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Food prices in a pandemic: Global data show higher costs for nutritious food groups

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Abstract: The COVID pandemic has cut lives, livelihoods and supply chains, leading to price spikes for some foods and decline for others. We compare monthly retail food prices in up to 180 countries through February 2021, and find significant rises for more nutritious food groups with higher case counts. Prices by food group complement data on farm commodity prices and overall consumer price indexes, and can help guide policy for resilience and response to shocks.

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Contribution statement: WM conceived the study and obtained funding; YB led the analysis and data visualization; LC, AE, SL, YU, NV and MZ assembled data and conducted analyses; WM and YB wrote the paper.

Food prices in a pandemic: Global data show higher costs for nutritious food groups

COVID-19 has reached all countries of the world, destroying lives and livelihoods at unprecedented speed and scale. News services have reported food price spikes and temporary shortages, but agricultural production and food distribution has continued to function without the extremes of food scarcity or government rationing seen during wartime or natural disasters with comparable levels of mass casualties¹. This article reports on a compilation of national data on consumer prices before and during the pandemic, offering an updated view of global food systems with distinctive implications for policy response and market monitoring.

Previous analyses of world food markets typically focus on agricultural commodities sold in bulk for regional and international trade, or countries' overall consumer price index (CPI). Global indicators such as the Food and Agriculture Organization (FAO)'s world food price index fluctuate from month to month but remained near historic lows through most of the pandemic, and then rose in anticipation of higher incomes after recovery². National studies from such countries as India, China, Brazil and the United States show even larger fluctuations and often declining trends in wholesale prices³⁻⁶, with some suggestive evidence of retail price rises in several European countries⁷ and urban India⁸.

To inform policies regarding global consumers' access to diverse foods on retail markets, we compiled all available sources of consumer price data from around the world, following a protocol registered in May 2020⁹. In this study we report global average levels of consumer price indexes (CPI) in up to 180 countries from January 2019 to February 2021, as well as average prices by food group from early-warning systems (EWS) for a total of 1,309 distinct food items in 86 lower- and middle-income countries. The methods and datasets are detailed in the Methods section supported by the supplementary figures. Our compilation of these data is part of a larger global effort to improve reporting and analysis of consumer food prices and the affordability of healthy diets, funded by the Bill & Melinda Gates Foundation and UKAid¹⁰. Price reporting by food group could be done in near real time for food system monitoring, to inform both long-run development policy and resilience in response to shocks such as the COVID pandemic, climate change and conflict.

COVID-19 in agriculture and food systems

A wide range of evidence reveals that COVID-19 has led to dramatic changes in food demand and supply, but has so far done little to slow agricultural production on the farm^{11–13}. The disease emerged and spread first in cities, transmitted from person to person through close contact especially indoors, and was slow to reach farmers whose physical isolation limits exposure to the virus. In more urban areas, fear of infection led individuals to limit their contacts and led many institutions and governments to close public spaces, driving consumers away from restaurants and cafeterias towards purchase of packaged and retail items¹⁴. The sudden switch to food at home led to brief price spikes and low inventory as consumers stocked up, and some farmers were forced to dump perishable items such as milk, vegetables and fruits that could not be repurposed for individual sale.

As the pandemic proceeds, it has become clear that its most lasting effects on food systems have occurred through job loss that worsens poverty and food insecurity^{15,16}. Among food system workers, the biggest impact has been on employees who live off the farm, including seasonal and migrant workers who live and travel in groups, meatpacking and greenhouse workers who labor together in closed spaces, and retail vendors who are in frequent contact with many customers^{17,18}. The result could be a new kind of food price crisis in which agricultural production continues and commodity prices are low during the crisis due to depressed demand, and then rise in anticipation of increased demand after recovery, but retail prices remain elevated throughout the crisis due to the high cost of maintaining supply chains off the farm.

