Discussion Paper Series

RIEB

Kobe University

DP2014-17

Nutritional Status of Children, Food Consumption Diversity and Ethnicity in Lao PDR*

Samuel Kobina ANNIM
Katsushi S. IMAI

March 29, 2014

Research Institute for Economics and Business Administration
Kobe University
2-1 Rokkodai, Nada, Kobe 657-8501 JAPAN

NUTRITIONAL STATUS OF CHILDREN, FOOD CONSUMPTION DIVERSITY AND ETHNICITY IN LAO PDR[1]

Samuel Kobina Annim
Department of Economics, University of Cape Coast, Ghana

Katsushi S. Imai *
Economics, School of Social Sciences, University of Manchester, UK
& RIEB, Kobe University, Japan

26th March 2014

Abstract

This study examines the effect of consumption of diversified diets and cultural practices on the nutritional status of children less than five years. The primary hypothesis of the study is that rearing of poultry, sheep and goats enable households to have access to diversified food items, which in turn increases the nutritional status of children in the household. Ordinary Least Squares and Instrumental Variable estimations techniques are employed based on a sample of over 10,000 children less than five years old from the 2011 Lao Social Indicator Survey. The main finding is that children in households that rear livestock consume diversified diets and that in turn leads to higher nutritional status. Both positive and negative statistically significant signs are observed for the prevalence of malnutrition across different ethnic groups in Lao PDR. Thus a one-size fit all intervention for malnutrition will have challenges. From a policy perspective, there should be a campaign for the consumption of diversified foods rather than a single or a couple of food items. To ensure the consumption of diversified food items, rearing of livestock has to be promoted through alternative options including educational campaigns.

Keywords: *Diversified Diet, Livestock, Ethnicity, Height-for-age, Weight-for-Age and Weight-for-Height, Lao PDR.*

JEL Codes: I12; I18 and Q18

Corresponding Author
Katsushi S. Imai (Dr.)
Economics, School of Social Sciences, University of Manchester, Arthur Lewis Building, Oxford Road, Manchester M13 9PL, UK; Phone: +44-(0)161-275-4827 ; Fax: +44-(0)161-275-4928 ; E-mail: e-mail: subhasish.dey@manchester.ac.uk

Introduction

[1] This study has been funded by IFAD (International Fund for Agricultural Development). We are grateful to Stefania Dina for her support and guidance throughout the study.

Adequate nutrition is essential for child's intellectual and physical development. Therefore ensuring that infants and children have adequate nutrition is an important step towards a healthy populace. This translates into reduced public expenditure on health curative related issues and also promotes economic growth. In response, awareness about child malnutrition[2] and taking pragmatic steps to reduce its incidence via strategies such as food security has heightened. The forgoing is supported by the observation that target 1C of the first Millennium Development Goals (Eradicate Extreme Poverty and Hunger by 2015) identifies prevalence of underweight children under-five years of age and proportion of population below minimum level of dietary energy consumption as the targets. To this end various nations, especially in developing countries have instituted programmes and action plans to promote better nutritional status for different age groups (infants, children and adults). In spite of these attempts nearly 870 million people globally, were malnourished between 2010 and 2012 (Food and Agriculture Organization (FAO), 2012). Not surprisingly, about 98 percent of these people live in developing countries. Like all other poverty indicators, the vulnerable and children are most affected by malnutrition. About half of the estimated 10.9 million child deaths worldwide have been attributed to poor nutrition (Can and Hunger Notes, 2013). Also, malnutrition has been attributed to a number of diseases because it weakens the immune system to fight bacteria. Available evidence suggests that malnutrition as an underlying contributing factor to a number of diseases and child death is as follows: diarrhea (61%); malaria (57%); measles (52%); pneumonia (45%) and child death (53%) (Black, Morris, & Bryce, 2003; Bryce, Boschi-Pinto, Shibuya, Black, & WHO Child Health Epidemiology Reference Group, 2005).

The proportion of children stunted (<-2SD of height-for-age z-scores), wasted (<-2SD of weight-for-height z-scores), and underweight (<-2SD of weight-for-age z-scores), have been used as indicators for measuring Target 1C of MDG1 (Annim, Awusabo-Asare, Amo-Adjei, & ICF International, 2013). Current global estimates put these indicators at 106 million stunted, 101 million underweight and 52 million wasted. An approximated 70 to 90 percent of the global incidence of malnutrition is in Africa and Asia. The fact that these two regions have high rates of child malnutrition is not surprising since they also have the highest poverty rates in world.

Notwithstanding the fact that Southern Asia has achieved progress in reducing malnutrition in recent years, the region still has the highest proportion of underweight children (31%) (MDG Report, 2013). In South East Asia and the Pacific, the prevalence at the aggregate masks the wide differentials at the individual country level. Figure 1 presents prevalence rates of stunting, wasting and underweight of children less than five years for countries in South East Asia and the Pacific for 2010. However, in India and Thailand the available data is for 2005/06 and 2011 for Vietnam. Comparing countries with data on malnutrition for 2010-11 that is Lao PDR, Bhutan, Vietnam and China, Lao PDR has the highest prevalence for all three anthropometric indicators. In deed for underweight and wasting the rates in Lao PDR is twice that of Bhutan and China. Prevalence rates of Lao PDR is based on the recent Lao PDR Social Indicator Survey (2011-

[2] In the paper, malnutrition is used to refer to children with <-2SD for height-for-age, weight-for-age and weight-for-height. Proportion of overweight is negligible in Lao PDR (about 2%).

2012) which reports 27 percent of children under age five are moderately underweight and seven percent are severely underweight; 44 percent are also moderately stunted and 19 percent are severely stunted and six percent are reported as moderately wasted with one percent severely wasted. Although the malnutrition prevalence rates reported for India relates to a 2005/06 survey which makes comparison with 2010 statistics a bit restrictive, the high prevalence which is about the same for Lao PDR in the same year (Figure 2) is worth highlighting. This is because the comparable prevalence rates will constitute a good base for benchmarking differences in policies in the two countries that might have contributed to changes in malnutrition prevalence rates.

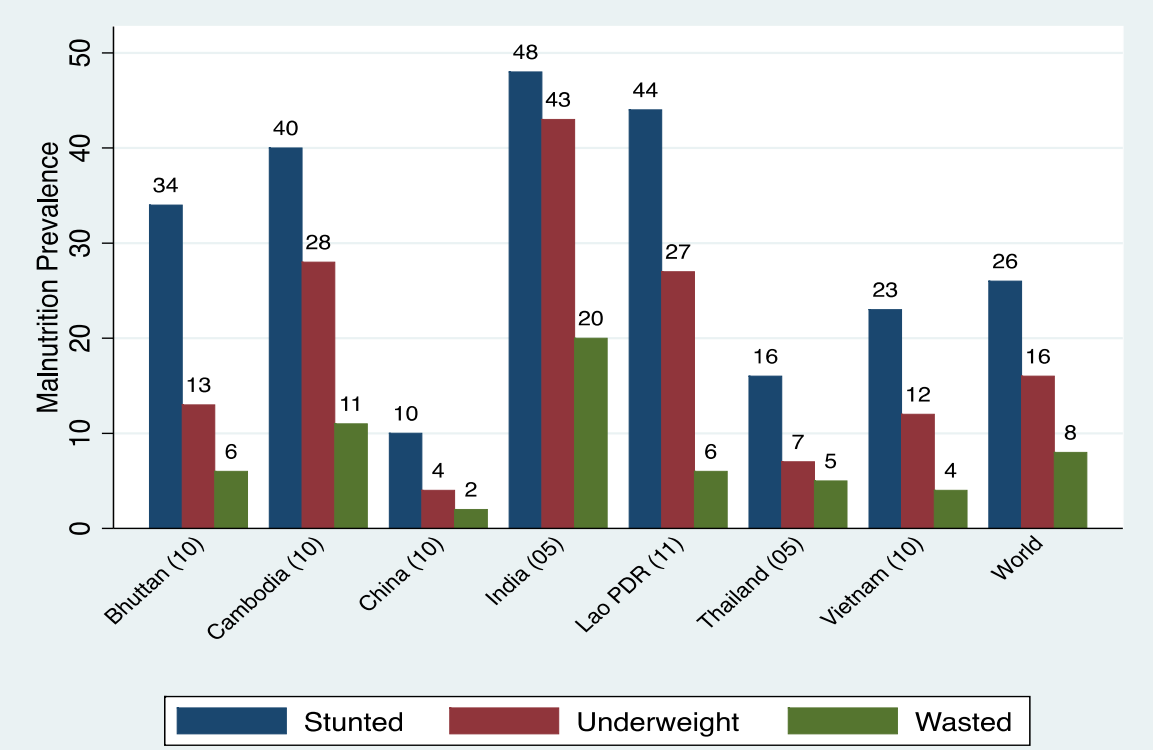

Figure 1: Prevalence of Malnutrition by Countries in South East Asia and The Pacific in 2010
Source: www.childinfo.org

Since 2000 different surveys have captured information on the prevalence of child malnutrition in Lao PDR. Use of such surveys should take into consideration the differences in sampling since though nationally representative; some are skewed towards the rural areas whereas others have both rural and urban focus. Figure 2 presents malnutrition in Lao PDR from six national surveys namely; National Health Survey (NHS), (2000); Multiple Indicator Cluster Survey (MICS), (2006); World Food Programme (WFP), (2006); Lao PDR Social Indicator Cluster Survey (LSIS), (2011) and Risk and Vulnerability Survey (RVS), (2013). Two of the six surveys (WFP and RVS) although had a national coverage in terms of provincial and agro-ecological zone, representation targeted only rural households.

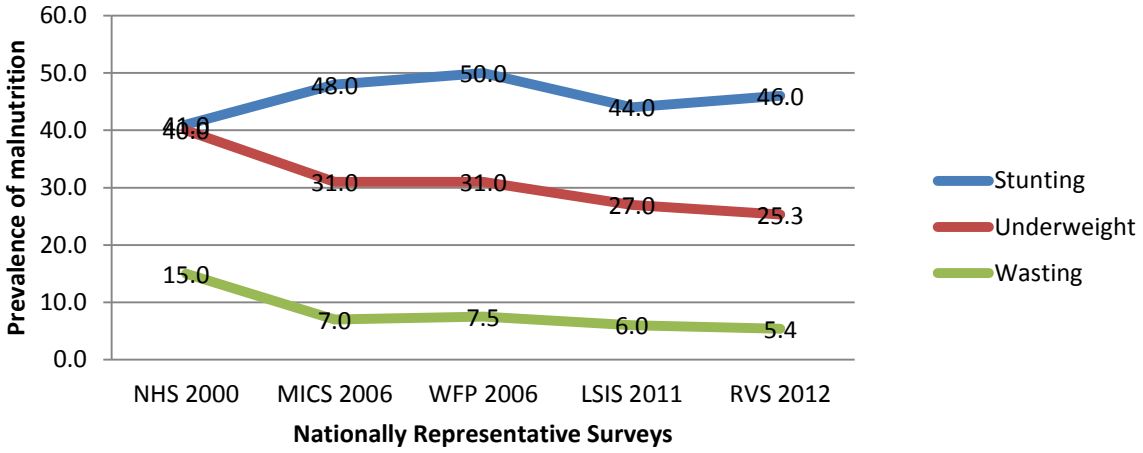

Figure 2: Trends of Malnutrition in Lao PDR based on different Nationally Representative Survey for the Period 2000 to 2012

Of the three malnutrition indicators, wasting has declined more over the period 2000 to 2012 irrespective of the sample target of the survey that is either rural or both rural and urban. While underweight has also declined over the same period the percentage change is about 15 with the recent survey (RVS) showing that underweight in Lao PDR is 25.3. Stunting rates over the period 2000 to 2012, have fluctuated both for surveys with rural and urban orientation as well as comparison across surveys with different sample (rural and urban) orientation. Comparing the NHS 2000 with LSIS 2011, both rural and urban orientation, children too short for their heights (stunted) have increased by three percentage points. On the other hand, comparing height-for-age for children less than five years using the two surveys with a sample inclination towards rural households (WFP 2006 and RVS 2012), stunting in Lao PDR for rural households has declined by four percentage points.

The minimal and varied progress made towards reducing malnutrition in Lao PDR deepens concern on the consequences of malnutrition. Figures 3 and 4 corroborate the positive association between under-5 mortality and child malnutrition for different regions and among ethnic groups in Lao PDR.

