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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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Keywords: food security; dietary diversity; underweight; wasting; income; COVID-19; Lao PDR; malnutrition; local food production

Abstract

Objectives: We assessed the relative difficulty in meeting food needs during the COVID-19 pandemic compared to before; determined associations 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=1,122) with children under five years.

Primary and secondary outcomes measured: Survey respondents reported the relative ease of access of food and health care as well as changes in income and expenditures compared to 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 five.

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, 7.15), than households who found it more difficult. We estimated that decreases in child bodyweight by 0.5 – 1% would increase wasting in this population by 1.7 – 2.1 percentage points.

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

List of abbreviations:

LMICs: low- and middle-income countries

FAO: Food and agriculture organization

FCS: food consumption score

CSI: coping strategies index

DDS: dietary diversity score

HAZ: height-for-age Z-score

WAZ: weight-for-age Z-score

WHZ: weight-for-height Z-score

Strengths and limitations of this study

- We characterize food security across all members of the household, including women and children, through a series of standardized 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 marginalized population with high prevalence of ethnic minorities, for whom little data on nutrition was previously available.
- The results of this study may not be generalizable 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 to before, are subject to recall bias.

Introduction

Disruptions to food, economics, and health systems during the COVID-19 pandemic are expected to increase the risk of malnutrition among low- and middle-income countries (LMICs) [1-4]. The food supply chain has faced challenges across multiple stages, including loss of labor 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, are simultaneously expected to reduce country-specific gross national incomes (GNI) by around 8% in most LMICs [7]. Losses in income are expected to push an additional 1.4 million people into extreme poverty, classified as earning less than $1.90 per day [7]. Overall, the World Food Programme projects that the number of people in LMICs who are food insecure will double, from 135 million in 2019 to 265 million by the end of 2020 [8]. 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 health care workers, and limited personal protective equipment [9].

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 [10, 11]. One study estimates that there could be a 14.3% increase in the prevalence of moderate or severe wasting among children younger than five 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-five deaths per month [12]. To prevent a global malnutrition crisis, leaders from four United Nations agencies (UNHCR, UNICEF, FAO, WHO) have issued an immediate call to action, recommending $2.4 billion be directed to avoiding child malnutrition through wasting treatment and prevention, vitamin A supplementation, and breastfeeding support [13]. 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% [14]. Lao PDR experienced its first case of COVID-19 infection in March 2020 [15]. Shortly afterwards, the government imposed a strict lockdown for six 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 (e.g., mask wearing and social distancing), but borders remain closed to everyone except those who entered the country via special mission flights, who must undergo strict quarantine and testing in government authorised facility [16]. Between March 2020 and February 2021, only 45 cases had been reported in Lao PDR, mainly among individuals returning to the country [17]. In April 2021, a second outbreak of COVID-19 occurred that spread quickly during New Year celebrations. A second lockdown was imposed on April 25th with provincial and district travel restricted, surveillance on closed country borders increased, and testing and contact tracing efforts increased. Between April 1, 2021 and June 1, 2021, over 1,800 cases were confirmed, the majority in the capital city, Vientiane, with the first confirmed death from COVID-19 occurring in May of 2021 [17].

While Lao PDR has reported fewer cases of COVID-19 than its neighbouring countries, 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 February 14, 2020 to January 30, 2021 [18]. 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 [19]. 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 [9]. The economic effects of the pandemic are expected to be felt most strongly in Luang Prabang province, a popular tourist destination. 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 [20]. This is particularly concerning, as the Luang Prabang province bears a disproportionate burden of children who are stunted (41.3%) or underweight (25%) [14].

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 health care during the COVID-19 pandemic compared to 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 on 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 Health Care Program to monitor and evaluate public health activities over a

three-year period, starting in 2017. Data were collected from three districts - Nan, NamBak, and Pak Ou - in Luang Prabang Province. These districts have a high prevalence of ethnic minorities, particularly Hmong and Khmu ethnicities. Livelihoods are largely agriculturally based.

Sampling plan

The target overall sample size was 1,200 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 two years, if it contained a child under the age of five, 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 five per household was assessed, and anthropometric measurements taken. If there were more than one child under five 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 Supplemental Info.

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 standardized questionnaire developed by Save the Children, International to assess the impact of COVID-19 globally [21]. Respondents were asked if, compared to 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 to before the pandemic, it was much harder, somewhat harder, easier, or the same to access health care. Finally, families were asked if they lost income or reduced their expenditures during the pandemic, and if so, asked to estimate by what percent.

Calculation of household food security and maternal and child dietary diversity

Household food security was assessed through two standard indicators: the food consumption score and coping strategy index. The food consumption score (FCS) is a frequency weighted household dietary diversity score 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 [22]. 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). Higher scores indicate better food security.

The Coping Strategies Index (CSI) was also used to compare household food security. CSI is calculated by multiplying the weekly frequency of five behaviors by the weight of the behavior and summing for all behaviors [23]. 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). Lower scores indicate better food security. The CSI has good agreement with other indicators of household food insecurity, including the household food insecurity and access scale [24].

In addition, we calculated an individual dietary diversity score (DDS) for women and children aged 6-59 months [25]. 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 (i.e., 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 [25]. 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 ten 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 five of the ten food groups to meet her minimum dietary diversity [25]. Women who reported having an abnormal diet (i.e., 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 (HAZ), and weight-for-height (WHZ) Z-scores were determined using 2006 WHO Growth Standards [26]. A child was considered stunted, wasted, or underweight if they had a WAZ, WHZ, or WAZ score below -2SD, respectively. The degree to which even small changes to body

weight will translate into changes in the proportion of children classified as underweight or wasted varies between populations, as it depends on the density of Z-scores clustered around the dichotomous classification threshold of -2SD [27]. As undernutrition prevalence is a key indicator used to monitor progress and allocate nutrition and other health services, we considered the theoretical implications of increased food insecurity on undernutrition prevalence in our population. We examined the change in childhood undernutrition in our study population to a simulated reduction in bodyweight. Following prior study, we presumed potential COVID-19 associated shocks to range between a 0.5% and 1% reduction in bodyweight [27]. We simulated a reduction of 0.5% and 1% by multiplying child weight by 0.995 and 0.99, respectively, and recalculated the WAZ and WHZ scores under this simulated weight.

Statistical analysis

Data were analyzed in R version 3.5 [28]. Survey weights were calculated using the inverse probability of selection for a child (for child outcome) or a household (for household or maternal outcomes). The survey package in R was used to calculate means and percentages accounting for survey weights, and standard errors used to calculate 95% confidence intervals were determined accounting for clustering [29]. Univariate and multivariate associations were assessed using generalized linear models, accounting for survey weights, and using cluster robust standard errors to adjust for clustering at the village level. A directed-acyclic-graph (DAG) was used to identify variables that may confound the relationship between pandemic-associated changes and household food security, where a confounder is defined as a variable associated with the exposure, causally associated with the outcome, and not on the causal pathway between exposure and outcome. Multivariate models examining the relationship between pandemic-associated changes and household food security included fixed effects for potential confounding factors of 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.

Ethics

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. 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). A copy of the ethical approval is included in the Supplemental Info.

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. Community members were informed of the results of this study during one of their monthly village health days. The results were conveyed verbally and with posters by the village health volunteers.

Results

Interviews were completed for 1,122 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 five years in the study region was high, with the survey-weighted prevalence of wasting at 4.5% (95% CI: 3.5, 5.8), underweight at 18.2% (95% CI: 15.9, 20.7%), and stunting at 32.9% (95% CI: 29.6, 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 to before (Table 1). A weighted 60.9% (95% CI: 57.6, 64.1%) of individuals reported that it was somewhat harder to meet food needs, while 17.6% (95% CI: 15.4, 20.0%) reported that it was much harder. Among the 874 individuals who found it harder to meet food needs, the 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 food consumption score was 60.9 (95% CI: 59.7, 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 4.21 (95% CI: 3.95, 4.18) food groups in the day prior to the survey, corresponding to 62.5% (95% CI: 59.1, 65.8) of children that met the minimum DDS requirement. Women consumed an average of 5.38 (95% CI: 5.25, 5.51) food groups, corresponding to 67.7% (95% CI: 64.4, 70.9) meeting her minimum DDS. Compared to 2017, households in 2020 demonstrated significantly ($p < 0.05$) lower dietary diversity and household food security. In 2017, 76% of women and 69% of children met their minimum dietary diversity score, and the average CSI for households was 0.7 points lower. There was no change in household FCS from 2017 to 2020.

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 to 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 food consumption score among households who found it harder to meet their food needs was 2.74 points lower (95% CI: 0.55, 4.92) than the average food consumption score 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 coping strategies index among households who had a harder time meeting their food needs was higher, indicating lower food security, but not significantly so. Dietary diversity scores 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.

Figure 1. Violin plot showing distribution of two household food security measures, together with their median and interquartile range (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 to those who did not. Vertical bars represent 95% confidence intervals. 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. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

Resiliency to food insecurity

We estimated the percentage of a household's food sources in the past week that was self-produced (e.g., farmed, fished, hunted, gathered). On average, families met 42% of their food needs through self-production (interquartile range: 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, 7.15%) lower among households who found it harder to meet their food needs compared to household who experienced no change. 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.

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, 57.4%) reporting losing between 25-50% of their income. 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 significantly decreased food security in univariate analyses as measured by the FCS, CSI, 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, 7.05) units lower, and a CSI that was 0.83 (95% CI: -0.07, 1.74) units higher than families who did not reduce spending. Dietary diversity scores for children were lower among households who had more difficulty meeting their food needs during the pandemic, but not significantly so in adjusted analyses.

Figure 4. A) Mean decrease in expenditures reported, stratified by the percent reduction in household income. Vertical bars represent 95% confidence intervals. B) The difference in mean of food security indicator among households who reduced spending during the pandemic compared to those who did not. Vertical bars represent 95% confidence intervals. 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. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

Access to health care

A weighted 37.4% (95% CI: 34.6, 40.2%) of individuals reported that it was somewhat harder to access healthcare compared to before the pandemic, while 4.8% (95% CI: 3.7, 6.1%) reported that it was much harder (Table 1). We identified 123 (11%) women and 557 (50%) children who had experienced fever,

diarrhea, or respiratory infection in the two weeks prior to the survey. Of these, a weighted 69.7% (95% CI: 66.3, 73.0%) of children and 81.2% (95% CI: 73.3, 87.2) of women sought care from a health facility. We found no association between healthcare seeking behavior and relative ability to access health care.

Sensitivity of undernutrition prevalence to small shocks in bodyweight

We did not find any difference in WAZ or WHZ scores among children from households who experienced greater difficulty meeting their food needs or among children from households who lost income or reduced spending. We examined the change in the proportion of children classified as wasted or underweight under simulated shocks in which bodyweight decreased by 0.5% and 1%. In the study population, we observed a prevalence of wasting of 4.5%. If bodyweight were to decrease by 0.5% or 1%, we estimated a prevalence of wasting of 6.2% and 6.6%, respectively, in our population (Figure 5). In other words, a decrease in bodyweight by 0.5 – 1% would be associated with a disproportionate increase in wasting of 1.7 – 2.1 percentage points in our study population. Similarly, we observed a prevalence of underweight of 18.2%. If bodyweight were to decrease by 0.5% or 1%, we estimated a prevalence of underweight of 19.0% and 20.5%, respectively. Therefore, a decrease in bodyweight by only 0.5 – 1% would be associated with an increase in underweight of 0.8 – 2.3 percentage points in our study population.

Figure 5. WHZ and WAZ curves among children under 5 under observed (cyan) conditions and under a simulated shock in which body weight reduces by 1% (pink). Area shaded to the left of -2 represents the proportion of children classified as wasted or underweight, respectively.

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 25-50% 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 food consumption score and coping strategies index. Nevertheless, the small differences in food security indicators suggests 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. Self-production of food via farming, hunting, fishing, or fathering 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 limited, but growing, body of empirical data that suggests 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 [30]. 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 [30]. An interrupted time series analysis in Bangladesh found that median incomes fell from US$212 to $59 during a two-month stay at home order, while the proportion of

families living on less than $1.90 per day rose from 0.2% to 47.3% [31]. In this 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% [31]. Finally, 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 [21]. 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).

Randomized control trials demonstrate that improved access to proper nutrition can improve WAZ and WHZ Z-scores [32-34]. We examined theoretical implications of a decrease in bodyweight on undernutrition prevalence, finding that a decrease in bodyweight of only 0.5 – 1% would be associated with a larger percentage point increase in wasting (1.7 – 2.1 percentage points) and underweight (0.8 – 2.3 percentage points) in our study population. While LMICs have seen progress in reducing prevalence of wasting and underweight, yearly reductions are small. Analysis of DHS data collected between 1990 and 2012 from 36 LMICs found that, on average, the prevalence of wasting decreased by 0.07 percentage points per year [35], while in Lao PDR, the prevalence of underweight decreased by an average of 1.1 percentage points per year between 2012 and 2017 [14, 36]. This suggests that even small effects of COVID-19 on food security, and thus bodyweight, could undo years of progress. This echoes findings from a study conducted in India and is likely generalizable to many LMICs where there is a high prevalence of undernutrition [27]. 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 child dietary diversity score between these groups in multivariate analyses. This may suggest that households in our study population prioritized maternal and child consumption patterns even as families struggled to meet food needs. All villages in the study population have been receiving interventions focused on sustainable behavioral change for maternal

and child nutrition, so individuals in the population may have been more likely to prioritize the nutrition of these vulnerable populations.

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 to households who found it more difficult to meet their food needs. Reducing reliance on food supply from other places or countries is recognized 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 that integrate arable farming, horticulture, backyard farming, and animal farming [37]. The FAO advocate 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 co-benefits [38].

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 programs may be particularly suited to addressing the challenge of food insecurity [7, 39, 40]. A randomized control trial in Colombia in March 2020, at the start of a national quarantine, found that 90% of families randomized to an arm that received cash transfers of $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 [41]. Other randomized control trials demonstrate reductions of severe food insecurity among those who received a cash transfer or a direct food transfer by nearly 25% [42, 43]. 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% [44].

This study has limitations. First, the results of this survey may not be generalizable 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 [45]. Additionally, while initial control measures limited local movement, these restrictions were largely relaxed by May 2020, seven months prior to the survey, with the main intervention remaining being strict border closure. We expect, therefore, that compared to other LMICs, the effects of food security and access to health care 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 to 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 to other provinces [20]. Indeed, our survey found a greater proportion of household reduced expenditures (64%) compared to 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 prioritized meeting the needs of mothers and children even as their 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 generalizable to larger, more urban areas. Finally, the relationships with FCS may not be generalizable 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. While diversity of foods consumed was low, consumption of staples and meat/fish/insects was high, and these food groups are given large weights in calculating the weighted mean.

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 health care, 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 emphasize 2017 data here.

Conclusion

Lao PDR's early efforts to control the spread of COVID-19 have been successful, with fewer documented cases to date relative to neighboring countries. Nevertheless, the effect of the pandemic on food security in livelihoods in LMICs may be severe, and the second wave of cases, and associated lockdown measures, in April 2021 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 programs, 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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Contributorship statement

PC, HC, and JRH conceptualized the research. PC and HC assisted in data collection. PC and JRH analyzed 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. All authors edited and read the manuscript.

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.

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Data sharing statement

Data is owned by the Luang Prabang Provincial Health Department and permission has been granted for its use.

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612 **Table 1.** Self-reported effects of the pandemic on household access to food, health care, and income.

	Weighted percentage (95% Confidence interval)	N
Relative ability to meet family's food needs now compared to before the pandemic (N = 1120)		
Easier	0.83 (0.38, 1.82)	8
No change	20.7 (18.3, 23.3)	238
Somewhat harder	60.9 (57.6, 64.1)	698
Much harder	17.6 (15.4, 20.0)	176
Reasons it is harder to meet food needs during the pandemic (N = 874)		
Items more expensive	51.2 (46.4, 56.0)	415
Household lost income	45.3 (40.9, 49.9)	465
Less food is available	36.6 (33.1, 40.2)	561
Markets are closed	36.5 (32.3, 41.0)	555
Proportion of household income lost during the pandemic (N = 1122)		
No income lost	14.4 (12.3, 16.6)	165
1-25%	17.5 (14.6, 20.7)	192
26-50%	54.4 (51.3, 57.4)	607
51-75%	9.2 (1.7, 11.2)	104
76-100%	4.6 (3.5, 6.1)	54
Percent reduction in household expenditures during the pandemic (N = 1122)		
No reduction	36.3 (33.2, 39.6)	415
1-25%	23.2 (19.4, 27.4)	257
26-50%	35.7 (32.9, 38.6)	400
51-75%	3.9 (2.9, 5.3)	41
76-100%	0.89 (0.44, 1.8)	9
Relative ability to access health care now compared to before the pandemic (N = 1121)		
Easier	0.40 (0.15, 1.09)	8
No change	47.0 (44.0, 50.0)	544
Somewhat harder	37.4 (34.6, 40.2)	413
Much harder	4.8 (3.7, 6.1)	48
Undecided	10.0 (7.5, 13.1)	108

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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. 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. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

	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, -1.29)*	-2.74 (-4.92, -0.55)*	-6.53 (-8.23, -4.79)*	-5.24 (-7.05, -3.42)*	60.9 (59.7, 62.3)
CSI	0.07 (-0.86, 0.99)	0.36 (-0.65, 1.37)	0.83 (-0.07, 1.74)	1.32 (0.40, 2.25)*	3.6 (3.1, 4.1)
DDS (child)	-0.21 (0.41, -0.01)*	-0.20 (-0.41, 0.01)	-0.20 (-0.38, -0.02)*	-0.10 (-0.29, 0.09)	4.14 (4.04, 4.24)
DDS (mother)	-0.15 (-0.40, 0.01)	-0.10 (-0.33, 0.12)	-0.08 (-0.28, 0.12)	0.07 (-0.13, 0.26)	5.38 (5.26, 5.51)

*represents statistical significance at p<0.05

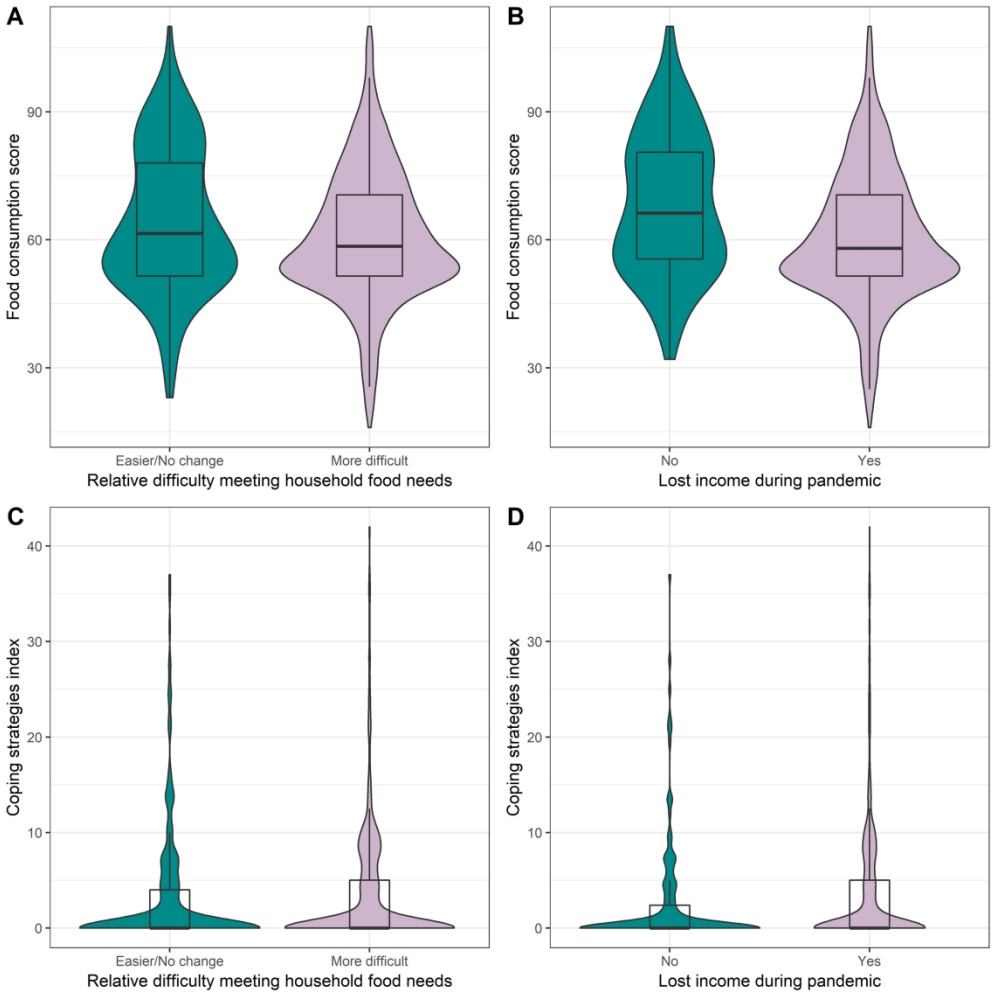

Figure 1. Violin plot showing distribution of two household food security measures, together with their median and interquartile range (IQR). Household food security was measured through food consumption score (FCS) (A, B) and coping strategies index (CSI) (C, D). Food insecurity is associated with low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

228x228mm (300 x 300 DPI)

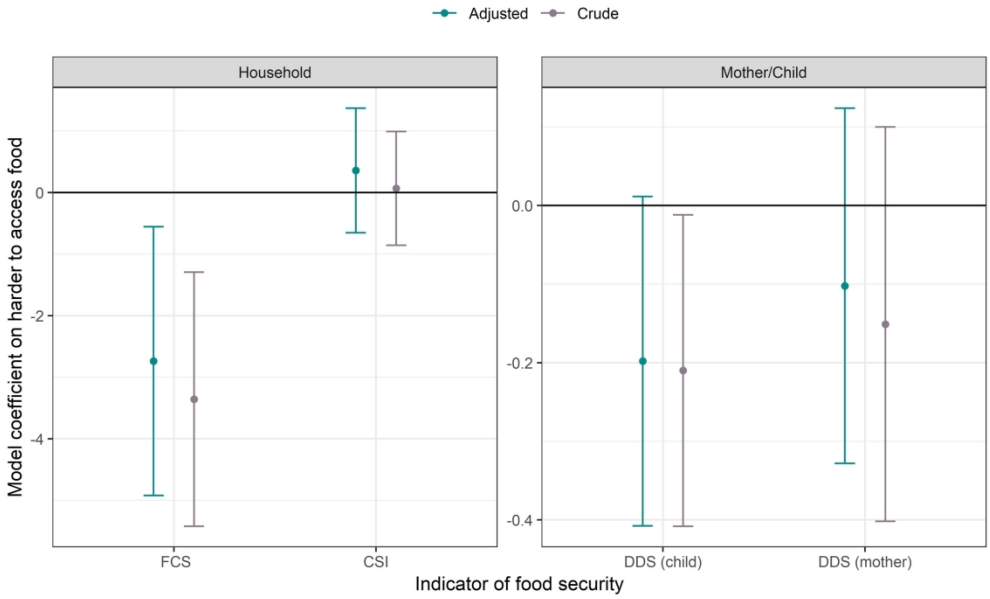

Figure 2. . The difference in mean of food security indicator among households who had a harder time meeting their food needs during the pandemic compared to those who did not. Vertical bars represent 95% confidence intervals. Adjusted models for households control for household ethnicity, household 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. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

203x127mm (300 x 300 DPI)

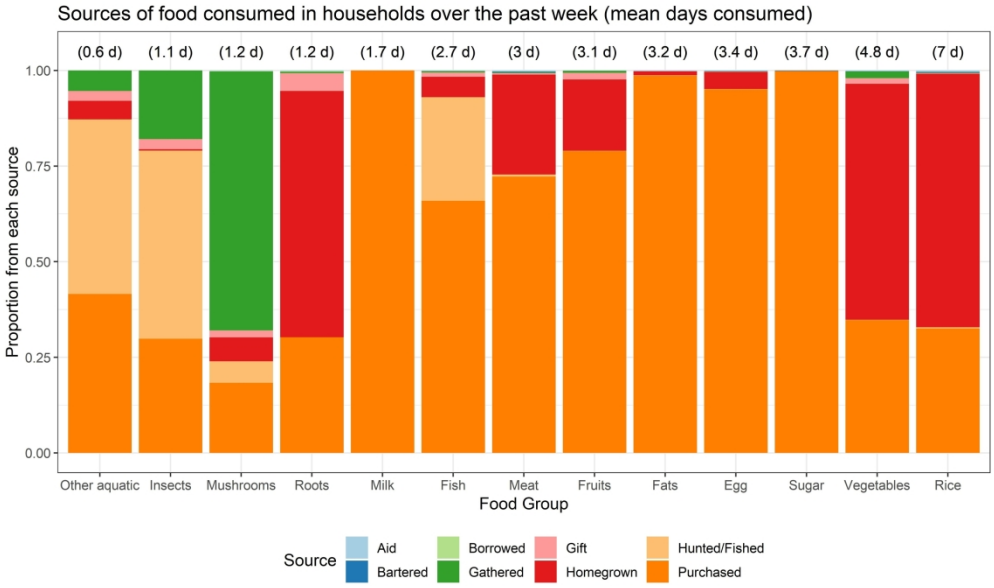

Figure 3. Proportional source of each food group consumed during the past week by households. Numbers in parenthesis above the bars indicates the mean number of days per week household consumed these food groups.

