

Are Coping Strategies Used by Households
During Times of Food Insecurity Associated with Nutritional Status
for Children Under 5 in Lao PDR?

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Abstract

Are coping strategies used by households
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for children under 5 in Lao PDR?

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Objectives: To explore associations between frequency and type of coping strategies employed by households and nutritional status (stunting, wasting, underweight) for children under five.

Study Design: Cross sectional study conducted in three southern provinces of Lao PDR.

Methods: Study universe included 401 households which self-reported as being food insecure in the prior month. Food insecure households selected from the following five coping strategies (strategies were not mutually exclusive) used during times when there was inadequate food for the household: 1. Consumed less preferred, less expensive foods 2. Borrowed food, or help from friend/relative 3. Limited portion size at mealtimes 4. Restricted consumption by adults so small children could eat 5. Reduced number of meals eaten. A coping frequency index was created based on the frequency in which coping strategies were employed during acute food insecurity as follows: daily, 3-6 days a week, 1-2 days a week, less than once a week or never. The frequency coping score was plotted against nutritional outcomes. In addition to the coping index, a relative coping strategy score was calculate for each household to examine the relationship between type of coping strategy and nutritional outcomes. This relative coping score was plotted against nutritional outcomes.

Results: Statistically significant ($\leq .003$) differences were observed between food secure and food insecure households in terms of age, residence, income, mother's education, underweight and stunted status. Statistically significant ($\leq .003$) differences were found between households that had low coping scores (<10) and high coping scores (≥ 10) by income and stunting status. The correlation between nutritional status and both measures of coping: frequency and type of coping strategy was weak.

Discussion: This report confirms that residence, income and mother's education are related to food security. Type of coping strategy did not show a relationship with stunting, wasting or underweight status. Frequency of coping showed a relationship with income and stunting.

Interventions targeted at improving the nutritional status of children under five in Lao PDR should be broad and aim to influence the many determinants associated with undernutrition

1. Introduction

1.1 Undernutrition

An undernourished individual is unable to acquire enough food to consume at a level sufficient for meeting his or her dietary energy requirements (1). Undernutrition is defined as the outcome of undernourishment, and/or poor absorption and/or poor biological use of nutrients consumed as a result of repeated infectious disease (1). It includes being underweight for one's age, too short for one's age (stunted), dangerously thin for one's height (wasted) and deficient in vitamins and minerals (micronutrient malnutrition). Diets that do not provide adequate calories, protein for growth and maintenance, and micronutrients will result in undernourished individuals (2). The ability to fully utilize food consumed is also a component of undernutrition as individuals with reoccurring infectious disease may be unable to absorb and use nutrients from consumed food (2).

Adequate nutrition encompasses more than caloric intake and diversity of food is also included. A high quality diet rich in proteins, essential fatty acids, and micronutrients improves birth weight, growth and cognitive development and decreases levels of child mortality (2). 'Hidden hunger', when inadequate micronutrients are consumed may be experienced even when the minimum amount of calories is consumed (2)(3). The term hidden hunger is used because those experiencing micronutrient deficiencies may not feel hungry or show any other clinical symptoms, but are not ingesting the essential nutrients required for growth and sustained health. Micronutrient deficiency is especially devastating in young infants since

vitamins and minerals are critical for cellular and humoral immune responses, learning and cognitive functions, work capacity and reproductive health (4).

1.2 Determinants of Nutritional Status

A child's nutritional status is a consequence of a multitude of factors, Figure 1 the Lancet Framework for actions to achieve optimum fetal and child nutrition and development provides an excellent visual of the determinants of nutritional status and interventions for its improvement (5). Some factors begin to influence a child before he or she is born, such as the health of one's mother. Once a child enters the world he or she continues to be influenced by their mother through feeding practices, which are affected by the mother's knowledge of best infant feeding practices. Caregiving practices and knowledge are a result of the social, economic and political landscape in which one lives. As a child ages household dynamics affect the nutritional status of a child. Intra-household food allocation can be affected by family size and the sex and age of a child. Food security, in itself, is function of four key factors, which will be addressed further in this study and should be noted is only one determinant of a child's nutritional status. The availability, access and utilization of food together influence the health of a child. The ability of a child to fully utilize food is related to the environmental conditions in which a child lives and access to health services. Infectious disease acquisition will prevent a child from fully utilizing food consumed (2). These determinants, working in conjunction, may amplify their affect on a child's nutritional status and developmental progress.

Addressing undernutrition requires a combination of both nutrition-sensitive and nutrition-specific interventions. *Nutrition-specific interventions* focus on immediate causes of

undernutrition and address caregiving and feeding practices and reducing the burden of infectious diseases. These goals are achieved through dietary supplementation, increased feeding knowledge, treatment of malnutrition, disease prevention and nutritional emergency interventions. The 'first 1,000 days' of life from conception, through pregnancy, infancy and early childhood for the first two years of a child's life is a decisive period during which undernutrition will have caused irreversible damage (6). Often called the 'window of opportunity' because of the profound effect nutritional practices have on the developing child and because damage sustained during this period is often permanent (6). Interventions are commonly targeted to this early life stage as is reflected in the portfolio of nutrition-specific interventions in the Lancet model Figure 1 (5).

The underlying and basic causes of malnutrition are addressed through *nutrition-sensitive interventions* (7) and target issues such as agriculture and food security, maternal mental health, resources for feeding and caregiving practices, water and sanitation, early child development, and health and family planning services. Examples of both nutrition-sensitive and nutrition-specific interventions can be viewed in Figure 1 (5). When optimum fetal and child nutrition are realized a myriad of lifelong benefits result starting with decreased morbidity and mortality in early childhood, increased development, school performance and learning capacity, increased adult stature, reduced obesity and non-communicable diseases, and increased work

capacity and productivity.

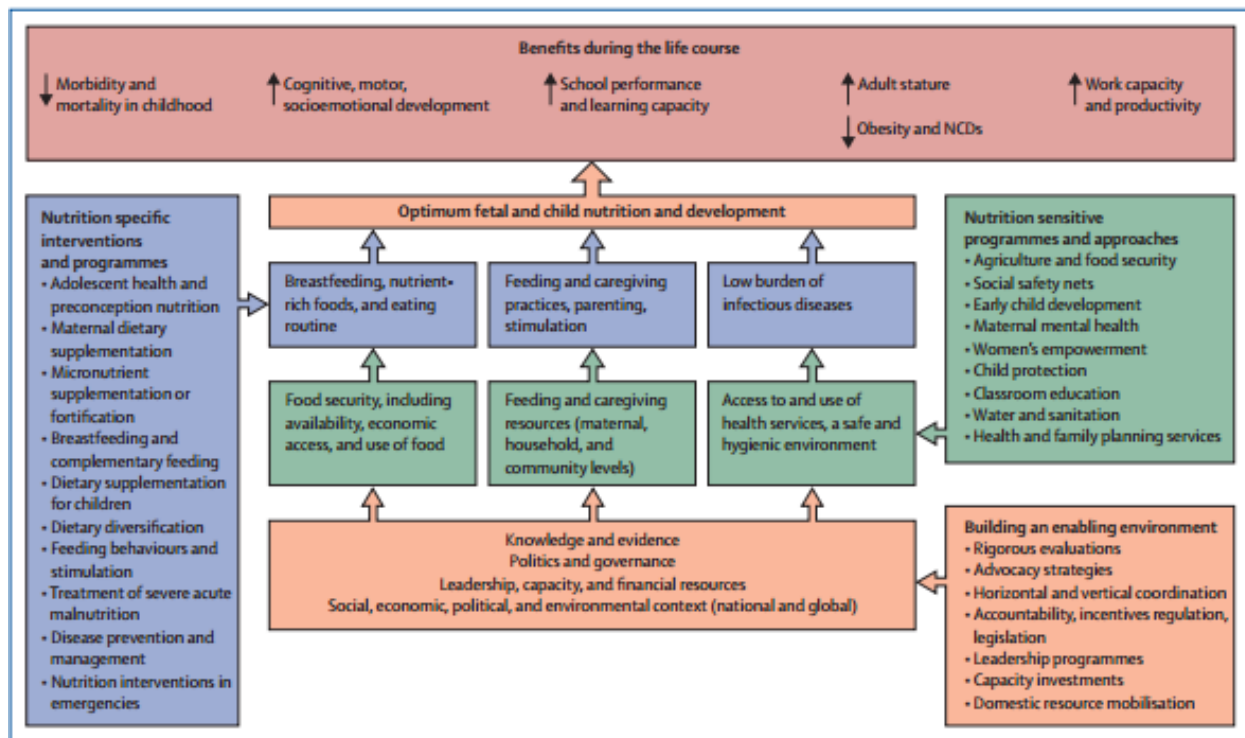


Figure 1 Lancet Framework for actions to achieve optimum fetal and child nutrition and development

1.3 Assessment of Nutritional Status

When children are unable to meet the dietary requirements needed for development their growth is impaired. This retarded physical outcome can be measured. Anthropometry is widely employed to serve as a proxy of nutritional status of populations, as well as the overall health of individuals. For children under five years of age, it is used to assess physical growth, and based on comparisons to international growth references, can help to estimate the magnitude of both acute and chronic undernutrition. Stunting, wasting and underweight status are indicators of poor nutrition. Stunting, a measure of low height-for-age, is a result of chronic undernutrition and recurrent or chronic illness. Wasting, a measure of low weight-for-height

indicates acute deficiency. Underweight status, a measure of low weight-for-age is a composite of both chronic and acute undernutrition, and fails to discriminate between the two.

