Don’t Forget about the Children – Latent Food Insecurity in Rural Cambodia

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Abstract

Despite encouraging developments in overall undernourishment figures our analysis of rural Cambodian households reveals very high malnutrition in children. In this paper we use a novel panel data set from Stung Treng in Cambodia which allows to compare different household food security indicators with each other and individual level anthropometric data of children under five. While the large majority of households appear to be food secure according to the Food Consumption Score (FCS) and the Household Hunger Scale (HHS), the Household Food Insecurity Access Scale (HFIAS) and the Coping Strategies Index (CSI) classify less than four percent of the households in Stung Treng as food secure. Stunting and underweight measures for children show that between 38 to 45 percent of children under five are classified as undernourished. Analyzing the influence of household characteristics on these different measures for food security we find that the FCS is largely driven by household characteristics and livelihood strategy choices whereas the anthropometrics show little or zero correlation. Household wealth, inequality, and the prevalence of shocks however, has a strong influence on both measures. Individual and mother specific characteristics are vital to explain child malnutrition.

Keywords Malnutrition, Undernutrition, Food Security, Anthropometrics, Cambodia, Income Inequality, Shocks

JEL code Health and Economic Development I15, Economic Development O15

Halving food insecurity was one major aim of the Millennium Development Goals (MDGs), which, according the FAO (2015), has been already met in large parts of the developing world. In Cambodia, undernourishment figures declined from 38% in 1992 to 25% in 2006 (Ecker and Diao 2011). Additionally, the country witnessed rapid economic growth in the past decade with household consumption increasing by almost 40 percent (WB 2014). Most of this growth benefitted the poor and as a result poverty rates dropped to 20.5 percent. Although these figures are encouraging food insecurity and malnutrition are still widespread in Cambodia. The FAO estimates that currently 2.2 million people still suffer from undernourishment accounting for 14.2% of the population and malnutrition in terms of the weight-for-age indicator for children under five is estimated at 24% (WB 2016).

Using a variety of household food security indicators and anthropometric measures for children under five we find that common indicators such as the Food Consumption Score (FCS) or the Coping Strategies Index (CSI) do not reveal great problems with food insecurity in rural Cambodia. However, anthropometric data for children under five – measured with weight-to-height ratios – indicates that malnutrition, stunting, and nutrition deficiencies are still a common phenomenon. As malnutrition in children has severe consequences for their human capital accumulation and future health (sources) we aim to contrast the different underlying concepts and empirically assess the structural differences of household food security and child malnutrition.

With its pro poor economic growth in the past decade but persistent child undernutrition and recent economic slowdown, Cambodia is at an interesting point where policy makers should continue to strengthen their effort to increase food security and decrease malnutrition.

In the food security literature four important dimensions, availability, access, use and utilization, and stability (FAO 1996), have been identified. However, also different levels at which food security is measured matter (Coates 2013). Therefore, we are want to capture household food security using different food security. Furthermore, we use anthropometrics in children under five to capture individual level malnutrition and health status which typically is not reflected in household level food security indicators (De Haen et al. 2011, Vollmer et al. 2014). Using a novel dataset from Stung Treng, a Northern remote province of Cambodia we attempt show the gaps and give an overview of the different dimensions picked up by the individual indicators. Therefore, we first compare household food security according to major food security indicators as shown in Maxwell et al. (2014). Second, we investigate the difference between one major food security indicator, the FCS, and anthropometrics in children under five in relation to household and individual specific characteristics and shocks experienced in the past.

The remainder of the paper is organized as follows. Section II gives a detailed overview of the food security and anthropometrics literature. In addition it discusses relevant studies for Cambodia. Section III introduces the data set and the analytical methods used. Section IV presents and discusses the results and Section V concludes.

Section II: Food security, undernutrition, and livelihood strategies

Today's commonly used definition of food security was adopted at the World Food Summit in 1996. Accordingly "*Food security exists when all people, at all times, have physical, [social][1] and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life*" (FAO 1996). Based on the definition the following four dimensions of food security are derived: (i) availability, (ii) access, (iii) use and utilization, and (iv) stability. The fist dimension, availability, relates to

[1] The term "social" was added in 2002.

the actual disposability of food. The second dimension, access, captures household's ability to acquire food in sufficient quality and quantity. The third dimension, use and utilization, refers to behavioral, health and hygienic components. Usage of food within the household should capture intra-household food allocation or feeding and preparing practices. Further, utilization concerns an individual's ability to absorb and metabolize the nutrients from the food. The fourth dimension, stability, depicts the temporal aspect of food security. Even though seasonal fluctuations are common in agricultural output this seasonality should not affect people's food security.