254x152mm (300 x 300 DPI)

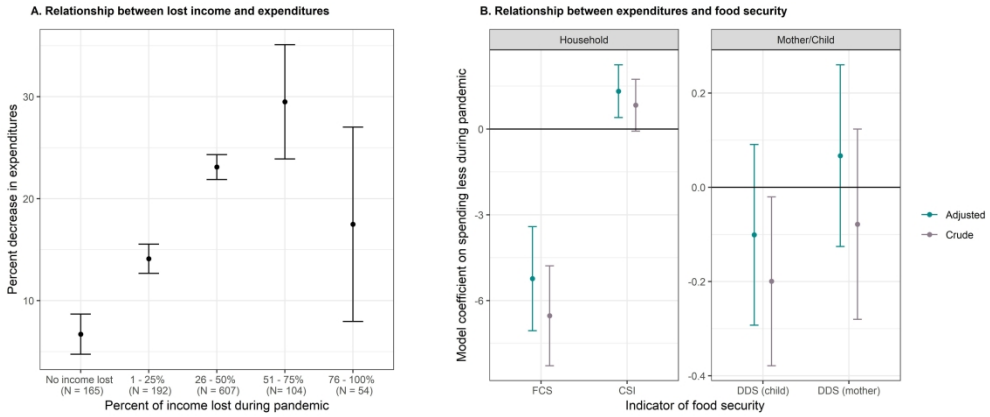

Figure 4. A) Mean decrease in expenditures reported, stratified by the percent reduction in household income. Vertical bars represent 95% confidence intervals. B) The difference in mean of food security indicator among households who reduced spending during the pandemic compared to those who did not. Vertical bars represent 95% confidence intervals. 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. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

304x127mm (300 x 300 DPI)

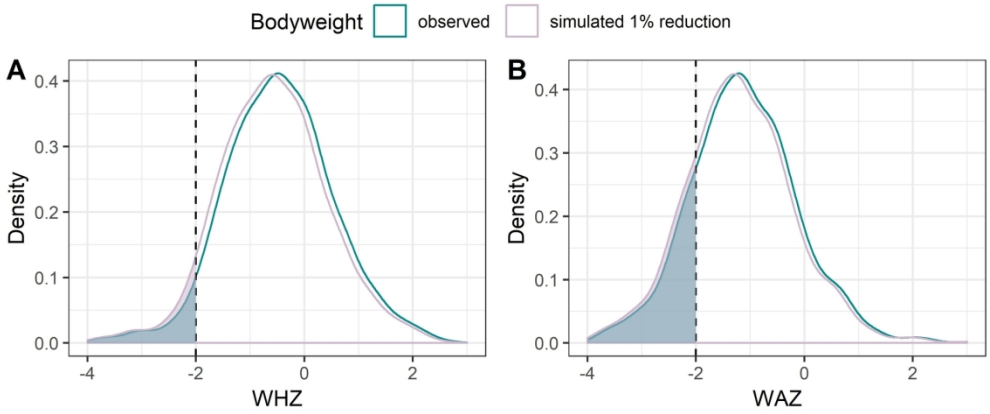

Figure 5. WHZ and WAZ curves among children under 5 under observed (cyan) conditions and under a simulated shock in which body weight reduces by 1% (pink). Area shaded to the left of -2 represents the proportion of children classified as wasted or underweight, respectively.

177x76mm (300 x 300 DPI)

Supplemental Info for:

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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Contents

Survey tool

Endline Interview Questionnaire – 2020

Health and Nutrition Assessment

Introductory Statement to the Interview
Good Morning/Good Afternoon. My name is _____and I am here on behalf of the Primary Health Care program. We are conducting a survey on the health and nutritional status of women and children. You have been selected by chance from the list of families with children under the age of five. Is this correct? The purpose of this interview is to obtain information about the health and nutrition status of you and your child. We are interested in interviewing mothers of children aged five or less. Are you the mother of the child? (*If no),* Is the mother of the child at home? (*If yes, wait until she arrives, and re-explain purpose).* Could you please spare some time (around 45 minutes) for the interview? The information you give will be confidential and will only be used to prepare a report of general findings – but will not include any names. You will not get any additional entitlements because of the interview. At any time during the survey, you are free to stop the survey, or choose not answer any question. If you are willing to participate in this survey, please indicate your oral consent by saying "yes" or "no".
May I start now? ☐ *Yes, permission is given ⇨ Go to 101 to begin the interview.* ☐ *No, permission is not given ⇨ Tell this result to your supervisor and move to the next household.*
Enumerators– *If the respondent is not willing, do not ask any of the questions and move to the next household. If the household contains children under the age of 5, but the mother is not present, ask when it is a good time to return, and return at a later time. We only want to interview mothers of children under the age of 5.*

General Information				
No.	Item	Name		
101	District			
102	Village			
103	Date of interview	DD	MM	YYYY
		_ _	_ _	2016
104	Interviewer's Name/Number	_ _		

Household Demographic Information			
First, we would like to ask some questions about yourself and the people who live in this household.			
No.	**Question**	**Response**	**Notes**
201	How old are you?	Age (in completed years): ___ ___	
202	To what ethnic group does the head of this household belong?	1……Lao Lom 2……Hmong 3……Khmu 4……Mien 5……Lue 6…..Akha 7…..Muser 98……Other (Specify…….)	
203	What is your marital status?	1…….Married (monogamous) 2…….Married (polygamous) 3…….Not married, but living with a man 4…….Single 5…….Divorced or separated 6…….Widowed	

204	What is your relationship to the head of the household (HHH)?	1……. Head of household 2……. Wife of the HHH 3……. Daughter of the HHH 4…….Daughter in law of HHH 5…….Granddaughter of HHH 98….Other relation	1 → 206 2 → 206
205	Is the head of the household male or female?	0…….Female 1…….Male	*if 204 ≠ 1 or 2*
206	Have you ever attended school?	1…….Yes 0…….No	0 → 208
207	What is the highest level of school you completed?	1…….Preschool 2…….Primary 3…….Lower Secondary 4…….Upper secondary 5…….Post-secondary vocational, tertiary/ diploma 6…….Higher	*if 206 =1*
208	Did the head of the household attend school?	1…….Yes 0…….No 99….Don't know	*if 204≠1* 1 → 209 0 → 210
209	What is the highest level of school completed by the head of the household?	1…….Preschool 2…….Primary 3…….Lower Secondary 4…….Upper secondary 5…….Post-secondary vocational, tertiary/ diploma 6…….Higher 99…Don't know	*if 208 = 1*
210	How many household members are aged 15 years or more?	____ ____	

	Prompt to include self in this count		
211	How many household members are below 15 years of age?	____ ____	
212	How many household members are below 5 years of age?	____ ____	Check: 212 ≤ 211
213	How many members are in your own family?	____ ____	

Dietary Intake			
Now we would like to ask some questions about the diet of yourself and one of your children. *Enumerators, if there are more than one children under the age of five, randomly select one child. Ask the name of the child, and use that name for the rest of the interview.*			
No.	**Question**	**Response**	**Notes**
400	When was this child born? *Probe: Using MCH book, house registration, other official document*	__ ____ ___	
401	How many months old is this child? *Probe: Using important holidays, dates, etc.*	___ ___ months	0-59 only!
402	Is the child selected (Child's name) your youngest child? *Probe: the last child of alive children?*	1…….Yes 0…….No	
403	Yesterday during the day or night, was your diet a typical diet? *Probe: She had special ceremonies or illnesses that led her to have less or much more than her typical eating.?*	1…….Yes 2…….No. I ate more. 3…….No. I ate less 99…….Do not know	
404	Yesterday during the day or night, did you eat more or less or same amount of food compared to your eating before this pregnancy?	1……Increased amount 2……Same amount 3……Decreased amount 99…..Do not know	*if 226=1 (currently pregnant*)
405	Yesterday during the day or night, did you eat more or less or same amount of animal source foods compared to your eating before this pregnancy?	1……Increased amount 2……Same amount 3……Decreased amount 99…..Do not know	*if 226=1 (currently pregnant*)

	Probe: Using examples of animal food or product in their general contexts and comparing with her usual eating style		
406	I would like to ask you about foods that you may have had yesterday during the day or night. I am interested to know whether you had the item even if combined with other foods. Please include foods consumed outside of your home. YESTERDAY DURING THE DAY OR NIGHT, DID YOU DRINK/EAT (FOOD GROUP ITEMS)? *Questions and filters (Circle the corresponding code and you can underline more than one answer)* Always start with: 'YESTERDAY DID YOU EAT….'		
406a	Any offal items (excluding intestines)? *Probe: such as liver, brain, lung, heart, gizzard, kidney, of any animal*	1.....Yes 0.....No 99.....Do not know	
406b	The intestine of any animal?	1.....Yes 0.....No 99.....Do not know	
406c	Any kind of meat? *Probe:* such as any meat, such as beef (fresh or dry), buffalo, pork, goat, chicken, goose, duck, sausage, blood sausage, sour sausage	1.....Yes 0.....No 99.....Do not know	
406d	Any kind of eggs? *Probe: 'such as?' eggs from chicken, duck, turtle or other animals*	1.....Yes 0.....No 99.....Do not know	
406e	Any kind of fish or aquatic animals? *Probe: 'such as?' fresh, fermented or dried fish, swamp eel, squid, shrimp (fresh or dry), crab, granulated ark, clam, snail, frog, water insects*	1.....Yes 0.....No 99.....Do not know	
406f	Any kind of wild animals? *Probe: 'such as?' lizard, rat, rabbit, wild bird, small birds*	1.....Yes 0.....No 99.....Do not know	

406g	Any kind of insects or grubs? *Probe: 'such as?' silk worm pupa, cricket, weaver ant, ant egg, etc.*	1.....Yes 0.....No 99.....Do not know	
406h	Any kind of dairy products (not including coffee creamer)? *Probe: 'such as?' cheese (butter), yogurt, or other milk products*	1.....Yes 0.....No 99.....Do not know	
406i	Other foods that came from an animal. Example: pork skin	1.....Yes 0.....No 99.....Do not know	
406j	Sticky rice (refined or unrefined), roasted rice, rice, pre-chewed rice, rice noodles, maize, noodles, thick porridge, or other foods made from grains?	1.....Yes 0.....No 99.....Do not know	
406k	White or purple coloured foods from roots such as white yams, purple yams, yam bean, cassava, white radish, white potato, or any other white or purple colored foods from roots.	1.....Yes 0.....No 99.....Do not know	
406l	Pulses/lentils/tofu/bean curd	1.....Yes 0.....No 99.....Do not know	
406m	Nuts or seeds (e.g. Sesame seeds, mung bean, ground bean, sun flower seed, cashew nuts etc.)	1.....Yes 0.....No 99.....Do not know	
406n	Any dark green leafy vegetables such as pak choi, swamp cabbage, morning glory, sweet potato leaves, Chinese kale	1.....Yes 0.....No 99.....Do not know	
406o	Ripe orange fleshed mangoes, ripe orange fleshed papayas, pumpkin, carrots, sweet potatoes that are yellow or orange inside?	1.....Yes 0.....No 99.....Do not know	
406p	Other vegetables	1.....Yes 0.....No 99.....Do not know	
406q	Other fruit	1.....Yes 0.....No 99.....Do not know	
Now, I would like to ask about feeding practices for your child selected.			

407	Has (CHILD'S NAME) ever been breastfed?	1.....Yes 0.....No	*if 401 < 24* 0→409
408	Was (CHILD's NAME) breastfed yesterday, either during the day or the night?	1.....Yes 0.....No 99.....Do not know	*if 401 < 24* & *407 = 1*
409	Did (NAME) drink anything from a bottle with a nipple yesterday, during the day or night?	1.....Yes 0.....No 99.....Do not know	*if 401 < 24*
410	Did (NAME) drink or eat vitamin or mineral supplements yesterday, during the day or night?	1.....Yes 0.....No 99.....Do not know	*if 401 < 24*
411	How long after birth did you first put (NAME) to the breast? *If immediately, record 00. If less than 24 hours, record hours. If over 24 hours, record 25. If unknown, record 99.*	_____ hours	*if 401 < 24* & *407 = 1*
412	Did (CHILD'S NAME) have any liquid other than breast milk, such as canned, powdered or fresh animal milk, infant formula, juice, thin porridge, or clear soup (Nam Keang) yesterday, during the day or night?	1.....Yes 0.....No 99.....Do not know	*if 401 < 24* 0 → 413 99 → 413
412a	How many times did (CHILD'S NAME) receive milk other than breastmilk, such as canned, powdered or fresh animal milk, or infant formula?	_____ times 99.....Do not know	*if* *401 = 6-23* & *412 = 1*
413	When do you think is the best time to start breastfeeding a child after giving birth?	***Enumerators:*** *read off all answer choices and circle the best one* 1.....Within the first hour after giving birth 2.....Within the first six hours after giving birth 3.....Within the first twelve hours after giving birth 4.....Within one day after giving birth 99.....Do not know	

414	I would like to ask you about foods that the selected child (CHILD'S NAME) may have had yesterday during the day or night. I am interested to know whether HE/SHE had the item even combined with other foods. Please include foods consumed outside of your home. YESTERDAY DURING THE DAY OR NIGHT, DID THE SELECTED CHILD (CHILD'S NAME) DRINK/EAT (FOOD GROUP ITEMS)? Always start with: 'YESTERDAY DID (NAME) EAT….'		*if 401 ≥ 6*
414a	Commercially fortified baby food, e.g., cerelac	1.....Yes 0.....No 99.....Do not know	
414b	Sticky rice (white or brown), roasted rice, rice, pre-chewed rice, rice noodles, maize, noodles, porridge, or other foods made from grains?	1.....Yes 0.....No 99.....Do not know	
414c	Pumpkin, carrots or sweet potatoes that are yellow or orange inside?	1.....Yes 0.....No 99.....Do not know	
414d	White or purple coloured foods from roots such as white yams, purple yams, yam bean, cassava, white radish, white potato, or any other white or purple colored foods from roots.	1.....Yes 0.....No 99.....Do not know	
414e	Any dark green, leafy vegetables such as pak choi, swamp cabbage, morning glory, sweet potato leaves, Chinese kale?	1.....Yes 0.....No 99.....Do not know	
414f	Ripe or orange-fleshed mangos, or papayas	1.....Yes 0.....No 99.....Do not know	
414g	Any other fruits or vegetables	1.....Yes 0.....No 99.....Do not know	
414h	Liver, brain, lung, heat, gizzard, kidney, intestine, or other organ of any animal	1.....Yes 0.....No 99.....Do not know	
414i	Any meat, such as beef (fresh or dry), buffalo, pork, lamb, goat, chicken, goose, duck, sausage, blood sausage, sour sausage	1.....Yes 0.....No 99.....Do not know	
414j	Eggs from chicken, duck, turtle or other animals	1.....Yes 0.....No	

		99.....Do not know	
414k	Fresh, fermented or dried fish, swamp eel, squid, shrimp (fresh or dry), shellfish, crab, granulate ark, clam, snail	1.....Yes 0.....No 99.....Do not know	
414l	Any wild animals such as lizard, frog, rat, rabbit, wild bird, small bird	1.....Yes 0.....No 99.....Do not know	
414m	Insects or grubs such as silk worm pupa, cricket, weaver ant, any insect eggs, water insects	1.....Yes 0.....No 99.....Do not know	
414n	Any foods made from beans, Leucanea (bean), common pea, lentils, or nuts, including tofu?	1.....Yes 0.....No 99.....Do not know	
414o	Cheese, yogurt, or other food made from milk?	1.....Yes 0.....No 99.....Do not know	
414p	Any oil, pork fat, or butter or foods made with any of these	1.....Yes 0.....No 99.....Do not know	
414q	Any packaged foods such as packaged noodles, chocolates, sweets, candies, pastries, cakes, or biscuits	1.....Yes 0.....No 99.....Do not know	
415	How meals (solid or semi-solid food) did (CHILD'S NAME) eat yesterday? *Enter 99 if unknown*	_____ times 99.....Do not know	*if 401 ≥ 6*
416	Did (CHILD'S NAME) eat any solid, semi-solid or soft foods (such as porridge, rice, pre-chewed rice, fruits, bread, meat, eggs, vegetables) yesterday?	1.....Yes 0.....No 99.....Do not know	*if 401 < 6* 0 → 418 99 → 418
417	In the first three days after delivery or when you returned to work in the rice field, was (*name*) given anything to drink other than breast milk?	1.....Yes 0.....No 99.....Do not know	*if 401 < 6* & *407 = 1*
Now, I understand eating pattern of you and your child. I would now like to ask more about eating practices of women who are breastfeeding.			
418	Yesterday during the day or night, did you eat more or less or same amount of food compared to your eating before this pregnancy?	1.....Increased amount 2.....Same amount 3.....Decreased amount 99.....Do not know	*if 401 < 6* & *407 = 1*

	Probe: Comparing with her usual eating style.		
419	Yesterday during the day or night, did you eat more or less amount of animal source foods compared to your eating before this pregnancy? *Probe: Using example of animal food or product in their general contexts and comparing with her usual eating style.*	1……Increased amount 2……Same amount 3……Decreased amount 99…..Do not know	*if 401 < 6 & 407 = 1*

Household Food Security and Expenditures			
No.	**Question**	**Response**	
I would like to ask you some questions about how much your household spends on health services and other things. *For all questions in this section report all values in local currency, whether paid in cash or in kind*			
501	In the last 4 weeks, how much did your household spend on: Food, including such things as [rice], meat, fruits, vegetables, and cooking oils. Include the value of any food that was produced and consumed by the household, and exclude alcohol, tobacco and restaurant meals.		_____,000 kip
502	In the last 4 weeks, how much did your household spend on: Housing, gas, electricity, water, telephone, and heating fuel		_____,000 kip
503	In the last 4 weeks, how much did your household spend on: Education fees and supplies		_____,000 kip
504	In the last 4 weeks, how much did your household spend on: Health care costs		_____,000 kip
505	In the last 4 weeks, how much did your household spend on: All other goods and services not yet mentioned		_____,000 kip
506	In the last 4 weeks, how much did your household spend in total? (Should equal 501 + 502 + 503 + 504 + 505)		_____,000 kip
507	In the **past month**, how often have you used any of the methods when you did not have enough food or money to buy food?		
507a	Rely on less preferred, less expensive foods?	1…….1 day per week 2…….1-2 days a week	

		3…….3-4 days a week 4…….5-6 days a week 5…….Daily 6…….Never/<1 time per week
507b	Borrow food or money from friends or relatives?	1…….1 day per week 2…….1-2 days a week 3…….3-4 days a week 4…….5-6 days a week 5…….Daily 6…….Never/<1 time per week
507c	Limit portions at mealtimes?	1…….1 day per week 2…….1-2 days a week 3…….3-4 days a week 4…….5-6 days a week 5…….Daily 6…….Never/<1 time per week
507d	Limit adult intake?	1…….1 day per week 2…….1-2 days a week 3…….3-4 days a week 4…….5-6 days a week 5…….Daily 6…….Never/<1 time per week
507e	Reduce number of meals per day?	1…….1 day per week 2…….1-2 days a week 3…….3-4 days a week 4…….5-6 days a week 5…….Daily 6…….Never/<1 time per week

Now I would like to ask you some questions about food that the household ate in the last 7 days

	508. How many **days** in the past week (last 7 days) did your household eat the following foods? Number of days eaten (out of last 7 days)	**509** What is the source of this food for each item mentioned? *if 508 > 0* Food Source Code: 1. Home grown crop or livestock production 2 Purchased food 3 Gathered forest products 4 Hunting/fishing 5 Borrowed

			6 Food aid 7 Exchanged/barter 8 Gift from family/relatives
A.	Rice (sticky rice, white rice)	__	__ __
B.	Maize / Corn	__	__ __
C.	Cassava	__ __	__ __
D.	Other roots of tubers (potatoes, yam)	__	__
E.	Pulses/Lentils/Tofu/Bean Curd	__	__
F.	Vegetables (green leafy, carrot, pumpkin…)	__	__
G.	Bamboo shoots / mushrooms	__	__
H.	Fruits	__	__
I.	Fish, fish paste	__	__
J.	Other aquatic animals (crab, snail, shrimp…)	__	__
K.	Meat (beef, pork, chicken)	__	__
L.	Wild animals/Insects	__	__
M.	Eggs	__	__
N.	Milk	__	__
O.	Sugar	__	__
P.	Oil/Butter/Animal Fat	__	__

510	How many hours in the past week did you spend gathering food from the forest?		*if any 509 = 3*
511	How many hours in the past week did you spend hunting?		*if any 509 = 4*
512	How many hours in the past week did you spend fishing?		*if any 509 = 4*
513	Compared to before the pandemic, is it easier or harder to meet your family's food needs?	1. Much easier 2. Somewhat easier 3. No change 4. Somewhat harder 5. Much harder 99. Don't know/no answer	1 →514 2 →514 3 →514 99→514
513a	What is the reason it is harder to meet your food needs during the pandemic? Select all that apply	1. Items are more expensive 2. Markets being closed 3. Foods not available 4. HH had lost income.	*if 513 = 4 or 5*

		98. Others (specify) 99. Don't know/no answer	
514	Did you lose income due to the pandemic?	1. Yes 0. No 99. Don't know/no answer	0→ 515 99→515
514a	If yes, how much did you lose, as a proportion of your income? (give best guess)	1. 0-25% 2. 25-50% 3. 50-75% 4. 75-100%	*if 514=1*
515	Do you spend less money due to the pandemic?	1. Yes 0. No 99. Don't know/no answer	0→516 99→516
515a	If yes, how much did you spend less, as a proportion of your expenditure? (give best guess)	1. 0-25% 2. 25-50% 3. 50-75% 4. 75-100%	*if 515=1*
516	Is it more difficult to access health services now compared to before the pandemic?	1. Much easier 2. Somewhat easier 3. No change 4. Somewhat harder 5. Much harder	

VI. Illness and Treatment			
Now we would like to ask about any recent illnesses that the selected child (CHILD'S NAME) may have had.			
No.	**Question**	**Response**	
601	Did (CHILD'S NAME) have diarrhea in the past two weeks, where diarrhea is defined as three or more loose stools or one loose, bloody stool in a 24 hour period?	1…….Yes 0…….No 99……Do not know	0→603 99→603
602a	Now I would like to know how much (CHILD'S NAME) was given to drink, including breast milk, during the diarrhea Was he/she given less than usual to drink, about the same amount, or more than usual to drink? *If less, probe: Was he/she given much less than usual to drink or somewhat less?*	1…….Much less 2…….Somewhat less 3…….About the same 4…….More 5…….Nothing to drink 99……Do not know	*if 601 = 1*

602b	During the time (CHILD'SNAME) had diarrhea, was HE/SHE given either: a) A fluid made from a special packet called (ORALYTE/NAM THA LAY PHOUN)? b) Recommended homemade fluid such as coconut water or rice water with salt?	1…….Yes, Nam Tha Lay Phoun 2…….Yes, Recommended Homemade Fluid 3……..No 99…….Do not know	*if 601 = 1*
602c	When (CHILD'S NAME) had diarrhea, was he/she given less than usual to eat, about the same amount, or more than usual to eat? *If less, probe: Was he/she given much less than usual to eat or somewhat less?*	1……Much less 2……Somewhat less 3……About the same 4……More 5……Nothing to eat 99….Do not know	*if 601 = 1*
603	Has (CHILD'S NAME) been ill with a fever any time in the past two weeks?	1…….Yes 0…….No 99……Do not know	
604	Has (CHILD'S NAME) had an illness with a cough at any time in the last two weeks?	1…….Yes 0…….No 99……Do not know	0→605 99→605
604a	When (CHILD'S NAME) was sick with a cough, did he/she breathe faster than normal with short, rapid breaths or have difficulty breathing?	1…….Yes 0…….No 99……Do not know	*if 604 = 1* 0→605 99→605
604b	Was the fast or difficult breathing due to a problem in the chest or to a blocked or runny nose?	1……Chest only 2……Nose only 3……Both 99……Do not know	*if 604a = 1*
605	At any time during the past two weeks, did you (*mother)* have diarrhea?	1…….Yes 0…….No 99……Do not know	
606	At any time during the past two weeks, have you (*mother)* been ill with a fever?	1…….Yes 0…….No 99……Do not know	
607	When (CHILD'S NAME) was sick, did you seek advice or treatment from any source?	1…….Yes 0…….No 99……Do not know	*if 601, 603 or 604 =1* 0→609 99→609
608	From where did you seek advice or treatment?	1…Government hospital 2…….Health centre	*if 607 = 1*

	Probe: Anywhere else? *(Multiple response)*	3…Village health worker 4…….Outreach team 5…Lao Women Union worker 6…Private hospital/ clinic 7…….Private physician 8…….Private pharmacy 9…….Mobile Clinic 10……Relative/friend 11……Shop 12…Traditional healer 98……Other	
609	When (YOU) was sick, did you seek advice or treatment from any source?	1…….Yes 0…….No 99……Do not know	*if 605 or 606=1* 0 → 700 99→ 700
610	From where did you seek advice or treatment? *Probe:* Anywhere else? *(Multiple response)*	1…….Government hospital 2…….Health centre 3…….Village health worker 4…….Outreach team 5…….Lao Women Union worker 6…….Private hospital/ clinic 7…….Private physician 8…….Private pharmacy 9…….Mobile Clinic 10……Relative/friend 11……Shop 12…Traditional healer 98……Other	*if 609 = 1*

VIII. Anthropometry			
No	**Question**	**Response**	**Notes**
As part of this survey, we are measuring the growth of children 0-59 mo. Child growth is an important indicator of health. Poor growth is a serious health problem that usually results from poor nutrition, poor sanitation, or infection. This measurement will help us design programs to improve child health. We will share with you the measurements, but will not share the information with anyone else outside the survey team. Do you have any questions?			

