional mandates are much narrower and their financial sustainability is much less clear than the government funding for inflation monitoring that is provided through official statistical organizations for their country’s national accounts, or the early warning systems established in international agencies to target agricultural interventions and nutrition assistance.

4.3 Expanding food price collection to inform policy

The data shown in this study reveal that neither currently reported CPI data nor EWS data are sufficient for monitoring the cost of healthy diets or consistent tracking of the prices of diverse nutritious foods over time. This study’s analysis of the available CPI and EWS data shows major gaps and heterogeneity in the level, type, breadth, format, and timeliness of price data reported, but reveals the potential for existing data collection infrastructure to be used in more effective ways. Both CPI and EWS platforms could provide very useful price information to guide agriculture and food policies, and help countries leverage their social protection systems and safety net programs to meet nutrition and health objectives. The data that are actually collected (if not always reported) include numerous examples of animal-source foods, fruits and vegetables, and oils and fats, in addition to the starchy staples that have been the longstanding focus of global food price reporting. Only a few countries have no national price data available

at all, while others report only aggregate averages that hide variation in prices among nutritionally relevant food groups.

If governments were to expand availability of item prices or report average prices for nutritionally relevant food groups and healthy diet baskets, governments could target policies and programs towards the universal accessibility of healthy diets at all times and places. Development goals relating to food security can be realized only when all people have access to sufficient, safe, nutritious food to meet dietary needs – which can best be monitored through the cost and affordability of healthy diets. Improved coverage and reporting would help CPI data meet its core purpose of measuring price levels for macroeconomic policy (Dabalén et al., 2020), in addition to using CPI data for policies and programs in agriculture, nutrition and health. For low-income countries there is also great potential for expanding EWS data collection to include more diverse food items and groups, and to cover more remote areas with greater risks of malnutrition than the population centers where most CPI data is collected.

In summary, improving the diversity of food price data collection for EWS, and improving the transparency, standardization, and timeliness of CPI item-level data reporting, would build on existing statistical platforms to help guide intervention towards agricultural, food and nutrition objectives. More timely reporting of standardized prices for diverse items would help track change in the cost of nutritious foods to guide agriculture and food policy, and track the affordability of healthy diets for use in nutrition assistance and social protection programs. The metadata analyzed in this study reveal how national governments and international agencies could expand on existing price data collection systems to help meet global development goals, including universal access to a healthy diet at all times for all people around the world.

References

- Abbey, G., 2020. Is this the most interesting job in the world? AIR Inc., Cambridge, MA (<https://airshare.air-inc.com/is-this-the-most-interesting-job-in-the-world>).
- Adamovic, M., 2021. Methodology and motivation for Numbeo. Numbeo, Inc., Belgrade, Serbia (www.numbeo.com).
- Allen, R.C., 2017. Absolute Poverty: When Necessity Displaces Desire. *Am. Econ. Rev.* 107, 3690–3721. <https://doi.org/10.1257/aer.20161080>
- Arimond, M., Ballard, T., Kennedy, G., Martin-Prével, Y., 2016. Minimum Dietary Diversity for Women: A Guide to Measurement. FAO, Rome.
- Bai, Y., Alemu, R., Block, S.A., Headey, D., Masters, W.A., 2020a. Cost and affordability of nutritious diets at retail prices: Evidence from 177 countries. *Food Policy* 101983. <https://doi.org/10.1016/j.foodpol.2020.101983>
- Bai, Y., Costlow, L., Ebel, A., Laves, S., Ueda, Y., Volin, N., Zamek, M., Masters, W., 2021. Food prices in a pandemic: Global data show higher costs for nutritious food groups Food Prices for Nutrition project working paper. <https://doi.org/10.21203/rs.3.rs-710555/v1>
- Bai, Y., Masters, W.A., 2020. Retail food prices at purchasing power parity exchange rates: A first look at aggregate ICP 2017 data. The World Bank, Washington, DC <https://blogs.worldbank.org/opendata/retail-food-prices-purchasing-power-parity-exchange-rates-first-look-aggregate-icp-2017>.
- Bai, Y., Naumova, E.N., Masters, W.A., 2020b. Seasonality of diet costs reveals food system performance in East Africa. *Sci. Adv.* 6. <https://doi.org/10.1126/sciadv.abc2162>
- Bose, I., Baldi, G., Kiess, L., de Pee, S., 2019. The “Fill the Nutrient Gap” analysis: An approach to strengthen nutrition situation analysis and decision making towards multisectoral policies and systems change. *Matern. Child. Nutr.* 15, e12793. <https://doi.org/10.1111/mcn.12793>
- Brinkman, H.-J., Pee, S. de, Sanogo, I., Subran, L., Bloem, M.W., 2010. High food prices and the global financial crisis have reduced access to nutritious food and worsened nutritional status and health. *J. Nutr.* 140, 153S-161S. <https://doi.org/10.3945/jn.109.110767>
- Capéau, B., Dercon, S., 2006. Prices, Unit Values and Local Measurement Units in Rural Surveys: an Econometric Approach with an Application to Poverty Measurement in Ethiopia. *J. Afr. Econ.* 15, 181–211. <https://doi.org/10.1093/jae/eji028>