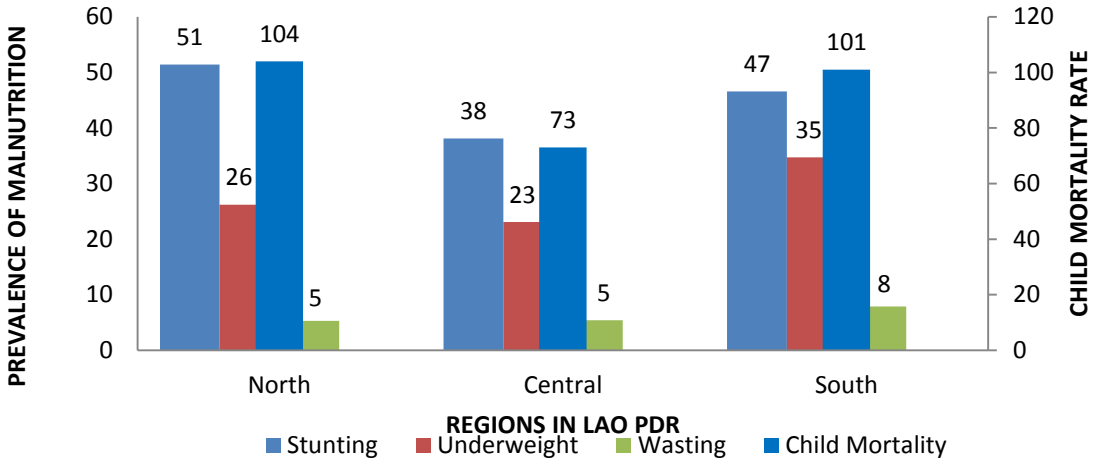

Figure 3. Regional Prevalence of Malnutrition and Under-5 Mortality in Lao PDR in 2011
Source: LSIS Survey Data (2011)

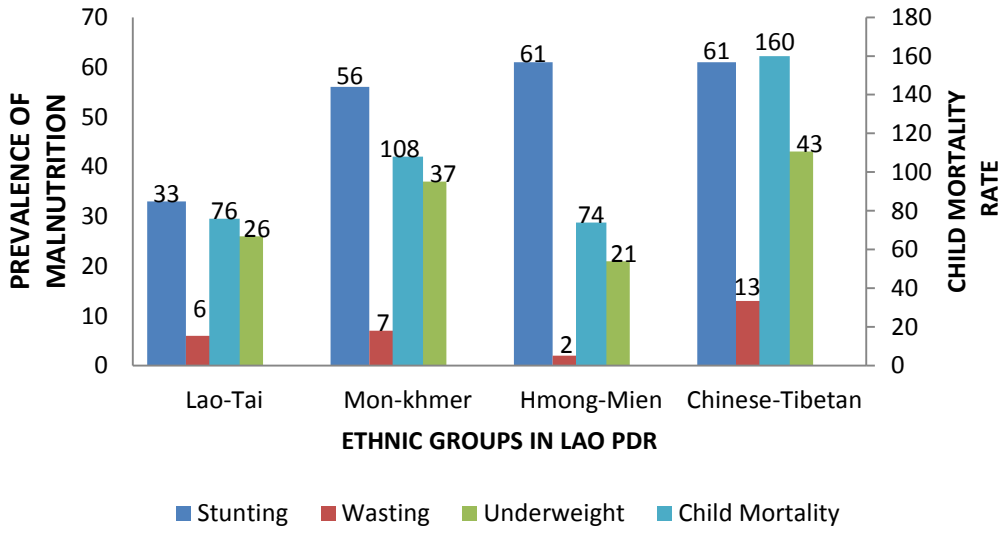

Figure 4: Prevalence of Malnutrition among Ethnic Groups and Under-5 Mortality in Lao PDR in 2011
Source: LSIS Survey Data 2011

The Government of Lao PDR (GoL) has over the years implemented programmes and policies to reduce the incidence of poverty and improve nutrition. Most recent of such policies are the "Right to Adequate Food" which the GOL ratified the International Covenant on Economic, Social and Cultural Rights (ICESCR) (50) in 2007 and the "National Nutrition Policy" (NNP) formulated in 2008. The NNP identified priority areas to tackle the malnutrition menace and as well set targets to be achieved by 2015 and 2020. Prevalence rates presented in Figure 2 indicates a slow progress in achieving all three anthropometric targets set in 2015 that is stunting (34%), wasting (4%) and underweight (22%). This raises a number of questions including the following: were the targets overambitious; were there any signals of poorly targeting the 'right' group of malnourished children and were the targets divergent in a manner that inhibited the

optimal harnessing of the expected benefits. The latter justifies the recommendation of a convergence approach in addressing the malnutrition menace in Lao PDR (United Nations, 2013). The Multisectoral Food and Nutrition Security (FNS) Action Plan designed for the period 2014 – 2020 primarily, aims at accelerating the progress in reducing undernutrition via the implementation of both nutrition-sensitive and nutrition-specific interventions. In this regard, agriculture, education, health and water, sanitation and hygiene (WASH) related interventions would be implemented in the next seven years. Examining the conditional effect of each of these factors on malnutrition, as per this paper's orientation, is therefore imperative and timely.

From a theoretical perspective, manifestation of malnutrition (stunting, wasting and underweight) is underpinned by three major constructs: structural (residence and geographic), underlying household/family (sanitation, parental education, wealth, childcare practices), immediate (diseases, health promotion and prevention and food security – times child was fed, child characteristics e.g. age, sex birth order etc.) (UNICEF, 1990). Thus the extant literature identifies food intake as one of the proximate (immediate) determinants of child's nutritional status. Though this might be suggestive that the relationship between food security and nutritional status is well known, there exists a knowledge gap on the transmission mechanism given the comprehensive definition of food security. Food security from the extant literature have been defined to include at least four diverse components namely; food quantity, quality, diversity and sustainability. Returns of a policy intervention aimed at ensuring food security will largely depend on which component of food security is being pursued. For instance, a policy on food security from a supply (production) perspective will address the availability of food concern but not likely to translate into impact positively on nutritional status. The impact on nutritional status is determined by the nutrients in food consumption and a variety of food items consumed.

The relationship between food security and nutritional status is also marred by differences in unit of observation and/or analysis. That is in examining the nutritional status of children in a household, observation/measurement of food security could be at different levels namely; children, mothers and household. Choice of any of these three will impact on the nutritional status of the children in the household however, the transmission mechanism for the impact would be different and also might take different time periods. For instance, mothers who are food secured are likely to produce nutritious breast milk for their children which will translate into better nutritional status of the children. However, for children more than two years of age other direct consumption of other semi-solid food items will engender a much more positive nutritional status if complemented with the nutritious breast milk. These complexities have paved way for this exercise to test the following hypotheses: consumption of individual food items namely; infant formula, milk, yoghurt or semi-solid food have positive effect of the nutritional status of children and consumption of a diversified basket of food items yields a positive effect on the nutritional status of children. The importance of dietary diversity in the child health production function is underscored in Hooshmand and Udipi (2013) who found that dietary diversity scores were high among children who had normal weight and overweight and lowest among children who were underweight.

As indicated earlier, the UNICEF, (1990) conceptual framework for the manifestation of nutritional identifies household/family conditions as the underlying factors. In this regard, the issue of care is illuminated. Since care is intangible, several factors have been used as proxies to measure the degree of care that a child is likely to get from the household/family. This exercise extends its orientation to examine factors that are likely to influence the care that a child would receive as a result of mother's educational status and ethnic group of the household.

In Lao PDR, poor maternal education has been cited as one of the causes of malnutrition. The LSIS (2012) estimate that about 69 per cent of young women (age 15 – 24) are literate compared to 77 % young men, with variation across regions. Studies that have tried to link education to malnutrition try to identify pathways through which the education effect is realized. A review of the literature show four broad pathways: socioeconomic status; women's empowerment and autonomy; health knowledge and attitudes; and health and reproductive behavior (see Makoka & ICF International, 2013). Thus empirical works in this area have modeled the effect of maternal education in the child health production function following these broad themes.

The main argument of the models on women's bargaining power is that through education women are able to participate in the decision making process which ultimately affects child health outcomes. Thus educational attainments allow women to exert higher control over health choices that affect them as well as their children (Hobcraft, 1993). In the view of Frost, Forste, and Haas, (2005) maternal education creates awareness about child health with regards to causes, prevention and treatment of diseases. Also it does promotes awareness on the importance of immunization (Ruel, habicht, Pinstrup-Andersen, & Grohn, 1992) and causes a behavioral shift from just accepting child health outcomes as given towards the implementation of simple health knowledge. Studies that have investigated the relationship between child health outcome and maternal education have found a positive impact of education on child health. Makoka (2013) Show that the threshold necessary for women's education in significant reduction in child health ranges from at least five years of schooling in Tanzania to eight years in Zimbabwe and nine years in Malawi. In their study in India, Imai et al. (Imai, Annim, Gaiha, & Kulkarni, 2012) concluded empowering women through education has positive impact on the weight-for-age and weight-for-height of children. An earlier study by Phimmasone, Douangpoutha, Fauveau, and Pholsena, (1996) shows that Laotian women who had complete primary education were less likely to have children who are stunted or wasting.

One other factor that greatly influences child health outcomes in developing countries is cultural beliefs. Cultural beliefs and practices can have both positive and negative impact on child health. Some societies have strict codes on diet for pregnant and infants that prohibits the intake of specific food items and animal products. Neumann, Gewa, & Bwibo (2012) mentions negative cultural beliefs, in addition to poverty, lack of availability and accessibility of animal food, as one of the main causes of micronutrient deficiency among infants in developing countries. Cultural and beliefs affect health attribution and ultimately determine choice of remedy. Some authors have argued that poverty must not always be blamed for the non-adoption of modern preventive and curative health care as the cost is sometimes within the means of the poor. But

rather non-adoption must be blamed on social and cultural beliefs concerning child health outcomes (Feyisetan & Adeokun, 1992).

In Lao PDR, different ethnic groups have certain beliefs that may influence child and maternal health. Holmes, Hoy, Lockley, Thammavongxay, KBounnaphol, Xeuatvongsa, Toole (2007) report that most Khmu mothers discard colostrum for 1-6 days for the fear of causing diarrhea. The baby is instead fed by dipping cotton bud into honey or glucose for the period until white appears and some infants are also fed chewed rice or rice soup from day one. In other instances, some foods are forbidden, it is believed among the Lue that egg delay teething or cause tooth problems. Also, Sa et al. (2013) in a study on the cultural influence on the food security-nutrition nexus among children of the Khmu ethnic group in Lao PDR, observes wide variation in the feeding practices of both mothers and children. Notable among the restrictions is the feeding taboos during pregnancy and post partum and the early introduction of pre-lacteal foods. These cultural beliefs may influence childcare and feeding habits of mothers and infants.

Of the factors that affect child health outcomes, dietary diversity and nutrition have received attention in recent times. Dietary diversity is particularly important for infants and young children who need nutrient and energy-dense food for healthy growth as well as physical and mental development. It is recommended that breast milk should be supplemented with nutritious diet after 6 month of exclusive breastfeeding. To this end most infant feeding guidelines emphasis dietary diversity as a way of improving nutritional status of children. To test this hypothesis Arimond and Ruel (2004) used data from the Demographic Health survey for 11 countries. After controlling for household socioeconomic status, the study found a positive association between diversified diet and child nutritional status. An earlier study by (Onyango, Koski, & Tucker (1998) also found that it is important to ensure dietary diversity among children aged 1 to 3. The findings of these works therefore suggest that public health interventions for children should also emphasis dietary diversity in addition to exclusive breastfeeding.

This paper examines the relationship between child malnutrition in Lao PDR and food security, mother's education and cultural differences. Specific hypotheses tested in this paper are as follows: (i) consumption of a diversified basket of food (made up of a count of the nine food items) yields consistent results across all three anthropometric indicators compared to the consumption of individual food items; (ii) cultural practices that impose restriction on the food consumption/habits and childcare contribute to malnutrition and (iii) mothers with higher education have children with better nutritional status. In addition to these hypotheses, this exercise explores the relationship between ownership of agricultural land/size and malnutrition in Lao PDR. The latter is exploratory because land is one of the variables that have been used in capturing wealth of the household in the LSIS data and therefore its effect is swept away when both variables are included in a model. Also, the measurement of the land size using hectares lumps up most of the households (about two-thirds) as having less than two hectares. This masks the differences in land size across households and therefore restricts our understanding of the effect of the potential effect of land on malnutrition.