901	What is the age, in months, of (NAME)?	_____	Same as 401
902	What is the sex of (NAME)?	0…….Female 1…….Male	
903	***Enumerator:*** *Check for bilaterial pitting edema*	1……Present 0……Not present 99….Unsure 98….Not checked	1→906
904	Now I am going to weigh (NAME). ***Enumerator:*** *If the child is under 2 years old, weigh the mom by herself. The child should wear as few clothes as possible. If the child is wearing clothes, weigh the mom holding an extra pair of clothes (if an extra pair exists) similar to the weight of the clothes the child is wearing. Tare the scale. Then weigh the mom holding the child. Record the weight of the child.*	____ ____ . ____ kg	*if 903 =0*
905	***Enumerator:*** *was (NAME) undressed to the minimum?* *(note…if child was dressed but mother held clothes, indicate 'no clothes')*	0…….No clothes 1…….Few clothes 2…….Many clothes	
906	Now I am going to measure the arm of (NAME). ***Enumerator:*** *record the MUAC measurement, in cm*	____ ____ . ____ cm	*if 401 ≥ 6*
907	*Record the color of the MUAC tape*	1…….Green 2…….Yellow 3…….Red	*if 401 ≥ 6*
908	Now I am going to measure the height of (NAME). ***Enumerator:*** *record the height measurement of the child, in cm. If the child is less than 23 months, measure the child lying down.*	____ ____ . ____ cm	
909	*How was the person actually measured? Lying down or standing up?*	1…….Lying down 2…….Standing	
910	Now I am going to measure your arm. ***Enumerator:*** *record the MUAC measurement of the mother, in cm.*	____ ____ . ____ cm	

Closing Statement to the Interview
The interview is complete. Thank you so much for your time and patience. Your help will allow us to work together to improve the health and nutrition of your child and community.
Enumerators: *indicating completeness:* ☐ *Yes, interview is complete ⇨ Move to the next household* ☐ *No, interview was not complete ⇨ Tell this result to your supervisor and move to the next household.*

Ethical approval

ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ
ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກະພາບ ວັດທະນາຖາວອນ

ກະຊວງສາທາລະນະສຸກ
ມະຫາວິທະຍາໄລ ວິທະຍາສາດ ສຸຂະພາບ
ຄະນະກຳມະການຈັນຍາທຳການຄົ້ນຄວ້າວິທະຍາສາດ
ເບີໂທ: 021 240255

ເລກທີ 131 --/ຄຈຄ
ນະຄອນຫຼວງວຽງຈັນ, ວັນທີ 19 FEB 2021

ໃບອະນຸມັດຈັນຍາທຳ

ຊື່ໂຄງການ: ສຶກສາຜົນກະທົບຈາກການລະບາດຂອງພະຍາດໂຄວິດ ຕໍ່ກັບຄວາມປອດໄພ ແລະ ການບໍລິໂພກອາຫານ, ການເຂົ້າເຖິງການບໍລິການສາທາລະນະສຸກ ແລະ ການໃຊ້ຈ່າຍ ໃນແຕ່ລະຄອບຄົວ ຢູ່ທາງພາກໃຕ້ຂອງ ສປປ ລາວ (ປັດ Proposal version 2.1, ລົງວັນທີ 09 ກຸມພາ ປີ 2021).

ຊື່ຜູ້ຄົ້ນຄວ້າຫຼັກ: ປອ. ດຣ ເພັດສະໜັນ ຈັນທະວົງໄລ, ຮອງຫົວໜ້າພະແນກຄົ້ນຄວ້າວິທະຍາສາດ, ສະຖາບັນຄົ້ນຄວ້າ ແລະ ພັດທະນາການສຶກສາ.

ໄລຍະເວລາການຮັບຮອງ: 01 ປີ.

ຄະນະກຳມະການຈັນຍາທຳຄົ້ນຄວ້າວິທະຍາສາດ ໄດ້ທຳການພິຈາລະນາໂຄງການຄົ້ນຄວ້າດັ່ງກ່າວ ແລະ ເຫັນວ່າ ການຄົ້ນຄວ້າຄັ້ງນີ້ຈະບໍ່ສົ່ງຜົນກະທົບທາງດ້ານຮ່າງກາຍ ແລະ ຈິດໃຈຂອງຜູ້ທີ່ເຂົ້າຮ່ວມໃນການສຶກສາ ແລະ ບໍ່ແຕະຕ້ອງ ເຖິງບັນຫາຈັນຍາທຳຂອງການຄົ້ນຄວ້າ. ໂຄງການຄົ້ນຄວ້າດັ່ງກ່າວນີ້ຈະມີຜົນປະໂຫຍດອັນໃຫຍ່ຫຼວງ ໃນການປະກອບສ່ວນວຽກງານການສົ່ງເສີມສຸຂະພາບ ໂດຍທາງກົງ ແລະ ທາງອ້ອມ ຕໍ່ຜູ້ເຂົ້າຮ່ວມການສຶກສາ, ແລະ ເປັນຂໍ້ມູນພື້ນຖານ ທີ່ສຳຄັນໃນການຄົ້ນຄວ້າຄັ້ງຕໍ່ໄປແກ່ ວົງການສາທາລະນະສຸກລາວ ແລະ ຂະແໜງການວິທະຍາສາດ ໃນອະນາຄົດ.

ດັ່ງນັ້ນ, ຄະນະກຳມະການຈັນຍາທຳການຄົ້ນຄວ້າຂອງ ມະຫາວິທະຍາໄລ ວິທະຍາສາດ ສຸຂະພາບ ຈຶ່ງເຫັນດີອະນຸມັດດຳເນີນຈັນຍາທຳການຄົ້ນຄວ້າສຳລັບໂຄງການດັ່ງກ່າວນີ້. ຜູ້ເຮັດການຄົ້ນຄວ້າຫຼັກຕ້ອງຮັບປະກັນວ່າທີມງານຄົ້ນຄວ້າທັງໝົດໄດ້ຮັບຮູ້ ກ່ຽວກັບ ເງື່ອນໄຂຂອງການອະນຸມັດຈາກຄະນະກຳມະການຈັນຍາທຳການຄົ້ນຄວ້າ ຂອງ ມວສ ລວມທັງເອກະສານທີ່ຖືກອະນຸມັດ. ຜູ້ເຮັດການຄົ້ນຄວ້າຫຼັກຕ້ອງໄດ້ແຈ້ງໃຫ້ທາງເລຂາຂອງຄະນະກຳມະການຈັນຍາທຳ ຄົ້ນຄວ້າຮັບຊາບຖ້າມີ ການແກ້ໄຂເພີ່ມເຕີມ ຫຼື ການປ່ຽນແປງ ແລະ ຕ້ອງລາຍງານຄວາມຄືບໜ້າຂອງໂຄງການຄົ້ນຄວ້າ ຄືດັ່ງລຸ່ມນີ້:

- ກໍລະນີມີການປ່ຽນແປງໃດໆທີ່ມີຄວາມສຳຄັນຕໍ່ກັບໂຄງການ ແລະ ເຫດຜົນຂອງການປ່ຽນແປງນັ້ນ, ລວມທັງຂໍ້ບົ່ງຊີ້ທາງດ້ານຈັນຍາທຳ;
- ເກີດຜົນກະທົບທີ່ຮ້າຍແຮງຕໍ່ຜູ້ເຂົ້າຮ່ວມ ແລະ ການແກ້ໄຂຜົນກະທົບດັ່ງກ່າວ;
- ເກີດເຫດການທີ່ບໍ່ໄດ້ຄາດຄິດ ຫຼື ຄາດເດົາລ່ວງໜ້າ;
- ກໍລະນີຜູ້ເຮັດການຄົ້ນຄວ້າຫຼັກບໍ່ສາມາດສືບຕໍ່ເຮັດໜ້າທີ່ຂອງຕົນໄດ້ ຫຼື ມີການປ່ຽນແປງໃດໆທີ່ກ່ຽວຂ້ອງກັບທຸກຄົນໃນໂຄງການຄົ້ນຄວ້າດັ່ງກ່າວ;
- ກໍລະນີມີການຢຸດຕິ ຫຼື ປິດໂຄງການຄົ້ນຄວ້າກ່ອນໂຄງການຈະສຳເລັດ.

ເອກະສານທີ່ອະນຸມັດ

ເອກະສານທີ່ໄດ້ຮັບການທົບທວນຜິຈາລະນາ ແລະ ອະນຸມັດຈາກ ຄະນະກຳມະການຈັນຍາທຳການຄົ້ນຄວ້າວິທະຍາສາດ

ເອກະສານປະກອບ	ສະບັບທີ (version)	ລົງທີ
ຍົກສະເໜີໂຄງການຄົ້ນຄວ້າ	Version 2.1	09 ກຸມພາ ປີ 2021
ເຄື່ອງມືເກັບຂໍ້ມູນ (ແບບຟອມສອບຖາມ ແລະ ອື່ນໆ)	Version 1.3	09 ກຸມພາ ປີ 2021

ປະທານ

ຄະນະກຳມະການຈັນຍາທຳຄົ້ນຄວ້າວິທະຍາສາດ

ດຣ.ນ. ຈັນຖະໜອມ ມະນີທິບ

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-7
Objectives	3	State specific objectives, including any prespecified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7-8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8-10
Bias	9	Describe any efforts to address potential sources of bias	8,11
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	12
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	11
		(*e*) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	12
		(b) Give reasons for non-participation at each stage	12
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12
		(b) Indicate number of participants with missing data for each variable of interest	12
Outcome data	15*	Report numbers of outcome events or summary measures	13-15; 26

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13-15; 27
		(*b*) Report category boundaries when continuous variables were categorized	13-15
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	21
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-20
Generalisability	21	Discuss the generalisability (external validity) of the study results	21
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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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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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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Keywords: food security; dietary diversity; underweight; wasting; income; COVID-19; Lao PDR; malnutrition; local food production

Abstract

Objectives: We assessed the relative difficulty in meeting food needs during the COVID-19 pandemic compared to 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=1,122) with children under five years.

Primary and secondary outcomes measured: Survey respondents reported the relative ease of access of food and health care as well as changes in income and expenditures compared to 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 five.

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, 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 programs that offset income losses may help.

List of abbreviations:

LMICs: low- and middle-income countries

FAO: Food and agriculture organization

FCS: food consumption score

CSI: coping strategies index

DDS: dietary diversity score

HAZ: height-for-age Z-score

WAZ: weight-for-age Z-score

WHZ: weight-for-height Z-score

Strengths and limitations of this study

- We characterize food security across all members of the household, including women and children, through a series of standardized 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 marginalized population with high prevalence of ethnic minorities, for whom little data on nutrition was previously available.
- The results of this study may not be generalizable 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 to 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- and middle-income countries (LMICs) [1-4]. The food supply chain has faced challenges across multiple stages, including loss of labor 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 to 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 health care 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 five 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-five 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 $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 six 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 (e.g., 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 February 14, 2020 to January 30, 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 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 this 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 health care during the COVID-19 pandemic compared to 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 Health Care Program to monitor and evaluate public health activities over a three-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 1,200 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 two years, if it contained a child under the age of five, 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 five per household was assessed, and anthropometric measurements taken. If there were more than one child under five 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 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 standardized questionnaire developed by Save the Children, International to assess the impact of COVID-19 globally [29]. Respondents were asked if, compared to 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 to before the pandemic, it was much harder, somewhat harder, easier, or the same to access health care. Finally, families were asked if they lost income or reduced their expenditures during the pandemic, and if so, asked to estimate by what percent.

Calculation of household food security and maternal and child dietary diversity

Household food security was assessed through two standard indicators: the food consumption score and coping strategy index. The food consumption score (FCS) is a frequency weighted household dietary diversity score 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 Coping Strategies Index (CSI) was also used to compare household food security. CSI is calculated by multiplying the weekly frequency of five behaviors by the weight of the behavior and summing for all behaviors [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 behaviors 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 behavioral 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 organizations as a key indicator in program 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 categorize 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 dietary diversity score (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 (i.e., 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 ten 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 five of the ten food groups to meet her minimum dietary diversity [35]. Women who reported having an abnormal diet (i.e., 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 (HAZ), 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 -2SD, respectively.

Statistical analysis

Data were analyzed in R version 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

standard errors used to calculate 95% confidence intervals 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 generalized linear models, accounting for survey weights, and using cluster robust standard errors to adjust for clustering at the village level. A directed-acyclic-graph (DAG) was used to identify the set of minimally sufficient covariates to adjust for to block confounding pathways between the exposure and the outcome (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 minimized model AIC as compared to inclusion of only a subset of these covariates. 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 percent 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 to 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).

Ethics

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. 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). A copy of the ethical approval is included in the 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 1,122 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 five years in the study region was high, with the survey-weighted prevalence of wasting at 4.5% (95% CI: 3.5, 5.8), underweight at 18.2% (95% CI: 15.9, 20.7%), and stunting at 32.9% (95% CI: 29.6, 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 to before (Table 1). A weighted 60.9% (95% CI: 57.6, 64.1%) of individuals reported that it was somewhat harder to meet food needs, while 17.6% (95% CI: 15.4, 20.0%)

reported that it was much harder. Among the 874 individuals who found it harder to meet food needs, the 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 food consumption score was 60.9 (95% CI: 59.7, 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 4.21 (95% CI: 3.95, 4.18) food groups in the day prior to the survey, corresponding to 62.5% (95% CI: 59.1, 65.8) of children that met the minimum DDS requirement. Women consumed an average of 5.38 (95% CI: 5.25, 5.51) food groups, corresponding to 67.7% (95% CI: 64.4, 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 dietary diversity score, 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 to 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 (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 to 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 food consumption score among households who found it harder to meet their food needs was 2.74 points lower (95% CI: 0.55, 4.92) than the average food consumption score 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 coping strategies index among households who had a harder time meeting their food needs was higher, indicating lower food security, but not significantly so. Dietary diversity scores 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 percent of expenditures spent on food as covariates found similar model coefficients (Table S1), although dietary diversity score 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 to households who reported food availability and market closures as the reason for their difficulty.

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 to those from household who reported no change in ability to meet food needs.

Figure 1. Violin plot showing distribution of two household food security measures, together with their median and interquartile range (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 to those who did not. Vertical bars represent 95% confidence intervals. 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. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

Resiliency to food insecurity

We estimated the percentage of a household's food sources in the past week that was self-produced (e.g., farmed, fished, hunted, gathered). On average, families met 42% of their food needs through self-production (interquartile range: 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, 7.15%) lower among households who found it harder to meet their food needs compared to 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.

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, 57.4%) reporting losing between 25-50% of their income. 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, 7.05) units lower, and a CSI that was 0.83 (95% CI: -0.07, 1.74) units higher than families who did not reduce spending. Dietary diversity scores 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 percent of expenditures spent on food as covariates in multivariable models did not change these conclusions (Table S1).

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

Figure 4. A) Mean decrease in expenditures reported, stratified by the percent reduction in household income. Vertical bars represent 95% confidence intervals. B) The difference in mean of food security indicator among households who reduced spending during the pandemic compared to those who did not. Vertical bars represent 95% confidence intervals. 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. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

Access to health care

A weighted 37.4% (95% CI: 34.6, 40.2%) of individuals reported that it was somewhat harder to access healthcare compared to before the pandemic, while 4.8% (95% CI: 3.7, 6.1%) reported that it was much harder (Table 1). We identified 123 (11%) women and 557 (50%) children who had experienced fever, diarrhea, cough and/or respiratory infection in the two weeks prior to the survey. Among both women and children with illness in the past two weeks, >60% had fever (see Figures S4-S5 for Venn diagrams). Of these, a weighted 69.7% (95% CI: 66.3, 73.0%) of children and 81.2% (95% CI: 73.3, 87.2) of women sought care from a health facility. We found no association between healthcare seeking behavior, either for stratified by condition or in aggregate, and relative ability to access health care 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 25-50% 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 food consumption score (which correlates best with caloric intake) and coping strategies index (which correlates best with vulnerability to shocks). Nevertheless, the small differences in food security indicators suggests 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 was more strongly associated with reductions in household food security, as measured by both the FCS and the CSI, as compared to 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 suggests 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 $59 during a two-month stay at home order, while the proportion of families living on less than $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).

Randomized 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 dietary diversity score between these groups in multivariate analyses. This may suggest that households in our study population prioritized 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, and more than offset by increases in egg consumption. All villages in the study population have been receiving interventions focused on sustainable behavioral change for maternal and child nutrition, so individuals in the population may have been more likely to prioritize the nutrition of these vulnerable populations. Indeed, eggs were promoted as part of behavioral 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 to households who found it more difficult to meet their food needs. Reducing reliance on food supply from other places or countries is recognized 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 advocate 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 co-benefits [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 to 2020. Globally, reliance on homegrown food production may have increased as a response to lockdown measures [7] and helped stabilize food consumption patterns amidst market uncertainty [11]. Yet, increased reliance on gathering or growing food may represent a source of unpaid labor that could be devoted to other activities [49]. Care must be taken that local food grown solutions minimize 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 programs may be particularly suited to addressing the challenge of food insecurity [51-53]. A randomized control trial in Colombia in March 2020, at the start of a national quarantine, found that 90% of families randomized to an arm that received cash transfers of $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 randomized 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 generalizable 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, seven months prior to the survey, with the main intervention remaining being strict border closure. We expect, therefore, that compared to other LMICs, the effects of food security and access to health care 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 to 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 to other provinces [24]. Indeed, our survey found a greater proportion of household reduced expenditures (64%) compared to 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 prioritized meeting the needs of mothers and children even as their 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 generalizable to larger, more urban areas. Similarly, the relationships with FCS may not be generalizable 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 emphasize 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 health care, 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 emphasize 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 how 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 neighboring 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 programs, 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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Contributorship statement

PC, HC, and JRH conceptualized the research. PC and HC assisted in data collection. PC and JRH analyzed 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. All authors edited and read the manuscript.

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.

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Data sharing statement

Data is owned by the Luang Prabang Provincial Health Department and permission has been granted for its use.

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

	Weighted percentage (95% Confidence interval)	N
Relative ability to meet family's food needs now compared to before the pandemic (N = 1120)		
Easier	0.83 (0.38, 1.82)	8
No change	20.7 (18.3, 23.3)	238
Somewhat harder	60.9 (57.6, 64.1)	698
Much harder	17.6 (15.4, 20.0)	176
Reasons it is harder to meet food needs during the pandemic (N = 874)		
Items more expensive	51.2 (46.4, 56.0)	415
Household lost income	45.3 (40.9, 49.9)	465
Less food is available	36.6 (33.1, 40.2)	561
Markets are closed	36.5 (32.3, 41.0)	555
Proportion of household income lost during the pandemic (N = 1122)		
No income lost	14.4 (12.3, 16.6)	165
1-25%	17.5 (14.6, 20.7)	192
26-50%	54.4 (51.3, 57.4)	607
51-75%	9.2 (1.7, 11.2)	104
76-100%	4.6 (3.5, 6.1)	54
Percent reduction in household expenditures during the pandemic (N = 1122)		
No reduction	36.3 (33.2, 39.6)	415
1-25%	23.2 (19.4, 27.4)	257
26-50%	35.7 (32.9, 38.6)	400
51-75%	3.9 (2.9, 5.3)	41
76-100%	0.89 (0.44, 1.8)	9
Relative ability to access health care now compared to before the pandemic (N = 1121)		
Easier	0.40 (0.15, 1.09)	8
No change	47.0 (44.0, 50.0)	544
Somewhat harder	37.4 (34.6, 40.2)	413
Much harder	4.8 (3.7, 6.1)	48
Undecided	10.0 (7.5, 13.1)	108

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. 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. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

	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, -1.29)*	-2.74 (-4.92, -0.55)*	-6.53 (-8.23, -4.79)*	-5.24 (-7.05, -3.42)*	60.9 (59.7, 62.3)
CSI	0.07 (-0.86, 0.99)	0.36 (-0.65, 1.37)	0.83 (-0.07, 1.74)	1.32 (0.40, 2.25)*	3.6 (3.1, 4.1)
DDS (child)	-0.21 (0.41, -0.01)*	-0.21 (-0.43, 0.01)	-0.20 (-0.38, -0.02)*	-0.11 (-0.31, 0.08)	4.14 (4.04, 4.24)
DDS (mother)	-0.15 (-0.40, 0.01)	-0.10 (-0.34, 0.15)	-0.08 (-0.28, 0.12)	0.06 (-0.14, 0.25)	5.38 (5.26, 5.51)

*represents statistical significance at p<0.05

Supplemental Info for:

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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Table S1. Multivariate model results adding additional covariates to the model. Coefficients represent the 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. Adjusted models for households control for household ethnicity, household size, education level of mother and the head of household, district, **total expenditures**, and **percent of expenditures spent on food**. Adjusted models for mothers include additionally mother's age. Adjusted models for children include additionally child's age and sex. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

	Model coefficients (95% CI)	
	Harder to access food during the pandemic	**Decreased expenditures during the pandemic**
FCS	-2.76 (-5.03, -0.50)*	-5.10 (-6.94, -3.27)*
CSI	0.23 (-0.81, 1.27)	1.46 (0.52, 2.41)*
DDS (child)	-0.23 (-0.45, -0.01)*	-0.10 (-0.30, 0.10)
DDS (mother)	-0.11 (-0.35, 0.14)	0.06 (-0.14, 0.25)

*represents statistical significance at p<0.05

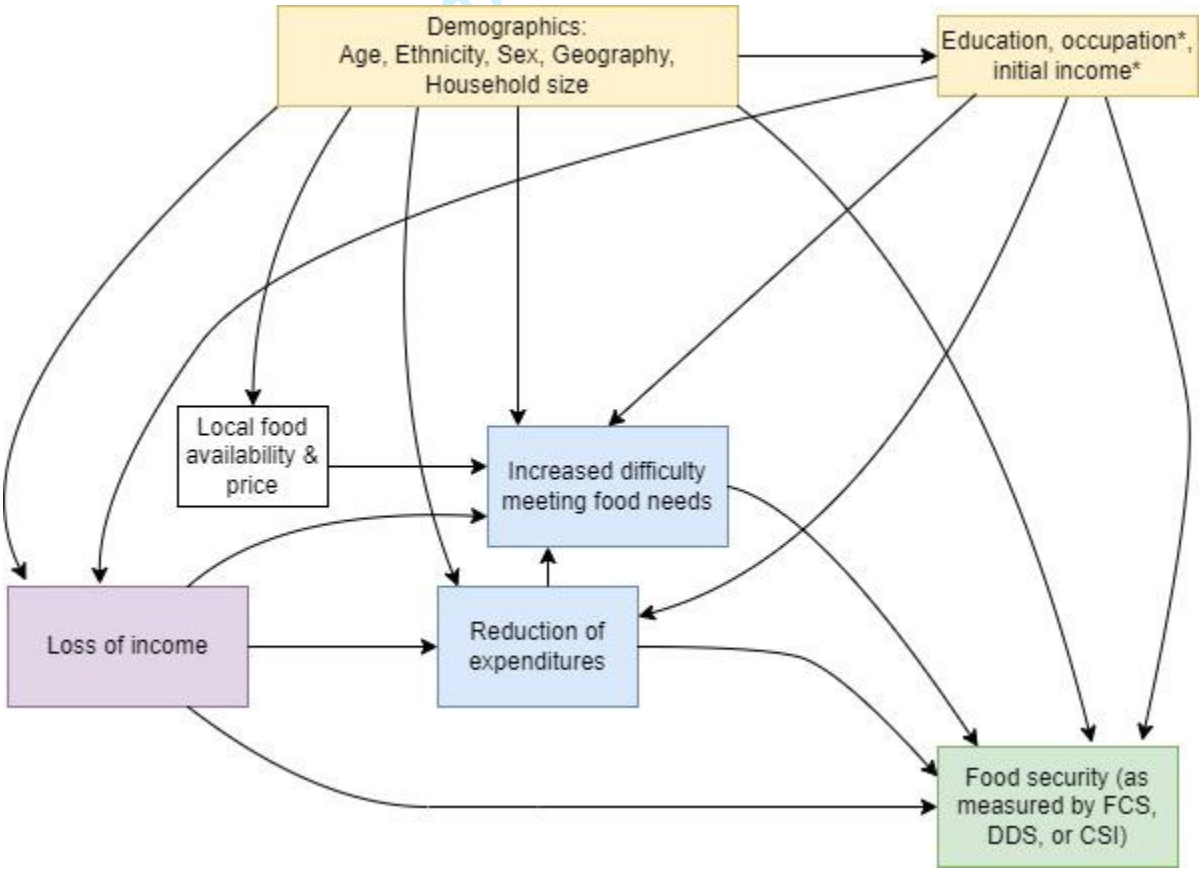

Figure S1. Directed acyclic graph (DAG) indicating the minimum set of covariates (yellow) to remove backdoor pathways between exposures (blue) and outcomes (green). White boxes are unmeasured upstream influences. Covariates indicated with an asterisk (*) are unmeasured. FCS = Food Consumption Score; DDS = Dietary Diversity Score; CSI = Coping Strategies Index.