- Cavallo, A., 2021. Covid Inflation: Evidence from Real-Time Data, Markus Academy Lecture. Bendheim Center for Finance, Princeton University, Princeton, NJ.
- Christensen, G., Bronchetti, E.T., 2020. Local food prices and the purchasing power of SNAP benefits. *Food Policy* 95, 101937. <https://doi.org/10.1016/j.foodpol.2020.101937>
- Dabalén, A., Gaddis, I., Nguyen, N.T.V., 2020. CPI Bias and its Implications for Poverty Reduction in Africa. *J. Econ. Inequal.* 18, 13–44. <https://doi.org/10.1007/s10888-019-09429-3>
- Darmon, N., Drewnowski, A., 2015. Contribution of food prices and diet cost to socioeconomic disparities in diet quality and health: a systematic review and analysis. *Nutr. Rev.* 73, 643–660. <https://doi.org/10.1093/nutrit/nuv027>
- Deaton, A., 1988. Quality, Quantity, and Spatial Variation of Price. *Am. Econ. Rev.* 78, 418–430.
- Dizon, F., Herforth, A., Wang, Z., 2019. The cost of a nutritious diet in Afghanistan, Bangladesh, Pakistan, and Sri Lanka. *Glob. Food Secur.* 21, 38–51. <https://doi.org/10.1016/j.gfs.2019.07.003>
- Dupré, M.-T., 2005. The ILO October Inquiry: Statistics on Occupational Wages and Hours of Work and on Retail Food Prices. *Ind. Relat. J. Econ. Soc.* 44, 193–196. <https://doi.org/10.1111/j.0019-8676.2004.00378.x>
- Ecker, O., Qaim, M., 2011. Analyzing Nutritional Impacts of Policies: An Empirical Study for Malawi. *World Dev.* 39, 412–428. <https://doi.org/10.1016/j.worlddev.2010.08.002>
- Economist Intelligence Unit, 2021. Worldwide Cost of Living 2020. Economist Intelligence Unit, New York, NY. <https://www.eiu.com/n/campaigns/worldwide-cost-of-living-2020>.
- Esoko, 2021. Data Collection, Profiling and Deployment Services. Esoko, Inc., Accra, Ghana <https://esoko.com/datacollection>
- Euromonitor, 2021. Methodology for Euromonitor Passport data. Euromonitor International, London. <https://www.portal.euromonitor.com/portal/help/methodology>.
- FAO, 2021a. Consumer Price Indices Metadata. Food and Agriculture Organization, Rome <http://www.fao.org/faostat/en/#data/CP/metadata>
- FAO, 2021b. FAO DataLab Food Prices Methodology. Food and Agriculture Organization, Rome. <http://datalab.review.fao.org/datalab/website/food-prices>

- FAO, IFAD, UNICEF, WFP and WHO, 2020. The State of Food Security and Nutrition in the World 2020: Transforming food systems for affordable healthy diets. FAO.
<https://doi.org/10.4060/CA9692EN>
- Gro Intelligence, 2021. As Peanut Prices Rally, China to Launch Futures Contract. Gro Intelligence, New York. <http://gro-intelligence.com>
- Headey, D.D., Alderman, H.H., 2019. The Relative Caloric Prices of Healthy and Unhealthy Foods Differ Systematically across Income Levels and Continents. *J. Nutr.* 149, 2020–2033. <https://doi.org/10.1093/jn/nxz158>
- Herforth, A., Arimond, M., Álvarez-Sánchez, C., Coates, J., Christianson, K., Muehlhoff, E., 2019. A Global Review of Food-Based Dietary Guidelines. *Adv. Nutr.* 10, 590–605. <https://doi.org/10.1093/advances/nmy130>
- Herforth, A., Bai, Y., Venkat, A., Ebel, A., Masters, W.A., 2020. Cost and affordability of nutritious diets across and within countries. Technical Background Paper for The State of Food Security and Nutrition in the World, 2020. FAO: Rome.
<https://doi.org/10.4060/cb2431en>
- Hirvonen, K., Bai, Y., Headey, D., Masters, W.A., 2020. Affordability of the EAT–Lancet reference diet: a global analysis. *Lancet Glob. Health* 8, e59–e66.
[https://doi.org/10.1016/S2214-109X\(19\)30447-4](https://doi.org/10.1016/S2214-109X(19)30447-4)
- Kennedy, G., Ballard, T., Dop, M., 2011. Guidelines for measuring household and individual dietary diversity. FAO, Rome, Italy. <http://www.fao.org/3/i1983e/i1983e.pdf>
- Lee, A., Mhurchu, C.N., Sacks, G., Swinburn, B., Snowdon, W., Vandevijvere, S., Hawkes, C., L'Abbé, M., Rayner, M., Sanders, D., Barquera, S., Friel, S., Kelly, B., Kumanyika, S., Lobstein, T., Ma, J., Macmullan, J., Mohan, S., Monteiro, C., Neal, B., Walker, C., 2013. Monitoring the price and affordability of foods and diets globally. *Obes. Rev.* 14, 82–95. <https://doi.org/10.1111/obr.12078>
- Mahrt, K., Mather, D., Herforth, A., Headey, D.D., 2019. Household dietary patterns and the cost of a nutritious diet in Myanmar. International Food Policy Research Institute (IFPRI), Washington, DC. <https://doi.org/10.2499/p15738coll2.133344>
- Martin-Prevel, Y., Arimond, M., Allemand, P., Wiesmann, D., Ballard, T.J., Deitchler, M., Dop, M.C., Kennedy, G., Lartey, A., Lee, W.T., Moursi, M., 2017. Development of a Dichotomous Indicator for Population-Level Assessment of Dietary Diversity in Women