Anthropometric indices are compared to the new WHO international reference population and children that fall more than two standard deviations below the median of the reference are classified as moderately or severely undernourished by different indicators, while those that fell more than three standard deviations below the median of the reference were classified as being severely undernourished by the respective indicators.

1.4 Consequences of Undernutrition

In 2013 Black reported that undernutrition contributed to 3 million child deaths each year, 45% of the total (8). Women during pregnancy, infants and young children are especially vulnerable to undernutrition. Sufficient nutrition during the first 1,000 days helps ensure proper development and plays a significant role in lifelong health outcomes. Inadequate nutrition can result in irreversible damage, impairing both the physical and mental development of a child (4) including reduced mental capacity, reduced school performance and working capacity, and overall increased susceptibility to infections and diseases (9). Undernutrition is a risk factor for both diarrhea and pneumonia, which are the leading infectious causes of childhood morbidity and mortality (10). In addition to having an increased risk of dying from diarrhea and pneumonia an undernourished child is at an increased risk of dying from measles (8)(11). Black's 2013 study stated, "Undernutrition can be deemed the cause of death in a synergistic association with infectious diseases; if the undernutrition did not exist, the deaths would not have occurred." Stunting and severe wasting (outcomes of

undernutrition) in the first two years of life cause irreparable harm and when followed by rapid weight gain during ages 3-5 has been reported to significantly increase the risk of chronic disease later in life (4). In 2008 it was estimated that 2.2 million child deaths and 21% of disability adjusted life years (DALYs)* were a result of stunting, wasting and intrauterine growth restriction (16).

- ❖ “DALYs combine years of life lost due to premature death and years of life lived with disabilities (YLD) into one indicator allowing assessment of the total loss of health from different causes. One DALY can be regarded as roughly 1 lost year of so-called healthy life” (16).

When individuals are unable to meet their nutritional needs proper development is hindered, both physically and cognitively, and they are less productive members of their community (12).

Children that fail to develop fully will subsequently have poor levels of cognition and education, which are both linked to lower lifetime earnings (12)(13)(14). Stunting is associated with reduced years in schooling and analyses from 51 countries reported that, on average, each year in schooling increases wages by 9.7% (12). School performance is also affected; stunted children learn less per year in school. It is estimated that the loss in adult income from being stunted but not in poverty is 22.2% (12). Countries with large proportions of children unable to achieve full development will be disadvantaged in terms of national growth.

Furthermore, poor cognitive and physical development have important intergenerational effects. Maternal short stature is a risk factor for cesarean delivery and a low maternal body mass index restricts intrauterine growth, which has implications for birth weight (8). Improved parental education, especially for mothers, is associated with smaller families,

improved child survival, health, nutrition, cognition and education (12). Thus, the cycle of impaired development can be transmitted through generations.

1.5 Food Security

The Food and Agriculture Organization (FAO) defines food security as existing when “all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (15). A single indicator may not describe the complexity of food security. The FAO has identified four main dimensions of food security (15):

1. Physical **availability** of food – food availability focuses on the ‘supply side’ of food and is a result of food production, stock levels and net trade. It may be aggregated at the regional, national, district or community level.
2. Economic and physical **access** to food – a sufficient supply of food at national or international levels does not guarantee household level food security. Concerns about insufficient food access have shifted policy focus on incomes, expenditure, markets and prices to achieve food security objectives.
3. Food **utilization** – refers to intra-household distribution of food and an individual’s ability to make the most of the nutrients in the food through absorption and metabolism. Utilization takes into account feeding practices, food storage, processing and preparation (including water and cooking fuel used and hygiene conditions).
4. **Stability** of the other three dimensions over time – inadequate availability, access or utilization on a periodic basis and will result in food insecurity. Climatic or political instability, or economic factors such as unemployment, rising food costs can impact one’s food security status.

Beyond these four dimensions, two types of food insecurity exist: chronic and acute (15). Chronic food insecurity exists when people are unable to meet minimum food requirements over a sustained period of time, compromising food stability and often is the

result of household poverty. Chronic food insecurity is considered a structural issue (3). Acute food insecurity occurs when there is an abrupt decrease in the ability to produce or access an adequate amount of food to maintain a good nutritional status. This temporary food insecurity is a result of short-term shocks and variations in food availability and food access including changes in domestic food production, food prices and household incomes (13). This study seeks to examine the relationship between coping strategies employed by households during times of acute food insecurity (as defined by insults in the prior month) and their association with nutritional outcomes.

The tools employed to measure food security have shifted over the years. Initially, food security was measured and interventions focused solely on the availability of food (16). As comprehension of the “access” component of food security was realized, additional tools and methods to measure access to food were sought. Proxy measures (usually indirect/derived measurements) addressing access issues have commonly been used with varying levels of success (16). Problems have been identified with common proxy measures such as dietary intake or anthropometry for addressing food security (16)(17)(18). Twenty-four hour food recall requires high data collection costs and risks recall bias and disease is known to influence nutritional status which may undermine the use of anthropometry for addressing food security (17)(18). The move away from objective and towards more subjective, experience or perception-based measurement tools means a shift to qualitative data collection focused on gathering respondents’ perceptions and responses to food insecurity. This measurement change has been used to address the issue that one may be food insecure but still consume adequate macro and micronutrients and even have anthropometric values that reflect

sufficient nutrition (17). Hadley and Crooks argue that defining food insecurity on the basis of the aforementioned indicators confuses an outcome with a definition and that food insecure individuals may be missed.

Assessing whether a household is food secure or insecure is a complex task (19). The validity of tools employed to measure food insecurity has been widely debated and assessing the degree to which households experience food insecurity has been a significant challenge (16). Webb makes the case that better measurement is needed between severity and frequency of household food insecurity behaviors. Studies have used coping strategies reported by households during food shortages as proxy measures of food insecurity and to determine its severity (16)(18).

1.6 Food Insecurity Coping Strategies

When faced with food shortages, households must make difficult decisions about how to feed and who to feed in their families. Bedeke describes the pattern of household responses to food insecurity as: risk minimization, risk absorption and finally risk taking for survival (3). UNICEF reported increasingly severe coping strategies were employed by households during the 2008 – 2009 global economic downturn when food insecurity was experienced (20). The most severe coping strategies were reported as 1) eating less (and less nutritious) meals, 2) diminished health seeking behaviors and 3) children dropping out of school. The study further reported that in some settings, coping strategies harmful to children such as decreasing food consumption were over twice as likely to be employed by poorer households than wealthier households in response to food insecurity (20). The decisions or coping strategies caretakers

are forced to make during food shortages may have lasting impacts on a child's health, as well as the well-being of the overall family. Food insecurity has been shown to be a managed process whereby households/caregivers make adjustments to minimize its impact (17). Coping strategies, with regard to food insecurity, have been described as "short-term responses to an immediate and inhabitual decline in access to food" (17). Coping strategies help households survive under dire conditions but are different from adaptive strategies (long-term permanent changes) which are employed during chronic food insecurity (16).

