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Changes in household food security, access to health services and income in northern Lao PDR during the COVID-19 pandemic: a cross-sectional survey

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ABSTRACT

Objectives We assessed the relative difficulty in meeting food needs during the COVID-19 pandemic compared with before; determined the relationship between pandemic-associated difficulties in food access and household, maternal and child food security; and identified resiliency-promoting strategies.

Design A cross-sectional survey of households undertaken in November 2020.

Setting Rural districts of Luang Prabang Province, Lao People's Democratic Republic.

Participants Households (N=1122) with children under 5 years.

Primary and secondary outcomes measured Survey respondents reported the relative ease of access of food and healthcare as well as changes in income and expenditures compared with before March 2020. We determined indicators of food security and source of foods consumed for households, women and children, as well as prevalence of malnutrition in children under 5.

Results Nearly four-fifths (78.5%) found it harder to meet household food needs during the pandemic. The most common reasons were increased food prices (51.2%), loss of income (45.3%) and decreased food availability (36.6%). Adjusting for demographics, households with increased difficulty meeting food needs had lower food consumption scores and child dietary diversity. Over 85% of households lost income during the pandemic. Decreased expenditures was associated with reliance on more extreme coping strategies to meet food needs. The households who experienced no change in meeting food needs produced a greater percentage of their food from homegrown methods (4.22% more, 95% CI 1.28 to 7.15), than households who found it more difficult.

Conclusions Pandemic-associated shocks may have large effects on food insecurity. Action is needed to mitigate consequences of the pandemic on nutrition. Local food production and safety net programmes that offset income losses may help.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ We characterise food security across all members of the household, including women and children, through a series of standardised measures, and describe the source of foods consumed, permitting identification of strategies to promote resilience in this population.
⇒ We capture a large, representative sample of Luang Prabang Province, a marginalised population with high prevalence of ethnic minorities, for whom little data on nutrition were previously available.
⇒ The results of this study may not be generalisable to other counties with varying economic profiles or rates of COVID-19, to urban communities, or to rural provinces with lower reliance on tourism.
⇒ The analyses are cross-sectional, preventing establishment of causal relationships.
⇒ Self-reported measures, including food consumption patterns and relative ability to meet food needs during the pandemic as compared with before, are subject to recall bias.

INTRODUCTION

Disruptions to food, economics and health systems during the COVID-19 pandemic have increased the risk of malnutrition among low-income and middle-income countries (LMICs).[1–4] The food supply chain has faced challenges across multiple stages, including loss of labour for agricultural production and postharvest handling due to movement restrictions or illnesses; closure of processing and distributing facilities; disruptions in distribution networks under restricted trade policies; and changes in consumer demand and market access.[5] Such challenges have resulted in increases in food prices, with the Food and Agricultural Organization (FAO) reporting that wheat and rice prices increased by 8% and 25%, respectively, between March 2019 and April 2020.[6] Economic disruptions, such as business closures and declines in tourism, have reduced country-specific gross national incomes in most LMICs.[7] The World Bank estimates that the pandemic pushed an additional 119 to 124 million people into extreme poverty in 2020,[8] and surveys across multiple

LMICs reveal losses in income among the majority of households.[8–12] An estimated 118 to 161 million more individuals faced hunger in 2020 as compared with in 2019.[7] This increase in the number of people undernourished was apparent in all subregions of Africa and Latin America, and most subregions of Asia, and was more than five times greater than the highest increase in undernourishment in the past two decades.[7] Compounding this effect, health services designed to catch and treat acute malnutrition may be disrupted in many LMICs. For instance, UNICEF estimates a reduction of 30% in the coverage of essential nutrition services in LMICs due to difficulties in mobility of both users and providers, interruption of non-COVID-19 services in communities, higher burdens on the healthcare workers and limited personal protective equipment.[13]

Increased food insecurity coupled with a decline in access to essential nutritional services is expected to lead to increases in the prevalence of childhood wasting, an acute form of malnutrition associated with elevated risk of mortality.[14 15] One study estimates that there could be a 14.3% increase in the prevalence of moderate or severe wasting among children younger than 5 years in the 118 LMICs due to COVID-19-related income losses.[2] By another projection, an increase in wasting of this order of magnitude (10%–50%), coupled with a decline in maternal and child health services by 9.8%–15.9%, would be associated with an increase of 9.8%–44.7% in under-5 deaths per month.[16] To prevent a global malnutrition crisis, leaders from four United Nations agencies (UNHCR, UNICEF, FAO, WHO) have issued an immediate call to action, recommending US$2.4 billion be directed to avoiding child malnutrition through wasting treatment and prevention, vitamin A supplementation and breastfeeding support.[17] Alongside these efforts, leaders have called for research that estimates the scale and reach of nutrition challenges, including country-specific estimates of the effect of the pandemic on incomes, and the ability to meet food needs and access health services.

Lao People's Democratic Republic (PDR) has one of the highest rates of malnutrition in southeast Asia, with a national prevalence of stunting of 33%, underweight of 21% and wasting of 9%.[18] Lao PDR experienced its first case of COVID-19 infection in March 2020.[19] Shortly afterwards, the government imposed a strict lockdown for 6 weeks, stopping human movement between districts, provinces and across the border. A total of six cases were identified between March and April 2020. Beginning in May 2020, restrictions on within-country movement eased along with adherence to protective measures (eg, mask wearing and social distancing), but borders were closed to everyone except those who entered the country via special mission flights, who underwent strict quarantine and testing in government authorised facility.[20] Between March 2020 and February 2021, only 45 cases had been reported in Lao PDR, mainly among individuals returning to the country.[21] In April 2021, an outbreak of COVID-19 occurred, with the first confirmed death in May of 2021.[21] Cases peaked in December of 2021, and as of February, 2022, the country has had over 148 600 confirmed cases and 621 deaths.[21]

While Lao PDR has reported fewer cases of COVID-19 than neighbouring countries,[21] it may experience substantial economic and food security effects of the pandemic. The FAO reports that food prices in Lao PDR have increased by 7.1% between 14 February 2020 to 30 January 2021.[22] At the same time, the Ministry of Labour and Social Welfare reported a surge in unemployment from 2% before the pandemic to 25% as of May 2020.[23] Moreover, in a national assessment, UNICEF found that between August 2019 and August 2020, there was a 10%–24% decline in the coverage of maternal health services, newborn services, routine vaccinations, screening for child wasting and treatment of child wasting.[13] The economic effects of the pandemic are expected to be felt most strongly in Luang Prabang province, a popular tourist destination in nothern Lao PDR. In 2019, Luang Prabang received about 638 000 international visitors and 222 000 domestic tourists. In May 2020, 78% of Luang Prabang's tourism enterprises were closed, and those that remained open did so largely at partial capacity.[24] This is particularly concerning, as the Luang Prabang province bears a disproportionate burden of children who are stunted (41.3%) or underweight (25%).[18] The rural and mountainous provinces of Luang Prabang are particularly vulnerable to undernutrition as poverty rates are high and they are often isolated, with difficult access to markets, healthcare and other public services and water infrastructure.[25 26] There is a high prevalence of minority ethnolinguistic groups, particularly Hmong and Khmu ethnicities, in these regions and livelihoods are largely agriculturally based. Heavy reliance on rice with limited animal protein contributes to nutritional deficiencies.[27] In northern Lao PDR, newborns are commonly fed masticated sticky rice after birth, and 97% of women report following culturally determined restricted diets for one or more months postpartum, reducing consumption of all food groups, except rice.[28]

In rural provinces of Luang Prabang where documented COVID-19 transmission was low, we aimed to (1) assess the relative difficulty in meeting food needs and accessing healthcare during the COVID-19 pandemic compared with before the pandemic; (2) compare self-reported difficulty in meeting food needs to indicators of food security among women, children and the household; (3) identify strategies associated with increased resiliency to food insecurity.