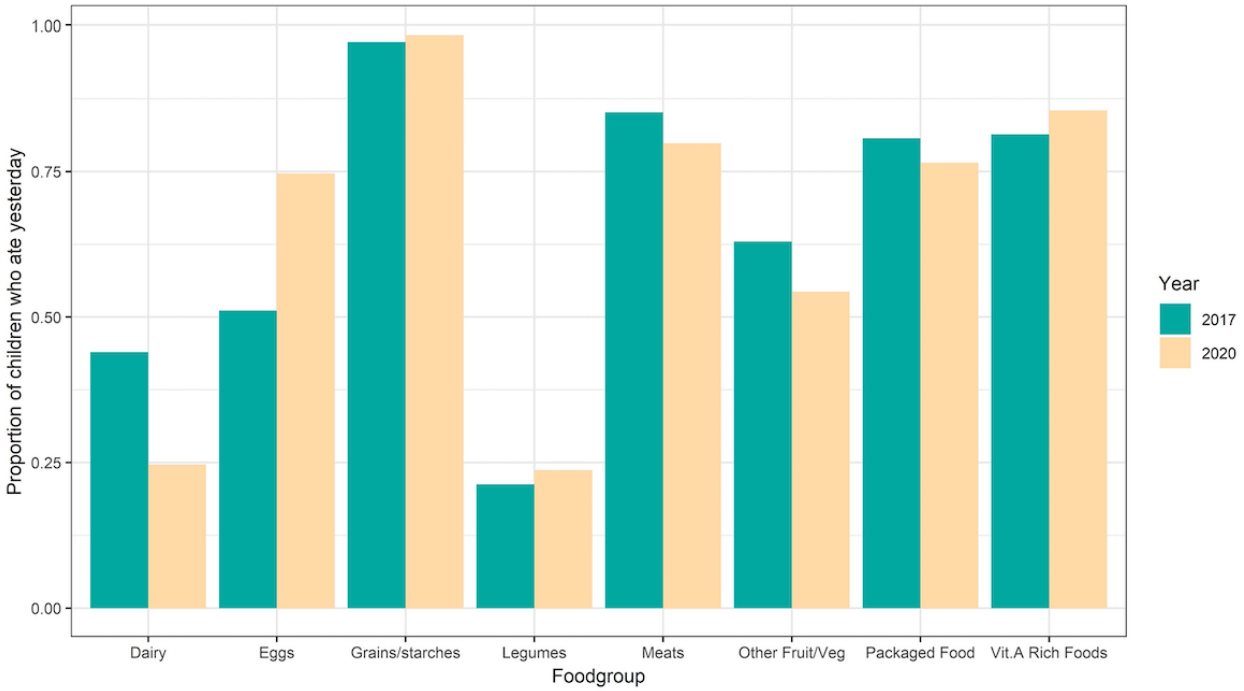

Figure S2. Prevalence of food group consumption in children 6-59 months, past 24 hours

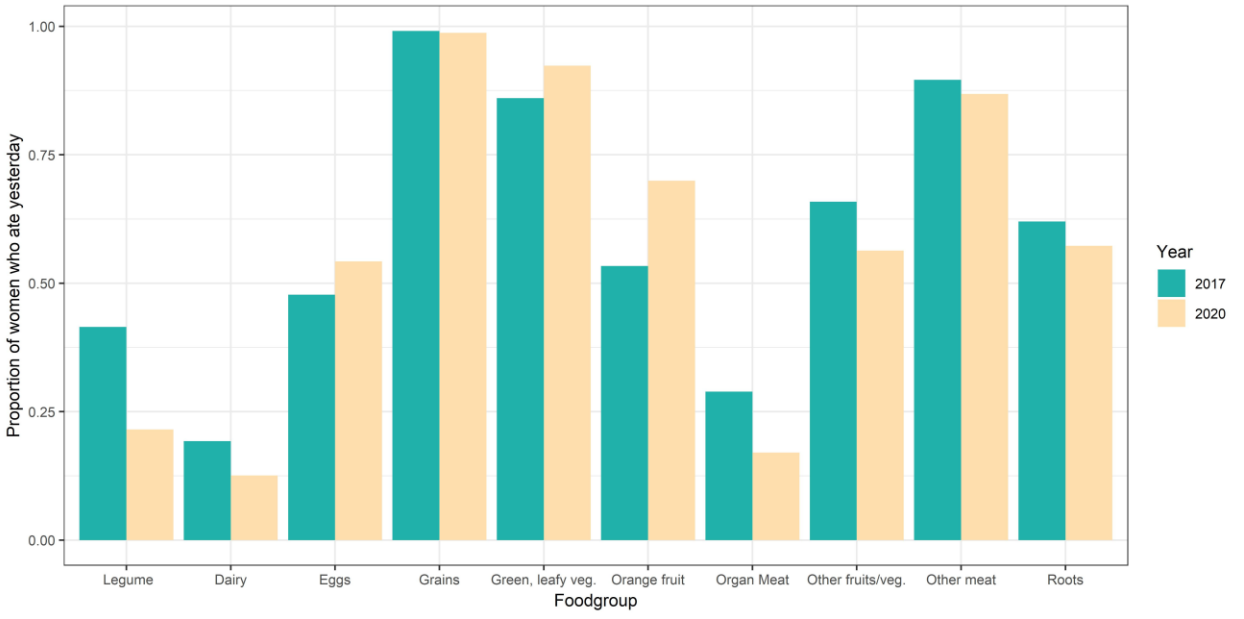

Figure S3. Prevalence of food group consumption in mothers of children <59 months, past 24 hours

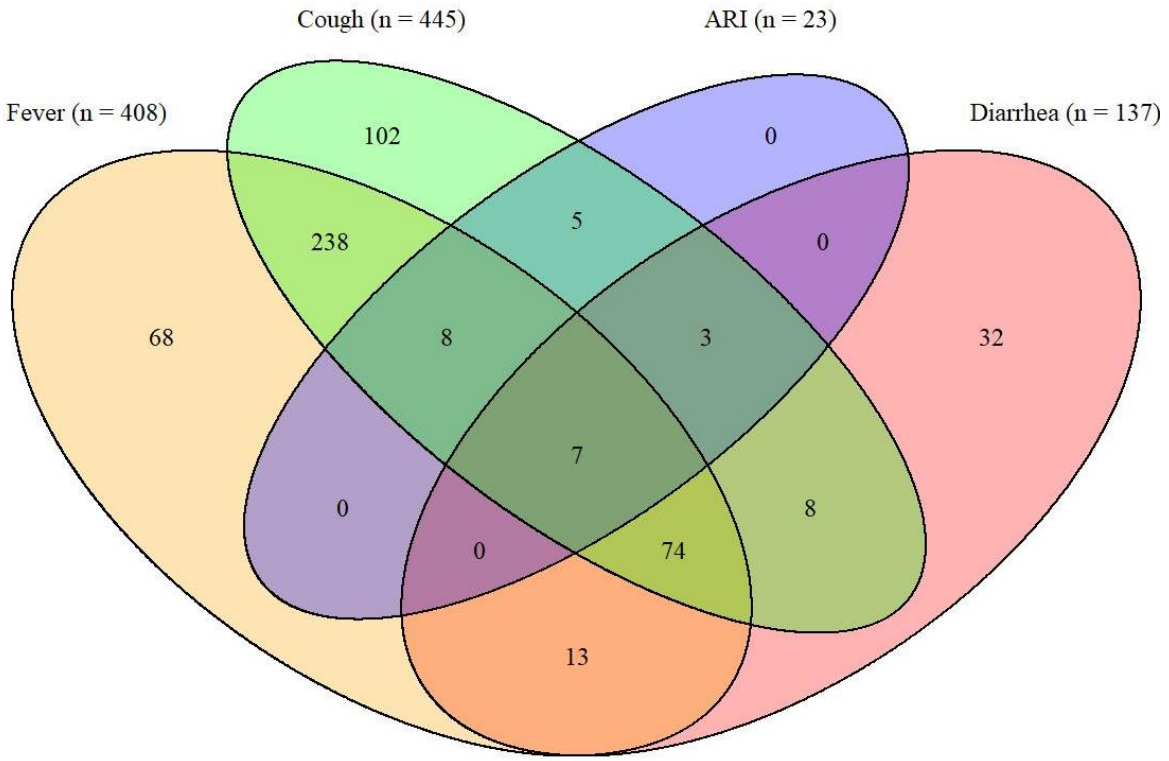

Figure S4. Venn diagram showing distribution of symptoms among the 557 children with fever, cough, ARI, or diarrhea in the past two weeks.

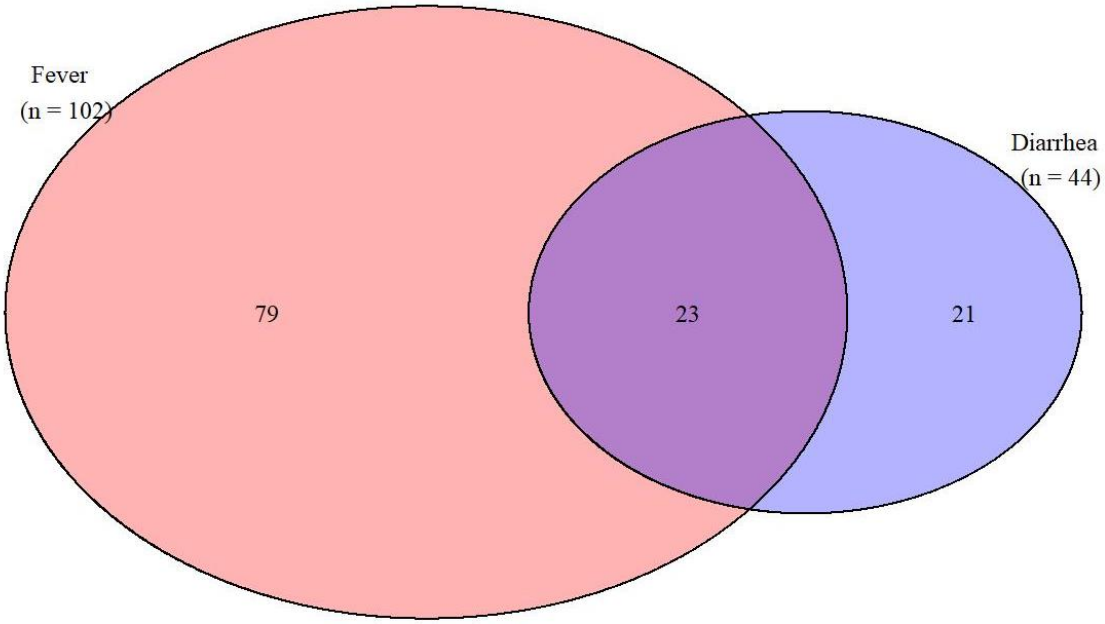

Figure S5. Venn diagram showing distribution of symptoms among the 123 mothers with fever or diarrhea in the past two weeks.

Survey tool

Endline Interview Questionnaire – 2020

Health and Nutrition Assessment

Introductory Statement to the Interview
Good Morning/Good Afternoon. My name is _____and I am here on behalf of the Primary Health Care program. We are conducting a survey on the health and nutritional status of women and children. You have been selected by chance from the list of families with children under the age of five. Is this correct? The purpose of this interview is to obtain information about the health and nutrition status of you and your child. We are interested in interviewing mothers of children aged five or less. Are you the mother of the child? (*If no),* Is the mother of the child at home? (*If yes, wait until she arrives, and re-explain purpose).* Could you please spare some time (around 45 minutes) for the interview? The information you give will be confidential and will only be used to prepare a report of general findings – but will not include any names. You will not get any additional entitlements because of the interview. At any time during the survey, you are free to stop the survey, or choose not answer any question. If you are willing to participate in this survey, please indicate your oral consent by saying "yes" or "no".
May I start now? ☐ *Yes, permission is given ⇨ Go to 101 to begin the interview.* ☐ *No, permission is not given ⇨ Tell this result to your supervisor and move to the next household.*
Enumerators– *If the respondent is not willing, do not ask any of the questions and move to the next household. If the household contains children under the age of 5, but the mother is not present, ask when it is a good time to return, and return at a later time. We only want to interview mothers of children under the age of 5.*

General Information				
No.	Item	Name		
101	District			
102	Village			
103	Date of interview	DD	MM	YYYY
		_ _	_ _	2016
104	Interviewer's Name/Number	_ _		

Household Demographic Information			
First, we would like to ask some questions about yourself and the people who live in this household.			
No.	**Question**	**Response**	**Notes**
201	How old are you?	Age (in completed years): ___ ___	
202	To what ethnic group does the head of this household belong?	1……Lao Lom 2……Hmong 3……Khmu 4……Mien 5……Lue 6…..Akha 7…..Muser 98……Other (Specify……)	
203	What is your marital status?	1…….Married (monogamous) 2…….Married (polygamous) 3…….Not married, but living with a man 4…….Single 5…….Divorced or separated 6…….Widowed	

204	What is your relationship to the head of the household (HHH)?	1……. Head of household 2……. Wife of the HHH 3……. Daughter of the HHH 4…….Daughter in law of HHH 5…….Granddaughter of HHH 98….Other relation	1 → 206 2 → 206
205	Is the head of the household male or female?	0…….Female 1…….Male	*if 204 ≠ 1 or 2*
206	Have you ever attended school?	1…….Yes 0…….No	0 → 208
207	What is the highest level of school you completed?	1…….Preschool 2…….Primary 3…….Lower Secondary 4…….Upper secondary 5…….Post-secondary vocational, tertiary/ diploma 6…….Higher	*if 206 =1*
208	Did the head of the household attend school?	1…….Yes 0…….No 99….Don't know	*if 204≠1* 1 → 209 0 → 210
209	What is the highest level of school completed by the head of the household?	1…….Preschool 2…….Primary 3…….Lower Secondary 4…….Upper secondary 5…….Post-secondary vocational, tertiary/ diploma 6…….Higher 99…Don't know	*if 208 = 1*
210	How many household members are aged 15 years or more?	____ ____	

	Prompt to include self in this count		
211	How many household members are below 15 years of age?	____ ____	
212	How many household members are below 5 years of age?	____ ____	Check: 212 ≤ 211
213	How many members are in your own family?	____ ____	

Dietary Intake			
Now we would like to ask some questions about the diet of yourself and one of your children. *Enumerators, if there are more than one children under the age of five, randomly select one child. Ask the name of the child, and use that name for the rest of the interview.*			
No.	**Question**	**Response**	**Notes**
400	When was this child born? *Probe: Using MCH book, house registration, other official document*	__ ____ ___	
401	How many months old is this child? *Probe: Using important holidays, dates, etc.*	___ ___ months	0-59 only!
402	Is the child selected (Child's name) your youngest child? *Probe: the last child of alive children?*	1…….Yes 0…….No	
403	Yesterday during the day or night, was your diet a typical diet? *Probe: She had special ceremonies or illnesses that led her to have less or much more than her typical eating.?*	1…….Yes 2…….No. I ate more. 3…….No. I ate less 99…….Do not know	
404	Yesterday during the day or night, did you eat more or less or same amount of food compared to your eating before this pregnancy?	1……Increased amount 2……Same amount 3……Decreased amount 99…..Do not know	*if 226=1 (currently pregnant*)
405	Yesterday during the day or night, did you eat more or less or same amount of animal source foods compared to your eating before this pregnancy?	1……Increased amount 2……Same amount 3……Decreased amount 99…..Do not know	*if 226=1 (currently pregnant*)

	Probe: Using examples of animal food or product in their general contexts and comparing with her usual eating style		
406	I would like to ask you about foods that you may have had yesterday during the day or night. I am interested to know whether you had the item even if combined with other foods. Please include foods consumed outside of your home. YESTERDAY DURING THE DAY OR NIGHT, DID YOU DRINK/EAT (FOOD GROUP ITEMS)? *Questions and filters (Circle the corresponding code and you can underline more than one answer)* Always start with: 'YESTERDAY DID YOU EAT….'		
406a	Any offal items (excluding intestines)? *Probe: such as liver, brain, lung, heart, gizzard, kidney, of any animal*	1.....Yes 0.....No 99.....Do not know	
406b	The intestine of any animal?	1.....Yes 0.....No 99.....Do not know	
406c	Any kind of meat? *Probe:* such as any meat, such as beef (fresh or dry), buffalo, pork, goat, chicken, goose, duck, sausage, blood sausage, sour sausage	1.....Yes 0.....No 99.....Do not know	
406d	Any kind of eggs? *Probe: 'such as?' eggs from chicken, duck, turtle or other animals*	1.....Yes 0.....No 99.....Do not know	
406e	Any kind of fish or aquatic animals? *Probe: 'such as?' fresh, fermented or dried fish, swamp eel, squid, shrimp (fresh or dry), crab, granulated ark, clam, snail, frog, water insects*	1.....Yes 0.....No 99.....Do not know	
406f	Any kind of wild animals? *Probe: 'such as?' lizard, rat, rabbit, wild bird, small birds*	1.....Yes 0.....No 99.....Do not know	

406g	Any kind of insects or grubs? *Probe: 'such as?' silk worm pupa, cricket, weaver ant, ant egg, etc.*	1.....Yes 0.....No 99.....Do not know	
406h	Any kind of dairy products (not including coffee creamer)? *Probe: 'such as?' cheese (butter), yogurt, or other milk products*	1.....Yes 0.....No 99.....Do not know	
406i	Other foods that came from an animal. Example: pork skin	1.....Yes 0.....No 99.....Do not know	
406j	Sticky rice (refined or unrefined), roasted rice, rice, pre-chewed rice, rice noodles, maize, noodles, thick porridge, or other foods made from grains?	1.....Yes 0.....No 99.....Do not know	
406k	White or purple coloured foods from roots such as white yams, purple yams, yam bean, cassava, white radish, white potato, or any other white or purple colored foods from roots.	1.....Yes 0.....No 99.....Do not know	
406l	Pulses/lentils/tofu/bean curd	1.....Yes 0.....No 99.....Do not know	
406m	Nuts or seeds (e.g. Sesame seeds, mung bean, ground bean, sun flower seed, cashew nuts etc.)	1.....Yes 0.....No 99.....Do not know	
406n	Any dark green leafy vegetables such as pak choi, swamp cabbage, morning glory, sweet potato leaves, Chinese kale	1.....Yes 0.....No 99.....Do not know	
406o	Ripe orange fleshed mangoes, ripe orange fleshed papayas, pumpkin, carrots, sweet potatoes that are yellow or orange inside?	1.....Yes 0.....No 99.....Do not know	
406p	Other vegetables	1.....Yes 0.....No 99.....Do not know	
406q	Other fruit	1.....Yes 0.....No 99.....Do not know	
Now, I would like to ask about feeding practices for your child selected.			