Shariff et al. found that differences exist in coping strategies used by food secure versus food insecure households (21). In a study of household food insecurity and coping strategies of poor rural Malaysian communities, households were categorized as either food secure or food insecure using the Radimer/Cornell Hunger and Food Insecurity instrument, which measures hunger and food insecurity and differentiates among households experiencing increasingly severe food insecurity and hunger (22). The In-depth interviews were conducted with women from both food secure (N=84) and food insecure (N=116) households about the type of food coping strategy adopted. The coping strategies adopted by these two types of households in early attempts to minimize the adverse shocks associated with household food insecurity were significantly different. Borrowing money to buy food and receiving money from family members and neighbors were techniques food secure households used to prevent them from experiencing food insufficiency (21). Food secure households reduced the number of meals at a significantly higher proportion than food insecure households. A higher percentage of food insecure households reported cooking whatever was available at home in comparison to food secure households. Shariff's study shows that the type of coping strategy adopted by

households is related to whether or not a household is in fact, food secure or insecure (21). Hadley and Crooks argue that coping mechanisms are shaped by changing local circumstances and will produce variable outcomes in terms of health. It has been acknowledged that coping strategies employed by households shift initially from protection of economic assets, to disposal of assets, and finally to destitution, thus the severity of the situation results in the type of coping strategy utilized (17).

Maxwell also proposed measuring coping strategies as a food security indicator. He identified six short-term food-based coping strategies employed by urban households during times of insufficient food (18). These were based on a number of in-depth interviews with the household member primarily responsible for the preparation and provision of food in a major African urban center in 1995. These six coping tactics were subsequently ranked, by focus group discussions, according to its perceived severity. Ranked from least severe to most severe the strategies are as follows:

1. Eating foods that are less preferred
2. Limiting portion size
3. Borrowing food or money to buy food
4. Maternal buffering
5. Skipping meals
6. Skipping eating for whole days

Thus, depending on the magnitude of the duration and severity of food insecurity, coping mechanisms ranging from less to more extreme were employed. Some types of coping strategies employed by households may have harmful effects for children, such as skipping

meals or limiting portion size, or may have protective properties for children such as maternal buffering/ restricted consumption by adults so small children could eat (19)(20).

1.7 Food Security & Nutritional Status

Studies have shown that food insecurity and nutritional status are associated. In 2012 Hadely and Crooks reviewed eight studies from low income countries examining the relationship between household food insecurity and child nutritional status (17). The review showed that food insecurity tended to be associated with poorer nutritional status apart from study design, age of child or measure of food insecurity. The association between household food insecurity and nutritional status of children was examined in Nepal using data from 2011 (23). Classification of food insecurity was determined by answers to seven questions referencing the previous 12 months with four response options (never, rarely, sometimes, often). Based on these responses households were determined as food secure, or mildly, moderately or severely food insecure. A significant association was established between food insecurity and malnutrition among children under five in Nepal. Analyses showed that 51% of children from severely food insecure households were stunted compared to 33% from food secure households (23). By underweight status, 40% were from severely food insecure households versus 23% from secure households (23). Odds ratios show that children from severely food insecure households were 1.5 and 1.4 times more likely as children from food secure households to be stunted and underweight, respectively (23). Interestingly, household food insecurity and wasting among child showed no association in this study.

1.8 Lao People's Democratic Republic (PDR)

Lao People's Democratic Republic (PDR), located in Southeast Asia, is a small landlocked country with six million residents (13). It is classified by the United Nations as a least developed country which is defined by suffering from structural impediments to sustainable development (24). This designation is based on three factors: gross national income per capita, a human assets index (including nutrition, health, education and adult literacy) and economic vulnerability. While Lao PDR is on track to meet some of the Millennium Development Goals such as reducing child mortality and halting the spread of malaria and TB, undernutrition remains a major problem (13). It should be noted that in 2014 Lao PDR was upgraded from the FAO low-income food-deficit list due to its net food trade position (25). This study analyzes data collected from three provinces, Saravane, Sekong, and Attapeu, located in southern Lao PDR (Figure 2).

The geography of Lao PDR contributes to food insecurity. The terrain in Lao PDR can be divided into two zones: lowlands and uplands. The lowlands are better integrated into the national infrastructure and production of rice surpluses are common in these areas (13). The uplands are scattered and remote and are often food-deficit areas.

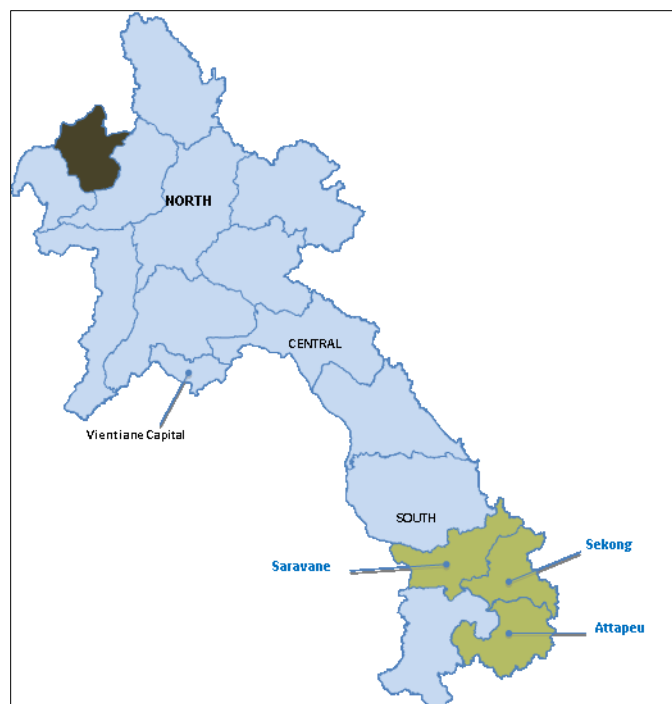


Figure 2 Lao PDR

Over 70 percent of the population lives in the upland zones, thus making it imperative to have strong transport infrastructure to move cereals and foods from the production zones in the South to the main population areas (13). It is also important to note that Lao PDR is the world's most heavily bombed country per capita and many unexploded ordnances (UXO) mar the landscape making travel and transport of goods dangerous in some regions and prevents the land from agricultural use and animal husbandry (13). Additionally, natural disasters are also common occurrences. The World Food Program (WFP) reports that Lao PDR faces serious droughts and floods every one and a half years which plays a role in food availability (13).

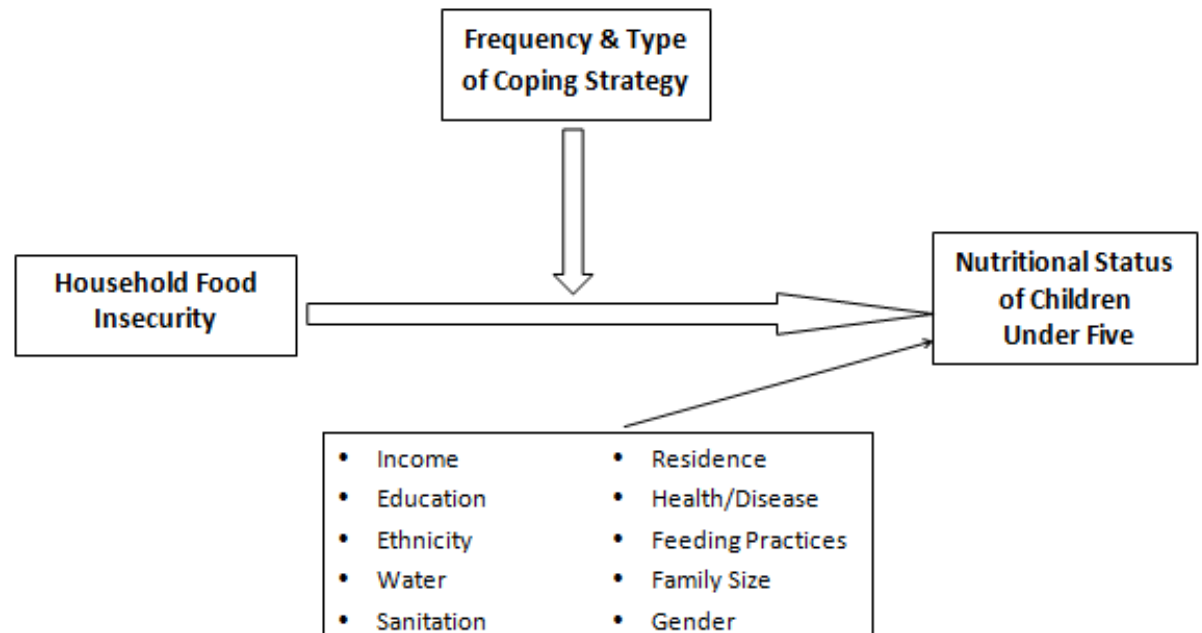
Despite economic advances, high stunting and underweight prevalence has remained steady over the last ten years (26). Undernutrition remains a problem in Lao PDR because of unequal economic growth, persistent development challenges and past political challenges (13). Regionally, nutrition figures from Lao PDR are worse than surrounding countries. Data from 2000 to 2007 show the prevalence of stunting and underweight was higher than levels from other Indochina countries (27). Within Lao PDR, children from southern provinces have higher proportions of poor nutrition outcomes in comparison to other regions (27). Data from a nationally representative sample collected in 2011 provide estimates for the prevalence of stunting, wasting and underweight for children under five. Prevalence levels for stunting are the highest indicating a chronic undernutrition issue in Lao PDR (28). Nationally, almost half (44.1%) of children are stunted (28). There is a large variation observed by province (Sekong, 63.3%; Saravane, 54.6%; Attapeu, 39.5%) (28). Levels of wasting were lower, nationally, 6.3% of children are wasted (28). Although Attapeu had the lowest prevalence of stunting of the three provinces it has the highest prevalence of wasting (Attapeu, 10.2%; Sekong, 7.5%; Saravane,

7.3%) (28). A quarter (26.4%) of children under five are underweight in Lao PDR. In Sekong almost half (46.5%) are underweight followed by Saravane (41.4%) and Attapeu (32.0%) (28). Children from rural residences consistently showed higher levels of undernutrition in comparison to children from urban residences (28).