METHODS

Survey region and population

We obtained data from a cross-sectional, household survey conducted in November 2020 from the Lao Provincial Health Department. Data were collected as part of the Lao Health Department's endline evaluation of the Primary Healthcare Programme to monitor and evaluate

public health activities over a 3-year period, starting in 2017. Data were collected from three districts—Nan, NamBak and Pak Ou—in Luang Prabang Province.

Sampling plan

The target sample size was 1200 households. The sample size was chosen to detect with 95% confidence and 80% power a change from 77.7% to 83% in the proportion of women delivering with a skilled birth attendant since the baseline survey in 2017, accounting for a design effect of 1.5 and a non-response rate of 5%. A household was considered eligible for selection if members have lived in the village for at least 2 years, if it contained a child under the age of 5, and if an adult respondent provided verbal, informed consent to participate.

Household selection followed a multistage clustered sampling design that stratified by the three districts. In the first stage, 25 villages were selected using probability proportional to size sampling. In the second stage, 30 households per village were selected using simple random sampling from a list of eligible households prepared by the village head in collaboration with the village health volunteer. The health and diet of one child under the age of 5 per household was assessed, and anthropometric measurements taken. If there were more than one child under 5 years in the house, a third stage of sampling was used, in which one child was selected using simple random sampling.

Household questionnaire

Household questionnaires were administered verbally by trained data collectors. Information of household demographics, household food security, maternal and child diet, child anthropometrics, and self-reported changes in food access, income, expenditures and access to health services during the pandemic were collected. The survey was translated into Lao language, and back translated to ensure correct translation. One enumerator per team was also fluent in the local languages of Khmu and Hmong, in case the respondent did not speak Lao. A copy of the reduced survey tool is included in the online supplemental information.

The endline survey used the same questionnaire as the baseline survey, which was adapted from global standard reproductive, maternal, newborn and child health and nutrition surveys, and added questions related to food security and access to health services during the pandemic. These additional questions were adapted from a standardised questionnaire developed by Save the Children, International to assess the impact of COVID-19 globally.[29] Respondents were asked if, compared with before the pandemic, it was much harder, somewhat harder, easier or the same to meet their family's food needs. If harder, families were asked to list the reasons why. Similarly, respondents were asked if, compared with before the pandemic, it was much harder, somewhat harder, easier or the same to access healthcare. Finally, families were asked if they lost income or reduced their expenditures during the pandemic, and if so, asked to estimate by what per cent.

Calculation of household food security and maternal and child dietary diversity

Household food security was assessed through two standard indicators: the food consumption score (FCS) and Coping Strategy Index (CSI). The FCS is a frequency weighted household dietary diversity score (DDS) calculated by multiplying the frequency of consumption of different food groups consumed by a household during the 7 days before the survey by a weighting factor, and summing.[30] The food groups, and their respective weights include: main staples (2), pulses (3), vegetables (1), fruit (1), meat and fish (4), dairy (4), sugar (0.5) and oils/butter (0.5). Lower values for FCS reflect greater food insecurity, as measured by households consuming nutritious foods with lower frequency and/or diversity.

The reduced CSI was also used to compare household food security. CSI is calculated by multiplying the weekly frequency of five behaviours by the weight of the behaviour and summing for all behaviours.[31] The five standard coping strategies and their severity weightings are: eating less-preferred foods (1.0); borrowing food/money from friends and relatives (2.0); limiting portions at mealtime (1.0); limiting adult intake (3.0) and reducing the number of meals per day (1.0). Higher values for CSI reflect greater food insecurity, as measured by engagement in more frequent and/or severe behaviours when they do not have enough food or money to buy food.[31]

The CSI and FCS are significantly correlated with each other and other indicators of household food insecurity, including the household food insecurity and access scale, yet there is enough difference between indicators that prior work recommends use of multiple metrics to capture different aspects of food insecurity.[32] By capturing behavioural response, CSI has been shown to be a better indicator of future consumption than FCS, and thus a good measure of vulnerability to future shocks.[33] By capturing dietary diversity, FCS correlates well with caloric consumption and is commonly used by the World Food Programme and other major organisations as a key indicator in programme monitoring. CSI is more likely to identify a household as food insecure, while FCS is more likely to miss households that are food insecure.[32] Both can be used as continuous values. CSI has no universal thresholds associated with it for creating categorical indicators, although prior study from Ethiopia proposed to categorise scores below 3 as indicative of acceptable food security.[32] FCS has universal thresholds established, with scores above 35 indicative of acceptable food security; yet, prior study demonstrates that a sizeable proportion of households with an FCS≥35 classify as food insecure according to caloric intake.[34]

In addition, we calculated an individual DDS for women and children aged 6–59 months.[35] DDS for children aged 24–59 months is calculated by summing the total number of food groups consumed in the previous

24 hours, where the food groups are defined as: grains, roots and white tubers; legumes and nuts; dairy products; meat; eggs; vitamin A-containing fruits and vegetables (ie, dark-green, leafy vegetables, fruits that are orange on the inside); other fruits and vegetables. The child must consume at least four of the seven food groups to meet their minimum acceptable dietary diversity.[35] For children aged 6–23 months, breastmilk is added as an eighth food group and the child must consume five out of eight food groups to meet minimum acceptable dietary diversity.

DDS for women is tallied by adding up the number of food groups consumed out of the following 10 groups: grains, roots and white tubers; legumes; nuts and seeds; dairy products; meat; eggs; dark, leafy greens and vegetables; other vitamin-A-rich fruits and vegetables; other vegetables; other fruits. The woman must consume at least 5 of the 10 food groups to meet her minimum dietary diversity.[35] Women who reported having an abnormal diet (ie, ate much more or much less than normal) in the past 24 hours were excluded from analysis.

Anthropometric analysis

Weight and height of children were recorded to the nearest 0.01 kg and 0.1 cm, respectively. Weight-for-age (WAZ), height-for-age and weight-for-height (WHZ) Z-scores were determined using 2006 WHO Growth Standards.[36] A child was considered stunted, wasted or underweight if they had a WAZ, WHZ or WAZ score below −2 SD, respectively.