407	Has (CHILD'S NAME) ever been breastfed?	1.....Yes 0.....No	*if 401 < 24* 0→409
408	Was (CHILD's NAME) breastfed yesterday, either during the day or the night?	1.....Yes 0.....No 99.....Do not know	*if 401 < 24* & *407 = 1*
409	Did (NAME) drink anything from a bottle with a nipple yesterday, during the day or night?	1.....Yes 0.....No 99.....Do not know	*if 401 < 24*
410	Did (NAME) drink or eat vitamin or mineral supplements yesterday, during the day or night?	1.....Yes 0.....No 99.....Do not know	*if 401 < 24*
411	How long after birth did you first put (NAME) to the breast? *If immediately, record 00. If less than 24 hours, record hours. If over 24 hours, record 25. If unknown, record 99.*	_____ hours	*if 401 < 24* & *407 = 1*
412	Did (CHILD'S NAME) have any liquid other than breast milk, such as canned, powdered or fresh animal milk, infant formula, juice, thin porridge, or clear soup (Nam Keang) yesterday, during the day or night?	1.....Yes 0.....No 99.....Do not know	*if 401 < 24* 0 → 413 99 → 413
412a	How many times did (CHILD'S NAME) receive milk other than breastmilk, such as canned, powdered or fresh animal milk, or infant formula?	_____ times 99.....Do not know	*if* *401 = 6-23* & *412 = 1*
413	When do you think is the best time to start breastfeeding a child after giving birth?	***Enumerators:*** *read off all answer choices and circle the best one* 1.....Within the first hour after giving birth 2.....Within the first six hours after giving birth 3.....Within the first twelve hours after giving birth 4.....Within one day after giving birth 99.....Do not know	

414	I would like to ask you about foods that the selected child (CHILD'S NAME) may have had yesterday during the day or night. I am interested to know whether HE/SHE had the item even combined with other foods. Please include foods consumed outside of your home. YESTERDAY DURING THE DAY OR NIGHT, DID THE SELECTED CHILD (CHILD'S NAME) DRINK/EAT (FOOD GROUP ITEMS)? Always start with: 'YESTERDAY DID (NAME) EAT….'		*if 401 ≥ 6*
414a	Commercially fortified baby food, e.g., cerelac	1.....Yes 0.....No 99.....Do not know	
414b	Sticky rice (white or brown), roasted rice, rice, pre-chewed rice, rice noodles, maize, noodles, porridge, or other foods made from grains?	1.....Yes 0.....No 99.....Do not know	
414c	Pumpkin, carrots or sweet potatoes that are yellow or orange inside?	1.....Yes 0.....No 99.....Do not know	
414d	White or purple coloured foods from roots such as white yams, purple yams, yam bean, cassava, white radish, white potato, or any other white or purple colored foods from roots.	1.....Yes 0.....No 99.....Do not know	
414e	Any dark green, leafy vegetables such as pak choi, swamp cabbage, morning glory, sweet potato leaves, Chinese kale?	1.....Yes 0.....No 99.....Do not know	
414f	Ripe or orange-fleshed mangos, or papayas	1.....Yes 0.....No 99.....Do not know	
414g	Any other fruits or vegetables	1.....Yes 0.....No 99.....Do not know	
414h	Liver, brain, lung, heat, gizzard, kidney, intestine, or other organ of any animal	1.....Yes 0.....No 99.....Do not know	
414i	Any meat, such as beef (fresh or dry), buffalo, pork, lamb, goat, chicken, goose, duck, sausage, blood sausage, sour sausage	1.....Yes 0.....No 99.....Do not know	
414j	Eggs from chicken, duck, turtle or other animals	1.....Yes 0.....No	

		99.....Do not know	
414k	Fresh, fermented or dried fish, swamp eel, squid, shrimp (fresh or dry), shellfish, crab, granulate ark, clam, snail	1.....Yes 0.....No 99.....Do not know	
414l	Any wild animals such as lizard, frog, rat, rabbit, wild bird, small bird	1.....Yes 0.....No 99.....Do not know	
414m	Insects or grubs such as silk worm pupa, cricket, weaver ant, any insect eggs, water insects	1.....Yes 0.....No 99.....Do not know	
414n	Any foods made from beans, Leucanea (bean), common pea, lentils, or nuts, including tofu?	1.....Yes 0.....No 99.....Do not know	
414o	Cheese, yogurt, or other food made from milk?	1.....Yes 0.....No 99.....Do not know	
414p	Any oil, pork fat, or butter or foods made with any of these	1.....Yes 0.....No 99.....Do not know	
414q	Any packaged foods such as packaged noodles, chocolates, sweets, candies, pastries, cakes, or biscuits	1.....Yes 0.....No 99.....Do not know	
415	How meals (solid or semi-solid food) did (CHILD'S NAME) eat yesterday? *Enter 99 if unknown*	_____ times 99.....Do not know	*if 401 ≥ 6*
416	Did (CHILD'S NAME) eat any solid, semi-solid or soft foods (such as porridge, rice, pre-chewed rice, fruits, bread, meat, eggs, vegetables) yesterday?	1.....Yes 0.....No 99.....Do not know	*if 401 < 6* 0 → 418 99 → 418
417	In the first three days after delivery or when you returned to work in the rice field, was (*name*) given anything to drink other than breast milk?	1.....Yes 0.....No 99.....Do not know	*if 401 < 6* & *407 = 1*
Now, I understand eating pattern of you and your child. I would now like to ask more about eating practices of women who are breastfeeding.			
418	Yesterday during the day or night, did you eat more or less or same amount of food compared to your eating before this pregnancy?	1.....Increased amount 2.....Same amount 3.....Decreased amount 99.....Do not know	*if 401 < 6* & *407 = 1*

	Probe: Comparing with her usual eating style.		
419	Yesterday during the day or night, did you eat more or less amount of animal source foods compared to your eating before this pregnancy? *Probe: Using example of animal food or product in their general contexts and comparing with her usual eating style.*	1……Increased amount 2……Same amount 3……Decreased amount 99…..Do not know	*if 401 < 6 & 407 = 1*

Household Food Security and Expenditures			
No.	**Question**	**Response**	
I would like to ask you some questions about how much your household spends on health services and other things. *For all questions in this section report all values in local currency, whether paid in cash or in kind*			
501	In the last 4 weeks, how much did your household spend on: Food, including such things as [rice], meat, fruits, vegetables, and cooking oils. Include the value of any food that was produced and consumed by the household, and exclude alcohol, tobacco and restaurant meals.		_____,000 kip
502	In the last 4 weeks, how much did your household spend on: Housing, gas, electricity, water, telephone, and heating fuel		_____,000 kip
503	In the last 4 weeks, how much did your household spend on: Education fees and supplies		_____,000 kip
504	In the last 4 weeks, how much did your household spend on: Health care costs		_____,000 kip
505	In the last 4 weeks, how much did your household spend on: All other goods and services not yet mentioned		_____,000 kip
506	In the last 4 weeks, how much did your household spend in total? (Should equal 501 + 502 + 503 + 504 + 505)		_____,000 kip
507	In the **past month**, how often have you used any of the methods when you did not have enough food or money to buy food?		
507a	Rely on less preferred, less expensive foods?	1…….1 day per week 2…….1-2 days a week	

		3…….3-4 days a week 4…….5-6 days a week 5…….Daily 6…….Never/<1 time per week
507b	Borrow food or money from friends or relatives?	1…….1 day per week 2…….1-2 days a week 3…….3-4 days a week 4…….5-6 days a week 5…….Daily 6…….Never/<1 time per week
507c	Limit portions at mealtimes?	1…….1 day per week 2…….1-2 days a week 3…….3-4 days a week 4…….5-6 days a week 5…….Daily 6…….Never/<1 time per week
507d	Limit adult intake?	1…….1 day per week 2…….1-2 days a week 3…….3-4 days a week 4…….5-6 days a week 5…….Daily 6…….Never/<1 time per week
507e	Reduce number of meals per day?	1…….1 day per week 2…….1-2 days a week 3…….3-4 days a week 4…….5-6 days a week 5…….Daily 6…….Never/<1 time per week

Now I would like to ask you some questions about food that the household ate in the last 7 days

	508. How many **days** in the past week (last 7 days) did your household eat the following foods? Number of days eaten (out of last 7 days)	**509** What is the source of this food for each item mentioned? *if 508 > 0* Food Source Code: 1. Home grown crop or livestock production 2 Purchased food 3 Gathered forest products 4 Hunting/fishing 5 Borrowed

			6 Food aid 7 Exchanged/barter 8 Gift from family/relatives
A.	Rice (sticky rice, white rice)	__	__ __
B.	Maize / Corn	__	__ __
C.	Cassava	__ __	__ __
D.	Other roots of tubers (potatoes, yam)	__	__
E.	Pulses/Lentils/Tofu/Bean Curd	__	__
F.	Vegetables (green leafy, carrot, pumpkin…)	__	__
G.	Bamboo shoots / mushrooms	__	__
H.	Fruits	__	__
I.	Fish, fish paste	__	__
J.	Other aquatic animals (crab, snail, shrimp…)	__	__
K.	Meat (beef, pork, chicken)	__	__
L.	Wild animals/Insects	__	__
M.	Eggs	__	__
N.	Milk	__	__
O.	Sugar	__	__
P.	Oil/Butter/Animal Fat	__	__

510	How many hours in the past week did you spend gathering food from the forest?		*if any 509 = 3*
511	How many hours in the past week did you spend hunting?		*if any 509 = 4*
512	How many hours in the past week did you spend fishing?		*if any 509 = 4*
513	Compared to before the pandemic, is it easier or harder to meet your family's food needs?	1. Much easier 2. Somewhat easier 3. No change 4. Somewhat harder 5. Much harder 99. Don't know/no answer	1 →514 2 →514 3 →514 99→514
513a	What is the reason it is harder to meet your food needs during the pandemic? Select all that apply	1. Items are more expensive 2. Markets being closed 3. Foods not available 4. HH had lost income.	*if 513 = 4 or 5*

		98. Others (specify) 99. Don't know/no answer	
514	Did you lose income due to the pandemic?	1. Yes 0. No 99. Don't know/no answer	0→ 515 99→515
514a	If yes, how much did you lose, as a proportion of your income? (give best guess)	1. 0-25% 2. 25-50% 3. 50-75% 4. 75-100%	*if 514=1*
515	Do you spend less money due to the pandemic?	1. Yes 0. No 99. Don't know/no answer	0→516 99→516
515a	If yes, how much did you spend less, as a proportion of your expenditure? (give best guess)	1. 0-25% 2. 25-50% 3. 50-75% 4. 75-100%	*if 515=1*
516	Is it more difficult to access health services now compared to before the pandemic?	1. Much easier 2. Somewhat easier 3. No change 4. Somewhat harder 5. Much harder	

VI. Illness and Treatment			
Now we would like to ask about any recent illnesses that the selected child (CHILD'S NAME) may have had.			
No.	**Question**	**Response**	
601	Did (CHILD'S NAME) have diarrhea in the past two weeks, where diarrhea is defined as three or more loose stools or one loose, bloody stool in a 24 hour period?	1…….Yes 0…….No 99……Do not know	0→603 99→603
602a	Now I would like to know how much (CHILD'S NAME) was given to drink, including breast milk, during the diarrhea Was he/she given less than usual to drink, about the same amount, or more than usual to drink? *If less, probe: Was he/she given much less than usual to drink or somewhat less?*	1…….Much less 2…….Somewhat less 3…….About the same 4…….More 5…….Nothing to drink 99……Do not know	*if 601 = 1*

602b	During the time (CHILD'SNAME) had diarrhea, was HE/SHE given either: a) A fluid made from a special packet called (ORALYTE/NAM THA LAY PHOUN)? b) Recommended homemade fluid such as coconut water or rice water with salt?	1…….Yes, Nam Tha Lay Phoun 2…….Yes, Recommended Homemade Fluid 3……..No 99…….Do not know	*if 601 = 1*
602c	When (CHILD'S NAME) had diarrhea, was he/she given less than usual to eat, about the same amount, or more than usual to eat? *If less, probe: Was he/she given much less than usual to eat or somewhat less?*	1……Much less 2……Somewhat less 3……About the same 4……More 5……Nothing to eat 99….Do not know	*if 601 = 1*
603	Has (CHILD'S NAME) been ill with a fever any time in the past two weeks?	1…….Yes 0…….No 99……Do not know	
604	Has (CHILD'S NAME) had an illness with a cough at any time in the last two weeks?	1…….Yes 0…….No 99……Do not know	0→605 99→605
604a	When (CHILD'S NAME) was sick with a cough, did he/she breathe faster than normal with short, rapid breaths or have difficulty breathing?	1…….Yes 0…….No 99……Do not know	*if 604 = 1* 0→605 99→605
604b	Was the fast or difficult breathing due to a problem in the chest or to a blocked or runny nose?	1……Chest only 2……Nose only 3……Both 99……Do not know	*if 604a = 1*
605	At any time during the past two weeks, did you (*mother)* have diarrhea?	1…….Yes 0…….No 99……Do not know	
606	At any time during the past two weeks, have you (*mother)* been ill with a fever?	1…….Yes 0…….No 99……Do not know	
607	When (CHILD'S NAME) was sick, did you seek advice or treatment from any source?	1…….Yes 0…….No 99……Do not know	*if 601, 603 or 604 =1* 0→609 99→609
608	From where did you seek advice or treatment?	1…Government hospital 2…….Health centre	*if 607 = 1*

	Probe: Anywhere else? *(Multiple response)*	3…Village health worker 4…….Outreach team 5…Lao Women Union worker 6…Private hospital/ clinic 7…….Private physician 8…….Private pharmacy 9…….Mobile Clinic 10……Relative/friend 11……Shop 12…Traditional healer 98……Other	
609	When (YOU) was sick, did you seek advice or treatment from any source?	1…….Yes 0…….No 99……Do not know	*if 605 or 606=1* 0 → 700 99→ 700
610	From where did you seek advice or treatment? *Probe:* Anywhere else? *(Multiple response)*	1…….Government hospital 2…….Health centre 3…….Village health worker 4…….Outreach team 5…….Lao Women Union worker 6…….Private hospital/ clinic 7…….Private physician 8…….Private pharmacy 9…….Mobile Clinic 10……Relative/friend 11……Shop 12…Traditional healer 98……Other	*if 609 = 1*

VIII. Anthropometry			
No	**Question**	**Response**	**Notes**
As part of this survey, we are measuring the growth of children 0-59 mo. Child growth is an important indicator of health. Poor growth is a serious health problem that usually results from poor nutrition, poor sanitation, or infection. This measurement will help us design programs to improve child health. We will share with you the measurements, but will not share the information with anyone else outside the survey team. Do you have any questions?			

901	What is the age, in months, of (NAME)?	_____	Same as 401
902	What is the sex of (NAME)?	0…….Female 1…….Male	
903	***Enumerator:*** *Check for bilaterial pitting edema*	1……Present 0……Not present 99….Unsure 98….Not checked	1→906
904	Now I am going to weigh (NAME). ***Enumerator:*** *If the child is under 2 years old, weigh the mom by herself. The child should wear as few clothes as possible. If the child is wearing clothes, weigh the mom holding an extra pair of clothes (if an extra pair exists) similar to the weight of the clothes the child is wearing. Tare the scale. Then weigh the mom holding the child. Record the weight of the child.*	____ ____ . ____ kg	*if 903 =0*
905	***Enumerator:*** *was (NAME) undressed to the minimum?* *(note…if child was dressed but mother held clothes, indicate 'no clothes')*	0…….No clothes 1…….Few clothes 2…….Many clothes	
906	Now I am going to measure the arm of (NAME). ***Enumerator:*** *record the MUAC measurement, in cm*	____ ____ . ____ cm	*if 401 ≥ 6*
907	*Record the color of the MUAC tape*	1…….Green 2…….Yellow 3…….Red	*if 401 ≥ 6*
908	Now I am going to measure the height of (NAME). ***Enumerator:*** *record the height measurement of the child, in cm. If the child is less than 23 months, measure the child lying down.*	____ ____ . ____ cm	
909	*How was the person actually measured? Lying down or standing up?*	1…….Lying down 2…….Standing	
910	Now I am going to measure your arm. ***Enumerator:*** *record the MUAC measurement of the mother, in cm.*	____ ____ . ____ cm	

Closing Statement to the Interview
The interview is complete. Thank you so much for your time and patience. Your help will allow us to work together to improve the health and nutrition of your child and community.
Enumerators: *indicating completeness:* ☐ *Yes, interview is complete ⇨ Move to the next household* ☐ *No, interview was not complete ⇨ Tell this result to your supervisor and move to the next household.*

Ethical approval

ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ
ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກະພາບ ວັດທະນາຖາວອນ

ກະຊວງສາທາລະນະສຸກ
ມະຫາວິທະຍາໄລ ວິທະຍາສາດ ສຸຂະພາບ
ຄະນະກຳມະການຈັນຍາທຳການຄົ້ນຄວ້າວິທະຍາສາດ
ເບີໂທ: 021 240255

ເລກທີ 131 --/ຄຈຄ
ນະຄອນຫຼວງວຽງຈັນ, ວັນທີ 19 FEB 2021

ໃບອະນຸມັດຈັນຍາທຳ

ຊື່ໂຄງການ: ສຶກສາຜົນກະທົບຈາກການລະບາດຂອງພະຍາດໂຄວິດ ຕໍ່ກັບຄວາມປອດໄພ ແລະ ການບໍລິໂພກອາຫານ, ການເຂົ້າເຖິງການບໍລິການສາທາລະນະສຸກ ແລະ ການໃຊ້ຈ່າຍ ໃນແຕ່ລະຄອບຄົວ ຢູ່ທາງພາກໃຕ້ຂອງ ສປປ ລາວ (ປັດ Proposal version 2.1, ລົງວັນທີ 09 ກຸມພາ ປີ 2021).

ຊື່ຜູ້ຄົ້ນຄວ້າຫຼັກ: ປອ. ດຣ ເພັດສະໜ້ວນ ຈັນທະວົງໄລ, ຮອງຫົວໜ້າພະແນກຄົ້ນຄວ້າວິທະຍາສາດ, ສະຖາບັນຄົ້ນຄວ້າ ແລະ ພັດທະນາການສຶກສາ.

ໄລຍະເວລາການຮັບຮອງ: 01 ປີ.

ຄະນະກຳມະການຈັນຍາທຳຄົ້ນຄວ້າວິທະຍາສາດ ໄດ້ທຳການພິຈາລະນາໂຄງການຄົ້ນຄວ້າດັ່ງກ່າວ ແລະ ເຫັນວ່າ ການຄົ້ນຄວ້າຄັ້ງນີ້ຈະບໍ່ສົ່ງຜົນກະທົບທາງດ້ານຮ່າງກາຍ ແລະ ຈິດໃຈຂອງຜູ້ທີ່ເຂົ້າຮ່ວມໃນການສຶກສາ ແລະ ບໍ່ແຕະຕ້ອງ ເຖິງບັນຫາຈັນຍາທຳຂອງການຄົ້ນຄວ້າ. ໂຄງການຄົ້ນຄວ້າດັ່ງກ່າວນີ້ຈະມີຜົນປະໂຫຍດອັນໃຫຍ່ຫຼວງ ໃນການປະກອບສ່ວນວຽກງານການສົ່ງເສີມສຸຂະພາບ ໂດຍທາງກົງ ແລະ ທາງອ້ອມ ຕໍ່ຜູ້ເຂົ້າຮ່ວມການສຶກສາ, ແລະ ເປັນຂໍ້ມູນພື້ນຖານ ທີ່ສຳຄັນໃນການຄົ້ນຄວ້າຄັ້ງຕໍ່ໄປແກ່ ວົງການສາທາລະນະສຸກລາວ ແລະ ຂະແໜງການວິທະຍາສາດ ໃນອະນາຄົດ.

ດັ່ງນັ້ນ, ຄະນະກຳມະການຈັນຍາທຳການຄົ້ນຄວ້າຂອງ ມະຫາວິທະຍາໄລ ວິທະຍາສາດ ສຸຂະພາບ ຈຶ່ງຕົກລົງເຫັນດີອະນຸມັດດຳເນີນຈັນຍາທຳການຄົ້ນຄວ້າສຳລັບໂຄງການດັ່ງກ່າວນີ້. ຜູ້ເຮັດການຄົ້ນຄວ້າຫຼັກຕ້ອງຮັບປະກັນວ່າທີມງານຄົ້ນຄວ້າທັງໝົດໄດ້ຮັບຮູ້ ກ່ຽວກັບ ເງື່ອນໄຂຂອງການອະນຸມັດຈາກຄະນະກຳມະການຈັນຍາທຳການຄົ້ນຄວ້າ ຂອງ ມວສ ລວມທັງເອກະສານທີ່ຖືກອະນຸມັດ. ຜູ້ເຮັດການຄົ້ນຄວ້າຫຼັກຕ້ອງໄດ້ແຈ້ງໃຫ້ທາງເລຂາຂອງຄະນະກຳມະການຈັນຍາທຳ ຄົ້ນຄວ້າຮັບຊາບຖ້າມີ ການແກ້ໄຂເພີ່ມເຕີມ ຫຼື ການປ່ຽນແປງ ແລະ ຕ້ອງລາຍງານຄວາມຄືບໜ້າຂອງໂຄງການຄົ້ນຄວ້າ ຄືດັ່ງລຸ່ມນີ້:

- ກໍລະນີມີການປ່ຽນແປງໃດໆທີ່ມີຄວາມສຳຄັນຕໍ່ກັບໂຄງການ ແລະ ເຫດຜົນຂອງການປ່ຽນແປງນັ້ນ, ລວມທັງຂໍ້ບົ່ງຊີ້ທາງດ້ານຈັນຍາທຳ;
- ເກີດຜົນກະທົບທີ່ຮ້າຍແຮງຕໍ່ຜູ້ເຂົ້າຮ່ວມ ແລະ ການແກ້ໄຂຜົນກະທົບດັ່ງກ່າວ;
- ເກີດເຫດການທີ່ບໍ່ໄດ້ຄາດຄິດ ຫຼື ຄາດເດົາລ່ວງໜ້າ;
- ກໍລະນີຜູ້ເຮັດການຄົ້ນຄວ້າຫຼັກບໍ່ສາມາດສືບຕໍ່ເຮັດໜ້າທີ່ຂອງຕົນໄດ້ ຫຼື ມີການປ່ຽນແປງໃດໆທີ່ກ່ຽວຂ້ອງກັບທຸກຄົນໃນໂຄງການຄົ້ນຄວ້າດັ່ງກ່າວ;
- ກໍລະນີມີການຊີ້ປະກັນໄພຄຸ້ມຄອງຜູ້ເຂົ້າຮ່ວມການສຶກສາ ແລະ ການປະກັນໄພໝົດກຳນົດ;
- ເກີດຄວາມຊັກຊ້າໃນການເລີ່ມຕົ້ນໂຄງການເກີນກວ່າ 12 ເດືອນ; ແລະ
- ມີການຍຸດຕິ ຫຼື ປິດໂຄງການຄົ້ນຄວ້າກ່ອນໂຄງການຈະສຳເລັດ.

ເອກະສານທີ່ອະນຸມັດ

ເອກະສານທີ່ໄດ້ຮັບການທົບທວນຜິຈາລະນາ ແລະ ອະນຸມັດຈາກ ຄະນະກຳມະການຈັນຍາທຳການຄົ້ນຄວ້າວິທະຍາສາດ

ເອກະສານປະກອບ	ສະບັບທີ (version)	ວັນທີ
ຍົກສະເໜີໂຄງການຄົ້ນຄວ້າ	Version 2.1	09 ກຸມພາ ປີ 2021
ເຄື່ອງມືເກັບຂໍ້ມູນ (ແບບຟອມສອບຖາມ ແລະ ອື່ນໆ)	Version 1.3	09 ກຸມພາ ປີ 2021

ປະທານ

ຄະນະກຳມະການຈັນຍາທຳຄົ້ນຄວ້າວິທະຍາສາດ

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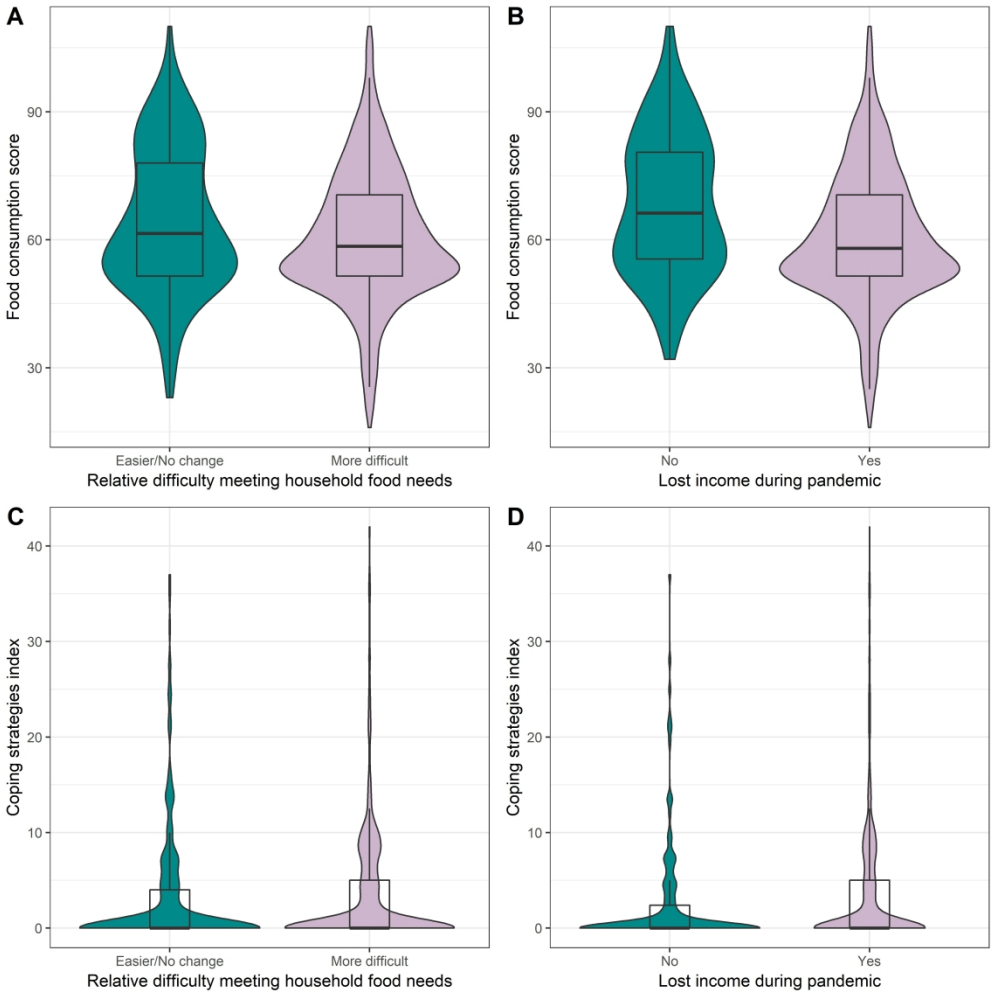

Figure 1. Violin plot showing distribution of two household food security measures, together with their median and interquartile range (IQR). Household food security was measured through food consumption score (FCS) (A, B) and coping strategies index (CSI) (C, D). Food insecurity is associated with low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

228x228mm (600 x 600 DPI)

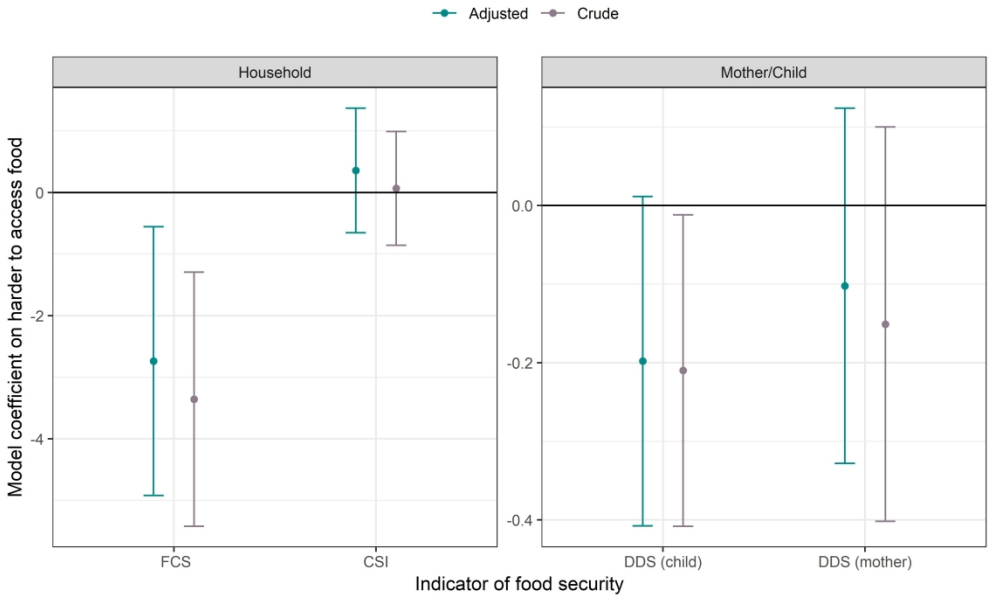

Figure 2. . The difference in mean of food security indicator among households who had a harder time meeting their food needs during the pandemic compared to those who did not. Vertical bars represent 95% confidence intervals. Adjusted models for households control for household ethnicity, household 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. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

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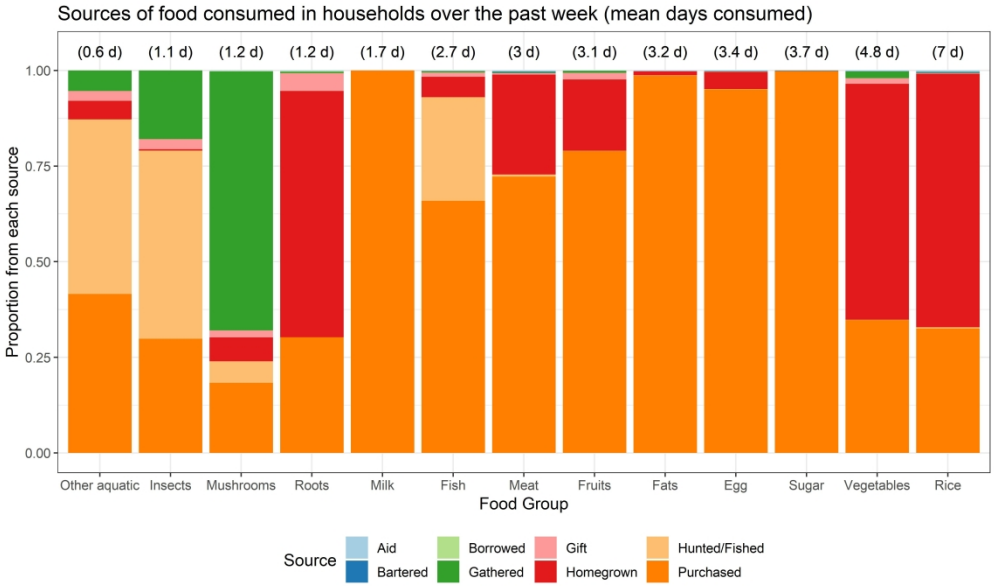

Figure 3. Proportional source of each food group consumed during the past week by households. Numbers in parenthesis above the bars indicates the mean number of days per week household consumed these food groups.