Motivation and guidance for this exercise is drawn from the sluggish reduction of malnutrition in Lao PDR and also from the exiting studies that have established the likelihood of these factors in influencing child malnutrition in other countries: food security (Arimond & Ruel, 2004; Steyn, Nel, Nantel, Kennedy, & Labadarios, 2006); mother education (Cochrane, Leslie, & O'Hara, 1982; Thomas, Strauss, & Henriques, 1991).

The rest of the paper is organized as follows. The next section considers the methodology adopted in this exercise. This is followed by the analyses and discussion of the results and lastly conclusions are drawn with policy recommendations and implications.

Methodology

Data

Data for the study was extracted from the Lao Social Indicator Survey (LSIS). The Ministry of Health and the Lao Statistics Bureau carried out this survey in 2011/2012. The LSIS (2012) is a household survey that applied the technical framework of both the Multiple Cluster Indicator Survey (MICS) and Demographic Health Survey (DHS). It thus provides up to date information on the health, social and economic circumstances of children, women and men : specific questions are related to health, nutrition, education, water and sanitation, marriage and sexual activity, fertility and mortality, contraception, HIV/AIDS, child protection, and use of mass media and information technology (LSIS, 2012).

In all 19,960 households were selected for inclusion in the survey out of which 18,843 were eventually interviewed. Within these households 22,476, 9,951 and 11,067, females, males and children respectively were interviewed. Out of the 11,067 children interviewed 10,162, 10,293 and 10,099 respectively were used for the weight-for-height, height-for-age and weight-for-age analyses. Even though these are significantly less than the total sample in the survey, our subsample is representative because the results from the subsample are consistent with the results in the report of the survey (see Figure 2, pp. 3)

Measurement of variables

This section describes measurement of the main variables used in the study i.e. food diversity, nutritional status (stunting, wasting and underweight), ethnicity and mothers education.

Food Consumption diversity: In the last decade, a variety of measures of food consumption diversity have emerged from different sources namely, academic researchers, World Food Programme (WFP), World Health Organization (WHO), United States Agency for International Development (USAID), and Food and Agriculture Organization (FAO). Primarily, the measures have focused on the consumption of different food groups and the unit of observation has been either the household or the individual. While all the measures underscore the importance of counting the number of different food groups, applying weights and including frequency of consumption in the measurement are some of the sources of variability across the measures.

For children, specifically those aged between 6 – 23 months, WHO (2010) recommends the use of a minimum dietary diversity (MDD) and minimum meal frequency (MMF) as indicators for food consumption diversity. The measure is based on a count of seven food groups namely, grains, roots and tubers; legumes and nuts; dairy products (milk, yogurt, cheese); flesh foods (meat, fish, poultry and liver/organ meats); eggs; vitamin-A rich fruits and vegetables; other fruits and vegetables and based on counts a child consuming any food item in at least four of the food groups is classified as consuming a diversified diet. To complement the use of counts, the MMF number of times breastfed and non-breastfed children receive solid, semi-solid, or soft foods or milk feeds has been recommended. The use of frequency is consistent with the WFP's computation of food consumption.

In view of the absence of a wide variety of food items in the LSIS survey for the construction of food groups, adopting fully the WHO approaches for computing food consumption diversity for children was a challenge for the current study. To partially surmount this challenge, but still using either the count or the frequency approach, consumption of breast milk, infant formula, yoghurt, semi-solid food, juice/juice drink, porridge, liquids from bottle with a nipple, vitamin or mineral supplement and other liquids in the last day preceding the survey was employed to capture food diversity score for children less than five years. Given the number of food items the score ranged between 0 and 9 implying that children with higher scores consumed a more diversified diet. Since the contribution of some of the food items such as liquids from bottle with a nipple and other liquids were not specific, sensitive variants (use a maximum of seven, eight or nine) were explored to assess variability in the estimated signs and coefficients. The results remained the same for instances where the basket of food items excluded liquids from bottle with a nipple and other liquids.

Nutrition status (Anthropometric indicates): Nutrition status of the child is measured using three anthropometric indicators, each capturing a different aspect of malnutrition. Stunting (height-for-age) is used as an indicator of chronic undernutrition attributable to prolonged food deprivation, wasting (weight-for-height) caused by more recent food deprivation and underweight (weight-for-age) is an indicator for both acute and chronic undernutrition. These indicators are captured as z-scores with values in range of ± 6 and thresholds for classifying nutritional status (WHO, 2006). Subsequently a child is classified as stunted, wasted or underweight if he/she had z-scores less than -2 standard deviations for height-for-age, weight-for-height and weight-for-age respectively. Binary outcome of these anthropometric indicators are used for descriptive analyses while the raw z-scores (continuous) partly warrants the engagement with least squares regression analysis.

Ethnicity: The ethnicity effect on child nutrition outcome was captured in this study with a set of dummy variables for the ethnic group of the household head. All household heads and for that matter children belong to Lao Tai, Khmu, or Hmong. Household heads belonging to other ethnic groups were put in a fourth category called other.

Mother's education: The mother's educational attainment was used to measure the effect of mother's knowledge on the appropriate care required to promote acquisition of better nutritional status for children. Highest level of schooling of the mother was used as a measure for educational attainment. Those with no formal education or preschool were put into one category and labeled as "none" and were assigned the value 0. The other categories are primary, lower secondary, upper secondary, Post-secondary and Higher (Tertiary education). The expectation is that mother's with higher education have better child knowledge which translates into improved child's nutritional status.

Model specification and estimation technique

This section presents the empirical model that was estimated as well as the estimation technique used to estimate the model. As indicated above we run three models for each of the nutrition indicators. Based on the reviewed literature and the purpose of this study we estimate the determinants of child nutrition as:

$$y_{ij} = \theta_o + \theta_1 food_i + \theta_2 mumedu_i + \theta_3 ethnic_i + \theta_4 mumage_i + \theta_5 urban_i + \theta_6 water_i + \theta_7 cage_i + \theta_8 toilet_i + \theta_9 kids_i + \theta_{10} fever_i + \theta_{11} diarrhea_i + \theta_{12} sex_i + \theta_{13} wealth_i + \theta_{14} kids_i + \theta_{15} Province_i + \epsilon_i \quad (1)$$

where: $\boldsymbol{food}$=food diversity score; $\boldsymbol{mumedu}$ =mother's education; $\boldsymbol{mumage}$=mother's age $\boldsymbol{ethnic}$ = ethnicity of head of the household; $\boldsymbol{urban}$=whether the household is in an urban area; $\boldsymbol{water}$=source of potable water; $\boldsymbol{toilet}$ = type of toilet facility; $\boldsymbol{kids}$=number of kids in the household; $\boldsymbol{fever}$=whether child had fever in the last two weeks; $\boldsymbol{diarrhea}$=whether child had diarrhea in the last two weeks; sex=the sex of the; $\boldsymbol{wealth}$ = wealth index of the household and $\boldsymbol{province}$=province fixed effect.

In the model, $j = (WAZ, HAZ, WHZ)$. The link between food diversity, mother's education and ethnicity and child health outcomes is investigated using Ordinary Least Squares (OLS). The use of OLS is appropriate in this instance because the dependent variables are continuous. The raw z-scores are used because it allows us to determine changes across observations instead of categories.

Estimating the above equation is based on the assumption that all variables in the model are strictly exogenous, however, food diversity is likely to be endogenous as a result of a bi-causal relationship with the health status of children. Since choice of feeding practices adopted by child care givers is informed by the health status of children, bi-causality is plausible. In this case, the direction of causality will run from the health status of the child to the choice of feeding practices. In view of this, Two Stage Least Square (TSLS) estimation technique was employed to control for the endogeneity. The number of poultry, goats and sheep the household owns as well as household ownership of bank account were used as instrument for food diversity. The underlying intuition of the choice of these instruments is based on the view that their effect is

directly related to food security and indeed the relationship between the instruments and the health status of children is only through food consumption.

To employ TSLS, the following two models were estimated:

$$food_i = \alpha_o + \alpha_1 mumedu_i + \alpha_2 ethnic_i + \alpha_3 mumage_i + \alpha_4 urban_i + \alpha_5 water_i + \alpha_6 cage_i + \alpha_7 toilet_i + \alpha_8 sex + \alpha_9 fever_i + \alpha_{10} diarrhea_i + \alpha_{11} we\square lth_i + \alpha_{12} kids_i + \alpha_{13} Province_i + \alpha_{14} poultry_i + \alpha_{15} goat_i + \alpha_{16} sheep_i + \alpha_{17} bank_i + v_i \quad (2)$$

and

$$y_{ij} = \beta_0 + \beta_1 \widehat{food}_\iota + \beta_2 mumedu_i + \beta_3 ethnic_i + \beta_4 mumage_i + \beta_5\, urban_i + \beta_6 water_i + \beta_7 cage_i + \beta_8 toilet_i + \beta_9 kids_i + \beta_{10} sex_i + \beta_{11} fever_i + \beta_{12} diarrhea_i + \beta_{13} wealth_i + \beta_{14} kids_i + \beta_{15} Province_i + u_i \quad (3)$$

where $\widehat{food}$ is the linear prediction food diversity score from expression (2). In Table 1 below we explain how the explanatory variables were defined and measured.

Table1: Definition and measurement of variables

Variable	Definition	Measurement
Male	Gender of child	0=Female; 1=Male
Fever	Was child ill with fever in last 2 weeks	0=No; 1=Yes
Diarrhea	Did child have diarrhea in the last 2 weeks	0=No; 1=Yes
Kids	Number of kids in the household	Count of children less than 5 years
Urban	Residence status of the household	1=Urban; 0=Rural
Mother's Age	Age of the child's mother	Measured in years. Ranges from 15-45 years
Child's age	Age of child in categories	Measured as: 0=0-5; 1=6-11; 2=12-23; 3=24-35; 4=36-47;5= 48-59
Mother's education	Mothers highest educational attainment	0=None;1= Primary; 2=Lower secondary; 3=Upper secondary; 4=Post-secondary non tertiary; 5=Higher
Wealth quintile	An index of the wealth status of the household	0=Poorest; 1=Second; 2= Middle; 3=Fourth; 4=Richest
Ethnicity	Ethnic group to which the household head belongs	0= Lao; 1=Khmu; 2=Hmong; 3=Other
Water source	Household's source water	0= Pipe; 1=Protected; 2=Unprotected
Toilet type	Type of toilet facility of household	0=Flush; 1= Pit latrine;2==Bush, Bucket and Other
Province	province of household	Set of dummy variables to capture the administrative regions in Lao PDR
Food diversity	Food diversity score	Measured as simple count of food items

Results and discussion

As a recall the objective of this exercise is to find the effect of food security, mother's education and ethnicity on child's health. This section presents the test for bivariate associations (descriptive) and conditional effect of each of the three main variables of interest (Least Squares) on nutritional status of children. For both the descriptive and inferential analyses three outcomes

of nutritional status namely height-for-age (stunting), weight-for-height (wasting) and weight-for-age (underweight) are used.

Table 2 presents prevalence rates of correlates of malnutrition as per the objectives of this exercise. On the association between food security and nutritional status two of the three anthropometric indicators (stunting and underweight) were statistical significant. For children who did not consume any of the food items and those who consumed at most any one of the food items nearly half for each of these two groups of children were stunted. For this same groups of children, about a-third of were underweight. In both instances, that is proportions of stunted and underweight children a decreasing relationship with food diversity was observed. That is more diversified consumption of a basket of food items was associated with lower prevalence rates of stunting and wasting..

The Table shows significant association between child stunting and underweight on one hand and mother's educational status on the other hand. The analysis shows that more than half of children from mothers with no formal education are stunted and 37 percent of them have weight considered too light for their age. As expected, the Table indicates that advancement in maternal education reduces the incidence of malnutrition. This finding supports an earlier argument by (Kamiya, 2011). In this study Kamiya (2011) argue that education level of parents affects child health outcomes in Lao PDR.