Statistical analysis

Data were analysed in R V.3.5.[37] Survey weights were calculated using the inverse probability of selection for a child (for child outcome) or a household (for household or maternal outcomes). We used the 'survey' package in R to calculate means and percentages accounting for survey weights, and SEs used to calculate 95% CIs were determined accounting for clustering.[38] Univariate and multivariate associations between food security indicators and pandemic-associated changes in income, expenditures and ability to meet food needs were assessed using generalised linear models, accounting for survey weights and using cluster robust SEs to adjust for clustering at the village level. A directed-acyclic-graph was used to identify the set of minimally sufficient covariates to adjust for to block confounding pathways between the exposure and the outcome (online supplemental figure S1). These covariates were associated with the exposure, causally associated with the outcome, and not on the causal pathway between exposure and outcome. Selected covariates to include were defined a priori as: household ethnicity, household size, education level of mother and the head of household, and district. Adjusted models for maternal outcomes additionally included mother's age, and models for children outcomes additionally included child's age and sex. Inclusion of all variables within this set of minimally sufficient covariates minimised model Akaike information criterion (AIC) as compared with inclusion of only a subset of these covariates. The AIC evaluates the model fit on training data using the log likelihood, and adds a penalty for model complexity. Lower values indicate better model fit. Because we did not capture income prior to the pandemic, which may act as a confounder, we examined the sensitivity of model coefficients to inclusion of total expenditures and the per cent of expenditures spent on food. These variables may be associated with initial income, but are not included in primarily analyses as they may lie on the causal pathway between exposures and outcome. Finally, we conducted stratified analyses to examine whether associations between food security and relative ability to meet food needs during compared with before the pandemic was modified by the most commonly reported reasons for increased difficulty (items more expensive, markets closed, less food available in markets and lost income).

Data were collected by the Lao Provincial Health Department as part of routine, non-research public health activities. We obtained data from the Lao Provincial Health Department. A copy of the ethical approval is included in the online supplemental information.

Patient and Public Involvement

Community members were involved in the conduct of this research. During the survey, community volunteers assisted in locating other community members for participation in the survey. Results, including village health profiles, were shared with provincial and district health department leadership and the head of the Maternal Child Health Department. Monthly village health days were held throughout the project period to convey information and results to community members, verbally and with handmade posters.

RESULTS

Interviews were completed for 1122 households, corresponding to a 93.5% response rate. Reasons for non-response included empty house (53.8%), parent not at home (38.5%) and inaccessible house (5.1%). The most common ethnicities of those interviewed were Khmu (463, 41.3%), Lao Lom (340, 30.3%) and Hmong (281, 25.0%). Undernutrition among children under 5 years in the study region was high, with the survey-weighted prevalence of wasting at 4.5% (95% CI 3.5% to 5.8%), underweight at 18.2% (95% CI 15.9% to 20.7%) and stunting at 32.9% (95% CI 29.6% to 36.4%).

Food security

Nearly four-fifths (78.5%) of the study population reported that it was harder to meet their family's food needs during the pandemic, as compared with before (table 1). A weighted 60.9% (95% CI 57.6% to 64.1%) of individuals reported that it was somewhat harder to meet food needs, while 17.6% (95% CI 15.4% to 20.0%) reported that it was much harder. Among the 874 individuals who found it harder to meet food needs, the

Table 1 Self-reported effects of the pandemic on household access to food, healthcare and income

	Weighted percentage (95% CI)	N
Relative ability to meet family's food needs now compared with before the pandemic (N=1120)		
Easier	0.83 (0.38 to 1.82)	8
No change	20.7 (18.3 to 23.3)	238
Somewhat harder	60.9 (57.6 to 64.1)	698
Much harder	17.6 (15.4 to 20.0)	176
Reasons it is harder to meet food needs during the pandemic (N=874)		
Items more expensive	51.2 (46.4 to 56.0)	415
Household lost income	45.3 (40.9 to 49.9)	465
Less food is available	36.6 (33.1 to 40.2)	561
Markets are closed	36.5 (32.3 to 41.0)	555
Proportion of household income lost during the pandemic (N=1122)		
No income lost	14.4 (12.3 to 16.6)	165
1%–25%	17.5 (14.6 to 20.7)	192
26%–50%	54.4 (51.3 to 57.4)	607
51%–75%	9.2 (1.7 to 11.2)	104
76%–100%	4.6 (3.5 to 6.1)	54
Percent reduction in household expenditures during the pandemic (N=1122)		
No reduction	36.3 (33.2 to 39.6)	415
1%–25%	23.3 (19.4 to 27.4)	257
26%–50%	35.7 (32.9 to 38.6)	400
51%–75%	3.9 (2.9 to 5.3)	41
76%–100%	0.89 (0.44 to 1.8)	9
Relative ability to access healthcare now compared with before the pandemic (N=1121)		
Easier	0.40 (0.15 to 1.09)	8
No change	47.0 (44.0 to 50.0)	544
Somewhat harder	37.4 (34.6 to 40.2)	413
Much harder	4.8 (3.7 to 6.1)	48
Undecided	10.0 (7.5 to 13.1)	108

most common reason reported was that foods were more expensive (51.2%), followed by household losing income (45.3%), food not available at markets (36.6%) and markets being closed (36.5%). The median monthly expenditure among households was US$133. Households spent, on average, 40% of their income on food, which was increased from 30% in 2017.

The mean FCS was 60.9 (95% CI 59.7 to 62.3) (table 2). Households consumed rice daily and meat and vegetables an average of 3.0 and 4.8 days per week, respectively. On average, children consumed 4.14 (95% CI 4.04 to 4.24) food groups in the day prior to the survey, corresponding to 62.5% (95% CI 59.1% to 65.8%) of children that met the minimum DDS requirement. Women consumed an average of 5.38 (95% CI 5.25 to 5.51) food groups, corresponding to 67.7% (95% CI 64.4% to 70.9%) meeting her minimum DDS. Compared to 2017, households in 2020 demonstrated significantly ($p<0.05$) lower dietary diversity and higher coping strategies. In 2017, 76% of women and 69% of children met their minimum DDS, and the average CSI for households was 0.7 points lower. The largest change in household food consumption between 2017 and 2020 was in meat consumption; in 2017, households ate meat an average of 6 days per week. Household consumption of vegetables (5.3 vs 4.8) was also lower in 2020 compared with 2017, while consumption of rice remained the same. While women and children consumed less meat in 2020 than in 2017, the difference was not as large as observed among other household members, and both women and children increased egg consumption (online supplemental figures S2 and S3).

The distribution of both household food security indicators differed by whether or not households found it harder to access food during the pandemic (figure 1). Among households who found it harder to meet their food needs during the pandemic, there was greater density of lower FCS (indicating worse food security) and higher CSI (indicating worse food security) compared with those who experienced no change. These relationships between household FCS and access to food during the pandemic were also seen in multivariate regression analyses (table 2; figure 2). Adjusting for ethnicity of the household, size of the household, district and education level of the mother and head of household, we estimated that the average FCS among households who found it harder to meet their food needs was 2.74 points lower (95% CI 0.55 to 4.92) than the average FCS among households who experienced no change (figure 2). This is roughly equivalent to consuming vegetables nearly three fewer times per week, or consuming rice one less time per week. The household CSI among households who had a harder time meeting their food needs was higher, indicating lower food security, but not significantly so. DDSs for women and children were lower among households who had more difficulty meeting their food needs during the pandemic, but not significantly so in adjusted analyses. Sensitivity analyses including total expenditures and per cent of expenditures spent on food as covariates found similar model coefficients (online supplemental table S1), although DDS for children met the criteria for statistically significant at the 95% confidence level. For all outcomes, households who reported that increased food prices were a major reason for increased difficulty meeting food needs were associated with the greatest deteriorations in food security or diversity, compared with households who reported food availability and market closures as the reason for their difficulty.