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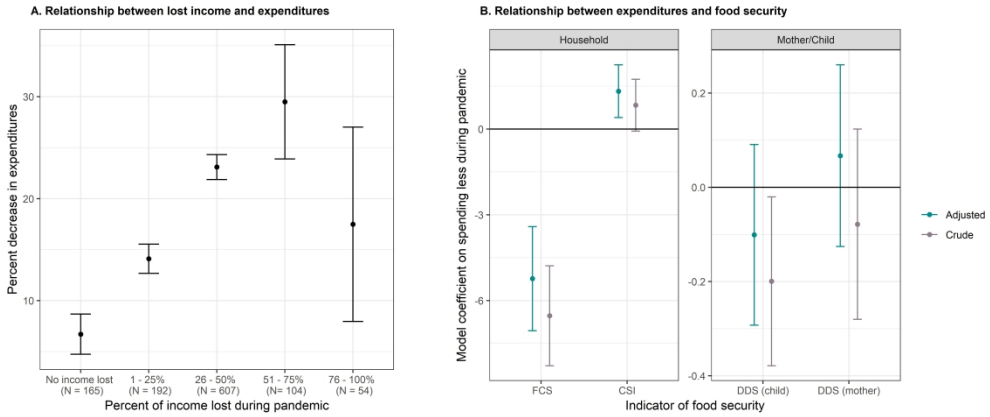

Figure 4. A) Mean decrease in expenditures reported, stratified by the percent reduction in household income. Vertical bars represent 95% confidence intervals. B) The difference in mean of food security indicator among households who reduced spending during the pandemic compared to those who did not. Vertical bars represent 95% confidence intervals. 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. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

304x127mm (600 x 600 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-7
Objectives	3	State specific objectives, including any prespecified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7-8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8-10
Bias	9	Describe any efforts to address potential sources of bias	8,11
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	12
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	11
		(*e*) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	12
		(b) Give reasons for non-participation at each stage	12
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12
		(b) Indicate number of participants with missing data for each variable of interest	12
Outcome data	15*	Report numbers of outcome events or summary measures	13-15; 26

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13-15; 27
		(*b*) Report category boundaries when continuous variables were categorized	13-15
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	21
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-20
Generalisability	21	Discuss the generalisability (external validity) of the study results	21
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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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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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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Keywords: food security; dietary diversity; underweight; wasting; income; COVID-19; Lao PDR; malnutrition; local food production

Abstract

Objectives: We assessed the relative difficulty in meeting food needs during the COVID-19 pandemic compared to 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=1,122) with children under five years.

Primary and secondary outcomes measured: Survey respondents reported the relative ease of access of food and health care as well as changes in income and expenditures compared to 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 five.

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, 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 programs that offset income losses may help.

List of abbreviations:

LMICs: low- and middle-income countries

FAO: Food and agriculture organization

FCS: food consumption score

CSI: coping strategies index

DDS: dietary diversity score

HAZ: height-for-age Z-score

WAZ: weight-for-age Z-score

WHZ: weight-for-height Z-score

Strengths and limitations of this study

- We characterize food security across all members of the household, including women and children, through a series of standardized 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 marginalized population with high prevalence of ethnic minorities, for whom little data on nutrition was previously available.
- The results of this study may not be generalizable 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 to 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- and middle-income countries (LMICs) [1-4]. The food supply chain has faced challenges across multiple stages, including loss of labor 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 to 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 health care 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 five 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-five 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 $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 six 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 (e.g., 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 February 14, 2020 to January 30, 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 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 this 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 health care during the COVID-19 pandemic compared to 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 Health Care Program to monitor and evaluate public health activities over a three-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 1,200 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 two years, if it contained a child under the age of five, 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 five per household was assessed, and anthropometric measurements taken. If there were more than one child under five 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 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 standardized questionnaire developed by Save the Children, International to assess the impact of COVID-19 globally [29]. Respondents were asked if, compared to 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 to before the pandemic, it was much harder, somewhat harder, easier, or the same to access health care. Finally, families were asked if they lost income or reduced their expenditures during the pandemic, and if so, asked to estimate by what percent.

Calculation of household food security and maternal and child dietary diversity

Household food security was assessed through two standard indicators: the food consumption score and coping strategy index. The food consumption score (FCS) is a frequency weighted household dietary diversity score 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 Coping Strategies Index (CSI) was also used to compare household food security. CSI is calculated by multiplying the weekly frequency of five behaviors by the weight of the behavior and summing for all behaviors [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 behaviors 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 behavioral 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 organizations as a key indicator in program 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 categorize 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 dietary diversity score (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 (i.e., 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 ten 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 five of the ten food groups to meet her minimum dietary diversity [35]. Women who reported having an abnormal diet (i.e., 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 (HAZ), 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 -2SD, respectively.

Statistical analysis

Data were analyzed in R version 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

standard errors used to calculate 95% confidence intervals 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 generalized linear models, accounting for survey weights, and using cluster robust standard errors to adjust for clustering at the village level. A directed-acyclic-graph (DAG) was used to identify the set of minimally sufficient covariates to adjust for to block confounding pathways between the exposure and the outcome (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 minimized model AIC as compared to inclusion of only a subset of these covariates. 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 percent 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 to 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).

Ethics

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. 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). A copy of the ethical approval is included in the 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 1,122 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 five years in the study region was high, with the survey-weighted prevalence of wasting at 4.5% (95% CI: 3.5, 5.8), underweight at 18.2% (95% CI: 15.9, 20.7%), and stunting at 32.9% (95% CI: 29.6, 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 to before (Table 1). A weighted 60.9% (95% CI: 57.6, 64.1%) of individuals reported that it was somewhat harder to meet food needs, while 17.6% (95% CI: 15.4, 20.0%)

reported that it was much harder. Among the 874 individuals who found it harder to meet food needs, the 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 food consumption score was 60.9 (95% CI: 59.7, 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 4.21 (95% CI: 3.95, 4.18) food groups in the day prior to the survey, corresponding to 62.5% (95% CI: 59.1, 65.8) of children that met the minimum DDS requirement. Women consumed an average of 5.38 (95% CI: 5.25, 5.51) food groups, corresponding to 67.7% (95% CI: 64.4, 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 dietary diversity score, 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 to 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 (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 to 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 food consumption score among households who found it harder to meet their food needs was 2.74 points lower (95% CI: 0.55, 4.92) than the average food consumption score 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 coping strategies index among households who had a harder time meeting their food needs was higher, indicating lower food security, but not significantly so. Dietary diversity scores 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 percent of expenditures spent on food as covariates found similar model coefficients (Table S1), although dietary diversity score 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 to households who reported food availability and market closures as the reason for their difficulty.

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 to 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 (e.g., farmed, fished, hunted, gathered). On average, families met 42% of their food needs through self-production (interquartile range: 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, 7.15%) lower among households who found it harder to meet their food needs compared to 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.

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, 57.4%) reporting losing between 25-50% of their income. 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, 7.05) units lower, and a CSI that was 0.83 (95% CI: -0.07, 1.74) units higher than families who did

not reduce spending. Dietary diversity scores 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 percent of expenditures spent on food as covariates in multivariable models did not change these conclusions (Table S1).

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

Access to health care

A weighted 37.4% (95% CI: 34.6, 40.2%) of individuals reported that it was somewhat harder to access healthcare compared to before the pandemic, while 4.8% (95% CI: 3.7, 6.1%) reported that it was much harder (Table 1). We identified 123 (11%) women and 557 (50%) children who had experienced fever, diarrhea, cough and/or respiratory infection in the two weeks prior to the survey. Among both women and children with illness in the past two weeks, >60% had fever (see Figures S4-S5 for Venn diagrams). Of these, a weighted 69.7% (95% CI: 66.3, 73.0%) of children and 81.2% (95% CI: 73.3, 87.2) of women sought care from a health facility. We found no association between healthcare seeking behavior, either for stratified by condition or in aggregate, and relative ability to access health care 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 25-50% 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 food consumption score (which correlates best with caloric intake) and coping strategies index (which correlates best with vulnerability to shocks). Nevertheless, the small differences in food security indicators suggests 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 was more strongly associated with reductions in household food security, as measured by both the FCS and the CSI, as compared to 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 suggests 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 $59 during a two-month stay at home order, while the proportion of families living on less than $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).

Randomized 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 dietary diversity score between these groups in multivariate analyses. This may suggest that households in our study population prioritized 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 was offset by increases in egg consumption. All villages in the study population have been receiving interventions focused on sustainable behavioral change for maternal and child nutrition, so individuals in the population may have been more likely to prioritize the nutrition of these vulnerable populations. Indeed, eggs were promoted as part of behavioral 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 to households who found it more difficult to meet their food needs. Reducing reliance on food supply from other places or countries is recognized 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 advocate 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 co-benefits [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 to 2020. Globally, reliance on homegrown food production may have increased as a response

to lockdown measures [7] and helped stabilize food consumption patterns amidst market uncertainty [11]. Yet, increased reliance on gathering or growing food may represent a source of unpaid labor that could be devoted to other activities [49]. Care must be taken that local food grown solutions minimize 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 programs may be particularly suited to addressing the challenge of food insecurity [51-53]. A randomized control trial in Colombia in March 2020, at the start of a national quarantine, found that 90% of families randomized to an arm that received cash transfers of $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 randomized 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 generalizable 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, seven months prior to the survey, with the main intervention remaining being strict border closure. We expect, therefore, that compared to other LMICs, the effects of food security and access to health care 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 to 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 to other provinces [24]. Indeed, our survey found a greater proportion of household reduced expenditures (64%) compared to 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 prioritized meeting the needs of mothers and children even as their 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 generalizable to larger, more urban areas. Similarly, the relationships with FCS may not be generalizable 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 emphasize 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 health care, 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 emphasize 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 how 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 neighboring 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 programs, 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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Contributorship statement

PC, HC, and JRH conceptualized the research. PC and HC assisted in data collection. PC and JRH analyzed 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. All authors edited and read the manuscript.

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.

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Data sharing statement

Data is owned by the Luang Prabang Provincial Health Department and permission has been granted for its use.

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Figure 1. Violin plot showing distribution of two household food security measures, together with their median and interquartile range (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 to those who did not. Vertical bars represent 95% confidence intervals. 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. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

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% confidence intervals. B) The difference in mean of food security indicator among households who reduced spending during the pandemic compared to those who did not. Vertical bars represent 95% confidence intervals. 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. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

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

	Weighted percentage (95% Confidence interval)	N
Relative ability to meet family's food needs now compared to before the pandemic (N = 1120)		
Easier	0.83 (0.38, 1.82)	8
No change	20.7 (18.3, 23.3)	238
Somewhat harder	60.9 (57.6, 64.1)	698
Much harder	17.6 (15.4, 20.0)	176
Reasons it is harder to meet food needs during the pandemic (N = 874)		
Items more expensive	51.2 (46.4, 56.0)	415
Household lost income	45.3 (40.9, 49.9)	465
Less food is available	36.6 (33.1, 40.2)	561
Markets are closed	36.5 (32.3, 41.0)	555
Proportion of household income lost during the pandemic (N = 1122)		
No income lost	14.4 (12.3, 16.6)	165
1-25%	17.5 (14.6, 20.7)	192
26-50%	54.4 (51.3, 57.4)	607
51-75%	9.2 (1.7, 11.2)	104
76-100%	4.6 (3.5, 6.1)	54
Percent reduction in household expenditures during the pandemic (N = 1122)		
No reduction	36.3 (33.2, 39.6)	415
1-25%	23.2 (19.4, 27.4)	257
26-50%	35.7 (32.9, 38.6)	400
51-75%	3.9 (2.9, 5.3)	41
76-100%	0.89 (0.44, 1.8)	9
Relative ability to access health care now compared to before the pandemic (N = 1121)		
Easier	0.40 (0.15, 1.09)	8
No change	47.0 (44.0, 50.0)	544
Somewhat harder	37.4 (34.6, 40.2)	413
Much harder	4.8 (3.7, 6.1)	48
Undecided	10.0 (7.5, 13.1)	108

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. 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. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

	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, -1.29)*	-2.74 (-4.92, -0.55)*	-6.53 (-8.23, -4.79)*	-5.24 (-7.05, -3.42)*	60.9 (59.7, 62.3)
CSI	0.07 (-0.86, 0.99)	0.36 (-0.65, 1.37)	0.83 (-0.07, 1.74)	1.32 (0.40, 2.25)*	3.6 (3.1, 4.1)
DDS (child)	-0.21 (0.41, -0.01)*	-0.21 (-0.43, 0.01)	-0.20 (-0.38, -0.02)*	-0.11 (-0.31, 0.08)	4.14 (4.04, 4.24)
DDS (mother)	-0.15 (-0.40, 0.01)	-0.10 (-0.34, 0.15)	-0.08 (-0.28, 0.12)	0.06 (-0.14, 0.25)	5.38 (5.26, 5.51)

*represents statistical significance at p<0.05

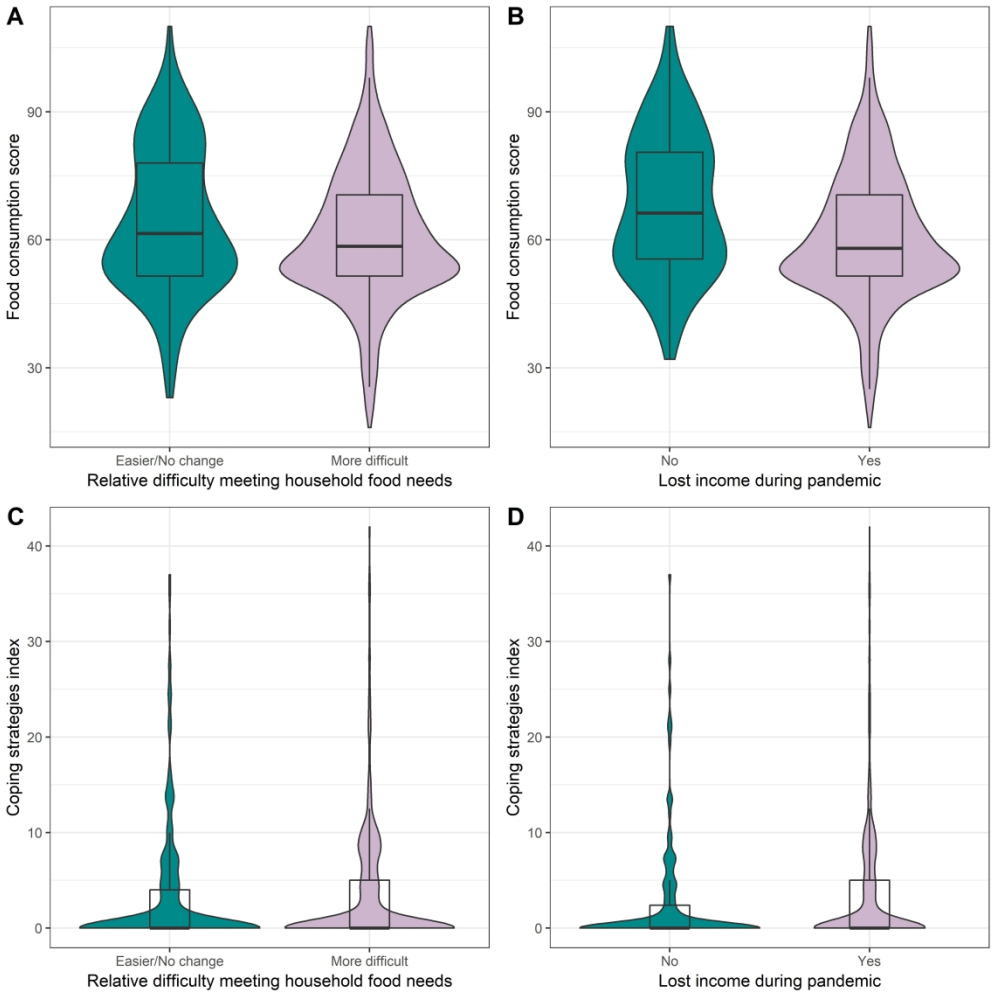

Figure 1. Violin plot showing distribution of two household food security measures, together with their median and interquartile range (IQR). Household food security was measured through food consumption score (FCS) (A, B) and coping strategies index (CSI) (C, D). Food insecurity is associated with low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

228x228mm (600 x 600 DPI)

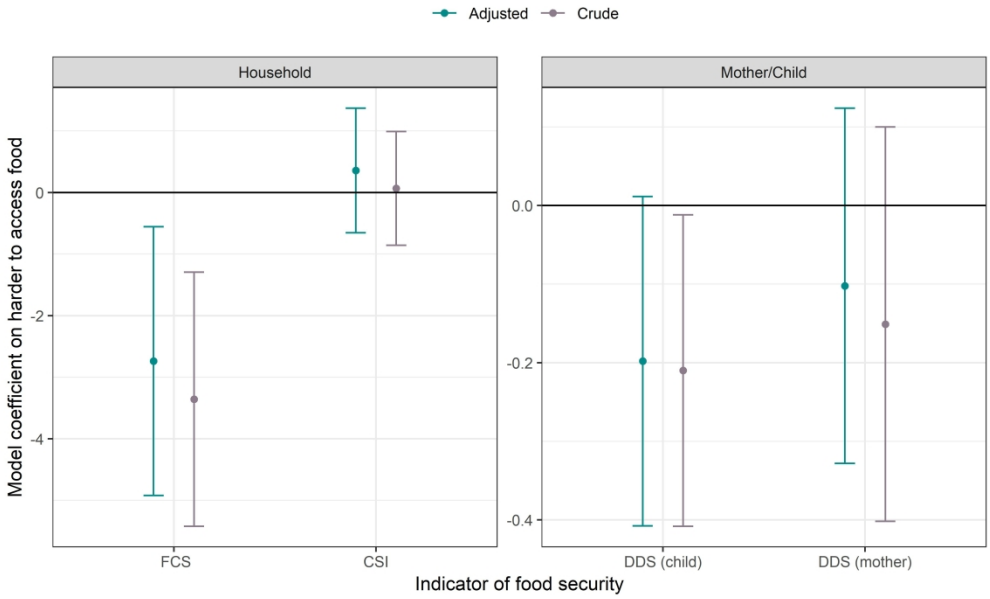

Figure 2. . The difference in mean of food security indicator among households who had a harder time meeting their food needs during the pandemic compared to those who did not. Vertical bars represent 95% confidence intervals. Adjusted models for households control for household ethnicity, household 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. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

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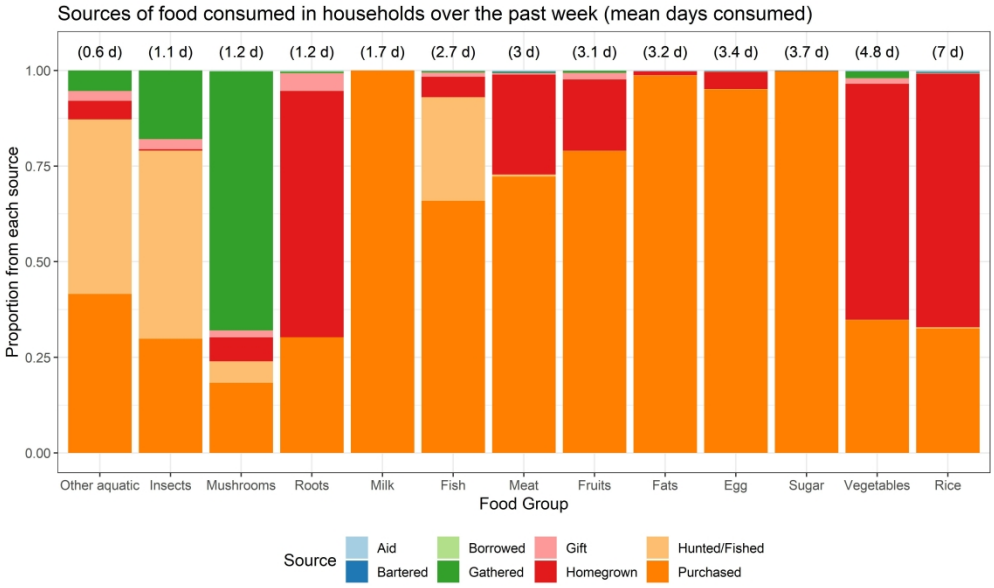

Figure 3. Proportional source of each food group consumed during the past week by households. Numbers in parenthesis above the bars indicates the mean number of days per week household consumed these food groups.