In all the three cases nutritional status tend to significantly vary across the ethnic divide. The ethnic group with the highest proportion of stunted children is Hmong (61 %) followed by Khmu (53.8 %). But we observe a different pattern in the case of underweight, in this instance more than a quarter of Khmu children are considered as underweight while one-fifth of Hmong children underweight. In a reverse finding, Hmong has the lowest proportion of child wasting. These figures are consistent with the finding in the Lao Social Indicators Survey [see Table NU.1 of the LSIS Report (2012)].

Table 1: Bivariate analysis of socioeconomic variables and anthropometric indicators

Socio-economic and demographic variables	Stunted		Wasted		Underweight	
	%	No. of Children	%	No. of Children	%	No. of Children
Age						
0-5	18.2	194	6.5	68	11.7	126
6-11	22.7	242	8.4	88	18	195
12-23	44.8	878	7.6	154	25.6	512
24-35	51	991	7.4	146	30.1	591
36-47	51.9	1089	4.9	105	30.8	650
48-59	54	1031	3.9	76	31.4	602
Chi square	**701.62 (Pr = 0.000)**		**43.45 (Pr = 0.000)**		**240.84 (Pr = 0.000)**	
Sex						
female	42.5	2,109	5.8	290	26.1	1,309.2
male	45.7	2,315	6.7	347	26.6	1,367.4
Total	44.1	4,424	6.3	637	26.4	2,676.6
Chi square	**10.85 (Pr = 0.001)**		**5.04 (Pr = 0.025)**		**0.43 (Pr = 0.514)**	
Diarrhea						
No	43.4	3,910	6.3	570	25.7	2,339
Yes	50.2	514	6.1	67	32.5	337
Chi square	**16.91 (Pr = 0.000)**		**0.02 (Pr = 0.876)**		**13.11 (Pr = 0.000)**	
Food diversity						
None	59.5	20	6.9	2	48.3	16
At most One	48	1216	7.3	205	29	746
At most two	49.1	1688	5.6	207	28.6	998
At most three	44.2	880	5.8	110	26.4	529
At most four	37	357	7	62	21.3	207
More than four	24.5	263	5.8	51	16.7	180
Chi square	**212.93 (Pr = 0.000)**		**9.97 (Pr = 0.076)**		**96.85 (Pr = 0.000)**	
Residence						
Rural	48.6	3,866	6.5	535	29.2	2,349
Urban	26.9	558	5.4	102	15.6	328
Chi square	**287.99 (Pr = 0.000)**		**2.27 (Pr = 0.131)**		**169.83 (Pr = 0.000)**	
Ownership of Agriculture Land						
No	40.5	1,066	6	147	23.9	634
Yes	45.4	3,358	6.4	490	27.3	2042
Chi square	**16.23 (Pr = 0.000)**		**0.38 (Pr = 0.537)**		**14.98 (Pr = 0.000)**	
Fever						
No	44.3	3,814	6.1	533	26.1	2,270
Yes	42.6	610	7.2	104	28.1	407
Chi square	**0.11 (Pr = 0.740)**		**2.42 (Pr = 0.120)**		**3.66 (Pr = 0.056)**	
Wealth index quintile						
Poorest	60.7	1,803	7.2	241	37	1,109
Second	49.7	1,070	6.5	150	29	637
Middle	41.5	761	5.9	110	24	446
Fourth	31.7	507	5.3	78	20	315
Richest	19.2	283	5	58	12	170
Chi square	**801.51 (Pr = 0.000)**		**10.33 (Pr = 0.035)**		**06.50 (Pr = 0.000)**	
Mother's education						
None	58.2	1,840	6.3	217	35.1	1,131
Primary	43.4	1,801	6.3	267	26	1,090
Lower secondary	33.8	508	6.9	97	20.2	304
Upper secondary	22.3	144	4.8	26	12.6	82
Post secondary non tertiary	29	98	6.6	21	17.9	61
Higher	14.1	33	4.5	9	4.1	10
Chi square	**519.35 (Pr = 0.000)**		**4.69 (Pr = 0.455)**		**285.87 (Pr = 0.000)**	

Ethnicity of household head						
Lao	31.8	1,475	6.2	240	20.8	972
Khmu	53.8	666	5.4	75	28.8	362
Hmong	61	757	2.5	34	21	263
Other	52.2	1,527	8	288	36.3	1080
Chi square	**552.82**	**(Pr = 0.000)**	**54.72**	**(Pr = 0.000)**	**322.91**	**(Pr = 0.000)**
Source of Drinking Water						
pipe	37.4	1,642	5.7	245	20	886
protected	48.3	1,219	6.5	186	30.5	779
unprotected	50	1,564	6.9	206	31.9	1012
Chi square	**118.90**	**(Pr = 0.000)**	**6.00**	**(Pr = 0.050)**	**159.16**	**(Pr = 0.000)**
Type of Toilet Facility						
Flush	34.1	1,656	5.4	254	19	932
Pit latrine	52.5	167	2.2	9	29.2	94
Bush, Bucket and Other	53.5	2,601	7.4	374	33.5	1650
Chi square	**358.51**	**(Pr = 0.000)**	**27.20**	**(Pr = 0.000)**	**278.37**	**(Pr = 0.000)**
Province						
Vientiane Capital	19.1	177	7.4	36	15.9	148
Phongsaly	61.5	200	5	26	34.7	117
Luangnamtha	54.1	139	21.8	104	39.9	106
Oudomxay	54.7	357	5	37	28.4	188
Bokeo	45.7	139	4.2	23	23	71
Luangprabang	45	301	3	18	19.9	135
Huaphanh	61.1	345	2	13	23.3	132
Xayabury	38.5	176	5.4	23	22.5	105
Xiengkhuang	52.7	264	1.9	11	19.8	100
Vientiane	41.3	287	4.6	26	18.6	130
Borikhamxay	39.6	148	6.4	28	19.4	73
Khammuane	41.5	233	6.9	42	29.8	169
Savannakhet	40.8	644	4.9	40	27.4	439
Saravane	54.6	466	7.3	57	41.4	357
Sekong	63.3	153	7.5	61	46.5	115
Champasack	36.2	316	6.3	39	26	229
Attapeu	39.5	79	10.2	53	32	64
Chi square	**461.89**	**Pr = 0.000**	**272.61**	**Pr = 0.000**	**366.06**	**Pr = 0.000**
Total	**44.1**		**6.3**		**26.4**	

Source: Computed from LSIS Data (2011)

Testing the association between child's age and malnutrition prevalence, 18.20 percent of children within zero to five months are stunted, 11.70 percent of them are underweight and 6.50 percent are wasted. Generally, the proportions of children who are stunted and underweight increase with an increase in child's age. This pattern could be because older children receive less attention in terms of feeding practices and childcare. However, the same cannot be said with child wasting, in this instance the age category with the highest proportion of children are between six and eleven months while those aged 48-59 months had the lowest proportion of underweights. Thus while child stunting and underweight may be a problem with older children, wasting is rather associated with younger children. In all the three instances the chi square tests show that anthropometric indicators vary significantly across age categories.

Agricultural land ownership and malnutrition

Since agriculture is an important source of livelihood of most Laotians, the study investigates the relationship between ownership of arable land malnutrition in Figure 5. The figure shows that majority of children who are stunted (60%); wasted (55%) and the underweight (58%) belong to households who have less than two hectares of arable land. Increasing the size of agricultural land also reduces the incidence of malnutrition. For instance about 20 percent, 23 percent and 22 percent of the stunted, wasted and underweight children respectively are found in households that have 2 hectares of arable and the proportions fall to nine percent, 10 percent and nine percent respectively for households that possess more than three hectares of arable land. Access to agricultural land is associated with access to adequate food supply which in turn reduces child malnutrition. Land ownership has been shown to reduce severe malnutrition in Bangladesh (Choudhury, Hanifi, Rasheed, & Bhuiya, 2011). In a related study elsewhere in Tajikistan, Baschieri and Falkingham (2007) indicated that living in households without access to land increases the risk of underweight by almost 50 percent.

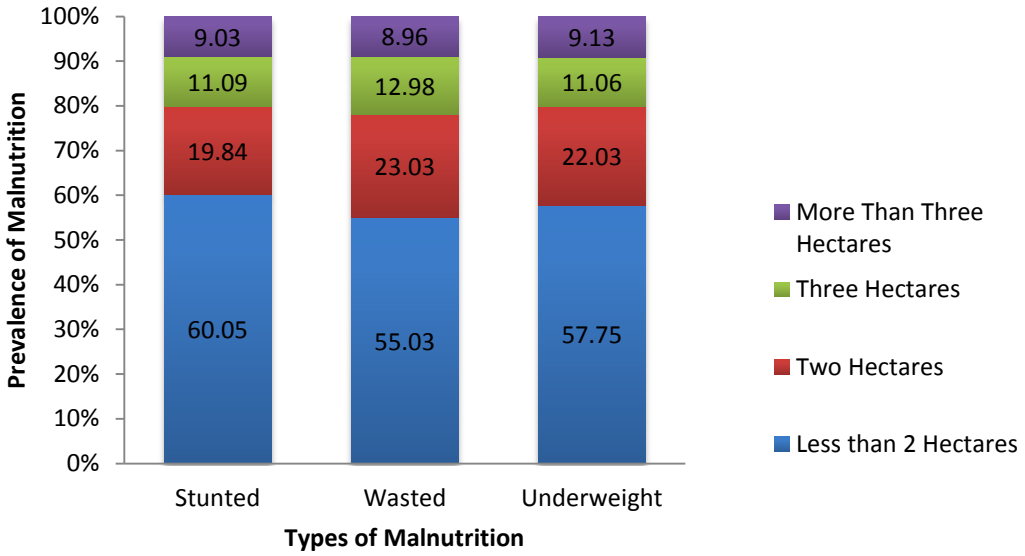

Figure 5: Land ownership and child malnutrition

Figure 6 presents the distribution of food diversity score in Lao PDR. About 60 percent of children consumed at most two of the food items, 29 percent consumed either three or four of the food items 11 percent were fed with more than four food items. That is, most children less than five years consume less diversified food items in Lao PDR. Because there is the tendency for children who are undergoing exclusive breastfeeding to distort the overall distribution the analysis is done for various age categories in Figure 6. More than half (59 %) of children less than six months had at most 1of the nine food items and only 2 percent consumed all the nine food items. For the more than half of children consuming at most one of the food items it is expected, as children in this age bracket should be exclusively breastfed. However, it is worth exploring the implications of children less than six months who are not undergoing exclusive breastfeeding. Broadly comparing children less than six months by those between six and 59 months, there is a change from the consumption of monotonous to diversified food items. An association between food consumption and age of the child is supported with a p-value of 0.00 for the statistical chi-square value of 695.29.