Table 2 Model coefficients representing difference in indicator between households who self-reported that it is harder to access food during the pandemic and those who report no change/easier; and those who decreased spending during the pandemic and those who did not

	Model coefficients				
	Harder to access food during the pandemic		Decreased expenditures during the pandemic		
	Crude difference (95% CI)	Adjusted difference (95% CI)	Crude difference (95% CI)	Adjusted difference (95% CI)	Population mean (95% CI)
FCS	−3.36 (−5.42 to 1.29)*	−2.74 (−4.92 to −0.55)*	−6.53 (−8.23 to 4.79)*	−5.24 (−7.05 to 3.42)*	60.9 (59.7 to 62.3)
CSI	0.07 (−0.86 to 0.99)	0.36 (−0.65 to 1.37)	0.83 (−0.07 to 1.74)	1.32 (0.40 to 2.25)*	3.6 (3.1 to 4.1)
DDS (child)	−0.21 (0.41 to 0.01)*	−0.21 (−0.43 to 0.01)	−0.20 (−0.38 to 0.02)*	−0.11 (−0.31 to 0.08)	4.14 (4.04 to 4.24)
DDS (mother)	−0.15 (−0.40 to 0.01)	−0.10 (−0.34 to 0.15)	−0.08 (−0.28 to 0.12)	0.06 (−0.14 to 0.25)	5.38 (5.26 to 5.51)

Adjusted models for households control for household ethnicity, household size, education level of mother and the head of household and district. Adjusted models for mothers include additionally mother's age. Adjusted models for children include additionally child's age and sex. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.
*Represents statistical significance at p<0.05.
CSI, Coping Strategy Index; DDS, dietary diversity score; FCS, food consumption score.

We did not find any difference in WAZ or WHZ scores among children from households who self-reported greater difficulty meeting their food needs compared with those from household who reported no change in ability to meet food needs.

Resiliency to food insecurity

We estimated the percentage of a household's food sources in the past week that was self-produced (eg, farmed, fished, hunted, gathered). On average, families

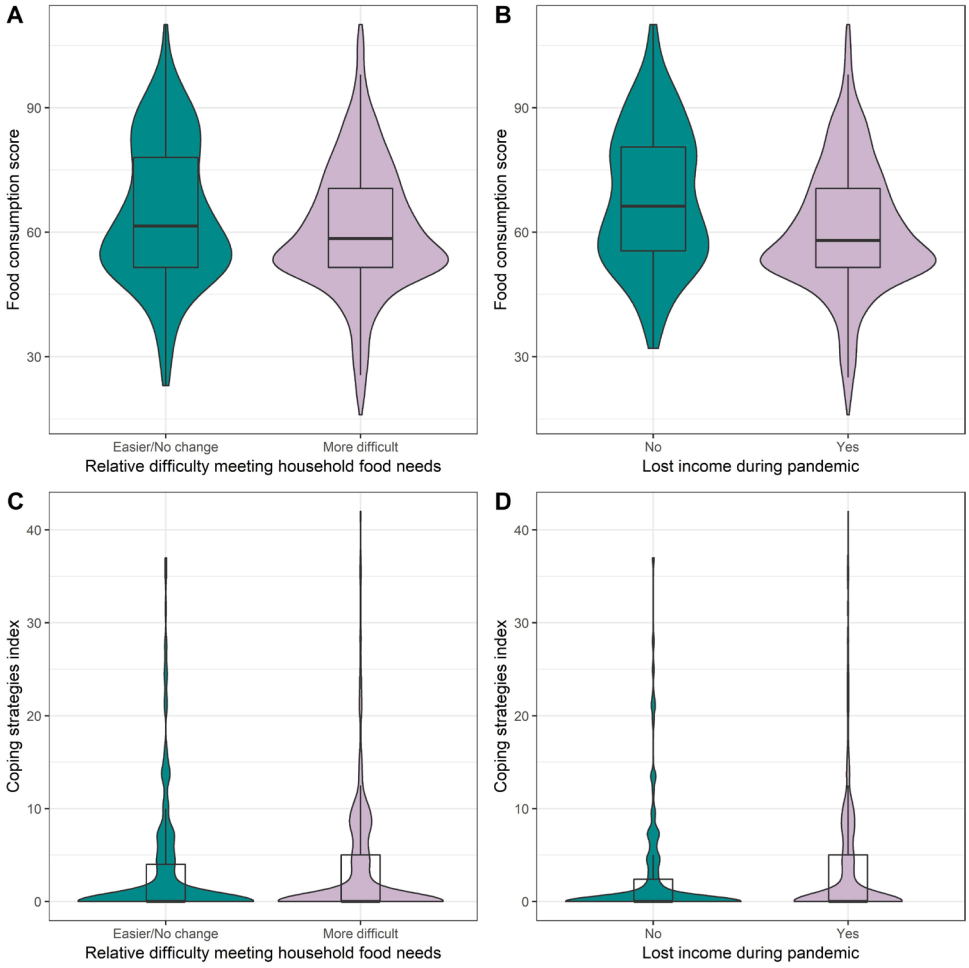

Figure 1 Violin plot showing distribution of two household food security measures, together with their median and IQR. Household food security was measured through food consumption score (FCS) (A, B) and Coping Strategies Index (CSI) (C, D). Food insecurity is associated with low FCS and high CSI.

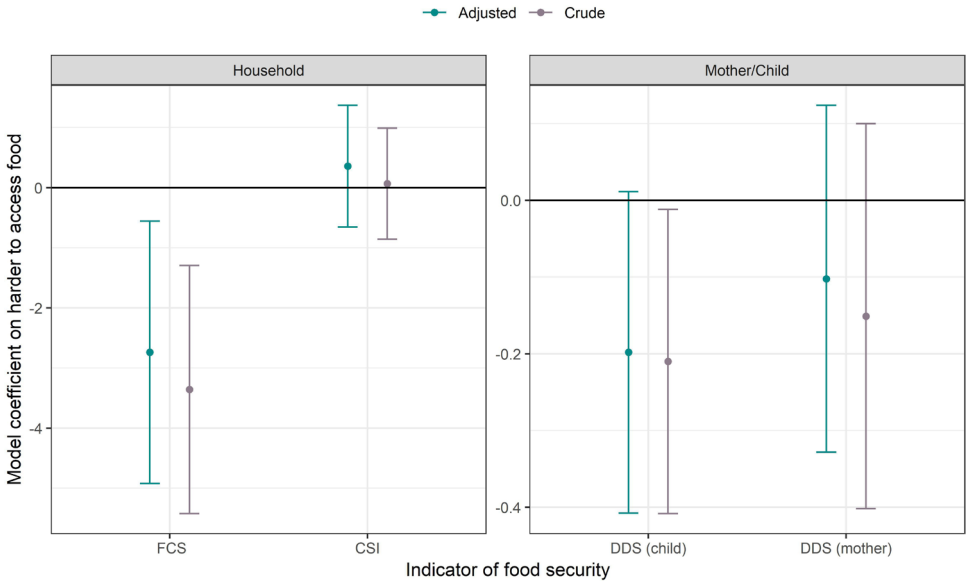

Figure 2 The difference in mean of food security indicator among households who had a harder time meeting their food needs during the pandemic compared with those who did not. Vertical bars represent 95% CIs. Adjusted models for households control for household ethnicity, household size, education level of mother and the head of household and district. Adjusted models for mothers include additionally mother's age. Adjusted models for children include additionally child's age and sex. Lower values for food consumption score (FCS) and dietary diversity score (DDS) and higher values of Coping Strategy Index (CSI) indicate greater food insecurity.

met 42% of their food needs through self-production (IQR: 27%–57%). Commonly self-produced foods included: insects, aquatic animals other than fish, mushrooms and roots (figure 3). Over half of households also self-produced rice and vegetables, and about one-quarter self-produced fish, meat and fruits. We found that households who derived a greater proportion of their food needs through homegrown methods were more resilient than families who purchased their foods. Adjusting for ethnicity of the household, size of the household, district and education level of the mother and head of household, we estimated that the average percentage of food obtained from homegrown methods was 4.22% (95% CI 1.28% to 7.15%) lower among households who found it harder to meet their food needs compared with household who experienced no change. On average, respondents spent 9.6 hours per week fishing, gathering or hunting food. Persons who found it harder to meet their food needs during the pandemic also spent fewer hours per week fishing, gathering or hunting, though the results were not significant.