Overall food prices and inflation

To identify change in retail food prices relative to all other goods and services, we analyzed all available monthly data on each country's overall CPI and their food CPI, including the ratio of food to all prices which we call the food price index (FPI). Each country's CPI and FPI is computed over many prices observed at diverse locations, intended to be nationally representative average weighted by expenditure shares for each item.

The global averages shown in Figure 1 are set to 100 in January 2019 so that cumulative changes since then are clearly visible, along with the 95% confidence interval (CI) around the global mean for each month. Panel A reveals that the CPI and food CPI rose at almost exactly the same rate from January through October 2019, with no change in the ratio of food prices to the prices of all goods and services (FPI). That FPI ratio rose slightly in November and December before a statistically significant rise from January through May to about 3% above its 2019 level, and then sustained at a range between 2% and 3% through February 2021. Those movements in retail prices during the pandemic clearly differ greatly from the FAO's global Food Price Index for traded agricultural commodities that fluctuates widely during this period.

Panel B of Figure 1 shows the relationship between food prices and the spread of COVID-19, measured as each month's accumulated number of cases per million people ever recorded in each country. Dots show individual country-month observations, including many at zero before the disease was first reported in that country, and a few observations at the far right showing price levels in countries at very high levels of cumulative case counts.

Figure 1 shows that in the months before COVID-19, trends in price levels for food (FCPI) and for all goods and services (CPI) were similar, but then places and times with higher cumulative case counts had significantly higher levels of FCPI than CPI. The ratio between them (FPI) indicates that food prices could reach more than 5% above the general price level once cumulative cases reach above 8,000 per million people. These are countries' official national statistics, using methods that could potentially be improved with further research. Most importantly, CPIs are calculated with expenditure weights derived from surveys conducted prior to the pandemic, before consumer spending had shifted towards food and away from categories such as travel, hospitality and other services. The systematically higher price of food shown here reveals the importance of that sector, and monitoring its prices relative to the cost of other things^{6,19,20}.

Prices by food group

To compare price changes across different types of food, we assembled all available observations of retail food prices reported by international organizations in their early warning systems (EWS) to guide agricultural aid and food assistance programs. Historically, these early warning systems focused on prices for basic staples (bread and cereal grains; pulses, nuts and seeds) in a few locations, but for 2019-2021 they include many items from diverse food groups (fruits and vegetables; dairy and eggs; meats; fish and seafood; oils and fats; sugar and confectionary) at multiple marketplaces a wide range of mostly low- and middle-income countries. In total we obtained 312,572 individual price observations from three international agencies for 86 mostly lower- and middle-income countries.

Figure 2 for individual items by food group is constructed similarly to Figure 1 for consumer price indexes, but since different countries report prices for different number of foods we use sample weights to show means and CIs for the average country. Also, item prices may be reported separately for multiple market locations within a country, and differences between places are absorbed using location fixed effects. Panel A reveals simultaneous acceleration of price rises in April as the pandemic spread. Notably, price growth for all other food groups outpaced than that of breads and cereals. Panel B shows that these higher price levels are robustly associated with the country's cumulative case counts of COVID-19 infection. Comparing the two panels reveals how fruit and vegetable prices spiked in April before northern hemisphere summer but declined thereafter in seasonal patterns documented elsewhere²¹, while dairy and eggs, meats, and pulses, nuts and seeds rose later making them more closely linked with case counts over time. Given the importance of these food groups for low-cost nutritious diets²², their high prices during COVID-19 is a major threat to nutrition security around the world.

Implications for policy

High consumer prices for many foods during the COVID-19 pandemic reveal the importance of postharvest distribution and retail services, not just agricultural production. Prices depend on the interaction of both demand and supply, with systematically higher prices for all food groups reflecting continued demand but elevated costs associated with the spread of COVID-19 and resulting burden of illness, worker protection and other disruption. So far the pandemic has not cut farm production, so agricultural commodity prices fell in anticipation of lower demand during the pandemic and rise in anticipation of recovery, but were not systematically elevated

during periods of high case counts. This kind of food price crisis can be addressed only through attention to off-farm aspects of the food system.