- of Reproductive Age. *Curr. Dev. Nutr.* 1, cdn.117.001701.
<https://doi.org/10.3945/cdn.117.001701>
- Masters, W.A., Bai, Y., Herforth, A., Sarpong, D.B., Mishili, F., Kinabo, J., Coates, J.C., 2018. Measuring the Affordability of Nutritious Diets in Africa: Price Indexes for Diet Diversity and the Cost of Nutrient Adequacy. *Am. J. Agric. Econ.* 100, 1285–1301.
<https://doi.org/10.1093/ajae/aay059>
- McCullough, E., Shin, S., Arsenault, J., Zhen, C., 2020. Harnessing Food Demand Systems for Improved Nutrition in Tanzania. University of Georgia Working Paper 58.
http://www.ellenmccullough.com/uploads/4/7/7/5/47756249/hds_tanzania_200405.pdf
- Moatsos, M., 2016. Global Absolute Poverty: Behind the Veil of Dollars. *J. Glob. Dev.* 7, 1–28.
<https://doi.org/10.1515/jgd-2016-0033>
- National Academies of Sciences, Engineering, and Medicine, 2020. Proprietary commercial data sources, in: *A Consumer Food Data System for 2030 and Beyond*. National Academies Press, Washington, DC. <https://doi.org/10.17226/25657>
- National Research Council, 1941. *Recommended Dietary Allowances*. The National Academies Press, Washington, DC.
- Raghunathan, K., Headey, D., Herforth, A., 2020. Affordability of nutritious diets in rural India. *Food Policy* 101982. <https://doi.org/10.1016/j.foodpol.2020.101982>
- Rao, M., Afshin, A., Singh, G., Mozaffarian, D., 2013. Do healthier foods and diet patterns cost more than less healthy options? A systematic review and meta-analysis. *BMJ Open* 3, e004277–e004277. <https://doi.org/10.1136/bmjopen-2013-004277>
- Reinsdorf, M., 2020. COVID-19 and the CPI. Working Paper No. 20/224. IMF, Washington, DC. <https://www.imf.org/en/Publications/WP/Issues/2020/11/05/COVID-19-and-the-CPI-Is-Inflation-Underestimated-49856>
- Schneider, K., 2020. Household consumption, individual requirements, and the affordability of nutrient-adequate diets - An application to Malawi (PhD Dissertation). Tufts University, Boston. <https://www.proquest.com/docview/2491292518>
- Stigler, G.J., 1945. The Cost of Subsistence. *J. Farm Econ.* 27, 303.
<https://doi.org/10.2307/1231810>

- Stoevska, V., 2020. COVID-19 is driving up food prices all over the world. ILOSTAT. International Labor Organization, Rome. <https://ilostat.ilo.org/covid-19-is-driving-up-food-prices-all-over-the-world>
- Swindale, A., Bilinsky, P., 2006. Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide (Version 2). FHI 360/FANTA, Washington, DC. <http://www.fantaproject.org>
- Swinnen, J., Squicciarini, P., 2012. Mixed Messages on Prices and Food Security. *Science* 335, 405–406. <https://doi.org/10.1126/science.1210806>
- United Nations, 2020. Food Systems Summit. United Nations, New York. <https://www.un.org/en/food-systems-summit>
- United Nations, 2018. Classification of Individual Consumption According to Purpose (COICOP). Series M, No. 99 White Cover Publication No. ST/ESA/STAT/SER.M/99. UN Department of Economic and Social Affairs, Statistics Division, New York. https://unstats.un.org/unsd/class/revisions/coicop_revision.asp
- Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L.J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J.A., Vries, W.D., Sibanda, L.M., Afshin, A., Chaudhary, A., Herrero, M., Agustina, R., Branca, F., Lartey, A., Fan, S., Crona, B., Fox, E., Bignet, V., Troell, M., Lindahl, T., Singh, S., Cornell, S.E., Reddy, K.S., Narain, S., Nishtar, S., Murray, C.J.L., 2019. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet* 393, 447–492. [https://doi.org/10.1016/S0140-6736\(18\)31788-4](https://doi.org/10.1016/S0140-6736(18)31788-4)
- Zwart, P. de, Leeuwen, B. van, Leeuwen-Li, J. van, 2014. Real wages since 1820, in: *How Was Life? Global Well-Being since 1820*. OECD, Paris, pp. 73–86. <https://read.oecd.org/10.1787/9789264214262-8-en>