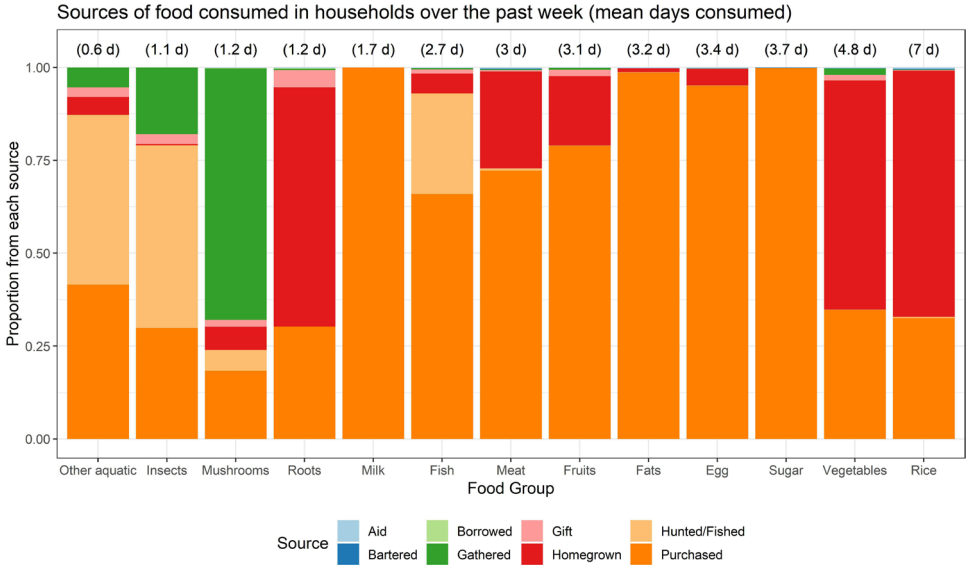

Figure 3 Proportional source of each food group consumed during the past week by households. Numbers in parenthesis above the bars indicates the mean number of days per week household consumed these food groups.

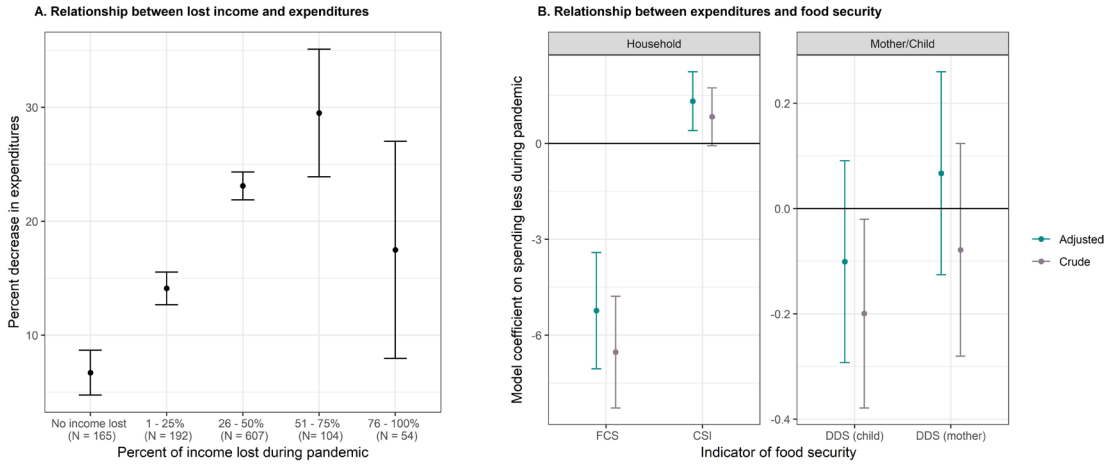

Figure 4 (A) Mean decrease in expenditures reported, stratified by the percent reduction in household income. Vertical bars represent 95% CIs. (B) The difference in mean of food security indicator among households who reduced spending during the pandemic compared with those who did not. Vertical bars represent 95% CIs. Adjusted models for households control for household ethnicity, household size, education level of mother and the head of household and district. Adjusted models for mothers include additionally mother's age. Adjusted models for children include additionally child's age and sex. Lower values for food consumption score (FCS) and dietary diversity score (DDS) and higher values of Coping Strategy Index (CSI) indicate greater food insecurity.

Income and expenditures

Over 85% of the study population reported losing income during the pandemic, with the majority of respondents (54.4%, 95% CI 51.3% to 57.4%) reporting losing between 25% and 50% of their income table 1. Households who reported declines in income were more likely to reduce spending, with the greater the reduction in income corresponding to greater reductions in household expenditures (figure 4A). A weighted 23.3% reported reducing household expenditures by 1%–25%, while 35.7% reported reducing expenditures by 25%–50%. The distribution of both household food security indicators also differed by whether or not households lost income during the pandemic (figure 1).

Households who reduced expenditures during the pandemic had significantly decreased food security in adjusted analyses, as measured by the FCS and the CSI, and significantly decreased food security in univariate analyses as measured by the FCS and child's DDS (figure 4B, table 2). In adjusted analyses, families who reported spending less during the pandemic had a household FCS that was 5.23 (95% CI 3.41 to 7.05) units lower, and a CSI that was 0.83 (95% CI −0.07 to 1.74) units higher than families who did not reduce spending. DDSs for children were lower among households who had more difficulty meeting their food needs during the pandemic, but not significantly so in adjusted analyses. Including total expenditures and per cent of expenditures spent on food as covariates in multivariable models did not change these conclusions (online supplemental table S1).

We did not find any difference in WAZ or WHZ scores among children from households who lost income or reduced spending compared with those who did not lose income or reduce spending.

Access to healthcare

A weighted 37.4% (95% CI 34.6% to 40.2%) of individuals reported that it was somewhat harder to access healthcare compared with before the pandemic, while 4.8% (95% CI 3.7% to 6.1%) reported that it was much harder (table 1). We identified 123 (11%) women and 557 (50%) children who had experienced fever, diarrhoea, cough and/or respiratory infection in the 2 weeks prior to the survey. Among both women and children with illness in the past 2 weeks, >60% had fever (see online supplemental figures S4 and S5 for Venn diagrams). Of these, a weighted 69.7% (95% CI 66.3% to 73.0%) of children and 81.2% (95% CI 73.3% to 87.2) of women sought care from a health facility. We found no association between healthcare seeking behaviour, either for stratified by condition or in aggregate, and relative ability to access healthcare during versus before the pandemic.