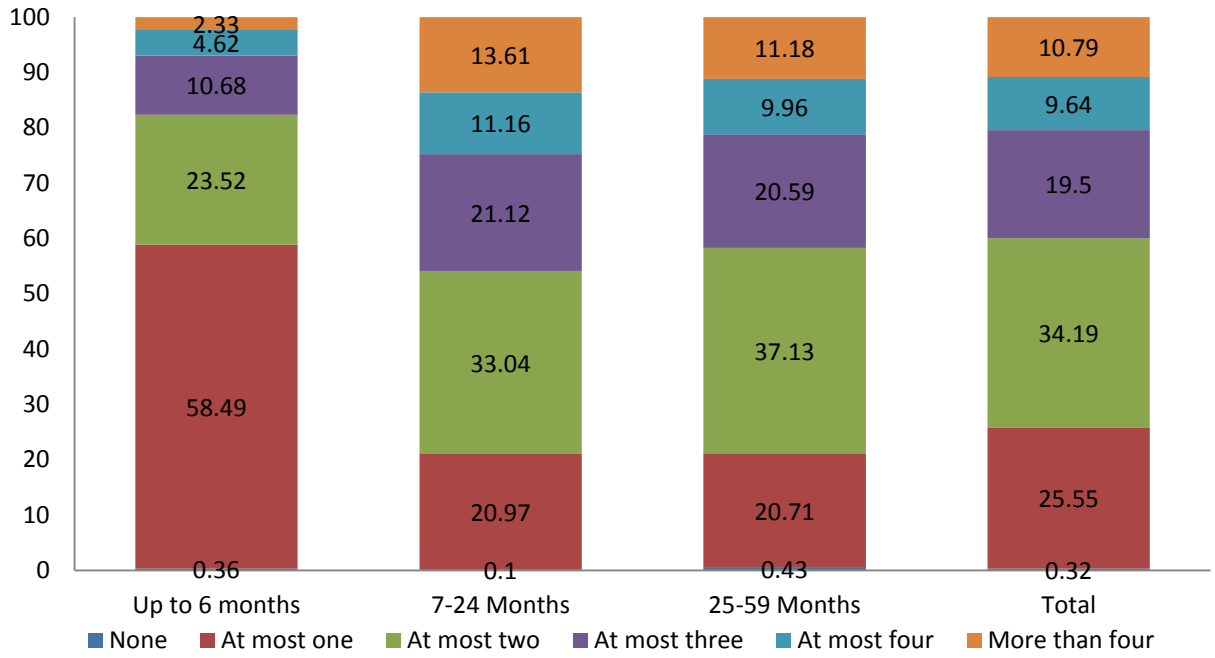

Figure 6: Food diversity score by age groups

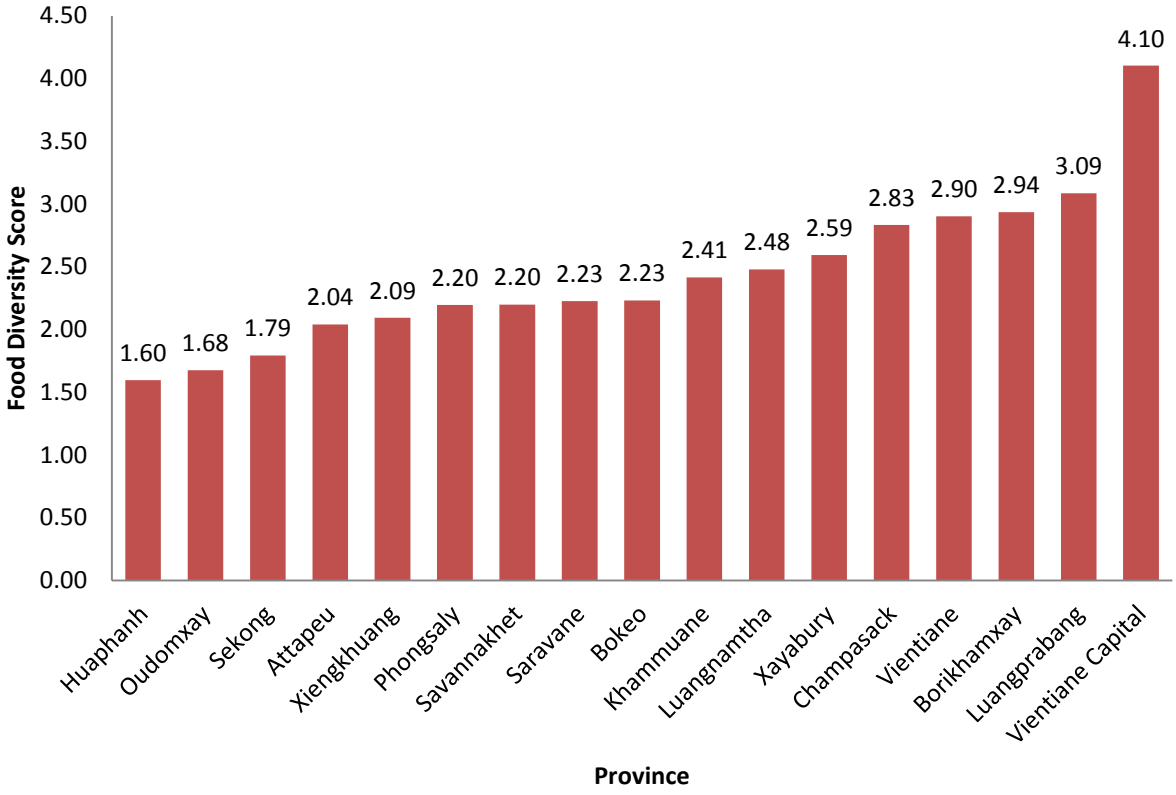

Figure 7: Distribution of food diversity score by provinces in Lao PDR

For the purpose of validation the computed food diversity is analysed from provincial perspective and compared with the recent Risk and Vulnerability Survey (RVS) conducted in 2013. In spite of the fact that the timing of the two surveys vary and also given that the RVS sample is inclined towards rural households finding broad patterns remains essential for proceeding with this exercise. The RVS captures food diversity based on a similar approach count of number of food items consumed by children less than five years. Further to this, a dummy for children consuming less than four food items is generated and classified as consuming sub-optimal dietary diversity. Using the agro-ecological zoning the RVS (2013) report indicates that 76.8 percent of all children less than five years in the Central-Southern Highlands (i.e. Khamouane, Savannakhet, Saravane, Sekong and Attapeu) were fed with sub-optimal dietary diversity. In our case Sekong and Attapeu Savannakhet, Saravane rank among the provinces with low food diversity scores. RVS (2013) also reports that Vientiane Plain (i.e. Vientiane, Borikhamxay, and Khammuane) is the agro ecological zone with the least number of children being fed with sub-optimal dietary diversity. Similarly from Figure 7, children in Vientiane, Bolikhamxay, and Khammuane on the average have a food diversity score of more than one. Thus, provincial patterns of the summary of food diversity score proposed in this exercise are broadly consistent with the agro-ecological patterns of dietary diversity in RVS (2013) report.

Results of multivariate regression

In Table 3, we estimate the effect of mother's education, food diversity and ethnicity on child health outcomes. As indicated in the methodology dietary diversity is captured by a count of number of food items consumed. The computation of this score is such that an increase in the score means more diversification hence better nutrition intake. This index was constructed from nine food items: infant formula, breastmilk, yoghurt, semi-solid food, juice/juice drink, porridge, liquids from bottle with a nipple, vitamin or mineral supplement and other liquids. The motivation for this variable is derived from the understanding that diversified diet enhances the likelihood of meeting nutrient requirements. The association between food diversity score and the three measures are significant all the indicating that dietary diversity is important in explaining child nutrition. This association is an indication that dietary diversity is an indicator of nutrient adequacy among child in Lao PDR. Our findings is supported by a similar study by (Arimond & Ruel, 2004). Arimond and Ruel (2004) found in seven (including Cambodia and Nepal) out of the 11 countries studied that dietary diversity is significantly associated with better nutritional status.

Ethnicity was significant in explaining child health outcomes. In the case of child stunting, children from Khmu and Hmong had lower HAZ scores than those from Lao-Tai ethnic group. For HAZ, the analysis shows that Hmong children had the worse z-scores than children from Lao-Tai and other ethnic groups. Conversely children from Khmu and Hmong had better weight-for-height z-scores than Lao-Tai children. In the case of underweight (weight-for-age) children less than five years among the Hmong had better nutrition than their counterparts belonging to the Lao-Tai ethnic. The patterns suggest that malnutrition for ethnic groups vary across the three anthropometric indicators. Feeding restriction practices observed by Sa et al (2013) among the Khmu that is pregnancy and post partum food taboos and early introduction of pre-lacteal feeding can be attributed to the observation that Khmu children are too short for their height.

In line with the objectives of the study, we proceed to examine the relationship between maternal education and child malnutrition. To this end, mother's level of education was used to capture the education effect in the models. The expectation is that as mother's education is associated with an understanding of the importance of good feeding and childcare practices enhance the nutritional status of their children. Again education also promotes access to health information from the mass media and also promotes community participation. Using mothers who have no formal education as the base category, we find that children from mothers with primary, lower and upper secondary and Higher education have significantly higher HAZ scores as compared to children from mothers with no formal education in the OLS models. In the WAZ model the difference is significant between children from mothers with primary, upper secondary and Higher and higher education on one hand and no formal education on the other hand. This goes to confirm the assertion that education is an important component of the health production function (Frost et al., 2005; Thomas et al., 1991; Variyam, Blaylock, Lin, Ralston, & Smallwood, 1999).

The models also contain a number of control variables that may affect child health outcome according to the literature reviewed. It can be observed from the Table that child's age significantly correlate with child health outcomes. Compared to the base age of 0-5 months, the models show that all the three indicators consistently decrease as a child's age increases. This finding is corroborated by an earlier work by (Babatunde, Olagunju, Fakayode, & Sola-Ojo, 2011). In this study Babatunde et al (2011). found that an increase in a child's age increases the probability of being stunted in Kwara State in Nigeria.

Since the current health status of a child can affect his nutrition status, we control for the current health status with two common illnesses (diarrhea and fever) among children. These illnesses tend to reduce anthropometric scores in all the models. The effect of diarrhea is significant in all the models; however, fever is significant only in affecting wasting and underweight. The effect of sex is captured with the male dummy variable. The sign and coefficient of the male variable shows that male children have higher chance of being stunted compared to female children. Specifically, males have 0.10 less height-for-age scores than females. This finding is not surprising since boys have been shown to have high probability of being malnourished than girls (Masiye, Chama, Chitah, & Jonsson, 2010; Wagstaff, Van Doorslaer, & Watanabe, 2003).

The HAZ and WHZ models show that children from households with large number of children have poorer nutritional status compared their counterparts from households with smaller number of children. In these models both height-for-age and weight-for-age decreases by approximately 0.03 for any additional child. The likely reason for this association could be that as the number of children increase parents and caretakers pay less attention to each individual child in terms of feeding and cleaning which will negatively affect their nutritional intake. Also large number of children also means that kids will have to share limited amount of food resources leading to insufficient food intake.

To further understand the correlates of child nutritional status, household's wealth was included in the models in Table 3. In the case of the HAZ and WAZ models, children in second, middle, fourth and highest categories have better nutritional status than children in poorest households. However, in the underweight model only children in highest households tend to have better health outcome than those in poorest households.

Access to safe water was included as an environmental variable. Children in households which use protected and unprotected water sources have lower WAZ and HAZ score than their counterparts from households that have access to pipe born water. Access to clean water promotes good hygiene which improves child's health (Baschieri & Falkingham, 2007)

Table 3: Regression analysis on child's consumption of diversified food items and nutritional Status in Lao PDR