1.9 Study Objectives

Figure 3 depicts the conceptual model for this study, which illustrates that multiple factors simultaneously influence the nutritional status of children under five. These factors exist on several socio-ecological levels; hence interventions aimed at reducing undernutrition of children under five need to be targeted at household, community and policy determinants. While this paper assesses one key determinant of the nutritional status of children as depicted by the large arrow, it is appreciated that other factors (in the small box in the figure below) are involved in its etiology.

Figure 3 Conceptual Model for Study



The basic hypothesis for this study is that households reporting frequent use of coping strategies during times of self-reported food insecurity will have children under five with poorer nutritional status than households that reported less frequent use of coping strategies. The basic premise behind this hypothesis is that households that reported high utilization of coping strategies likely suffer from more severe food insecurity than households reporting less frequent utilization, which will be observed by the nutritional status of these children. This study will aim to confirm the observation that there is a direct linear relationship between the severity of undernutrition and the severity of food insecurity as reflected by a gradient of coping strategies (17)(18). This study seeks to determine whether associations between type of coping strategy and nutritional status exist.

This study has two objectives.

Objective 1: Explore whether households that reported frequent usage of coping strategies have children under five with higher levels of stunting, wasting and underweight than households that reported less frequent utilization of coping strategies.

Objective 2: Examine if differences exist in stunting, wasting and underweight status by the type of coping strategy households employed.

2. Methods

2.1 Study Setting

Data were collected from three provinces (Attapeu, Saravane and Sekong) located in southern Lao PDR that have a high burden of undernutrition (Figure 2). Activities were conducted as part of the Maternal and Young Child Nutrition Food Security Initiative in Asia (MYCNSIA), a partnership between United Nations International Children's Emergency Fund (UNICEF) and the European Union (EU). MYCNSIA aims to improve child survival, growth and development through nutrition security and life cycle interventions. These three particular Provinces were targeted because of high undernutrition levels and required additional effort and focused program investment. Data for the present study came from a baseline survey conducted in the three provinces to form the basis future project evaluation. These provinces are located in a part of the country which is rugged and remote, and marked by poor road infrastructure (29). In addition, this region has a violent history. During the Vietnam War (Second Indochina War), the Hoh Chi Minh Trail went through both Attapeu and Saravane and heavy bombing was sustained. Unexploded ordinances (UXO) continue to mar the landscape making travel in the region dangerous. Saravane borders Thailand on its western side and almost half of it is covered by natural forest (29). Attapeu shares its borders with both

Cambodia and Vietnam. Sekong borders Vietnam to the west and encompasses several sizeable mountains throughout the region. It is one of the smallest provinces by population and the second smallest by area but is the most ethnically diverse and also one of the poorest (29)(30).

2.2 Study Design and Data Collection

The data for this study were generated from two complementary cross-sectional surveys conducted in 2011 and 2012. Both surveys were implemented by provincial and district health departments in the study area and were based, in large part, on the design of the Multiple Indicator Cluster Survey (MICS), the Demographic and Health Survey (DHS) and the Lao Reproductive Health Survey (LRHS). The two surveys included the Lao Social Indicators Survey (LSIS) and the Maternal and Young Child Nutrition in Asia (MYCNSIA) Baseline Survey. The LSIS was a national survey conducted by the Ministry of Health (MoH) and the Lao Statistics Bureau (LSB). The MYCNSIA was a tag-on survey to the LSIS created to collect additional detailed information on nutritional factors and designed by the National Institute of Public Health (NIOPH) in Lao PDR and UNICEF. The LSIS sample frame, from which the MYCNSIA sample was modeled, was designed to derive statistically robust and independent estimates for each province in the country. The data from the two surveys were matched and linked for the three MYCNSIA provinces, leading to a final data set which included a total of 1041 children under five. Table 1 shows the origin of key variables.

Table 1.

Survey Variables

Survey	Questionnaire	Categories
LSIS Survey	Children (0-59 months)	Anthropometry
	Household	Socio-demographic
MYCNSIA Survey	Household	Food Security

Four field teams were organized by the National Institute of Public Health for the MYCNSIA add-on, with one field team assigned to each province and two assigned to the larger province of Saravane. Each team was composed of four individuals with specific roles: supervisor, team leader, interviewer, and laboratory technician. Field team members were recruited from the NIOPH, the Hygiene and Prevention Department, and staff from target provinces. The supervisors monitored team operations, resolved issues that arose in the field and reviewed all completed questionnaires while in the field. Supervisors, teams leaders and interviewers all conducted face-to-face interviews. Prior to survey collection, meetings with local authorities (heads of villages), parents, village health volunteers, and health centre staff were coordinated to explain study objectives and to encourage community participation. Both surveys were completed in the three provinces between October 2011 and February 2012.

The MYCNSIA questionnaire asked households to self-report if they had sufficient food or money to buy food in the last month. In cases where they reported 'no, they self-identified as food insecure, and were then asked about strategies employed when food shortages were experienced and the frequency in which the strategy was utilized. Table 2 outlines the different coping strategy and frequency of use variables.

Table 2.

Coping Strategy Variables and Frequency of Use

Coping Strategy	Consumed less preferred, less expensive foods
	Borrowed food, or help from friend/relative
	Limited portion size at mealtimes
	Restricted consumption by adults so small children could eat
	Reduced number of meals eaten
Frequency of Use	Daily
	3-6 days a week
	1-2 days a week
	Less than once a week or never

2.3 Training

The MYCNSIA questionnaire was pretested on 30 mothers/caretakers at a hospital located in Vientiane. Field supervisors attended a three-day training of trainers workshop facilitated by a consultant from UNICEF's Regional Office in Bangkok. Trainers then facilitated a three-day workshop in September 2011 to train MYCNSIA enumerators who were responsible for conducting the fieldwork. Training consisted of two days in the classroom and one day in the field. Scores from a pre/post test verified that key interviewing protocols were understood by field workers.

The LSIS survey teams conducted all anthropometric measurements. Individuals were trained in proper measurement protocols by a UNICEF consultant in August 2011. A pre/post-test assessment was completed by individuals to ensure essential anthropometry measurement concepts and practices were understood by trainees. Measurements were performed twice in the field by two workers using standardized WHO procedures.

2.4 Nutritional Status Indicators

Anthropometric measurements collected in the field were used to assess nutritional status. Three anthropometric indices were used to gauge the nutrition status of the population, which included underweight, stunting and wasting. These were calculated based on measures of weight and height/recumbent length, which were measured following standard techniques. Weight was recorded to the nearest 0.1 kg, while length and height were recorded in centimeters to the nearest 0.1 cm. Anthropometric indices were compared to the new WHO international reference population and children that fell more than two standard deviations below the median of the reference were classified as moderately or severely undernourished by different indicators, while those that fell more than three standard deviations below the median of the reference were classified as being severely undernourished by the respective indicators. Data entry was completed in March 2012.