Actions to Protect and Improve Affordability of Healthy Diets

Appropriate policy responses to COVID-19 begin with disease control. The most important steps to protect food access are the public health measures used to stop any infectious disease, and thereby allow people to resume market interactions^{11,12}. Disease control is especially important for personal mobility and face-to-face interactions that place many food system workers at high risk of transmission^{17,18}. Among consumers, the most important step is to protect consumer incomes and purchasing power, through all elements of the social safety net for those who have lost livelihoods or had low incomes even before the pandemic^{1,16}.

Actions to Monitor Food Prices and the Cost of Healthy Diets

Food price monitoring has long focused on wholesale prices for a few commodities, but can now be extended to retail prices of all items needed for a healthy diet. This article demonstrates the feasibility of reporting month-to-month changes across all major food groups, using publicly available data. So far the CPI data for Figure 1 come from the national accounts and international agencies of 180 countries, while the individual item prices and food-group averages reported in Figure 2 come from international agencies reporting prices for 86 countries. A broader effort could accelerate reporting from these sources, and perhaps also expand coverage to more foods, more market locations, and more countries, aggregated by food group as reported here. Future work will make metadata more transparent so that quantities can be compared within and across countries, and permit global monitoring of retail prices for all major food groups in nearly real time.

Conclusions

Compilation of the data for this article was undertaken in response to the pandemic, repurposing our food price project's travel budget to employ multilingual research assistants for a preregistered analysis plan⁹. From October 2020, a new project at Tufts University working with the World Bank and the International Food Policy Research Institute (IFPRI) will expand use of the food prices shown here, computing the cost and affordability of healthy diets to guide agricultural and nutrition policy¹⁰. That work involves close collaboration with national governments to standardize reporting of CPI data, and with international agencies to expand the diversity, timeliness and relevance of other food price data.

Before the COVID-19 pandemic, poor diet quality had become the largest preventable cause of death and disability. The rise of obesity and cardiometabolic diseases, alongside continued low intake of nutritious and protective foods, led to investments aimed at bringing healthier diets within reach of everyone. New work on food prices and diet costs commissioned by UN agencies is being used to guide agricultural and food system investments²³, in ways that could be particularly valuable for pandemic response.

Methods

In this study, we compiled global dataset of CPIs and retail food prices from international agencies. In the time trend analysis, we included calendar month as categorical variable, and for correlation with the timing of each country's epidemic we use a cubic function of the country's

cumulative case count in each month. Analyses controlled fixed effects for each country in CPI models or market location for food price models to adjust for differences over space. All analyses and data visualizations were conducted using Stata/SE version 16.1 and RStudio 1.4.1106. Descriptions of the datasets are detailed below.

Consumer Price Indexes

Our price index data were downloaded from the FAO which disseminates food and agriculture data for all countries and territories of the world through the FAOSTAT at <http://www.fao.org/faostat/en/#home>. We downloaded the CPI and FCPI in June 2021 for 203 and 198 countries, respectively. We then downloaded the COVID-19 data required from the Our World in Data at <https://ourworldindata.org/coronavirus-source-data>, compensated with data from European Centre for Disease Prevention and Control, at <https://www.ecdc.europa.eu/en/covid-19/data>, and merged with the CPI database. After deleting countries without COVID information and dropping Venezuela experiencing hyperinflation, we then generated a dataset, where 180 and 177 countries have CPI and FCPI data from January 2019 through February 2021 (Figure S1).

Individual item prices

In the analysis, we used early warning system (EWS) data from three different organizations - the WFP's Vulnerability Analysis and Mapping (VAM) program (<https://data.humdata.org/dataset/wfp-food-prices>), the FAO's Global Information and Early Warning System (GIEWS) data for Food Price Monitoring and Analysis (<https://fpma.apps.fao.org/giews/food-prices/tool/public>) and the USAID-funded Famine Early Warning System Network (FEWS NET) data (<https://fews.net>), which provide monthly food price reporting mostly for low- and middle-income countries. Unlike CPI data, the EWS prices are not necessarily intended to be nationally representative of all consumer expenditure, but they do cover a wide range of items from diverse food groups, and are obtained from a wide range of smaller towns and open markets in remote areas that may not be captured by CPI.