	Weight –for-Height		Weight-for-Age		Height-for-Age	
	(OLS)	(IV)	(OLS)	(IV)	(OLS)	IV)
Male	0.02	0.03	-0.01	-0.00	-0.10**	-0.09*
	(1.00)	(0.93)	(-0.43)	(-0.16)	(-3.16)	(-2.34)
Fever	-0.18***	-0.21***	-0.14***	-0.21***	-0.02	-0.13+
	(-5.06)	(-4.22)	(-4.08)	(-3.76)	(-0.56)	(-1.73)
Diarrhea	-0.09*	-0.10*	-0.11**	-0.13*	-0.10+	-0.11+
	(-2.20)	(-2.06)	(-2.72)	(-2.48)	(-1.81)	(-1.76)
Food diversity	0.02+	0.18	0.04**	0.34+	0.04**	0.50+
	(1.75)	(0.97)	(3.28)	(1.70)	(2.82)	(1.94)
Kids	-0.01	-0.00	-0.03***	-0.01	-0.03*	-0.01
	(-1.33)	(-0.25)	(-3.42)	(-1.45)	(-2.38)	(-0.61)
Urban	0.02	0.02	0.04	-0.00	0.08	-0.00
	(0.50)	(0.37)	(0.94)	(-0.04)	(1.57)	(-0.06)
Mother' age	0.00	-0.00	0.01***	0.01**	0.01***	0.01***
	(0.90)	(-0.05)	(4.59)	(3.16)	(4.95)	(3.63)
Child's age (base=0-5)						
6-11	-0.52***	-0.68***	-0.44***	-0.68***	-0.32***	-0.69**
	(-8.30)	(-4.23)	(-6.97)	(-3.80)	(-4.17)	(-3.10)
12-13	-0.58***	-0.78***	-0.73***	-1.02***	-0.99***	-1.42***
	(-10.47)	(-3.99)	(-12.73)	(-4.75)	(-13.75)	(-5.13)
24-35	-0.49***	-0.71***	-0.85***	-1.15***	-1.22***	-1.62***
	(-8.70)	(-3.79)	(-14.99)	(-5.56)	(-16.99)	(-6.18)
36-47	-0.46***	-0.69***	-0.91***	-1.20***	-1.28***	-1.67***
	(-8.52)	(-3.74)	(-16.69)	(-5.81)	(-18.82)	(-6.36)
48-59	-0.52***	-0.71***	-1.01***	-1.28***	-1.27***	-1.67***
	(-9.63)	(-4.08)	(-18.45)	(-6.53)	(-18.67)	(-6.66)
Mother's edu. (base=None)						
Primary	0.01	-0.03	0.07*	0.01	0.13**	0.03
	(0.20)	(-0.55)	(2.05)	(0.25)	(2.99)	(0.49)
Lower Secondary	-0.04	-0.11	0.09+	-0.05	0.17**	-0.04
	(-0.81)	(-1.26)	(1.81)	(-0.46)	(2.90)	(-0.29)
Upper Secondary	0.03	-0.03	0.15*	0.06	0.21**	0.06
	(0.39)	(-0.27)	(2.30)	(0.47)	(2.68)	(0.36)
Post sec. non tertiary	-0.01	-0.09	0.01	-0.24	0.02	-0.44+
	(-0.09)	(-0.50)	(0.12)	(-1.22)	(0.22)	(-1.74)
Higher	0.02	-0.05	0.24*	-0.03	0.34**	-0.24
	(0.20)	(-0.31)	(2.41)	(-0.15)	(2.83)	(-1.03)
Wealth (base=Poorest)						
Second	0.04	0.03	0.18***	0.11*	0.25***	0.13*
	(1.17)	(0.58)	(4.61)	(2.23)	(5.26)	(2.21)
Middle	0.04	-0.00	0.24***	0.14*	0.35***	0.19*
	(0.93)	(-0.05)	(5.69)	(2.07)	(6.48)	(2.14)
Fourth	0.01	-0.05	0.28***	0.12	0.45***	0.15
	(0.27)	(-0.42)	(5.37)	(0.93)	(6.59)	(0.95)
Richest	0.14*	-0.04	0.49***	0.14	0.62***	0.13
	(2.21)	(-0.19)	(7.23)	(0.69)	(7.32)	(0.50)
Water (base=Pipe)						
Protected	0.04	0.04	-0.05	-0.06	-0.10*	-0.11*

	(1.07)	(1.03)	(-1.33)	(-1.28)	(-2.10)	(-1.98)
Unprotected	-0.04	-0.01	-0.09**	-0.06	-0.08+	-0.04
	(-1.10)	(-0.14)	(-2.61)	(-1.30)	(-1.80)	(-0.68)
Toilet (base=Flush)						
Pit latrine	0.01	0.06	0.12+	0.16*	0.10	0.14
	(0.13)	(0.96)	(1.93)	(2.27)	(1.26)	(1.52)
Bush, bucket, other	-0.07+	-0.06	-0.04	-0.02	-0.01	0.03
	(-1.90)	(-1.31)	(-1.20)	(-0.35)	(-0.12)	(0.48)
Ethnicity (base=Lao-Tai)						
Khmu	0.16**	0.17*	-0.03	0.02	-0.19**	-0.11
	(3.09)	(2.31)	(-0.52)	(0.23)	(-2.98)	(-1.02)
Hmong	0.53***	0.56***	0.18***	0.20**	-0.31***	-0.28***
	(10.54)	(9.31)	(3.43)	(3.15)	(-4.89)	(-3.43)
Other	0.06	0.06	-0.10*	-0.07	-0.22***	-0.15*
	(1.64)	(1.30)	(-2.49)	(-1.38)	(-4.69)	(-2.41)
Phongsaly	0.40***	0.59***	-0.10	0.18	-0.59***	-0.30
	(4.77)	(4.31)	(-1.16)	(1.15)	(-5.64)	(-1.57)
Luangnamtha	-0.24*	-0.07	-0.43***	-0.19	-0.28*	-0.02
	(-2.36)	(-0.51)	(-4.94)	(-1.31)	(-2.37)	(-0.11)
Oudomxay	0.21**	0.50*	-0.02	0.42+	-0.31**	0.24
	(2.64)	(2.47)	(-0.31)	(1.87)	(-3.18)	(0.84)
Bokeo	0.13+	0.31*	0.08	0.38*	-0.09	0.27
	(1.74)	(2.01)	(1.00)	(2.21)	(-1.01)	(1.26)
Luangprabang	0.28***	0.37***	0.12	0.22*	-0.24**	-0.18
	(3.67)	(3.91)	(1.46)	(2.02)	(-2.65)	(-1.36)
Huaphanh	0.35***	0.62**	-0.04	0.44+	-0.49***	0.15
	(4.78)	(2.59)	(-0.48)	(1.66)	(-5.43)	(0.44)
Xayabury	0.24**	0.43**	-0.08	0.20	-0.28**	0.03
	(2.92)	(3.00)	(-1.02)	(1.28)	(-2.91)	(0.17)
Xiengkhuang	0.34***	0.55**	0.08	0.45*	-0.29**	0.18
	(4.51)	(3.11)	(1.07)	(2.24)	(-3.10)	(0.72)
Vientiane	0.22**	0.36**	-0.05	0.16	-0.43***	-0.17
	(2.87)	(3.02)	(-0.74)	(1.18)	(-4.71)	(-0.97)
Borikhamxay	0.11	0.25*	0.02	0.23+	-0.21*	0.02
	(1.43)	(2.25)	(0.31)	(1.82)	(-2.17)	(0.11)
Khammuane	-0.10	0.08	-0.16*	0.11	-0.12	0.21
	(-1.42)	(0.55)	(-2.22)	(0.67)	(-1.34)	(1.03)
Savannakhet	0.12+	0.31+	-0.08	0.25	-0.22*	0.21
	(1.71)	(1.91)	(-1.14)	(1.39)	(-2.43)	(0.95)
Saravane	-0.09	0.05	-0.30***	-0.04	-0.42***	-0.07
	(-1.14)	(0.34)	(-3.75)	(-0.24)	(-4.51)	(-0.35)
Sekong	0.03	0.25	-0.40***	-0.04	-0.69***	-0.18
	(0.41)	(1.21)	(-5.25)	(-0.17)	(-7.20)	(-0.62)
Champasack	-0.07	0.05	-0.15*	0.06	-0.22**	0.04
	(-0.90)	(0.46)	(-2.05)	(0.47)	(-2.62)	(0.26)
Attapeu	-0.25***	-0.04	-0.14+	0.23	0.02	0.50+
	(-3.32)	(-0.19)	(-1.83)	(1.09)	(0.20)	(1.90)
Constant	-0.20+	-0.48	-0.93***	-1.56***	-1.06***	-1.97***
P	(-1.80)	(-1.36)	(-8.58)	(-3.96)	(-7.57)	(-3.88)
N	*10162*	*8246*	*10293*	*8350*	*10099*	*8190*
Hansen J statistic		5.36		3.76		5.29

P-value of Hansen J statistic	0.15	0.15	0.15
Underidentification test	19.66	19.51	19.24
P-value of underidentification test	0.00	0.00	0.00
Weak identification statistic	9.72	12.92	9.54

t statistics in parentheses; +p<0.1; * p<0.05; ** p<0.01; *** p<0.001

Taking cognizance of the likely endogeneity that may arise from bi-causality between the anthropometric indicators and food diversity, we estimate the three models using the number of poultry, goats and sheep the household owns as well as the household ownership of bank account as instruments. The TSLS estimation shows that food diversity causes improvement in both WAZ and HAZ scores. At 10 percent level of significance, Table 3 shows that food diversity causes both weight-for-age and height-for-age to increase by 0.34 and 0.50 units respectively.

The relationship between food consumption and child nutrition can be a bit misleading given the fact that feeding pattern varies across different age categories. For instance, nutritional status of children less than 6 months and undergoing exclusive breastfeeding will have no business with the consumption of semi-solid food. This partly contributes to the estimation of a variant of the models in Table 4. In Table 4 we estimate the model using selected individual food items namely, infant formula, milk and yoghurt which are common food item that infants are fed on in Lao PDR. Infant formula and milk are significant in explaining wasting, stunting and child underweight. In each model, milk and infant formula tend to improve child health outcome. However, yoghurt has a positive association with only child's weight-for-age z-scores.

To further explore the relationship between food consumption and nutrition status of children, estimations in Table 3 are replicated using a sub-sample of children aged 24 to 59 months and less than 6 months (see Appendix B). The rationale is to explore the effect of the consumption of individual foods items such as semi-solid food which is consumed at a later stage in the growth cycle of a child. Appendix B presents results of the sub-sample for the effect of the consumption of individual food items on nutritional status. Consumption of semi-solid food tends to be significant for but with a counterintuitive result. Child ever breastfed is significant in both WAZ and HAZ models for children less than 6 months

Table 4: Regression analysis on child's consumption of individual food items and nutritional status in Lao PDR

Dependent variables	(OLS) WHZ	(OLS) WAZ	(OLS) HAZ
Male	0.02	-0.01	-0.10**
	(0.98)	(-0.52)	(-3.22)
Fever	-0.18***	-0.14***	-0.03
	(-5.09)	(-4.13)	(-0.60)
Diarrhea	-0.09*	-0.12**	-0.10+
	(-2.24)	(-2.78)	(-1.86)
Infant formula	0.08*	0.09*	0.12*
	(2.01)	(2.26)	(2.32)
Milk	0.09*	0.17***	0.17**
	(2.03)	(3.95)	(3.20)
Yoghurt	0.04	0.13*	0.10
	(0.72)	(2.34)	(1.38)
Kids	-0.01	-0.03***	-0.02*
	(-1.25)	(-3.31)	(-2.31)
Urban	0.02	0.04	0.08
	(0.41)	(0.84)	(1.49)
Mother's age	0.00	0.01***	0.01***
	(0.91)	(4.64)	(4.98)
Child's age (base=0-5)			
6-11	-0.51***	-0.42***	-0.30***
	(-8.18)	(-6.73)	(-3.97)
12-13	-0.58***	-0.72***	-0.99***
	(-10.50)	(-12.82)	(-13.84)
24-35	-0.49***	-0.86***	-1.22***
	(-8.78)	(-15.24)	(-17.27)
36-47	-0.46***	-0.91***	-1.28***
	(-8.51)	(-16.89)	(-18.93)
48-59	-0.52***	-1.01***	-1.28***
	(-9.63)	(-18.67)	(-18.83)
Mother's edu. (base=None)			
Primary	0.01	0.07*	0.13**
	(0.24)	(2.15)	(3.07)
Lower Secondary	-0.04	0.08+	0.16**
	(-0.90)	(1.71)	(2.82)
Upper Secondary	0.02	0.14*	0.20**
	(0.30)	(2.19)	(2.59)
Post sec. non tertiary	-0.02	-0.02	-0.00
	(-0.26)	(-0.22)	(-0.03)
Higher	0.00	0.20*	0.31**
	(0.01)	(2.13)	(2.58)
Wealth (base=Poorest)			
Second	0.04	0.18***	0.25***
	(1.20)	(4.66)	(5.32)
Middle	0.04	0.24***	0.35***
	(0.91)	(5.67)	(6.47)
Fourth	0.00	0.27***	0.43***
	(0.10)	(5.08)	(6.43)