2.5 Food Insecurity and Coping Indicators

A coping index was computed based on the frequency that different coping strategies were employed. Households chose from five coping strategies when reporting food insecurity during previous month. Strategies were not mutually exclusive, meaning households could choose more than one coping strategy. A scale was created where households that reported employing a strategy daily received a 4, those using a strategy 3-6 days a week received a 3, usage of 1-2 days week received a 2, and those that employed a strategy less than once a week or never received a 1. Strategies were weighted equally. Thus, the maximum coping score possible was 20, households that employed all five strategies daily would receive a coping score

of 20. A relative coping score was computed for each household. This was carried out by first calculating an average coping amount for each household. Then the household's average coping amount was subtracted from each of the specific coping strategy scores. The relative coping score for each coping strategy was calculated as the frequency of that coping strategy (coded as 1-4 with 1 being <1 time weekly or never and 4 being daily) minus the mean frequency of all five coping strategies. An example follows: For strategies 1-5, assume the households responded with frequency of coping scores that were coded 2, 3, 2, 4, and 4. Then the average coping is $15/5=3$. So the relative use of strategies would be -1, 0, -1, 1, and 1. Thus the person uses strategies 1 and 3 less often than the other on average and uses strategies 4 and 5 more often. This relative coping score shows whether a particular coping strategy was used by the household more or less frequently than coping strategies were used overall by the household.

2.6 Analysis Plan

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 19. Analysis for this study was accomplished by merging two data sets: the Lao Social Indicators Survey (LSIS) and the Maternal and Young Child Nutrition Survey in Asia (MYCNSIA). Data sets were merged to include both household and child level data. Descriptive and bivariate analyses were completed.

Tables were created to compare differences between groups on key variables. Food secure versus food insecure households were identified based on their self-reported response to the question: *In the past month, did you not have enough food or money to buy food?*

Differences between low coping score versus high coping score households were also examined. Low coping score households were those with coping scores of less than 10, thus, high coping score households were those with scores equal to or greater than 10. The use of the number 10 as the cut-off value was chosen because 10 is the mode of the coping score index and because of the distribution of responses (10 was the most frequent score – Figure 3). Significance tests were calculated. Child age groupings were re-categorized in order to provide adequate numbers (≥ 5) in each cell for chi square tests. Groups were determined as statistically different from one another based on a p value of less than or equal to .003. A p value of .003 was used based on the Bonferroni correction (.05 / 18 (# of tests)) since multiple comparisons were being made. Scatterplots were also created to determine correlations between coping score and nutritional outcomes.

In order to examine the relationship between relative use of a particular coping strategy, which were coded as four frequencies, and nutritional outcomes, the relative coping score was plotted against nutritional status and shows the association between how frequently a household uses a certain strategy relative to their use of coping strategies overall.

3. Results

3.1 Demographics

Table 3 shows the demographic, socioeconomic and nutritional indicators of the sample. Over 95% of the children were between 6 and 35.9 months and from predominately rural households (82.8%). Sixty percent of mothers had received either a primary or secondary education. Two in five children were underweight, more than half of children were stunted and

over 10% of were wasted. Subsequent tables will explore indicators of nutritional outcomes. Of the 1041 children enumerated, only 814 had household level data records and anthropometry data was collected for 770 children and these were the focus of the final analysis.

Table 3. Demographic, socioeconomic and nutritional status indicators for children under 5 from sample

	Total	
Age		
<i>0-5.9 months</i>	10	1.0%
<i>6-11.9 months</i>	180	17.4%
<i>12-23.9 months</i>	403	38.9%
<i>24-35.9 months</i>	417	40.3%
<i>46-47.9 months</i>	24	2.3%
<i>48-59.9 months</i>	1	0.1%
Total	1035	
Sex		
<i>Male</i>	519	50.1%
<i>Female</i>	516	49.9%
Total	1035	
Residence		
<i>Urban</i>	140	17.2%
<i>Rural</i>	674	82.8%
Total	814	
Income wealth quintiles		
<i>Poorest</i>	180	22.1%
<i>Second</i>	161	19.8%
<i>Middle</i>	161	19.8%
<i>Fourth</i>	142	17.4%
<i>Richest</i>	170	20.9%
Total	814	
Mother's Education		
<i>None</i>	316	38.8%
<i>Primary</i>	372	45.7%
<i>Secondary and Above</i>	126	15.5%
Total	814	
Underweight		
<i>Not Underweight</i>	452	57.1%
<i>Moderate Underweight</i>	339	42.9%
Total	791	
Stunted		
<i>Not Stunted</i>	375	48.7%
<i>Moderate Stunted</i>	395	51.3%
Total	770	
Wasted		
<i>Not Wasted</i>	697	88.8%
<i>Moderate Wasted</i>	76	9.7%
<i>Severely Wasted</i>	12	1.5%
Total	785	

3.2 Underweight Children under Five

Table 4 shows the demographic and socioeconomic indicators of children less than 5 by underweight status. Over 40 percent (42.8%) of children were underweight. A positive relationship between age and underweight status can be seen, as prevalence of underweight status increases as children get older. The proportion of underweight children from rural households was 2.5 times higher than that of children from urban residences (17.6% and 48.0%, respectively). As wealth decreased the proportion of underweight children increased, three times more underweight children were from the poorest households as compared to the richest (61.5% and 19.8%, respectively). Underweight children were two times more likely to have uneducated mothers in comparison to children with more educated mothers (51.8% no education, 42.3% primary and 21.5% secondary or higher). Underweight status showed significant relationships with both stunting and wasting. Stunted children were over twice as likely to also be underweight. Similarly, wasted children were nearly seven times more likely to be underweight.

Table 4. Demographic and socioeconomic indicators of underweight children under 5

	Not Underweight		Underweight	
	N= 455	57.2%	N= 341	42.8%
Age*				
0-5.9 months	7	100.0%	0	0.0%
6-11.9 months	107	75.4%	35	24.6%
12-23.9 months	171	56.8%	130	43.2%
24-35.9 months	160	49.7%	162	50.3%
36-47.9 months	10	43.5%	13	56.5%
48-59.9 months	0	0.0%	1	100.0%
Total	455		341	
Sex				
Male	224	56.1%	175	43.9%
Female	231	58.2%	166	41.8%
Total	455		341	
Residence*				
Urban	112	82.4%	24	17.6%
Rural	343	52.0%	317	48.0%
Total	455		341	
Income wealth quintiles*				
Poorest	65	38.5%	104	61.5%
Second	83	52.5%	75	47.5%
Middle	91	56.5%	70	43.5%
Fourth	82	58.2%	59	41.8%
Richest	134	80.2%	33	19.8%
Total	455		341	
Mother's Education*				
None	149	48.2%	160	51.8%
Primary	211	57.7%	155	42.3%
Secondary and Above	95	78.5%	26	21.5%
Total	455		341	
Stunted*				
Not Stunted	329	87.0%	49	13.0%
Moderate Stunted	121	30.5%	276	69.5%
Total	450		325	
Wasted*				
Not Wasted	441	62.8%	261	37.2%
Moderate Wasted	11	12.6%	76	87.4%
Total	452		337	

* Statistically significant difference (p value < .05)

3.3 Stunted Children under Five

Table 5 displays the demographic and socioeconomic characteristics of children under five who were classified as stunted, suffering from chronic undernutrition and those who were not stunted. Over half (51.2%) of children under five were stunted. As age increased the proportion of stunted children also increased. A quarter of children 6-11.9 months were chronically undernourished, although it should be noted that the number of cases in this age group was quite small. The prevalence was as high as 61.4% among children 24-35.9 months. A strong relationship existed by residence. One in three (30.1%) children from urban households were stunted whereas almost twice this level (55.6%) of stunting was seen amongst children from rural households. A direct inverse association between income and stunting was found. Almost a quarter (72.7%) of the poorest children were stunted compared to less than one in three (28.8%) of the richest. Each step up in mother's education showed a decrease in stunted child proportion. Three out of five (57.9%) children with an uneducated mother showed indication of chronic undernutrition versus only one out of three with a mother attaining a secondary or higher education. The proportion of stunted children that were also underweight was much higher than for children not underweight (84.9% vs. 26.9%, respectively).