DISCUSSION

In a rural setting in Lao PDR with low documented COVID-19 transmission and high dependence on tourism, we found prevalent loss of income and increased difficulty in meeting household food needs following the start of the COVID-19 pandemic and a national border closure. In our household survey, we found that nearly four-fifths of the study population reported that it was harder to meet their family's food needs during the pandemic, with the most common reason being increases in food prices; indeed, families reported that the proportion of their household expenditure on food had doubled since baseline in 2017. At the same time, we found that over 85% of the study population reported losing income during the pandemic, with over half of respondents reported losing between 25% and 50% of their income. Respondents who

reported losses in income and and/or reported greater challenges meeting their food needs had small, but significant declines in household food security, as measured by the FCS (which correlates best with caloric intake) and CSI (which correlates best with vulnerability to shocks). Nevertheless, the small differences in food security indicators suggest that people in this population may have been able largely able to protect their consumption without heavy reliance on negative coping strategies, despite some deterioration. Decreased expenditures as a result of the pandemic were more strongly associated with reductions in household food security, as measured by both the FCS and the CSI, as compared with greater difficulty in food access. Moreover, of the reasons for challenges meeting food needs reported by the community, increased food prices were most strongly associated with lower FCS, higher CSI and lower DDS in women and children. Self-production of food via farming, hunting, fishing or gathering is common in this population, accounting for 42% of food consumed. Our study found that individuals who derived a greater proportion of the food from self-produced means were more resilient to pandemic-associated shocks.

Our results support a growing body of empirical data that suggest wide scale difficulty in meeting food needs and pervasive loss in income associated with the pandemic. In Kenya, surveys administered before and after the COVID-19 lockdown found that 52% of the population changed their dietary habits, most commonly via reductions in meat, dairy and bread.[11] Nearly all (95%) of respondents reported loss of income during the pandemic, with 88% finding that the resulting income was insufficient to meet food needs. Over one-third also attributed changes in food consumption to lower food availability, with households obtaining food from markets more likely to change food consumption patterns than those obtaining food from farming and livestock.[11] An interrupted time series analysis in Bangladesh found that median incomes fell from US$212 to US$59 during a 2-month stay at home order, while the proportion of families living on less than US$1.90 per day rose from 0.2% to 47.3%.[39] In that study, the proportion of households classified as moderately or severely food insecure rose from 5.6% and 2.7%, respectively, to 36.5% and 15.3%.[39] While global surveys indicate loss of income across all counties, the proportion of participants financially impacted by the pandemic is estimated to be three times higher in LMICs than in high income countries.[40] Longitudinal survey data from Ethiopia, Malawi, Nigeria and Uganda find that 77% of the population live in households that have lost income during the pandemic.[9] In a Save the Children global survey, 85% of families living in Asia reported income loss, with a strong negative association between income loss and dietary diversity.[29] To our knowledge, no study has yet to be published from Lao PDR, but an unpublished household survey in Phongsaly Province, another rural province, found that 46% of households reduced their expenditures, and 24% took out loans to buy food (personal communication).

Randomised control trials demonstrate that improved access to proper nutrition can improve WAZ and WHZ Z-scores.[41–43] In many LMICs, including Lao PDR, the density of Z-scores is clustered around the dichotomous classification threshold of −2SD, so even small changes to body weight can translate into meaningful changes in the proportion of children classified as underweight or wasted.[44] While LMICs have seen progress in reducing prevalence of wasting and underweight, yearly reductions in Lao PDR and other LMICs may be smaller than a percentage point,[18 45 46] suggesting that even small effects of COVID-19 on bodyweight could undo years of progress. At the same time, we did not observe a difference in the WAZ or WHZ scores between children whose household reported greater difficulty meeting food needs and those who did not, nor did we see a difference in maternal or child DDS between these groups in multivariate analyses. This may suggest that households in our study population prioritised maternal and child consumption patterns even as families struggled to meet food needs. We find that while household meat consumption was strongly reduced between 2020 and 2017, meat consumption of women and children was reduced only slightly. What is more, potential declines in protein intake for women and children due to lower meat consumption were offset by increases in egg consumption. All villages in the study population have been receiving interventions focused on sustainable behavioural change for maternal and child nutrition, so individuals in the population may have been more likely to prioritise the nutrition of these vulnerable populations. Indeed, eggs were promoted as part of behavioural change communication as an alternative and cheap source of protein when meat was too expensive or not available.

Our study suggests possible interventions that might mitigate the effect of the pandemic on food security. We found that households who were more likely to experience no change in meeting food needs during the pandemic derived a greater proportion of their food needs through homegrown methods (as opposed to purchasing foods) as compared with households who found it more difficult to meet their food needs. Reducing reliance on food supply from other places or countries is recognised by others to be a means of reducing the impact of the COVID-19 pandemic on food insecurity. Farm-system-for-nutrition approaches have been suggested as one solution, in which location-specific farm systems integrate arable farming, horticulture, backyard farming and animal farming in order to increase household access to nutritious foods while conserving natural resources.[47] The FAO advocates for improving the resilience of local food systems by facilitating access to locally produced food, shortening the supply chain by promoting direct purchase from local producers and promoting urban or backyard gardens that also offer financial and environmental cobenefits.[48] Because our study design could not establish trends in homegrown food production prior to the pandemic, we are unable to determine if households in our population

increased homegrown food production or time spent fishing, gathering or hunting as a response to the pandemic, although we found slightly higher prevalence of homegrown food production (48%) and time spent collecting food (12.0 hours) in 2017 as compared with 2020. Globally, reliance on homegrown food production may have increased as a response to lockdown measures[7] and helped stabilise food consumption patterns amidst market uncertainty.[11] Yet, increased reliance on gathering or growing food may represent a source of unpaid labour that could be devoted to other activities.[49] Care must be taken that local food grown solutions minimise contributions to the burden of time poverty, or are enacted along with interventions that offset time poverty.[50]

Our study also identified that loss of income and higher food prices are among the most important reason households are less able to meet their food needs. As such, social safety net programmes may be particularly suited to addressing the challenge of food insecurity.[51–53] A randomised control trial in Colombia in March 2020, at the start of a national quarantine, found that 90% of families randomised to an arm that received cash transfers of US$19 every 5–9 weeks spent the cash on food, which helped to offset the effects of the pandemic on food insecurity in the treatment arm.[54] Other randomised control trials demonstrate reductions of severe food insecurity among those who received a cash transfer or a direct food transfer by nearly 25%.[55 56] Systematic review and meta-analysis of 74 studies found that children from households who received cash transfers had reduced stunting by 2.5% and improved consumption of animal foods by 4.5%.[57]