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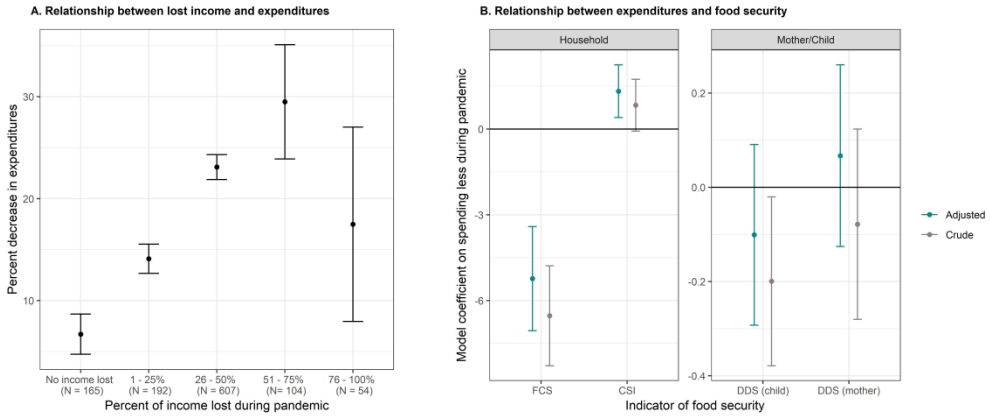

Figure 4. A) Mean decrease in expenditures reported, stratified by the percent reduction in household income. Vertical bars represent 95% confidence intervals. B) The difference in mean of food security indicator among households who reduced spending during the pandemic compared to those who did not. Vertical bars represent 95% confidence intervals. 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. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

304x127mm (600 x 600 DPI)

Supplemental Info for:

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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Table S1. Multivariate model results adding additional covariates to the model. Coefficients represent the 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. Adjusted models for households control for household ethnicity, household size, education level of mother and the head of household, district, **total expenditures**, and **percent of expenditures spent on food**. Adjusted models for mothers include additionally mother's age. Adjusted models for children include additionally child's age and sex. FCS = food consumption score; CSI = coping strategy index; DDS = dietary diversity score. Lower values for FCS and DDS and higher values of CSI indicate greater food insecurity.

	Model coefficients (95% CI)	
	Harder to access food during the pandemic	**Decreased expenditures during the pandemic**
FCS	-2.76 (-5.03, -0.50)*	-5.10 (-6.94, -3.27)*
CSI	0.23 (-0.81, 1.27)	1.46 (0.52, 2.41)*
DDS (child)	-0.23 (-0.45, -0.01)*	-0.10 (-0.30, 0.10)
DDS (mother)	-0.11 (-0.35, 0.14)	0.06 (-0.14, 0.25)

*represents statistical significance at p<0.05

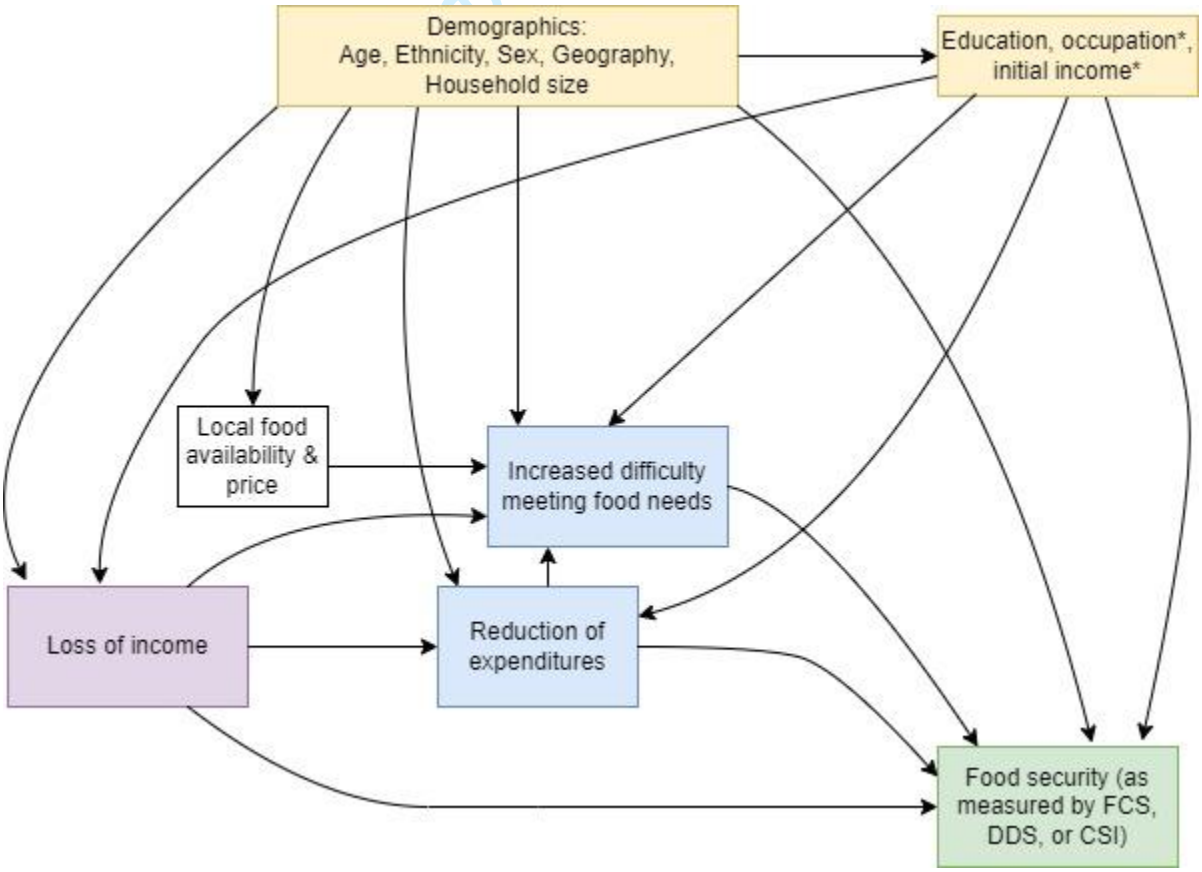

Figure S1. Directed acyclic graph (DAG) indicating the minimum set of covariates (yellow) to remove backdoor pathways between exposures (blue) and outcomes (green). White boxes are unmeasured upstream influences. Covariates indicated with an asterisk (*) are unmeasured. FCS = Food Consumption Score; DDS = Dietary Diversity Score; CSI = Coping Strategies Index.

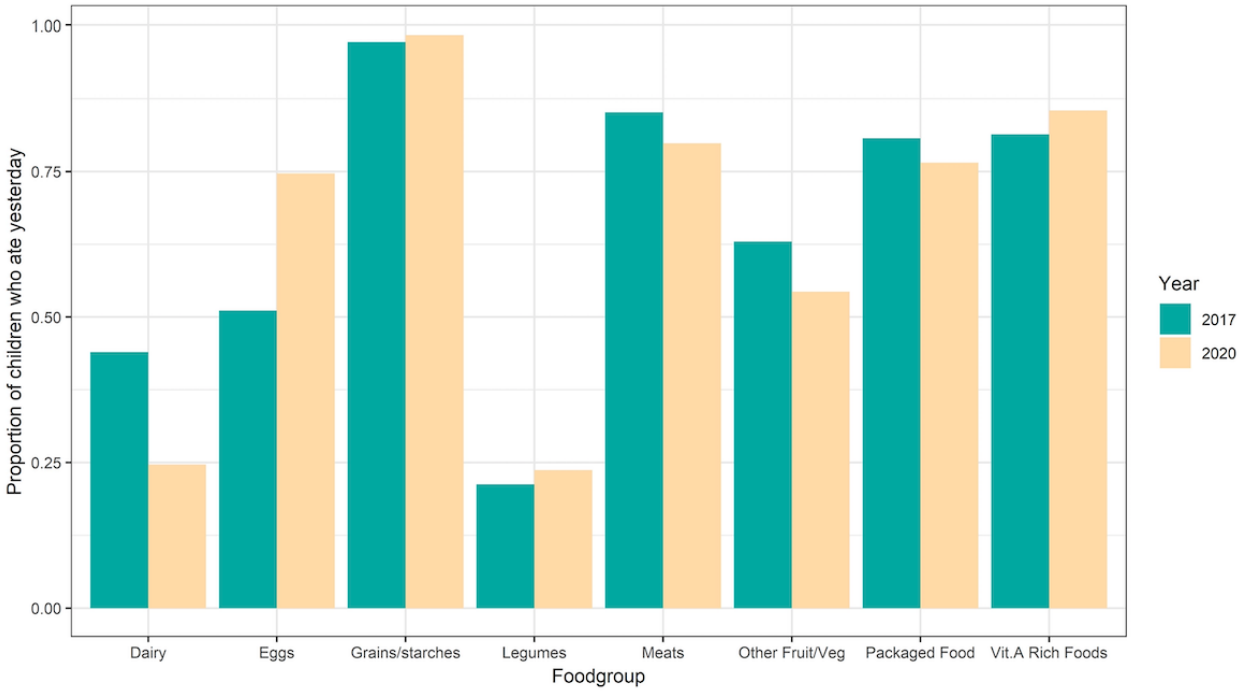

Figure S2. Prevalence of food group consumption in children 6-59 months, past 24 hours

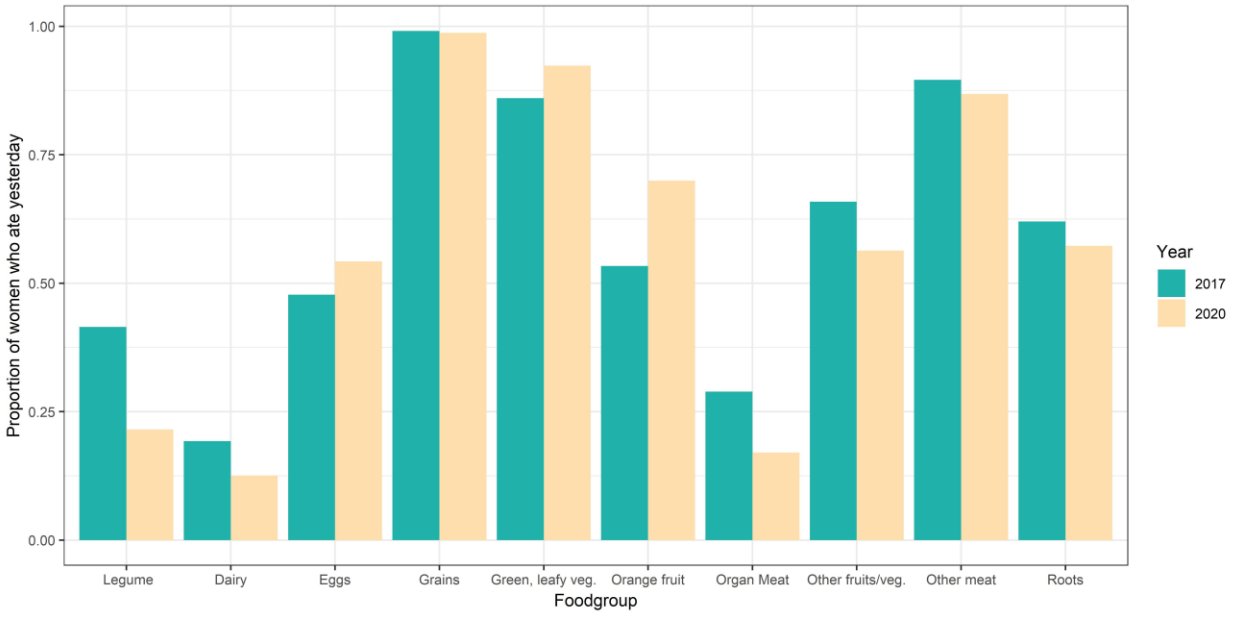

Figure S3. Prevalence of food group consumption in mothers of children <59 months, past 24 hours

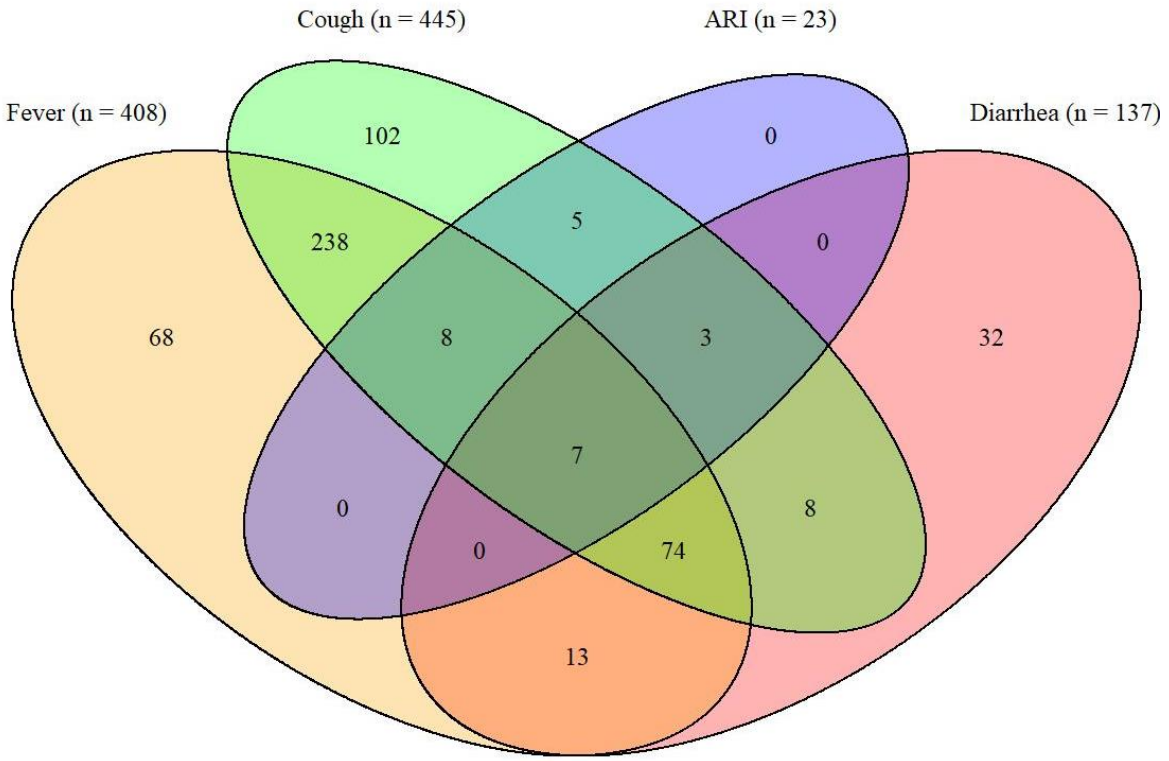

Figure S4. Venn diagram showing distribution of symptoms among the 557 children with fever, cough, ARI, or diarrhea in the past two weeks.

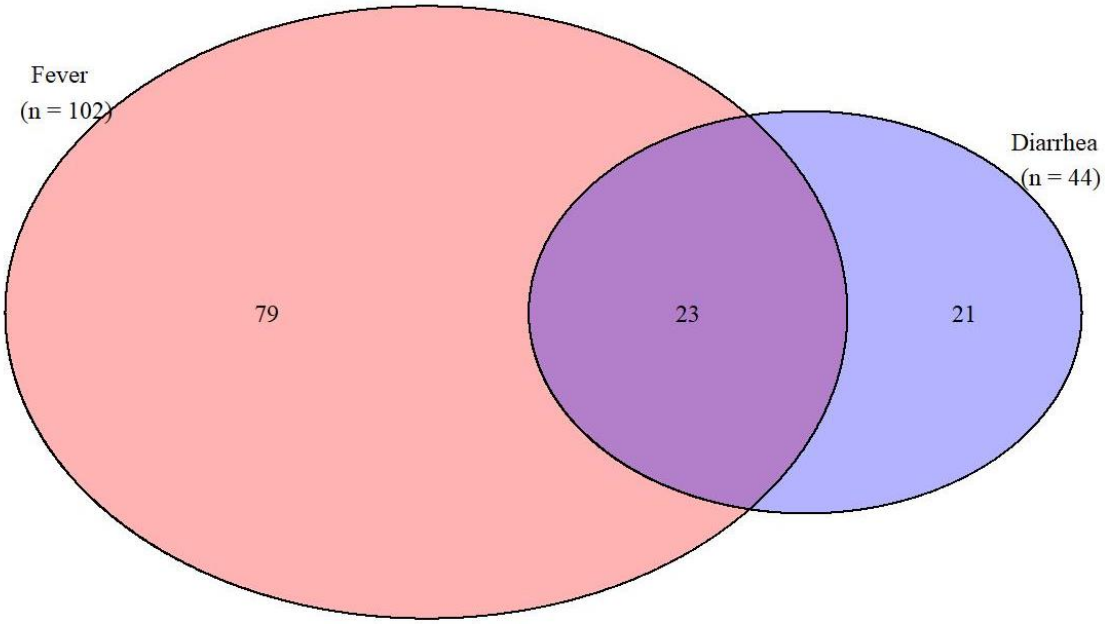

Figure S5. Venn diagram showing distribution of symptoms among the 123 mothers with fever or diarrhea in the past two weeks.

Survey tool

Endline Interview Questionnaire – 2020

Health and Nutrition Assessment

Introductory Statement to the Interview
Good Morning/Good Afternoon. My name is _____and I am here on behalf of the Primary Health Care program. We are conducting a survey on the health and nutritional status of women and children. You have been selected by chance from the list of families with children under the age of five. Is this correct? The purpose of this interview is to obtain information about the health and nutrition status of you and your child. We are interested in interviewing mothers of children aged five or less. Are you the mother of the child? (*If no),* Is the mother of the child at home? (*If yes, wait until she arrives, and re-explain purpose).* Could you please spare some time (around 45 minutes) for the interview? The information you give will be confidential and will only be used to prepare a report of general findings – but will not include any names. You will not get any additional entitlements because of the interview. At any time during the survey, you are free to stop the survey, or choose not answer any question. If you are willing to participate in this survey, please indicate your oral consent by saying "yes" or "no".
May I start now? ☐ *Yes, permission is given ⇨ Go to 101 to begin the interview.* ☐ *No, permission is not given ⇨ Tell this result to your supervisor and move to the next household.*
Enumerators– *If the respondent is not willing, do not ask any of the questions and move to the next household. If the household contains children under the age of 5, but the mother is not present, ask when it is a good time to return, and return at a later time. We only want to interview mothers of children under the age of 5.*

General Information				
No.	Item	Name		
101	District			
102	Village			
103	Date of interview	DD	MM	YYYY
		_ _	_ _	2016
104	Interviewer's Name/Number	_ _		

Household Demographic Information			
First, we would like to ask some questions about yourself and the people who live in this household.			
No.	**Question**	**Response**	**Notes**
201	How old are you?	Age (in completed years): ___ ___	
202	To what ethnic group does the head of this household belong?	1……Lao Lom 2……Hmong 3……Khmu 4……Mien 5……Lue 6…..Akha 7…..Muser 98……Other (Specify……)	
203	What is your marital status?	1…….Married (monogamous) 2…….Married (polygamous) 3…….Not married, but living with a man 4…….Single 5…….Divorced or separated 6…….Widowed	

204	What is your relationship to the head of the household (HHH)?	1……. Head of household 2……. Wife of the HHH 3……. Daughter of the HHH 4…….Daughter in law of HHH 5…….Granddaughter of HHH 98….Other relation	1 → 206 2 → 206
205	Is the head of the household male or female?	0…….Female 1…….Male	*if 204 ≠ 1 or 2*
206	Have you ever attended school?	1…….Yes 0…….No	0 → 208
207	What is the highest level of school you completed?	1…….Preschool 2…….Primary 3…….Lower Secondary 4…….Upper secondary 5…….Post-secondary vocational, tertiary/ diploma 6…….Higher	*if 206 =1*
208	Did the head of the household attend school?	1…….Yes 0…….No 99….Don't know	*if 204≠1* 1 → 209 0 → 210
209	What is the highest level of school completed by the head of the household?	1…….Preschool 2…….Primary 3…….Lower Secondary 4…….Upper secondary 5…….Post-secondary vocational, tertiary/ diploma 6…….Higher 99…Don't know	*if 208 = 1*
210	How many household members are aged 15 years or more?	____ ____	

	Prompt to include self in this count		
211	How many household members are below 15 years of age?	____ ____	
212	How many household members are below 5 years of age?	____ ____	Check: 212 ≤ 211
213	How many members are in your own family?	____ ____	

Dietary Intake			
Now we would like to ask some questions about the diet of yourself and one of your children. *Enumerators, if there are more than one children under the age of five, randomly select one child. Ask the name of the child, and use that name for the rest of the interview.*			
No.	**Question**	**Response**	**Notes**
400	When was this child born? *Probe: Using MCH book, house registration, other official document*	__ ____ ___	
401	How many months old is this child? *Probe: Using important holidays, dates, etc.*	___ ___ months	0-59 only!
402	Is the child selected (Child's name) your youngest child? *Probe: the last child of alive children?*	1…….Yes 0…….No	
403	Yesterday during the day or night, was your diet a typical diet? *Probe: She had special ceremonies or illnesses that led her to have less or much more than her typical eating.?*	1…….Yes 2…….No. I ate more. 3…….No. I ate less 99…….Do not know	
404	Yesterday during the day or night, did you eat more or less or same amount of food compared to your eating before this pregnancy?	1……Increased amount 2……Same amount 3……Decreased amount 99…..Do not know	*if 226=1 (currently pregnant*)
405	Yesterday during the day or night, did you eat more or less or same amount of animal source foods compared to your eating before this pregnancy?	1……Increased amount 2……Same amount 3……Decreased amount 99…..Do not know	*if 226=1 (currently pregnant*)

	Probe: Using examples of animal food or product in their general contexts and comparing with her usual eating style		
406	I would like to ask you about foods that you may have had yesterday during the day or night. I am interested to know whether you had the item even if combined with other foods. Please include foods consumed outside of your home. YESTERDAY DURING THE DAY OR NIGHT, DID YOU DRINK/EAT (FOOD GROUP ITEMS)? *Questions and filters (Circle the corresponding code and you can underline more than one answer)* Always start with: 'YESTERDAY DID YOU EAT….'		
406a	Any offal items (excluding intestines)? *Probe: such as liver, brain, lung, heart, gizzard, kidney, of any animal*	1.....Yes 0.....No 99.....Do not know	
406b	The intestine of any animal?	1.....Yes 0.....No 99.....Do not know	
406c	Any kind of meat? *Probe:* such as any meat, such as beef (fresh or dry), buffalo, pork, goat, chicken, goose, duck, sausage, blood sausage, sour sausage	1.....Yes 0.....No 99.....Do not know	
406d	Any kind of eggs? *Probe: 'such as?' eggs from chicken, duck, turtle or other animals*	1.....Yes 0.....No 99.....Do not know	
406e	Any kind of fish or aquatic animals? *Probe: 'such as?' fresh, fermented or dried fish, swamp eel, squid, shrimp (fresh or dry), crab, granulated ark, clam, snail, frog, water insects*	1.....Yes 0.....No 99.....Do not know	
406f	Any kind of wild animals? *Probe: 'such as?' lizard, rat, rabbit, wild bird, small birds*	1.....Yes 0.....No 99.....Do not know	

406g	Any kind of insects or grubs? *Probe: 'such as?' silk worm pupa, cricket, weaver ant, ant egg, etc.*	1.....Yes 0.....No 99.....Do not know	
406h	Any kind of dairy products (not including coffee creamer)? *Probe: 'such as?' cheese (butter), yogurt, or other milk products*	1.....Yes 0.....No 99.....Do not know	
406i	Other foods that came from an animal. Example: pork skin	1.....Yes 0.....No 99.....Do not know	
406j	Sticky rice (refined or unrefined), roasted rice, rice, pre-chewed rice, rice noodles, maize, noodles, thick porridge, or other foods made from grains?	1.....Yes 0.....No 99.....Do not know	
406k	White or purple coloured foods from roots such as white yams, purple yams, yam bean, cassava, white radish, white potato, or any other white or purple colored foods from roots.	1.....Yes 0.....No 99.....Do not know	
406l	Pulses/lentils/tofu/bean curd	1.....Yes 0.....No 99.....Do not know	
406m	Nuts or seeds (e.g. Sesame seeds, mung bean, ground bean, sun flower seed, cashew nuts etc.)	1.....Yes 0.....No 99.....Do not know	
406n	Any dark green leafy vegetables such as pak choi, swamp cabbage, morning glory, sweet potato leaves, Chinese kale	1.....Yes 0.....No 99.....Do not know	
406o	Ripe orange fleshed mangoes, ripe orange fleshed papayas, pumpkin, carrots, sweet potatoes that are yellow or orange inside?	1.....Yes 0.....No 99.....Do not know	
406p	Other vegetables	1.....Yes 0.....No 99.....Do not know	
406q	Other fruit	1.....Yes 0.....No 99.....Do not know	
Now, I would like to ask about feeding practices for your child selected.			