Richest	0.13+	0.46***	0.59***
	(1.92)	(6.70)	(6.89)
Water (base=Pipe)			
Protected	0.04	-0.04	-0.09*
	(1.16)	(-1.14)	(-1.97)
Unprotected	-0.04	-0.09*	-0.08+
	(-1.07)	(-2.52)	(-1.75)
Toilet (base=Flush)			
Pit latrine	0.01	0.12+	0.10
	(0.09)	(1.87)	(1.21)
Bush, bucket, other	-0.07+	-0.05	-0.01
	(-1.95)	(-1.29)	(-0.19)
Ethnicity (base=Lao-Tai)			
Khmu	0.16**	-0.02	-0.19**
	(3.14)	(-0.41)	(-2.91)
Hmong	0.54***	0.18***	-0.30***
	(10.60)	(3.58)	(-4.76)
Other	0.06+	-0.09*	-0.22***
	(1.72)	(-2.33)	(-4.58)
Province(base =Vientiane Capital)			
Phongsaly	0.41***	-0.09	-0.58***
	(4.88)	(-1.04)	(-5.50)
Luangnamtha	-0.22*	-0.40***	-0.25*
	(-2.20)	(-4.66)	(-2.14)
Oudomxay	0.21**	-0.02	-0.31**
	(2.71)	(-0.26)	(-3.14)
Bokeo	0.13+	0.07	-0.09
	(1.78)	(0.94)	(-1.03)
Luangprabang	0.30***	0.15+	-0.21*
	(3.93)	(1.84)	(-2.27)
Huaphanh	0.36***	-0.03	-0.48***
	(4.88)	(-0.45)	(-5.42)
Xayabury	0.24**	-0.08	-0.28**
	(2.93)	(-1.01)	(-2.91)
Xiengkhuang	0.36***	0.10	-0.27**
	(4.66)	(1.25)	(-2.94)
Vientiane	0.23**	-0.04	-0.42***
	(3.00)	(-0.60)	(-4.54)
Borikhamxay	0.12	0.02	-0.21*
	(1.48)	(0.29)	(-2.14)
Khammuane	-0.09	-0.15*	-0.11
	(-1.29)	(-2.05)	(-1.18)
Savannakhet	0.12+	-0.08	-0.22*
	(1.76)	(-1.16)	(-2.43)
Saravane	-0.08	-0.28***	-0.40***
	(-0.98)	(-3.57)	(-4.29)
Sekong	0.04	-0.40***	-0.68***
	(0.47)	(-5.32)	(-7.20)
Champasack	-0.06	-0.14+	-0.21*
	(-0.79)	(-1.89)	(-2.45)
Attapeu	-0.26***	-0.15*	0.01
	(-3.41)	(-1.98)	(0.09)

Constant	-0.18^{+}	-0.89***	-1.02***
	(-1.65)	(-8.34)	(-7.39)
N	10162	10293	10099

t statistics in parentheses $^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Conclusion, Policy Recommendations and Implications

This exercise has been undertaken in response to the need to hasten efforts aimed at reducing malnutrition prevalence rates in Lao PDR. In spite of GoL's initiative to reduce prevalence rate of malnutrition via the implementation of the NNP, recent statistics from the LSIS is alarming. Based on WHO's thresholds the following are inferred; 44 percent of stunted children is in the very high range, underweight prevalence of 27 percent falls within the high bracket and six percent of wasted children is categorized as medium. Thus none of the three anthropometric indicators falls within the low bracket. Central to the NNP in reducing malnutrition is food security hence this exercise engages the LSIS data to interrogate the relationship between food security and malnutrition. This exercise extended its orientation beyond food security to examine other correlates of malnutrition specifically, ownership of agricultural land, cultural practices (ethnicity) and mother's education.

Food security, one of the main variables of interest, was captured using nine food items namely; breast milk, infant formula, yoghurt, semi-solid food, juice/juice drink, porridge, liquids from bottle with a nipple, vitamin or mineral supplement and other liquids. In the context of the relationship between food security and malnutrition, this exercise is premised on the hypothesis that consumption of a diversified basket of food (made up of a count of the four food items) yields consistent results across all three anthropometric indicators compared to the consumption of individual food items. The latter is argued to be susceptible to other correlates of malnutrition notably, age of the child. Other hypotheses tested are; cultural practices that impose restriction on the food consumption/habits and childcare, contribute to malnutrition and mothers with higher education have children with better nutritional status. On the relationship between ownership of agricultural land/size and malnutrition, this study engages in an exploratory exercise. This is because land is one of the variables that have been used in capturing wealth of the household in the LSIS and therefore its effect is swept away when both variables are included in a model. Also, the measurement of the land size using hectares lumps up most of the households (about two-thirds) as having less than two hectares. This masks the differences in land size across households and therefore restricts our understanding of the effect of the potential effect of land on malnutrition.

Both bivariate descriptive and multivariate regression analyses were engaged in this exercise. The latter is the case as child health was measured with three anthropometric indicators; Weight-for-age z-scores (WAZ), height-for-age z-scores (HAZ) and weight-for-height z-scores (WHZ). Least Squares regression analysis instead of categorical dependent variable estimation technique was used since the dependent variables were captured as continuous variables based on the z-scores. Although cognizant of the fact that overweight constitutes malnutrition, the proportion of

children in Lao PDR is less than two percent and therefore its effect is negligible. Sensitivity analysis of the effect of overweight proportion on the analyses was explored and it was found not to be significant in influencing the main variables of interest. Identification of correlates was based on the UNICEF (1990) conceptual framework for explaining the manifestations of malnutrition.

On the exploratory exercise, households with land sizes less than two hectares had the highest proportion of prevalence rates for all the three anthropometric indicators. This observation was consistent with the a'priori expectation as land size is a source for producing food to satisfy one of the conditions for food security that is, its availability. GoL should in this regard, reconsider the agenda of land titling to help households have access to agricultural land. However, since this finding is based on a bivariate analysis, further studies for specific locations (agro-ecological zones, provinces and districts) is imperative as the nature of the land is worth taking into consideration, should a policy strategy be instigated in this direction.

Food security measured based on diversity panned out to be consistently significant across all three anthropometric indicators. This is satisfyingly reassuring and therefore all health promotion activities on the link between food security and malnutrition should backstop with diversity of consumption of food items and not the production of food only. While the GoL is commended for instituting policies to ensure food availability, household consumption of a monotonous food item notably rice should be discouraged. The effect of individual food items namely infant milk, milk, yoghurt and semi-solid food also influences child malnutrition. However, the effect is not consistent for all the food items across all three anthropometric indicators. Noteworthy is the fact that, infant milk and milk consumption yielded significant and positive results on better nutritional status for all three anthropometric indicators and therefore these food items as a transition from exclusive breastfeeding should be promoted. While the effect of the consumption of semi-solid food was found not to be significant for the overall sample (children less that 60 months) worth noting is the observation that for weight-for-height, this variable is significant but counterintuitive with children in older age bracket of the sample, that is between 25 and 60 months. In the model for this sub-sample, the effect of infant milk on malnutrition is eroded. This suggests that for this bracket, infant milk is either not consumed or even when consumed has no effect on the child's nutritional status.

The second variable of interest, cultural practices (measured by the different ethnic groups in Lao PDR) was significant in explaining child health outcomes. In the case of child stunting, children from Khmu and Hmong consistently had lower WAZ scores than those from Lao-Tai ethnic group. For HAZ, the analysis shows that Hmong children had better scores than children from Lao Tai so do children from other tribes. Conversely, children from Khmu and Hmong, and other ethnic groups had better weight-for-height z-scores than Lao-Tai children.

The third variable of interest in this exercise, mother's educational attainment, was observed to have a significant effect on malnutrition. Specifically, mothers with higher education compared to those with no education had children with better height-for-age and weight-for-age z-scores.

The largest coefficient in both cases of child health outcomes was observed for mothers with educational levels higher than post-secondary. In spite of the likelihood that mothers in this category would be time constrained as a result of other engagements such work, positive effects on better nutritional status are still observed. Further exercises using case studies to understand the channels through which mothers with high education are able to ensure that their children have better nutritional status are advised.

Household characteristics such as wealth and access to clean water are important in explaining child health. The study also found a negative association between number of children in the household and child health outcome.

Based on the conclusions from this study, the following recommendations are made for consideration by the three main Ministries namely, Ministry of Agriculture and Forestry (MAF), Ministry of Health (MoH) and Ministry of Education (MoE) in Lao PDR that are at the centre of the implementation of the Multisectoral Food and Nutrition Security (FNS) Action Plan (2014 – 2020). In addition, the recommendations below will be equally useful to other governmental institutions, development partners and civil society that are involved in nutritional interventions in Lao PDR. Firstly, there should be a campaign for the consumption of diversified foods rather than a single or a couple of food items. Secondly, to ensure the consumption of diversified food items, rearing of livestock has to be promoted. Thirdly, the consumption of diversified food and rearing of farm animals should be accompanied with adequate education on the nutritional contents of different food items and requisite cooking practices. Thus, education on appropriate care practices, specifically knowledge on child feeding requirements, should be improved. Finally, malnutrition interventions should take into consideration differences across ethnic groups for specific nutritional outcomes. One such specific consideration should be a direct campaign against 'unfriendly nutrition' cultural practices such as pregnancy and post-partum food taboos and early introduction of pre-lacteal food.

References

Annim, S. K., Awusabo-Asare, K., Amo-Adjei, J., & ICF International. (2013, August). Household Nucleation, Dependency and Child Health Outcomes in. DHS Working Papers. Retrieved from http://www.measuredhs.com/publications/publication-wp98-working-papers.cfm

Arimond, M., & Ruel, M. T. (2004). Dietary diversity is associated with child nutritional status: evidence from 11 demographic and health surveys. *The Journal of Nutrition*, *134*(10), 2579–2585.

Babatunde, R. O., Olagunju, F. I., Fakayode, S. B., & Sola-Ojo, F. E. (2011). Prevalence and Determinants of Malnutrition among Under-five Children of Farming Households in Kwara State, Nigeria. *Journal of Agricultural Science*, *3*(3), p173.

Baschieri, A., & Falkingham, J. (2007). Child poverty in Tajikistan. Retrieved from http://eprints.soton.ac.uk/47460/

Black, R. E., Morris, S. S., & Bryce, J. (2003). Where and why are 10 million children dying every year? *The Lancet*, *361*(9376), 2226–2234.

Bryce, J., Boschi-Pinto, C., Shibuya, K., Black, R. E., & WHO Child Health Epidemiology Reference Group. (2005). WHO estimates of the causes of death in children. *Lancet*, *365*(9465), 1147–1152. doi:10.1016/S0140-6736(05)71877-8

Choudhury, K. K., Hanifi, M. A., Rasheed, S., & Bhuiya, A. (2011). Gender inequality and severe malnutrition among children in a remote rural area of Bangladesh. *Journal of Health, Population and Nutrition (JHPN)*, *18*(3), 123–130.

Cochrane, S. H., Leslie, J., & O'Hara, D. J. (1982). Parental education and child health: intracountry evidence. *Health Policy and Education*, *2*(3), 213–250.

Feyisetan, B. J., & Adeokun, L. (1992). Impact of child care and disease treatment on infant mortality. In E. Van de Walle, G. Pison, & Mpembele Sala-Diakanda (Eds.), *Mortality and Society in Sub-Saharan Africa* (pp. 145–159). Oxford: Clarendon Press.

Frost, M. B., Forste, R., & Haas, D. W. (2005). Maternal Education and Child Nutritional Status in Bolivia: Finding the Links. *Social Sciences and Medicine*, *60*(2), 395–407.

Hobcraft, J. (1993). Women's Education, Child Welfare and Child Survival: A Review of the Evidence. *Health Transition Review*, *3*(2), 159–173.

Holmes, W., Hoy, D., Lockley, A., Thammavongxay, K., Bounnaphol, S., Xeuatvongsa, A., & Toole, M. (2007). Influences on maternal and child nutrition in the highlands of the northern Lao PDR. *Asia Pacific Journal of Clinical Nutrition*, *16*(3), 537.

Hooshmand, S., & Udipi, S. A. (2013). Dietary Diversity and Nutritional Status of Urban Primary School Children from Iran and India. *J Nutr Disorders Ther S*, *12*, 2161–0509.

Imai, K. S., Annim, S. K., Gaiha, R., & Kulkarni, V. S. (2012). *Does Women's Empowerment Reduce Prevalence of Stunted and Underweight Children in Rural India?* Retrieved from http://www.socialsciences.manchester.ac.uk/disciplines/economics/research/discussionpapers/pdf/EDP-1209.pdf

Kamiya, Y. (2011). Socioeconomic Determinants of Nutritional Status of Children in Lao PDR: Effects of Household and Community Factors. *Journal of Health, Population, and Nutrition*, *29*(4), 339–348.

Makoka, D., & ICF International. (2013). The Impact of Maternal Education on Child Nutrition: Evidence from Malawi, Tanzania, and Zimbabwe. DHS Working Papers. Retrieved from http://www.measuredhs.com/pubs/pdf/WP84/WP84.pdf

Masiye, F., Chama, C., Chitah, B., & Jonsson, D. (2010). Determinants of Child Nutritional Status in Zambia: An Analysis of a National Survey. *Zambia Social Science Journal*, *1*(1), 4.