This study has limitations. First, the results of this survey may not be generalisable to other countries, particularly those with higher COVID-19 incidence and greater restrictions on within-country movement. At the time of the survey (November 2020), fewer than 50 cases had been reported in Lao PDR, and health systems were not experiencing the same overwhelming of capacity as in many other countries.[58] Additionally, while initial control measures limited local movement, these restrictions were largely relaxed by May 2020, 7 months prior to the survey, with the main intervention remaining being strict border closure. We expect, therefore, that compared with other LMICs, the effects of food security and access to healthcare found in this study may be smaller than would be seen in other countries. At the same time, however, the effects of the pandemic on food security and income and expenditures may be seen more strongly in Luang Prabang as compared with other provinces within Lao PDR. As the province is home to the UNESCO World Heritage City of Luang Prabang, Luang Prabang province receives a greater proportion of its income from tourism as compared with other provinces.[24] Indeed, our survey found a greater proportion of household reduced expenditures (64%) compared with another, unpublished, survey in a different rural province, where 46% of households reduced expenditures (personal communication). As mentioned, households in the study population had been receiving educational messaging regarding the importance of maternal and child malnutrition, so may have prioritised meeting the needs of mothers and children even as they struggled to meet the families' food needs. Thus it is possible that other areas may have seen more dramatic declines in maternal and child nutrition. Moreover, the results of the survey may not be generalisable to larger, more urban areas. Similarly, the relationships with FCS may not be generalisable to other areas with different dietary patterns. The mean FCS in our study was 60.9, well above the generic cut-off of ≥35 for an acceptable score. We do not emphasise these thresholds in our study, as they have been shown to badly misclassify food insecurity in some contexts. For instance, in El Salvador, only 0.2% of households fell below the FCS threshold for food insecurity, while 19% had low caloric consumption.[34] Such may occur in this context as well, as while diversity of foods consumed was low, staples and meat/fish/insects were among the more commonly consumed food groups, and these food groups are given large weights in calculating the weighted mean. Finally, while we do not find associations between seeking care during illness and self-reported changes in access to healthcare, it is possible that individuals reduced routine wellness visits, which we do not assess in our survey.

Another limitation of our study relates to recall bias. Because control measures were first implemented in March 2020, and we implemented this survey in November 2020, there could be substantial recall bias, as participants are asked to compare ability to meet food needs, ability to access healthcare, and income and expenditures to a time period that extended 8 months prior up until the current time. The ideal observational research design would be to compare our estimates of food security and malnutrition to repeated estimates taken longitudinally, leading up to just prior to the pandemic. While we lack data from just before the pandemic, we have data from household surveys in the region collected in 2017. Estimates of food insecurity and the prevalence of children underweight and wasted from 2020 are higher than estimates from 2017, while estimates of dietary diversity from 2020 are lower than estimates from 2017. However, because changes in indicators between 2017 and 2020 cannot be attributed to the effects of the pandemic alone, we do not emphasise 2017 data here.

Roughly 3.5% of visited households were empty, which may represent a form of selection bias that may underrepresent adverse consequences of the pandemic if the empty households moved out of a need to avoid lockdown or preserve livelihoods. However, as was observed in 2017, many households within this population will leave for days at a time to attend to work in rice fields, which is expected to be the predominant reason for non-response. Finally, while we examine loss of income, we did not collect information on income prior to the pandemic nor occupation or occupational status of household members. While we control for education in multivariate models, which may

in part control for some variation due to income or occupational type, residual confounding may remain. Future work might seek to examine whether loss of occupation affects food security via lost income, and what types of work are most susceptible to loss.

CONCLUSION

Lao PDR's early efforts to control the spread of COVID-19 have been successful, with fewer documented cases to date relative to neighbouring countries. Nevertheless, the effect of the pandemic on food security on livelihoods in LMICs may be severe, and subsequent waves of cases, and associated lockdown measures, in 2021 and 2022 demonstrates that the threat of continued food security remains present. Increasing self-sufficiency through local food production, and/or supporting incomes via social safety nets such as cash transfer programmes, may mitigate some of these effects. As control measures to curb the transmission of COVID-19 continue, and as outbreaks occur intermittently with concomitant restrictions on movement, further study may be useful to understand what coping strategies people are using so that government and agencies can support the resilience of households in the long term.

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Contributors PC, HC and JH conceptualised the research. PC and HC assisted in data collection. PC and JRH analysed the data. HC and JRH wrote the manuscript. AV and KK lead the Save the Children health program in Luang Prabang and the Vientiane country office, respectively. JRH accepts full responsibility for the work. All authors edited and read the manuscript, have access to the data, and were involved in the decision to publish.

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Competing interests HC, AV and KK were or are currently employees of Save the Children, International. Save the Children supports a government led Primary Health Care Program in Luang Prabang which includes nutritional interventions.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Consent obtained directly from patient(s)

Ethics approval Ethical clearance for secondary data analysis was obtained from the Research Ethics Committee in the University of Health Sciences within the Lao Ministry of Health and Committee for the Protection of Human Subjects within University of California, Berkeley (protocol ID: 2021-05-14365). Participants gave informed consent to participate in the study before taking part.

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REFERENCES

1 Akseer N, Kandru G, Keats EC, *et al*. COVID-19 pandemic and mitigation strategies: implications for maternal and child health and nutrition. *Am J Clin Nutr* 2020;112:251–6.
2 Headey D, Heidkamp R, Osendarp S, *et al*. Impacts of COVID-19 on childhood malnutrition and nutrition-related mortality. *Lancet* 2020;396:519–21.
3 Food insecurity will be the sting in the tail of COVID-19. *Lancet Glob Health* 2020;8:e737.
4 United Nations Sustainable Development Group. Policy brief: the impact of COVID-19 on food security and nutrition; 2020.
5 Aday S, Aday MS. Impact of COVID-19 on the food supply chain. *Food Quality and Safety* 2020;4:167–80.
6 Torero M. Without food, there can be no exit from the pandemic. *Nature* 2020;580:588–9.
7 Food and Agriculture Organization of the United Nations. 2021 state of food security and nutrition in the world – report and InBrief. Rome FAO, IFAD, UNICEF, WFP and WHO; 2021.
8 Lakner C, Yonzan N, Gerszon Mahler D. Updated estimates of the impact of COVID-19 on global poverty: looking back at 2020 and the outlook for 2021. Washington DC World Bank; 2021.
9 Josephson A, Kilic T, Michler JD. Socioeconomic impacts of COVID-19 in low-income countries. *Nat Hum Behav* 2021;5:557–65.
10 Purnamasari R, Ali R. High-Frequency Monitoring of Households : Summary of Results from Survey Round 1, 01-07 May 2020; Indonesia COVID-19 Observatory Brief No 3. Washington DC World Bank; 2020.
11 Shupler M, Mwitari J, Gohole A, *et al*. COVID-19 impacts on household energy & food security in a Kenyan informal settlement: The need for integrated approaches to the SDGs. *Renewable and Sustainable Energy Reviews* 2021;144:111018.
12 Khetan AK, Salim Y, Lopez-Jaramillo P, *et al*. Variations in the financial impact of the COVID-19 pandemic across 5 continents: a cross-sectional, individual level analysis. *eClinicalMedicine* 2022;44.
13 UNICEF. Tracking the situation of children during COVID-19, 2020. Available: https://data.unicef.org/resources/rapid-situation-tracking-covid-19-socioeconomic-impacts-data-viz/
14 Black RE, Allen LH, Bhutta ZA, *et al*. Maternal and child undernutrition: global and regional exposures and health consequences. *Lancet* 2008;371:243–60.
15 Black RE, Victora CG, Walker SP, *et al*. Maternal and child undernutrition and overweight in low-income and middle-income countries. *Lancet* 2013;382:427–51.
16 Roberton T, Carter ED, Chou VB, *et al*. Early estimates of the indirect effects of the COVID-19 pandemic on maternal and child mortality in low-income and middle-income countries: a modelling study. *Lancet Glob Health* 2020;8:e901–8.
17 Fore HH, Dongyu Q, Beasley DM, *et al*. Child malnutrition and COVID-19: the time to act is now. *Lancet* 2020;396:517–8.
18 Lao Statistics Bureau. Lao social indicator survey II 2017, survey findings report. Vientiane, Lao PDR Lao Statistics Bureau and UNICEF; 2018.
19 World Health Organization. Ministry of Health and WHO respond to first case of COVID-19 in Laos Vientiane, 2020. Available: https://www.who.int/laos/news/detail/24-03-2020-ministry-of-health-and-who-respond-to-first-case-of-covid-19-in-laos
20 United Nations Sustainable Development Group. *UN Lao PDR socio-economic response framework to COVID-19*. Vientiene: UNSDG, 2020. https://reliefweb.int/report/lao-peoples-democratic-republic/un-lao-pdr-socio-economic-response-framework-covid-19
21 Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. *Lancet Infect Dis* 2020;20:533–4.