407	Has (CHILD'S NAME) ever been breastfed?	1.....Yes 0.....No	*if 401 < 24* 0→409
408	Was (CHILD's NAME) breastfed yesterday, either during the day or the night?	1.....Yes 0.....No 99.....Do not know	*if 401 < 24* & *407 = 1*
409	Did (NAME) drink anything from a bottle with a nipple yesterday, during the day or night?	1.....Yes 0.....No 99.....Do not know	*if 401 < 24*
410	Did (NAME) drink or eat vitamin or mineral supplements yesterday, during the day or night?	1.....Yes 0.....No 99.....Do not know	*if 401 < 24*
411	How long after birth did you first put (NAME) to the breast? *If immediately, record 00. If less than 24 hours, record hours. If over 24 hours, record 25. If unknown, record 99.*	_____ hours	*if 401 < 24* & *407 = 1*
412	Did (CHILD'S NAME) have any liquid other than breast milk, such as canned, powdered or fresh animal milk, infant formula, juice, thin porridge, or clear soup (Nam Keang) yesterday, during the day or night?	1.....Yes 0.....No 99.....Do not know	*if 401 < 24* 0 → 413 99 → 413
412a	How many times did (CHILD'S NAME) receive milk other than breastmilk, such as canned, powdered or fresh animal milk, or infant formula?	_____ times 99.....Do not know	*if* *401 = 6-23* & *412 = 1*
413	When do you think is the best time to start breastfeeding a child after giving birth?	***Enumerators:*** *read off all answer choices and circle the best one* 1.....Within the first hour after giving birth 2.....Within the first six hours after giving birth 3.....Within the first twelve hours after giving birth 4.....Within one day after giving birth 99.....Do not know	

414	I would like to ask you about foods that the selected child (CHILD'S NAME) may have had yesterday during the day or night. I am interested to know whether HE/SHE had the item even combined with other foods. Please include foods consumed outside of your home. YESTERDAY DURING THE DAY OR NIGHT, DID THE SELECTED CHILD (CHILD'S NAME) DRINK/EAT (FOOD GROUP ITEMS)? Always start with: 'YESTERDAY DID (NAME) EAT….'		*if 401 ≥ 6*
414a	Commercially fortified baby food, e.g., cerelac	1.....Yes 0.....No 99.....Do not know	
414b	Sticky rice (white or brown), roasted rice, rice, pre-chewed rice, rice noodles, maize, noodles, porridge, or other foods made from grains?	1.....Yes 0.....No 99.....Do not know	
414c	Pumpkin, carrots or sweet potatoes that are yellow or orange inside?	1.....Yes 0.....No 99.....Do not know	
414d	White or purple coloured foods from roots such as white yams, purple yams, yam bean, cassava, white radish, white potato, or any other white or purple colored foods from roots.	1.....Yes 0.....No 99.....Do not know	
414e	Any dark green, leafy vegetables such as pak choi, swamp cabbage, morning glory, sweet potato leaves, Chinese kale?	1.....Yes 0.....No 99.....Do not know	
414f	Ripe or orange-fleshed mangos, or papayas	1.....Yes 0.....No 99.....Do not know	
414g	Any other fruits or vegetables	1.....Yes 0.....No 99.....Do not know	
414h	Liver, brain, lung, heat, gizzard, kidney, intestine, or other organ of any animal	1.....Yes 0.....No 99.....Do not know	
414i	Any meat, such as beef (fresh or dry), buffalo, pork, lamb, goat, chicken, goose, duck, sausage, blood sausage, sour sausage	1.....Yes 0.....No 99.....Do not know	
414j	Eggs from chicken, duck, turtle or other animals	1.....Yes 0.....No	

		99.....Do not know	
414k	Fresh, fermented or dried fish, swamp eel, squid, shrimp (fresh or dry), shellfish, crab, granulate ark, clam, snail	1.....Yes 0.....No 99.....Do not know	
414l	Any wild animals such as lizard, frog, rat, rabbit, wild bird, small bird	1.....Yes 0.....No 99.....Do not know	
414m	Insects or grubs such as silk worm pupa, cricket, weaver ant, any insect eggs, water insects	1.....Yes 0.....No 99.....Do not know	
414n	Any foods made from beans, Leucanea (bean), common pea, lentils, or nuts, including tofu?	1.....Yes 0.....No 99.....Do not know	
414o	Cheese, yogurt, or other food made from milk?	1.....Yes 0.....No 99.....Do not know	
414p	Any oil, pork fat, or butter or foods made with any of these	1.....Yes 0.....No 99.....Do not know	
414q	Any packaged foods such as packaged noodles, chocolates, sweets, candies, pastries, cakes, or biscuits	1.....Yes 0.....No 99.....Do not know	
415	How meals (solid or semi-solid food) did (CHILD'S NAME) eat yesterday? *Enter 99 if unknown*	_____ times 99.....Do not know	*if 401 ≥ 6*
416	Did (CHILD'S NAME) eat any solid, semi-solid or soft foods (such as porridge, rice, pre-chewed rice, fruits, bread, meat, eggs, vegetables) yesterday?	1.....Yes 0.....No 99.....Do not know	*if 401 < 6* 0 → 418 99 → 418
417	In the first three days after delivery or when you returned to work in the rice field, was (*name*) given anything to drink other than breast milk?	1.....Yes 0.....No 99.....Do not know	*if 401 < 6* & *407 = 1*
Now, I understand eating pattern of you and your child. I would now like to ask more about eating practices of women who are breastfeeding.			
418	Yesterday during the day or night, did you eat more or less or same amount of food compared to your eating before this pregnancy?	1.....Increased amount 2.....Same amount 3.....Decreased amount 99.....Do not know	*if 401 < 6* & *407 = 1*

	Probe: Comparing with her usual eating style.		
419	Yesterday during the day or night, did you eat more or less amount of animal source foods compared to your eating before this pregnancy? *Probe: Using example of animal food or product in their general contexts and comparing with her usual eating style.*	1……Increased amount 2……Same amount 3……Decreased amount 99…..Do not know	*if 401 < 6 & 407 = 1*

Household Food Security and Expenditures			
No.	**Question**	**Response**	
I would like to ask you some questions about how much your household spends on health services and other things. *For all questions in this section report all values in local currency, whether paid in cash or in kind*			
501	In the last 4 weeks, how much did your household spend on: Food, including such things as [rice], meat, fruits, vegetables, and cooking oils. Include the value of any food that was produced and consumed by the household, and exclude alcohol, tobacco and restaurant meals.		_____,000 kip
502	In the last 4 weeks, how much did your household spend on: Housing, gas, electricity, water, telephone, and heating fuel		_____,000 kip
503	In the last 4 weeks, how much did your household spend on: Education fees and supplies		_____,000 kip
504	In the last 4 weeks, how much did your household spend on: Health care costs		_____,000 kip
505	In the last 4 weeks, how much did your household spend on: All other goods and services not yet mentioned		_____,000 kip
506	In the last 4 weeks, how much did your household spend in total? (Should equal 501 + 502 + 503 + 504 + 505)		_____,000 kip
507	In the **past month**, how often have you used any of the methods when you did not have enough food or money to buy food?		
507a	Rely on less preferred, less expensive foods?	1…….1 day per week 2…….1-2 days a week	

		3…….3-4 days a week 4…….5-6 days a week 5…….Daily 6…….Never/<1 time per week
507b	Borrow food or money from friends or relatives?	1…….1 day per week 2…….1-2 days a week 3…….3-4 days a week 4…….5-6 days a week 5…….Daily 6…….Never/<1 time per week
507c	Limit portions at mealtimes?	1…….1 day per week 2…….1-2 days a week 3…….3-4 days a week 4…….5-6 days a week 5…….Daily 6…….Never/<1 time per week
507d	Limit adult intake?	1…….1 day per week 2…….1-2 days a week 3…….3-4 days a week 4…….5-6 days a week 5…….Daily 6…….Never/<1 time per week
507e	Reduce number of meals per day?	1…….1 day per week 2…….1-2 days a week 3…….3-4 days a week 4…….5-6 days a week 5…….Daily 6…….Never/<1 time per week

Now I would like to ask you some questions about food that the household ate in the last 7 days

	508. How many **days** in the past week (last 7 days) did your household eat the following foods? Number of days eaten (out of last 7 days)	**509** What is the source of this food for each item mentioned? *if 508 > 0* Food Source Code: 1. Home grown crop or livestock production 2 Purchased food 3 Gathered forest products 4 Hunting/fishing 5 Borrowed

			6 Food aid 7 Exchanged/barter 8 Gift from family/relatives
A.	Rice (sticky rice, white rice)	__	__ __
B.	Maize / Corn	__	__ __
C.	Cassava	__ __	__ __
D.	Other roots of tubers (potatoes, yam)	__	__
E.	Pulses/Lentils/Tofu/Bean Curd	__	__
F.	Vegetables (green leafy, carrot, pumpkin…)	__	__
G.	Bamboo shoots / mushrooms	__	__
H.	Fruits	__	__
I.	Fish, fish paste	__	__
J.	Other aquatic animals (crab, snail, shrimp…)	__	__
K.	Meat (beef, pork, chicken)	__	__
L.	Wild animals/Insects	__	__
M.	Eggs	__	__
N.	Milk	__	__
O.	Sugar	__	__
P.	Oil/Butter/Animal Fat	__	__

510	How many hours in the past week did you spend gathering food from the forest?		*if any 509 = 3*
511	How many hours in the past week did you spend hunting?		*if any 509 = 4*
512	How many hours in the past week did you spend fishing?		*if any 509 = 4*
513	Compared to before the pandemic, is it easier or harder to meet your family's food needs?	1. Much easier 2. Somewhat easier 3. No change 4. Somewhat harder 5. Much harder 99. Don't know/no answer	1 →514 2 →514 3 →514 99→514
513a	What is the reason it is harder to meet your food needs during the pandemic? Select all that apply	1. Items are more expensive 2. Markets being closed 3. Foods not available 4. HH had lost income.	*if 513 = 4 or 5*

		98. Others (specify) 99. Don't know/no answer	
514	Did you lose income due to the pandemic?	1. Yes 0. No 99. Don't know/no answer	0→ 515 99→515
514a	If yes, how much did you lose, as a proportion of your income? (give best guess)	1. 0-25% 2. 25-50% 3. 50-75% 4. 75-100%	*if 514=1*
515	Do you spend less money due to the pandemic?	1. Yes 0. No 99. Don't know/no answer	0→516 99→516
515a	If yes, how much did you spend less, as a proportion of your expenditure? (give best guess)	1. 0-25% 2. 25-50% 3. 50-75% 4. 75-100%	*if 515=1*
516	Is it more difficult to access health services now compared to before the pandemic?	1. Much easier 2. Somewhat easier 3. No change 4. Somewhat harder 5. Much harder	

VI. Illness and Treatment			
Now we would like to ask about any recent illnesses that the selected child (CHILD'S NAME) may have had.			
No.	**Question**	**Response**	
601	Did (CHILD'S NAME) have diarrhea in the past two weeks, where diarrhea is defined as three or more loose stools or one loose, bloody stool in a 24 hour period?	1…….Yes 0…….No 99……Do not know	0→603 99→603
602a	Now I would like to know how much (CHILD'S NAME) was given to drink, including breast milk, during the diarrhea Was he/she given less than usual to drink, about the same amount, or more than usual to drink? *If less, probe: Was he/she given much less than usual to drink or somewhat less?*	1…….Much less 2…….Somewhat less 3…….About the same 4…….More 5…….Nothing to drink 99……Do not know	*if 601 = 1*

602b	During the time (CHILD'SNAME) had diarrhea, was HE/SHE given either: a) A fluid made from a special packet called (ORALYTE/NAM THA LAY PHOUN)? b) Recommended homemade fluid such as coconut water or rice water with salt?	1…….Yes, Nam Tha Lay Phoun 2…….Yes, Recommended Homemade Fluid 3……..No 99…….Do not know	*if 601 = 1*
602c	When (CHILD'S NAME) had diarrhea, was he/she given less than usual to eat, about the same amount, or more than usual to eat? *If less, probe: Was he/she given much less than usual to eat or somewhat less?*	1……Much less 2……Somewhat less 3……About the same 4……More 5……Nothing to eat 99….Do not know	*if 601 = 1*
603	Has (CHILD'S NAME) been ill with a fever any time in the past two weeks?	1…….Yes 0…….No 99……Do not know	
604	Has (CHILD'S NAME) had an illness with a cough at any time in the last two weeks?	1…….Yes 0…….No 99……Do not know	0→605 99→605
604a	When (CHILD'S NAME) was sick with a cough, did he/she breathe faster than normal with short, rapid breaths or have difficulty breathing?	1…….Yes 0…….No 99……Do not know	*if 604 = 1* 0→605 99→605
604b	Was the fast or difficult breathing due to a problem in the chest or to a blocked or runny nose?	1……Chest only 2……Nose only 3……Both 99……Do not know	*if 604a = 1*
605	At any time during the past two weeks, did you (*mother)* have diarrhea?	1…….Yes 0…….No 99……Do not know	
606	At any time during the past two weeks, have you (*mother)* been ill with a fever?	1…….Yes 0…….No 99……Do not know	
607	When (CHILD'S NAME) was sick, did you seek advice or treatment from any source?	1…….Yes 0…….No 99……Do not know	*if 601, 603 or 604 =1* 0→609 99→609
608	From where did you seek advice or treatment?	1…Government hospital 2…….Health centre	*if 607 = 1*

	Probe: Anywhere else? *(Multiple response)*	3…Village health worker 4…….Outreach team 5…Lao Women Union worker 6…Private hospital/ clinic 7…….Private physician 8…….Private pharmacy 9…….Mobile Clinic 10……Relative/friend 11……Shop 12…Traditional healer 98……Other	
609	When (YOU) was sick, did you seek advice or treatment from any source?	1…….Yes 0…….No 99……Do not know	*if 605 or 606=1* 0 → 700 99→ 700
610	From where did you seek advice or treatment? *Probe:* Anywhere else? *(Multiple response)*	1…….Government hospital 2…….Health centre 3…….Village health worker 4…….Outreach team 5…….Lao Women Union worker 6…….Private hospital/ clinic 7…….Private physician 8…….Private pharmacy 9…….Mobile Clinic 10……Relative/friend 11……Shop 12…Traditional healer 98……Other	*if 609 = 1*

VIII. Anthropometry			
No	**Question**	**Response**	**Notes**
As part of this survey, we are measuring the growth of children 0-59 mo. Child growth is an important indicator of health. Poor growth is a serious health problem that usually results from poor nutrition, poor sanitation, or infection. This measurement will help us design programs to improve child health. We will share with you the measurements, but will not share the information with anyone else outside the survey team. Do you have any questions?			

901	What is the age, in months, of (NAME)?	_____	Same as 401
902	What is the sex of (NAME)?	0…….Female 1…….Male	
903	***Enumerator:*** *Check for bilaterial pitting edema*	1……Present 0……Not present 99….Unsure 98….Not checked	1→906
904	Now I am going to weigh (NAME). ***Enumerator:*** *If the child is under 2 years old, weigh the mom by herself. The child should wear as few clothes as possible. If the child is wearing clothes, weigh the mom holding an extra pair of clothes (if an extra pair exists) similar to the weight of the clothes the child is wearing. Tare the scale. Then weigh the mom holding the child. Record the weight of the child.*	____ ____ . ____ kg	*if 903 =0*
905	***Enumerator:*** *was (NAME) undressed to the minimum?* *(note…if child was dressed but mother held clothes, indicate 'no clothes')*	0…….No clothes 1…….Few clothes 2…….Many clothes	
906	Now I am going to measure the arm of (NAME). ***Enumerator:*** *record the MUAC measurement, in cm*	____ ____ . ____ cm	*if 401 ≥ 6*
907	*Record the color of the MUAC tape*	1…….Green 2…….Yellow 3…….Red	*if 401 ≥ 6*
908	Now I am going to measure the height of (NAME). ***Enumerator:*** *record the height measurement of the child, in cm. If the child is less than 23 months, measure the child lying down.*	____ ____ . ____ cm	
909	*How was the person actually measured? Lying down or standing up?*	1…….Lying down 2…….Standing	
910	Now I am going to measure your arm. ***Enumerator:*** *record the MUAC measurement of the mother, in cm.*	____ ____ . ____ cm	

Closing Statement to the Interview
The interview is complete. Thank you so much for your time and patience. Your help will allow us to work together to improve the health and nutrition of your child and community.
Enumerators: *indicating completeness:* ☐ *Yes, interview is complete ⇨ Move to the next household* ☐ *No, interview was not complete ⇨ Tell this result to your supervisor and move to the next household.*

Ethical approval

ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ
ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກະພາບ ວັດທະນາຖາວອນ

ກະຊວງສາທາລະນະສຸກ
ມະຫາວິທະຍາໄລ ວິທະຍາສາດ ສຸຂະພາບ
ຄະນະກຳມະການຈັນຍາທຳການຄົ້ນຄວ້າວິທະຍາສາດ
ເບີໂທ: 021 240255

ເລກທີ 131 --/ຄຈຄ
ນະຄອນຫຼວງວຽງຈັນ, ວັນທີ 19 FEB 2021

ໃບອະນຸມັດຈັນຍາທຳ

ຊື່ໂຄງການ: ສຶກສາຜົນກະທົບຈາກການລະບາດຂອງພະຍາດໂຄວິດ ຕໍ່ກັບຄວາມປອດໄພ ແລະ ການບໍລິໂພກອາຫານ, ການເຂົ້າເຖິງການບໍລິການສາທາລະນະສຸກ ແລະ ການໃຊ້ຈ່າຍ ໃນແຕ່ລະຄອບຄົວ ຢູ່ທາງພາກໃຕ້ຂອງ ສປປ ລາວ (ປັດ Proposal version 2.1, ລົງວັນທີ 09 ກຸມພາ ປີ 2021).

ຊື່ຜູ້ຄົ້ນຄວ້າຫຼັກ: ປອ. ດຣ ເພັດສະໜັ່ນ ຈັນທະວົງໄລ, ຮອງຫົວໜ້າພະແນກຄົ້ນຄວ້າວິທະຍາສາດ, ສະຖາບັນຄົ້ນຄວ້າ ແລະ ພັດທະນາການສຶກສາ.

ໄລຍະເວລາການຮັບຮອງ: 01 ປີ.

ຄະນະກຳມະການຈັນຍາທຳຄົ້ນຄວ້າວິທະຍາສາດ ໄດ້ທຳການພິຈາລະນາໂຄງການຄົ້ນຄວ້າດັ່ງກ່າວ ແລະ ເຫັນວ່າ ການຄົ້ນຄວ້າຄັ້ງນີ້ຈະບໍ່ສົ່ງຜົນກະທົບທາງດ້ານຮ່າງກາຍ ແລະ ຈິດໃຈຂອງຜູ້ທີ່ເຂົ້າຮ່ວມໃນການສຶກສາ ແລະ ບໍ່ແຕະຕ້ອງ ເຖິງບັນຫາຈັນຍາທຳຂອງການຄົ້ນຄວ້າ. ໂຄງການຄົ້ນຄວ້າດັ່ງກ່າວນີ້ຈະມີຜົນປະໂຫຍດອັນໃຫຍ່ຫຼວງ ໃນການປະກອບສ່ວນວຽກງານການສົ່ງເສີມສຸຂະພາບ ໂດຍທາງກົງ ແລະ ທາງອ້ອມ ຕໍ່ຜູ້ເຂົ້າຮ່ວມການສຶກສາ, ແລະ ເປັນຂໍ້ມູນພື້ນຖານ ທີ່ສຳຄັນໃນການຄົ້ນຄວ້າຄັ້ງຕໍ່ໄປແກ່ ວົງການສາທາລະນະສຸກລາວ ແລະ ຂະແໜງການວິທະຍາສາດ ໃນອະນາຄົດ.

ດັ່ງນັ້ນ, ຄະນະກຳມະການຈັນຍາທຳການຄົ້ນຄວ້າຂອງ ມະຫາວິທະຍາໄລ ວິທະຍາສາດ ສຸຂະພາບ ຈຶ່ງຕົກລົງເຫັນດີອະນຸມັດດຳເນີນຈັນຍາທຳການຄົ້ນຄວ້າສຳລັບໂຄງການດັ່ງກ່າວນີ້. ຜູ້ເຮັດການຄົ້ນຄວ້າຫຼັກຕ້ອງຮັບປະກັນວ່າທີມງານຄົ້ນຄວ້າທັງໝົດໄດ້ຮັບຮູ້ ກ່ຽວກັບ ເງື່ອນໄຂຂອງການອະນຸມັດຈາກຄະນະກຳມະການຈັນຍາທຳການຄົ້ນຄວ້າ ຂອງ ມວສ ລວມທັງເອກະສານທີ່ຖືກອະນຸມັດ. ຜູ້ເຮັດການຄົ້ນຄວ້າຫຼັກຕ້ອງໄດ້ແຈ້ງໃຫ້ທາງເລຂາຂອງຄະນະກຳມະການຈັນຍາທຳ ຄົ້ນຄວ້າຮັບຊາບຖ້າມີ ການແກ້ໄຂເພີ່ມເຕີມ ຫຼື ການປ່ຽນແປງ ແລະ ຕ້ອງລາຍງານຄວາມຄືບໜ້າຂອງໂຄງການຄົ້ນຄວ້າ ຄືດັ່ງລຸ່ມນີ້:

- ກໍລະນີມີການປ່ຽນແປງໃດໆທີ່ມີຄວາມສຳຄັນຕໍ່ກັບໂຄງການ ແລະ ເຫດຜົນຂອງການປ່ຽນແປງນັ້ນ, ລວມທັງຂໍ້ບົ່ງຊີ້ທາງດ້ານຈັນຍາທຳ;
- ເກີດຜົນກະທົບທີ່ຮ້າຍແຮງຕໍ່ຜູ້ເຂົ້າຮ່ວມ ແລະ ການແກ້ໄຂຜົນກະທົບດັ່ງກ່າວ;
- ເກີດເຫດການທີ່ບໍ່ໄດ້ຄາດຄິດ ຫຼື ຄາດເດົາລ່ວງໜ້າ;
- ກໍລະນີຜູ້ເຮັດການຄົ້ນຄວ້າຫຼັກບໍ່ສາມາດສືບຕໍ່ເຮັດໜ້າທີ່ຂອງຕົນໄດ້ ຫຼື ມີການປ່ຽນແປງໃດໆທີ່ກ່ຽວຂ້ອງກັບທຸກຄົນໃນໂຄງການຄົ້ນຄວ້າດັ່ງກ່າວ;
- ກໍລະນີມີການຢຸດປະກັນໄພຄຸ້ມຄອງຜູ້ເຂົ້າຮ່ວມການສຶກສາ ແລະ ການປະກັນໄພໝົດກຳນົດ;
- ເກີດຄວາມຊັກຊ້າໃນການເລີ່ມຕົ້ນໂຄງການເກີນກວ່າ 12 ເດືອນ; ແລະ
- ມີການຍຸດຕິ ຫຼື ປິດໂຄງການຄົ້ນຄວ້າກ່ອນໂຄງການຈະສຳເລັດ.

ເອກະສານທີ່ອະນຸມັດ

ເອກະສານທີ່ໄດ້ຮັບການທົບທວນຜິຈາລະນາ ແລະ ອະນຸມັດຈາກ ຄະນະກຳມະການຈັນຍາທຳການຄົ້ນຄວ້າວິທະຍາສາດ

ເອກະສານປະກອບ	ສະບັບທີ (version)	ລົງທີ
ຍົກສະເໜີໂຄງການຄົ້ນຄວ້າ	Version 2.1	09 ກຸມພາ ປີ 2021
ເຄື່ອງມືເກັບຂໍ້ມູນ (ແບບຟອມສອບຖາມ ແລະ ອື່ນໆ)	Version 1.3	09 ກຸມພາ ປີ 2021

ປະທານ

ຄະນະກຳມະການຈັນຍາທຳຄົ້ນຄວ້າວິທະຍາສາດ

ດຣ.ນ. ຈັນຖະໜອມ ມະນີທິບ

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-7
Objectives	3	State specific objectives, including any prespecified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7-8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8-10
Bias	9	Describe any efforts to address potential sources of bias	8,11
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	12
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	11
		(*e*) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	12
		(b) Give reasons for non-participation at each stage	12
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12
		(b) Indicate number of participants with missing data for each variable of interest	12
Outcome data	15*	Report numbers of outcome events or summary measures	13-15; 26

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13-15; 27
		(*b*) Report category boundaries when continuous variables were categorized	13-15
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	21
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-20
Generalisability	21	Discuss the generalisability (external validity) of the study results	21
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.