Table 5. Demographic and socioeconomic indicators of stunted children under 5

	Not Stunted		Stunted	
	N= 378 48.7%		N= 397 51.2%	
Age*				
0-5.9 months	5	100.0%	0	0.0%
6-11.9 months	104	73.2%	38	26.8%
12-23.9 months	144	49.5%	147	50.5%
24-35.9 months	122	38.6%	194	61.4%
36-47.9 months	3	15.0%	17	85.0%
48-59.9 months	0	0.0%	1	100.0%
Total	378		397	
Sex				
Male	183	47.4%	203	52.6%
Female	195	50.1%	194	49.9%
Total	378		397	
Residence*				
Urban	93	69.9%	40	30.1%
Rural	285	44.4%	357	55.6%
Total	378		397	
Income wealth quintiles*				
Poorest	44	27.3%	117	72.7%
Second	67	43.8%	86	56.2%
Middle	83	51.9%	77	48.1%
Fourth	68	49.3%	70	50.7%
Richest	116	71.2%	47	28.8%
Total	378		397	
Mother's Education*				
None	126	42.1%	173	57.9%
Primary	173	48.5%	184	51.5%
Secondary and Above	79	66.4%	40	33.6%
Total	378		397	
Underweight*				
Not Underweight	329	73.1%	121	26.9%
Moderate Underweight	49	15.1%	276	84.9%
Total	378		397	
Wasted				
Not Wasted	339	49.1%	351	50.9%
Moderate Wasted	39	47.0%	44	53.0%
Total	378		395	

* Statistically significant difference (p value < .05)

3.4 Wasted Children under Five

Table 6 describes the demographic and socioeconomic characteristics of children who were classified as wasted, with acute undernutrition and those who were not wasted. Overall, one in ten children under five was wasted (11.1%). The proportion of boys who were wasted was one and half times higher than for girls. Wasting also showed large differences by residence. Wasted children were nearly three times more likely to be from rural households than urban (12.5% and 4.5%, respectively). Variation existed by income group. Only 6% of children from the richest income group were wasted whereas 10% of the poorest children were wasted, although data were inconclusive since the children from households in the middle wealth quintiles had higher wasting than those from the poorest households. A gradient by mother's education was also observed, as education increased the proportion of wasted children decreased, although the relationship was not significant. Nearly ten times more wasted children were underweight compared to having an average weight. Stunting showed no association with wasting.

Table 6. Demographic and socioeconomic indicators of wasted children under 5

	Not Wasted		Wasted	
	N= 702	88.9%	N=88	11.1%
Age				
<i>0-5.9 months</i>	4	57.1%	3	42.9%
<i>6-11.9 months</i>	126	88.7%	16	11.3%
<i>12-23.9 months</i>	264	88.9%	33	11.1%
<i>24-35.9 months</i>	285	89.1%	35	10.9%
<i>36-47.9 months</i>	22	95.7%	1	4.3%
<i>48-59.9 months</i>	1	100.0%	0	0.0%
Total	702		88	
Sex*				
<i>Male</i>	342	86.6%	53	13.4%
<i>Female</i>	360	91.1%	35	8.9%
Total	702		88	
Residence*				
<i>Urban</i>	128	95.5%	6	4.5%
<i>Rural</i>	574	87.5%	82	12.5%
Total	702		88	
Income wealth quintiles*				
<i>Poorest</i>	150	89.3%	18	10.7%
<i>Second</i>	132	83.5%	26	16.5%
<i>Middle</i>	137	85.1%	24	14.9%
<i>Fourth</i>	129	92.8%	10	7.2%
<i>Richest</i>	154	93.9%	10	6.1%
Total	702		88	
Mother's Education				
<i>None</i>	267	87.5%	38	12.5%
<i>Primary</i>	323	88.5%	42	11.5%
<i>Secondary and Above</i>	112	93.3%	8	6.7%
Total	702		88	
Underweight*				
<i>Not Underweight</i>	441	97.6%	11	2.4%
<i>Moderate Underweight</i>	261	77.4%	76	22.6%
Total	702		87	
Stunted				
<i>Not Stunted</i>	339	89.7%	39	10.3%
<i>Moderate Stunted</i>	351	88.9%	44	11.1%
Total	690		83	

* Statistically significant difference (p value < .05)

3.5 Food Insecurity

Table 7 shows the demographic, socioeconomic and nutritional indicators between food insecure and secure households. Overall, almost two in five (38.5%) households reported that they did not have enough food or money to buy food in the previous month, and were classified as food insecure for this study. Statistically significant differences were observed between food security and many variables and characteristics. A much lower proportion of urban households were food insecure (19.3%) than households in rural areas (51.3%). An inverse linear gradient was observed between wealth and household food security status, as income increased the proportion of food insecure homes decreased. Almost three quarters of the poorest households were food insecure (72.8%) compared to less than 15% of the richest households (14.7%). As a mother's education level increased the proportions of food insecurity decreased. Over half of mothers with no education were from households classified with food insecurity whereas less than 20% of mother's with a secondary education or higher were from food insecure households. Underweight status and chronic undernutrition showed associations with food insecurity. Over half of children under five classified as underweight and stunted were from food insecure households (55.2% and 53.2%, respectively) in contrast to children who were not underweight (38.5%) or not stunted (36.5%) reflecting an increased odds of about 1.5 times that reached statistical significance. Interestingly, in this population, there was no association between wasting, or acute undernutrition and food security.

Table 7. Demographic, socioeconomic and nutritional status indicators for children under 5 by household food security status (in last month)

	Food Insecure		Food Secure	
	N = 401	38.5%	N = 634	60.9%
Age*				
0-5.9 months	6	60.0%	4	40.0%
6-11.9 months	66	36.7%	114	63.3%
12-23.9 months	159	39.5%	244	60.5%
24-35.9 months	152	36.5%	265	63.5%
46-47.9 months	17	70.8%	7	29.2%
48-59.9 months	1	100.0%	0	0.0%
Total	401	38.7%	634	61.3%
Sex				
Male	212	40.8%	307	59.2%
Female	189	36.6%	327	63.4%
Total	401	38.7%	634	61.3%
Residence*				
Urban	27	19.3%	113	80.7%
Rural	346	51.3%	328	48.7%
Total	373	45.8%	441	54.2%
Income wealth quintiles*				
Poorest	131	72.8%	49	27.2%
Second	92	57.1%	69	42.9%
Middle	74	46.0%	87	54.0%
Fourth	51	35.9%	91	64.1%
Richest	25	14.7%	145	85.3%
Total	373	45.8%	441	54.2%
Mother's Education*				
None	165	52.2%	151	47.8%
Primary	185	49.7%	187	50.3%
Secondary and Above	23	18.3%	103	81.7%
Total	373	45.8%	441	54.2%
Underweight*				
Not Underweight	174	38.5%	278	61.5%
Moderate	187	55.2%	152	44.8%
Underweight	361	45.6%	430	54.4%
Total				
Stunted*				
Not Stunted	137	36.5%	238	63.5%
Moderate Stunted	210	53.2%	185	46.8%
Total	347	45.1%	423	54.9%
Wasted				
Not Wasted	314	45.1%	383	54.9%
Moderate Wasted	46	52.3%	42	47.7%
Total	360	45.9%	425	54.1%

* Statistically significant difference (p value ≤ .003)

3.6 Coping Frequency

Table 8 shows the weekly frequency in which households reported using different coping strategies and were not mutually exclusive (that is, households reported on the uses of each coping strategy, regardless of whether another had been adopted). Questions on coping and the calculation of the coping strategy index was only generated for households that reported not having enough food or money to buy food in the past month thus are included in table 9 and all subsequent analyses (n=401). Overall, households reported a low level of daily use of most coping strategies, although reduction in the number of meals was most often employed on a daily basis (12.0% of all food insecure households) of 3-6 times a week (5.0%). Generally, households employed coping strategies either once or twice a week, or on a weekly basis. Consuming less preferred/less expensive food was the second most commonly reported coping strategy on a daily basis, followed by limiting portion size at mealtimes and restricting consumption by adults in order for small children to eat (6%, 4.5% and 2.0%, respectively).

Table 8. Household coping strategy frequency

Type of Coping Strategy	Frequency of Use							
	Daily		3-6 days/week		1-2 days/week		<1 day/week or never	
Consume less preferred/less expensive foods	24	6.0%	32	8.0%	138	34.4%	207	51.6%
Borrow food, or help from a friend or relative	0	0.0%	21	5.2%	191	47.6%	189	47.1%
Limit portion size at mealtimes	18	4.5%	19	4.7%	198	49.4%	166	41.4%
Restrict consumption by adults in order for small children to eat	8	2.0%	17	4.2%	179	44.6%	197	49.1%
Reduce the number of meals eaten	48	12.0%	20	5.0%	155	38.7%	178	44.4%
Total	98		109		861		937	

Figure 4 depicts the distribution of coping scores computed by frequency of use and weighed equally. Nearly sixty percent of households received a coping score of less than 10 and there was heaping at the score of 10.0 but this cut-off point was designated in order to further discriminate between food insecure households in terms of their coping modalities.