Neumann, C. G., Gewa, C., & Bwibo, N. O. (2012). *Child nutrition in developing countries: critical role in health*. UCLA Working Paper. Retrieved from http://www.ph.ucla.edu/epi/faculty/detels/ph150/Neumann_Malnutrition.pdf

Onyango, A., Koski, K. G., & Tucker, K. L. (1998). Food diversity versus breastfeeding choice in determining anthropometric status in rural Kenyan toddlers. *International Journal of Epidemiology*, *27*(3), 484–489.

Phimmasone, K., Douangpoutha, I., Fauveau, V., & Pholsena, P. (1996). Nutritional status of children in the Lao PDR. *Journal of Tropical Pediatrics*, *42*(1), 5–11.

Ruel, M. T., habicht, J. P., Pinstrup-Andersen, P., & Grohn, Y. (1992). The Mediating Effect of Maternal Nutrition Knowledge on the Association between Maternal Schooling and Child Nutritional Status in Lesotho. *American Journal of Epidemiology*, *135*(8), 904–14.

Steyn, N. P., Nel, J. H., Nantel, G., Kennedy, G., & Labadarios, D. (2006). Food variety and dietary diversity scores in children: are they good indicators of dietary adequacy? *Public Health Nutrition*, *9*(5), 644–650.

Thomas, D., Strauss, J., & Henriques, M.-H. (1991). How does mother's education affect child height? *Journal of Human Resources*, 183–211.

United Nations (2013) Recommendations for Multisectoral Food and Nutrition Security Action Plan 2014 - 2020 United Nations, Lao PDR

Variyam, J. N., Blaylock, J., Lin, B.-H., Ralston, K., & Smallwood, D. (1999). Mother's Nutrition Knowledge and Children's Dietary Intakes. *American Journal of Agricultural Economics*, *81*(2), 373–384. doi:10.2307/1244588

Wagstaff, A., Van Doorslaer, E., & Watanabe, N. (2003). On decomposing the causes of health sector inequalities with an application to malnutrition inequalities in Vietnam. *Journal of Econometrics*, *112*(1), 207–223.

World Health Organization. (2010). Indicators for assessing infant and young child feeding practices: part 2: measurement.

APPENDICES

Appendix A: Summary Statistics of Variables used in Regression Analysis

Variable	Obs	Mean	Variance	Min	Max
WAZ	8350	-1.40	1.18	-5.83	4.78
WHZ	8246	-0.38	1.12	-4.88	4.91
HAZ	8190	-1.91	2.28	-5.98	5.83
Male	8190	0.50	0.25	0	1
Fever	8190	0.14	0.12	0	1
Diarrhea	8190	0.11	0.10	0	1
Number of Kids	8190	3.44	4.21	1	19
Diversity Score	8190	2.33	1.71	0	9
No. of Poultry	8190	13.94	252.33	0	95
No. of Goats	8190	0.32	3.21	0	60
No. of Sheep	8190	0.02	0.26	0	25
Own bank Acct	8190	0.13	0.11	0	1
Wealth quint	8190	2.44	1.74	1	5
Urban	8190	0.15	0.12	0	1
Mother's age	8190	28.03	46.82	15	49
Child Age (Categorical)	8190	3.87	2.53	1	6
Mother's education	8190	2.03	1.13	1	6
Water source	8190	1.91	0.70	1	3
Toilet type	8190	2.06	0.95	1	3
Ethnicity	8190	2.51	1.70	1	4
Province	8190	9.53	22.43	1	17

Appendix B: Regression analysis on child's consumption of individual food items and nutritional status for children less than 6 months and greater than 24 months in Lao PDR

	Under 6 months			2 years and above		
	WHZ2	WAZ2	HAZ2	WHZ2	WAZ2	HAZ2
Male	-0.05	-0.08	-0.07	0.03	0.05^{+}	-0.04
	(-0.56)	(-0.85)	(-0.56)	(0.97)	(1.70)	(-0.96)
Fever	-0.12	-0.02	0.02	-0.18***	-0.13**	-0.00
	(-0.82)	(-0.15)	(0.13)	(-3.83)	(-2.84)	(-0.02)
Diarrhea	-0.21	-0.26	0.02	-0.09	-0.13*	-0.19**
	(-1.23)	(-1.35)	(0.09)	(-1.52)	(-2.48)	(-2.62)
Ever breastfed	0.21	0.70*	0.95*			
	(0.65)	(2.39)	(2.15)			
Infant formula	0.01	0.22	0.41*	0.06	0.04	0.02
	(0.07)	(1.32)	(2.03)	(1.17)	(0.70)	(0.34)
Milk	0.38	0.52	0.21	0.08	0.14**	0.15*
	(1.25)	(1.54)	(0.58)	(1.43)	(2.65)	(2.39)
Yoghurt	-1.20**	-0.25	0.84	0.06	0.12^{+}	0.09
	(-3.06)	(-0.55)	(1.64)	(0.89)	(1.95)	(1.14)
Semi solid food				-0.06^{+}	-0.03	0.01
				(-1.93)	(-0.90)	(0.26)
Kids	0.02	0.01	0.02	-0.00	-0.02^{+}	-0.02^{+}
	(0.70)	(0.44)	(0.54)	(-0.29)	(-1.90)	(-1.81)
Urban	-0.15	-0.09	-0.11	0.06	0.07	0.05
	(-1.05)	(-0.61)	(-0.54)	(1.25)	(1.44)	(0.91)
Mother's age	-0.00	0.01	0.00	0.01*	0.01***	0.01***
	(-0.34)	(0.91)	(0.30)	(2.41)	(5.07)	(4.83)
Child's age						
12-23					0.42*	0.77**
					(2.53)	(2.73)
24-35				0.28	0.16***	0.07
				(1.35)	(4.23)	(1.53)
36-47				0.30	0.11**	0.00
				(1.47)	(3.13)	(0.09)
48-59				0.24	0.00	0.00
				(1.16)	(.)	(.)
Mother's edu (base=None)						
Primary	0.25^{+}	0.02	-0.15	0.01	0.07^{+}	0.11*
	(1.80)	(0.13)	(-0.83)	(0.34)	(1.89)	(2.31)
Lower Secondary	-0.02	0.07	0.11	0.03	0.14*	0.17*
	(-0.14)	(0.39)	(0.54)	(0.58)	(2.37)	(2.51)
Upper Secondary	0.43^{+}	0.17	-0.09	-0.02	0.10	0.16^{+}
	(1.72)	(0.85)	(-0.32)	(-0.27)	(1.25)	(1.67)
Post sec. non tertiary	-0.08	-0.32	-0.37	-0.04	-0.02	0.04
	(-0.25)	(-1.23)	(-1.04)	(-0.31)	(-0.23)	(0.29)
Higher	-0.19	-0.11	-0.18	0.13	0.35**	0.45**
	(-0.61)	(-0.32)	(-0.35)	(0.88)	(2.72)	(3.26)
Wealth quintile						

(base=Poorest)						
Second	-0.08	0.16	0.21	0.01	0.15***	0.30***
	(-0.52)	(1.02)	(1.07)	(0.13)	(3.45)	(5.37)
Middle	-0.20	-0.08	0.22	-0.00	0.21***	0.36***
	(-1.25)	(-0.44)	(1.06)	(-0.06)	(4.20)	(5.83)
Fourth	0.09	0.13	0.39	-0.04	0.21***	0.39***
	(0.43)	(0.64)	(1.45)	(-0.68)	(3.44)	(4.94)
Richest	-0.06	0.08	0.43	0.16*	0.55***	0.71***
	(-0.23)	(0.31)	(1.34)	(2.05)	(6.88)	(7.04)
Water (base=Pipe)						
Protected	-0.00	-0.12	-0.25	0.10*	0.01	-0.09
	(-0.00)	(-0.80)	(-1.21)	(2.22)	(0.15)	(-1.62)
Unprotected	-0.19	-0.20	-0.00	0.02	-0.05	-0.11*
	(-1.35)	(-1.54)	(-0.01)	(0.55)	(-1.33)	(-2.16)
Toilet (base=Flush)						
Pit latrine	-0.07	0.70*	0.80*	-0.01	0.02	0.03
	(-0.34)	(2.16)	(2.03)	(-0.10)	(0.28)	(0.33)
Bush, bucket, other	0.04	-0.13	-0.12	-0.10*	-0.10*	-0.04
	(0.24)	(-0.85)	(-0.69)	(-2.42)	(-2.47)	(-0.79)
Ethnicity (base=Lao-Tai)	-0.06	0.11	0.16	0.26***	-0.05	-0.28***
Khmu	(-0.28)	(0.58)	(0.54)	(4.22)	(-0.88)	(-3.77)
Hmong	0.48*	0.33+	0.06	0.60***	0.18**	-0.34***
	(2.31)	(1.71)	(0.22)	(10.01)	(2.86)	(-4.38)
Other	0.04	-0.11	-0.04	0.10*	-0.12**	-0.27***
	(0.26)	(-0.70)	(-0.20)	(2.17)	(-2.59)	(-4.98)
Province (base=Vientiane Capital)						
Phongsaly	1.05**	0.02	-0.89+	0.46***	-0.11	-0.72***
	(2.86)	(0.06)	(-1.89)	(4.55)	(-1.10)	(-5.90)
Luangnamtha	-0.34	-0.46	-0.52	-0.29*	-0.36***	-0.18
	(-0.73)	(-1.41)	(-1.06)	(-2.41)	(-3.40)	(-1.36)
Oudomxay	0.35	-0.16	-0.50	0.25**	0.01	-0.30*
	(1.20)	(-0.62)	(-1.28)	(2.67)	(0.15)	(-2.56)
Bokeo	0.12	-0.29	-0.58	0.21*	0.14	-0.05
	(0.42)	(-1.06)	(-1.54)	(2.24)	(1.47)	(-0.46)
Luangprabang	0.69*	-0.25	-0.97**	0.30**	0.17+	-0.18+
	(2.21)	(-0.91)	(-2.64)	(3.20)	(1.78)	(-1.74)
Huaphanh	1.02***	-0.62*	-1.67***	0.27**	0.01	-0.34**
	(3.51)	(-2.35)	(-4.54)	(3.06)	(0.11)	(-3.19)
Xayabury	0.81*	-0.77**	-1.35***	0.15	-0.01	-0.18
	(2.39)	(-2.74)	(-3.47)	(1.55)	(-0.10)	(-1.54)
Xiengkhuang	0.37	-0.17	-0.61	0.31***	0.02	-0.34**
	(1.15)	(-0.65)	(-1.59)	(3.38)	(0.17)	(-3.00)
Vientiane	0.47	-0.14	-1.32**	0.26**	-0.03	-0.40***
	(1.31)	(-0.59)	(-3.23)	(2.86)	(-0.30)	(-3.69)
Borikhamxay	-0.24	-0.00	0.13	0.24**	0.04	-0.29**
	(-0.85)	(-0.02)	(0.33)	(2.64)	(0.43)	(-2.61)

Khammuane	0.11	-0.15	-0.13	-0.05	-0.18*	-0.27*
	(0.41)	(-0.56)	(-0.38)	(-0.56)	(-1.96)	(-2.50)
Savannakhet	0.64*	-0.26	-0.96**	0.01	-0.07	-0.15
	(2.51)	(-1.17)	(-3.01)	(0.16)	(-0.84)	(-1.37)
Saravane	0.20	-0.35	-0.72+	-0.07	-0.30**	-0.40***
	(0.57)	(-1.23)	(-1.87)	(-0.75)	(-3.06)	(-3.56)
Sekong	0.46	-0.45+	-1.13**	0.04	-0.46***	-0.78***
	(1.56)	(-1.66)	(-3.13)	(0.39)	(-4.93)	(-6.96)
Champasack	-0.10	-0.32	-0.49	-0.04	-0.15+	-0.22*
	(-0.34)	(-1.34)	(-1.55)	(-0.48)	(-1.66)	(-2.14)
Attapeu	-0.05	-0.22	-0.26	-0.19*	-0.12	-0.04
	(-0.19)	(-0.82)	(-0.74)	(-2.07)	(-1.28)	(-0.32)
Constant	-0.49	-1.19*	-1.24+	-1.08***	-2.01***	-2.34***
	(-0.93)	(-2.40)	(-1.86)	(-4.56)	(-16.22)	(-15.25)
N	988	1038	1003	6090	6150	6054