22 Food and Agriculture Organization. FAO big data tool on Covid-19 impact on food value chains, 2020. Available: http://datalab.review.fao.org/datalab/website/covid19
23 Sengpaseuth P. Govt officials urged to expedite aid to the unemployed Vientiane Times; 2020.
24 Yamano T, Pradhananga M, Schipani S. *The Impact of COVID-19 on Tourism Enterprises in the Lao People's Democratic Republic: An Initial Assessment*. Vientiane: Asian Development Bank, 2020.
25 Boulom S, Essink DR, Kang M-H, *et al*. Factors associated with child malnutrition in mountainous ethnic minority communities in Lao PDR. *Glob Health Action* 2020;13:1785736-.
26 Group WB. Nutrition in Lao PDR: causes, determinants, and bottlenecks World Bank; 2016.
27 Li X, Yadav R, Siddique KHM. Neglected and underutilized crop species: the key to improving dietary diversity and fighting hunger and malnutrition in Asia and the Pacific. *Front Nutr* 2020;7:593711.
28 Smith TJ, Tan X, Arnold CD, *et al*. Traditional prenatal and postpartum food restrictions among women in northern Lao PDR. *Matern Child Nutr* 2022;18:e13273.
29 Burgess M, Sulaiman M, Arlini SM. The hidden impact of Covid-19 on children: a global research series: save the children, 2020. Available: https://resourcecentre.savethechildren.net/library/hidden-impact-covid-19-children-global-research-series
30 Programme WF. *Food consumption analysis: calculation and use of the food consumption score in food security analysis*. Rome, Italy: WFP, 2008.
31 Maxwell D, Caldwell R. *The coping strategies index: field methods Manuel*. Rome: World Food Programme, 2008.
32 Maxwell D, Vaitla B, Coates J. How do indicators of household food insecurity measure up? An empirical comparison from Ethiopia. *Food Policy* 2014;47:107–16.
33 Christiaensen LJ, Boisvert RN. On measuring household food vulnerability: case evidence from Northern Mali 2000.
34 World Food Programme. *Validation Study of the WFP's Food Consumption Indicator in the Central American Context, with A Focus on Intra-Household Sharing of Food*. Rome: WFP, 2012.
35 Peace FF. *FFP standard indicator Handbook*. Washington DC: USAID, 2011.
36 Bloem M. The 2006 WHO child growth standards. *BMJ* 2007;334:705–6.
37 R Core Team. R: a language and environment for statistical computing. Vienna, Austria R Foundation for Statistical Computing; 2015.
38 Lumley T. Survey: analysis of complex survey samples 3.30 ed. R Package 2014.
39 Hamadani JD, Hasan MI, Baldi AJ, *et al*. Immediate impact of stay-at-home orders to control COVID-19 transmission on socioeconomic conditions, food insecurity, mental health, and intimate partner violence in Bangladeshi women and their families: an interrupted time series. *Lancet Glob Health* 2020;8:e1380–9.
40 Khetan AK, Yusuf S, Lopez-Jaramillo P, *et al*. Variations in the financial impact of the COVID-19 pandemic across 5 continents: a cross-sectional, individual level analysis. *EClinicalMedicine* 2022;44:101284.
41 Null C, Stewart CP, Pickering AJ, *et al*. Effects of water quality, sanitation, handwashing, and nutritional interventions on diarrhoea and child growth in rural Kenya: a cluster-randomised controlled trial. *Lancet Glob Health* 2018;6:e316–29.
42 Luby SP, Rahman M, Arnold BF, *et al*. Effects of water quality, sanitation, handwashing, and nutritional interventions on diarrhoea and child growth in rural Bangladesh: a cluster randomised controlled trial. *Lancet Glob Health* 2018;6:e302–15.
43 Humphrey JH, Mbuya MNN, Ntozini R, *et al*. Independent and combined effects of improved water, sanitation, and hygiene, and improved complementary feeding, on child stunting and anaemia in rural Zimbabwe: a cluster-randomised trial. *Lancet Glob Health* 2019;7:e132–47.
44 Rajpal S, Joe W, Subramanian SV. Living on the edge? Sensitivity of child undernutrition prevalence to bodyweight shocks in the context of the 2020 national lockdown strategy in India. *J Glob Health Sci* 2020;2.
45 Ministry of Health and Lao Statistics Bureau. Lao social indicator survey. Vientiane Lao PDR; 2012.
46 Tzioumis E, Kay MC, Bentley ME, *et al*. Prevalence and trends in the childhood dual burden of malnutrition in low- and middle-income countries, 1990-2012. *Public Health Nutr* 2016;19:1375–88.
47 Bhavani RV, Gopinath R. The COVID19 pandemic crisis and the relevance of a farm-system-for-nutrition approach. *Food Secur* 2020;12:1–4.
48 FAO. COVID-19 and the role of local food production in building more resilient local food systems Rome; 2020.
49 Burchardt T. Time and income poverty 2008.
50 Whillans A, West C. Alleviating time poverty among the working poor: a pre-registered longitudinal field experiment. *Sci Rep* 2022;12:719.
51 Laborde D, Martin W, Vos R. Poverty and food insecurity could grow dramatically as COVID-19 spreads International Food Policy Research Institute; 2020. https://www.ifpri.org/blog/poverty-and-food-insecurity-could-grow-dramatically-covid-19-spreads
52 Amjath-Babu TS, Krupnik TJ, Thilsted SH, *et al*. Key indicators for monitoring food system disruptions caused by the COVID-19 pandemic: insights from Bangladesh towards effective response. *Food Secur* 2020;12:761–8.
53 Gilligan D. Social safety nets are crucial to the COVID-19 response: Some lessons to boost their effectiveness. In: *IFPRI book Chapters*, 2020: 102–5.
54 . The impact of emergency cash assistance in a pandemic: experimental evidence from Colombia. In: Londoño-Vélez J, Querubin P, eds. *113th Annual Conference on Taxation*. NTA, 2020.
55 Fahey CA, Njau PF, Dow WH, *et al*. Effects of short-term cash and food incentives on food insecurity and nutrition among HIV-infected adults in Tanzania. *AIDS* 2019;33:515–24.
56 Fenn B, Bulti AT, Nduna T, *et al*. An evaluation of an operations research project to reduce childhood stunting in a food-insecure area in Ethiopia. *Public Health Nutr* 2012;15:1746–54.
57 Manley J, Balarajan Y, Malm S, *et al*. Cash transfers and child nutritional outcomes: a systematic review and meta-analysis. *BMJ Glob Health* 2020;5.
58 Walker PGT, Whittaker C, Watson OJ, *et al*. The impact of COVID-19 and strategies for mitigation and suppression in low- and middle-income countries. *Science* 2020;369:413–22.