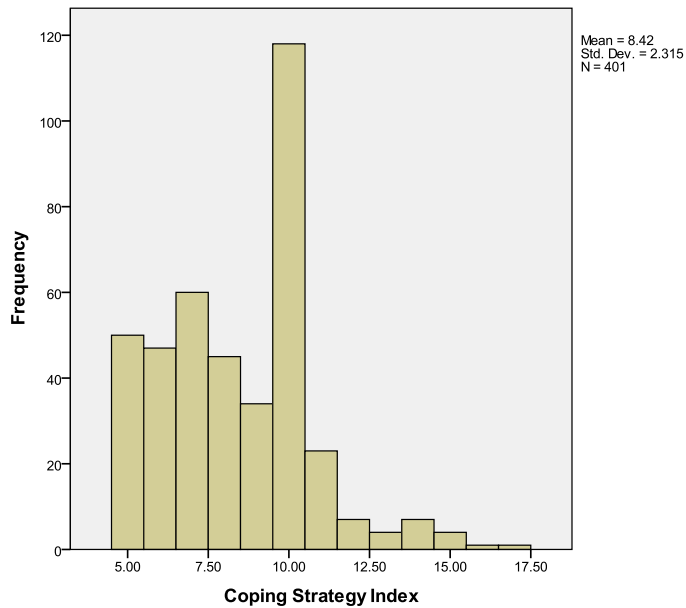


Figure 4. Distribution of Coping Strategy Index

Table 9 shows the demographic, socioeconomic and nutritional indicators between low and high coping households. As above, some 41.4% of the households had a high weekly coping frequency, defined by a coping score of more than 10 which was a reflection of the need to adopt and retain strategies in response to their food insecurity. Rural residences showed higher weekly coping frequency compared to urban residences (45.4% vs. 29.6%, respectively), although statistically significant differences by residence were not observed. The poorest households relied on coping more frequently than wealthier households with 64.1% of the poorest households receiving a high coping score compared to only 20.0% of the richest households, a difference which was statistically significant. The prevalence of chronic undernutrition was higher among children from households with high coping scores (50.0%) compared to those with low coping (33.6%), while similar differences were noted for underweight, although not as dramatic (47.6% underweight for children from high coping households vs. 39.7% amongst children from low coping households).

Table 9. Demographic, socioeconomic and nutritional status indicators for children under 5 by household coping score

	Low Coping Score (<10)		High Coping Score (≥10)	
	N= 236	58.9%	N= 165	41.1%
Age				
<i>0-5.9 months</i>	4	66.7%	2	33.3%
<i>6-11.9 months</i>	30	45.5%	36	54.5%
<i>12-23.9 months</i>	103	64.8%	56	35.2%
<i>24-35.9 months</i>	92	60.5%	60	39.5%
<i>46-47.9 months</i>	6	35.3%	11	64.7%
<i>48-59.9 months</i>	1	100.0%	0	0.0
Total	236	58.9%	165	41.1%
Sex				
<i>Male</i>	126	59.4%	86	40.6%
<i>Female</i>	110	58.2%	79	41.8%
Total	236	58.9%	165	41.1%
Residence				
<i>Urban</i>	19	70.4%	8	29.6%
<i>Rural</i>	189	54.6%	157	45.4%
Total	208	55.8%	165	44.2%
Income wealth quintile*				
<i>Poorest</i>	47	35.9%	84	64.1%
<i>Second</i>	57	62.0%	35	38.0%
<i>Middle</i>	45	60.8%	29	39.2%
<i>Fourth</i>	39	76.5%	12	23.5%
<i>Richest</i>	20	80.0%	5	20.0%
Total	208	55.8%	165	44.2%
Mother's Education				
<i>None</i>	89	53.9%	76	46.1%
<i>Primary</i>	106	57.3%	79	42.7%
<i>Secondary and Above</i>	13	56.5%	10	43.5%
Total	208	55.8%	165	44.2%
Underweight				
<i>Not Underweight</i>	105	60.3%	69	39.7%
<i>Moderate Underweight</i>	98	52.4%	89	47.6%
Total	203	56.2%	158	43.8%
Stunted*				
<i>Not Stunted</i>	91	66.4%	46	33.6%
<i>Moderate Stunted</i>	105	50.0%	105	50.0%
Total	196	56.5%	151	43.5%
Wasted				
<i>Not Wasted</i>	174	55.4%	140	44.6%
<i>Moderate Wasted</i>	24	58.5%	17	41.5%
<i>Severely Wasted</i>	4	80.0%	1	20.0%
Total	202	56.1%	158	43.9%

* Statistically significant difference (p value ≤ .003)

Plots were made for coping score by stunted, underweight and wasting status stratified by age, sex, residence, income, and mother's education. Strength of the relationships were calculated using Pearson correlation. As an example, Figure 5 shows the relationship between coping score and wasting stratified by mother's education. Relationships between stunting, underweight and wasting status by coping score were weak ($r = .025, -.049, .052$, respectively).

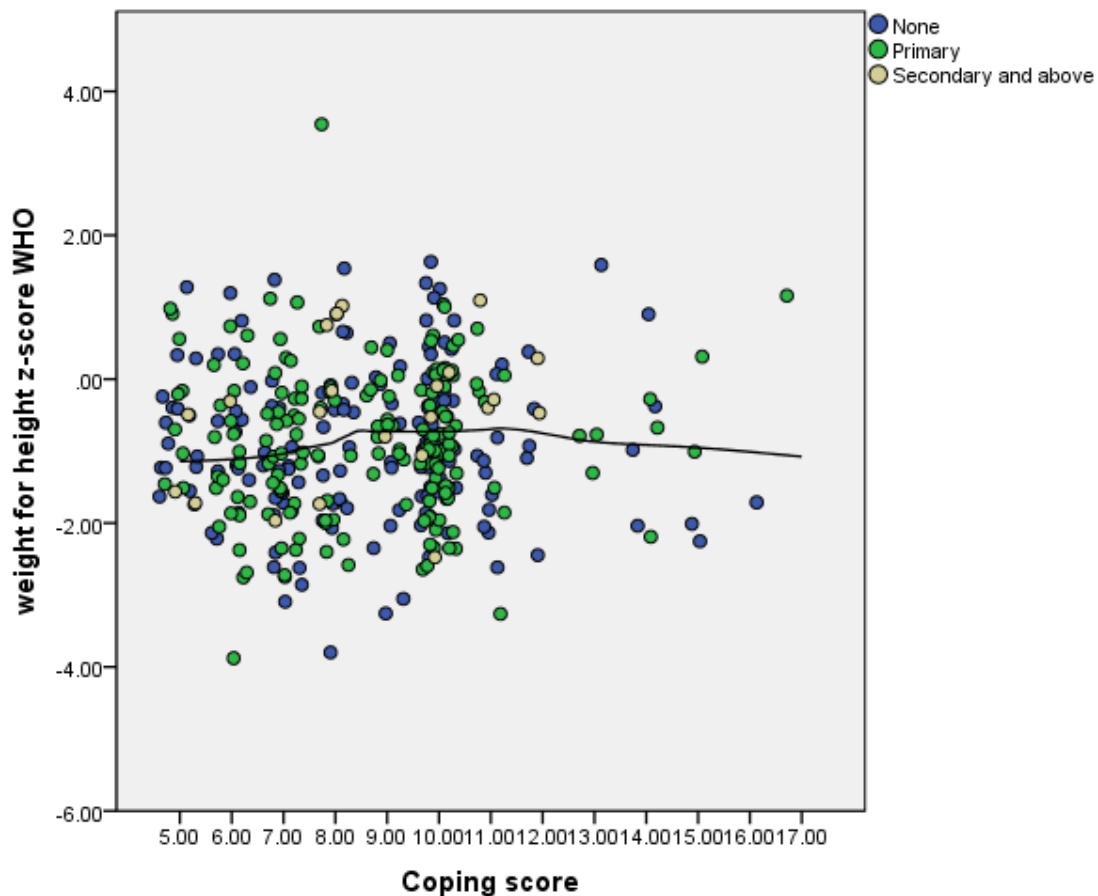


Figure 5. Association between wasting and coping score stratified by mother's education

Figure 6 plots the combined feature of consuming less preferred, less expensive foods relative to the amount in which they used coping strategies overall relative to weight-for-height status z-scores ($r = .069$). Fifteen plots were created showing the relationship between relative

food coping scores and stunting, wasting and underweight, but again no significant relationships were observed between relative coping frequencies and nutritional status.