We compiled datasets from the EWS data sources in May 2021, initially including 581 food items and 90 countries. We then categorized those food items into 8 food groups of breads & cereals, pulses, nuts & seeds, fruits & vegetables, dairy & eggs, sugar & confectionary, meats, fish and seafoods, and oils & fats. We kept observations for which prices were reported for January 2019 through February 2020 or later up to February 2021, and normalized each price to be 100 in January 2019. To remove extreme outliers that are almost certainly caused by data-entry errors, we trimmed the top and bottom 0.5% of normalized prices by food group and dropped observations with missing COVID or normalized prices, leaving a total of 312,572 observations in the final dataset.

Figures S2 and S3 provide a visual summary of the price dataset, which contains 1,309 country-items for 486 food items from 86 countries. As shown in Figure S2, a total of 50 countries (58.1%) have prices for 10 or more food items. A majority of country-items (65.1%) have prices updated through September 2020, and food groups are well represented over time as shown in Figure S3.

216 The country and item coverage described in this annex reveals some risk of selection bias in
217 global averages. To the extent that non-reporting is most common for the places and food items
218 whose supply chains are most stressed, leading to scarcity and high prices, our global averages
219 over the observed data are a lower bound that understates the actual rise in food prices associated
220 with COVID-19. Future work will examine patterns of non-reporting, as well as changes in
221 observed prices, with respect to a variety of country characteristics including COVID-19
222 exposure and policy responses.

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Fig.1 | Consumer price indexes for food and other items, January 2019 to February 2021, from 180 countries. Data shown refer to each country's national consumer price index (CPI), CPI for food and non-alcoholic beverages (FCPI), and food price index (FPI) ratio of food to overall price level since January 2019 (=100) from 180 countries. (A) shows the global mean and 95% CI in each month for those indexes, with the FAO world food commodity price index for comparison. (B) shows the global mean and its 95% CI at each level of reported cumulative monthly COVID-19 cases per million. The horizontal axis of Panel B is truncated at the far right to show 99% of the individual observations, although the regression line was estimated including all data including the 1% of prices observed with COVID-19 rates that are off the charts to the right for each food group.

Fig.2 | Average prices by food group, January 2019-February 2021 (n=1,309 country-items from up to 86 countries). Data shown are from a total of 312,572 price observations, each normalized to 100 in January 2019. A total of 85 countries report prices for breads & cereals, 54 for fruits & vegetables, 50 for pulses, nuts & seeds, 48 for meats, 45 for sugar & confectionery, 40 for oils & fats, 29 for dairy & eggs, and 23 for fish & seafood. Tubes, such as potatoes and sweet potatoes, are categorized as fruits and vegetables in the analysis. **(A)** shows the global mean and 95% CI in each month. **(B)** shows the global mean and its 95% CI at each level of reported COVID-19 cases per million. The horizontal axis of Panel B is truncated at the far right to show 99% of the individual observations, although the regression line was estimated including all data including the 1% of prices observed with COVID-19 rates that are off the charts to the right for each food group.

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Fig.S1 | Country coverage of the CPI data in the study. We included 180 and 177 countries with COVID data and CPI/food CPI data respectively from January 2019 through February 2021.

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Fig.S2 | Country and food item coverage of global food price dataset in the study. We included 86 countries with COVID data and retail food prices from January 2019 to February 2020 or onwards until February 2021. Color gradient indicates the number of food items included in each country.

Fig.S3 | Number of country-item in the global food price dataset by food group, January 2019-February 2021. Country-item is defined as the total food item numbers in all countries. Overtime, the number of country-item gradually declines from 1,309 in January 2019 to about 852 in February 2021.