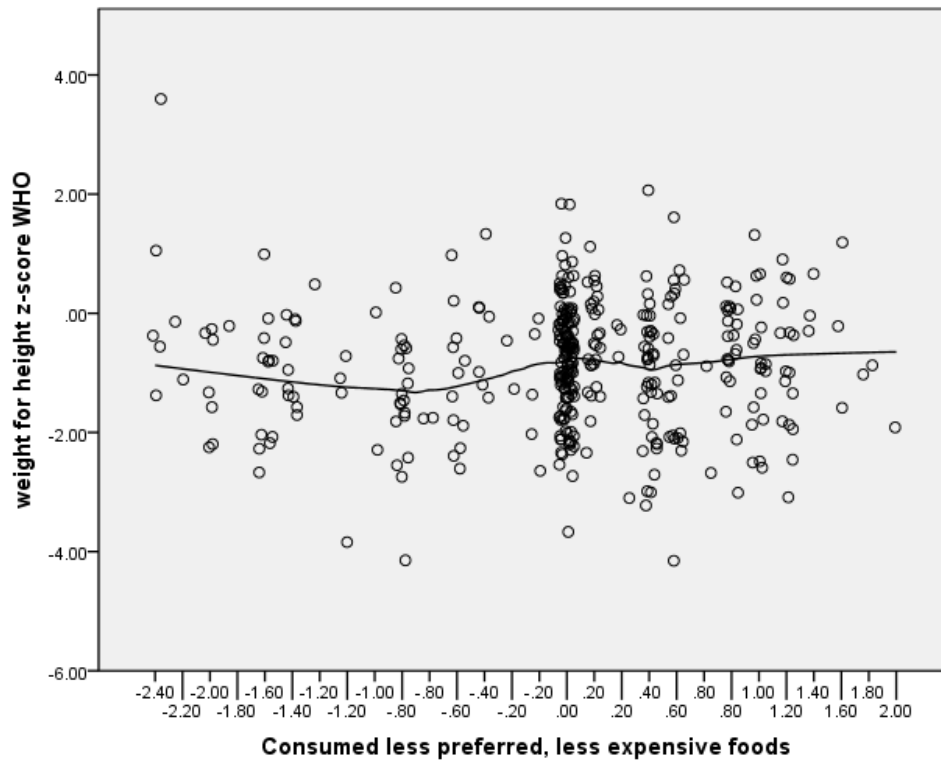


Figure 6. Association between wasting and relative frequency of consuming less preferred, less expensive foods

4. Discussion

Prevalence of undernutrition in Lao PDR is high. Two in five children were underweight, more than half of children were stunted and over 10% of were wasted. Children living in urban residences were clearly at an advantage in terms of nutritional status as children living in rural households had higher proportions of underweight, stunting and wasting. This relationship was also found by food security classification. As previously discussed, Lao PDR is comprised of lowlands and uplands with 70 percent of the population living in the later which are

characterized as having poor infrastructure. This has many implications for the health of a child. In terms of food security accessibility is likely an issue since transport of goods to these areas is difficult. Health care services are likely more difficult to access in rural and therefore more remote areas in comparison to urban areas. Income and mother's education both showed strong relationships with nutritional status. Richer households and those with more educated mothers resulted in higher proportions of children in good nutritional standing (absence of underweight, stunting and wasting).

Nearly 40 percent of households from our sample self-reported experiencing food insecurity in the prior month which presents a significant problem. A relationship with food security classification and residence was also found. A much lower proportion of urban households were food insecure (19.3%) than were classified as being food secure (80.7%). Interventions aimed at amending this could have a significant impact on food security and thus nutritional status. The government has identified this issue and developed campaigns targeted at improving the lives of upland residents which is discussed further.

This study examined the single pathway between nutritional status and coping strategies; figures 2 and 3 illustrate the multiple determinants that are associated with a child's nutritional status. Many factors besides food security and thus coping strategies influence the nutritional status of children under five making measurement complex. The first study conducted in Lao PDR (2011) to measure socioeconomic determinants of the nutritional status of children reported that causes of undernutrition in Lao PDR stemmed from socioeconomic conditions (27). The 2011 study showed that children in Lao PDR from low socioeconomic levels that are geographically isolated suffered greater risk of being undernourished. Additionally,

studies have found high prevalence of undernutrition in food secure households, which indicates that food security is only one of many determinants of undernutrition (23). The present study confirms that residence, income and mother's education are related to food security; other studies have reported that nutritional status and food security are associated (17)(23). This study provides no indication that type of coping is associated with stunting, wasting or underweight status.

Relationships between income, stunting and coping frequency were found. Poorer households reported higher utilization of coping strategies (64.1% poorest, 20.0% richest). This may be because wealthier households are able to use non-food coping strategies such as income/expenditure mechanisms when faced with food shortages (21). Examples of non-food coping strategies include selling valuable materials, reducing spending on education and having a second job (21). The survey conducted in Lao PDR only asked respondents about food coping techniques. A higher proportion of non stunted children were from low coping households (66.4%) compared to high coping households (33.6%). Stunting is a result of sustained undernutrition whereas coping responses (and food insecurity) were based on the households' experience the prior month which makes extrapolating a relationship between the two complicated.

Most households reported using coping strategies less than once a week followed closely by 1-2 times a week. The frequency of households reporting daily coping use or use 3-6 times a week lagged considerably behind responses of less frequent usage. This may be related to the severity of food insecurity experienced by households. A more sensitive measuring tool is needed to discern this in future studies.

In order to conquer food insecurity all four dimensions of food security (availability, access, utilization and stability) must be satisfied. The Lao PDR government has undertaken policies to encourage development and agricultural sustainability. A resettlement campaign moved communities from the less accessible highlands to the lowlands (13). This may have implications for food accessibility and utilization as health services are more accessible but adapting to a new life has been difficult for many communities (13). Slash and burn agriculture was banned to increase agricultural sustainability but these restrictions have limited the land available for cultivation (13). Lastly, eradication of opium production has left many without income generating work (13). These policies have all likely had an impact on the four components of food security for Lao PDR residents.

To address undernutrition governments can pursue either nutrition specific or nutrition sensitive interventions or a combination of both. Pinstrup-Andersen argues that treatment of chronic diseases and micronutrient supplementation address problems that could be prevented (31). He advises governments to design interventions aimed at changing the behavior of farmers, consumers, food processors, and other economic agents by incentivizing, regulating and increasing knowledge (31). Interventions geared at multiple determinants will have the greatest likelihood of success because of the multifaceted nature of undernutrition.

Several limitations exist in this study. Determining food insecurity is complex and the present study classified this variable through a single question. The 2014 Nepal study demonstrated that methods used to determine households as food secure and insecure and their subsequent relationship with undernutrition may be a factor in the outcome of these associations (23). Food insecurity classification was determined through self-reporting, which

may not have captured all households suffering from food insecurity especially those experiencing micronutrient deficiencies, as referred to previously as hidden hunger. Stated another way, households may not have the tools to accurately define whether they are food secure or insecure. Further analysis between dietary diversity and self-reported food insecurity could be examined in future studies. Households that reported not having enough food or money to buy food in the past month were excluded from the study, which reduced the sample size. A study conducted in Sekong Province in 2005 found that food insecurity was commonly experienced. In fact, half of the households reported having rice for only 3 months or less per year (32). Depending on the conditions during the time in which the present survey was conducted households that frequently experience food insecurity may have been missed because they considered themselves food secure at the time of the study, thus important coping strategy data may have been missed. Also, this study attempted to examine the relationship between a household level indicator and child level indicator which may introduce external factors influencing the pathway making a relationship more difficult to distill.

Additionally, coping strategy data was collected from households through self-reporting, which introduces recall bias. An individual reporting on the past month may not accurately remember how often individual coping strategies were employed. Coping strategy frequency was reported using a weekly frequency scale. There was no option for households to report never using an individual coping strategy instead, 'never' using a coping strategy was combined with using a coping strategy less than once a week, thus data for never employing an individual coping strategy was unavailable. Being unable to measure households that never used a coping

strategy may have limited the study's ability to determine the association between type of coping strategy and nutritional status of children under five in our study site.

Finally, the nature of a cross-sectional study provides only a snapshot of conditions in the study area and does not infer causality. Children that are stunted, wasted and underweight have likely been experiencing negative conditions extending for more than 30 days (with stunting as a long-term condition). A prospective study, in which data is collected over time, may be better geared for food security analysis since a seasonal component may exist and a households' experience with food security may change over time. Prospective data collection may uncover associations between coping strategies and nutritional status since these mechanisms may change as food security becomes more or less severe.

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