A range of indicators have been developed which attempt to measure the different dimensions. However, the picture of household food security changes quite drastically depending on the respective indicator. Several authors (Heady and Ecker 2013, Maxwell et al. 2014) state that a clarification of concepts is needed in order to improve the measurement of food and nutrition security.

Following Maxwell et al. (2014) the most commonly used food security indicators can be categorized into the following three groups: (i) dietary diversity and food frequency – including the Food Consumption Score (FCS), or the Household Dietary Diversity Score (HDDS); (ii) consumption behavior – such as the Coping Strategies Index (CSR) and the reduced Coping Strategies Index (rCSR); and (iii) experimental measures – containing the Household Food Insecurity Access Scale (HFIAS) and the Household Hunger Scale (HHS). In addition to these indicators a number of other food-related measures frequently appear including the FAO indicator of undernourishment, household survey consumption based measures, and anthropometrics (de Haen et al. 2011). The literature (Barrett 2010, Carletto et al. 2013, Coates 2013, De Haen et al. 2011, Heady and Ecker 2013, Maxwell et al. 2014) relates the different food security and undernourishment indicators vaguely to the four dimensions of food security. Dietary diversity and food frequency scores as well as the FAO undernourishment indicator capture availability, access and to a small extent use and utilization. Indicators related to consumption behavior, experimental measures, and anthropometrics give information about use and utilization. If observed across several periods, the food security indicators can also reveal stability. In contract the anthropometrics in children under five can detect availability, access, use and utilization of food across time since child development reacts long-term to malnutrition at an early age (source).

Related to data availability and the focus of the study different strands of the literature concentrate either on food security indicators measured at the household level (e.g.: Christiaensen et al. 2000, Farber Schwabe and Drimie 2009, Maxwell et al. 2014) or on undernourishment and health indicators measured preferably at the individual level (Ruel 2006). Studies evaluating food security indicators often try to relate the indicator to a more complex measures used in the economics literature like caloric intake (e.g.: Wiesmann et al. 2009).

Belonging to the first strand of the literature Maxwell et al. (2014) find a strong correlation between different food security indicators and similar time trends over time. They conclude, that each of the indicators measures elements of food security. If the indicators are used to categorize households into being food secure or food insecure, the individual indicators yield different results. In particular households are more likely to be categorized as food secure according to the FCS compared to the HFIAS. Given that the two scores measure different aspects of food security this is not surprising. This underlines the need to evaluate more than one indicator to capture different aspects of food security. Farber, Schwabe, and Drimie (2009) find that the HFIAS is inversely correlated to dietary diversity and conclude that dietary diversity scores are relevant to determine household food security. Constructing a new forward looking indicator Chistiaensen et al. (2000) show that dietary diversity

indicators and the coping strategy index are positively correlated meaning that both can detect similar issues of food insecurity. In addition, Hatløy, Torheim and Oshaug (1998) find that even simple measures such dietary diversity scores can give valuable information about nutritional adequacy and therewith access to sufficient amounts and varieties of food. Using data from Bolivia, Burkina Faso, and the Philippines, Melgar-Quinonez el al. (2006) validate that dietary diversity scores determine household's food security levels in diverse settings. In contrast, a recent study by Lovon and Mathiassen (2014) questions the accuracy of dietary diversity scores related to caloric intake. Yet, the authors still argue that the measures are able to detect quantitative and qualitative aspects of food consumption.

The literature using anthropometrics for children is much more diverse and relates not only to food security but also to health and poverty. Anthropometric measures are generally viewed superior to household level indicators because they are related to a particular individual and measure undernutrition directly (De Haen et al. 2011). However, especially for South Asia undernutrition might be overstated due to the difference between the studied population and the global reference group defined by the WHO. Thus, South Asia exhibits high undernutrition rates in under-five-year-olds compared to lower mortality and high economic growth rates (Klasen 2008). Similarly, Vollmer et al (2014) find that macroeconomic growth is only weakly associated with decreases in child stunting, underweight, and wasting. They relate their finding to the assumption that anthropometrics do not only capture food insecurity but also health issues which do not necessarily have to be connected to food security.

In her literature review Ruel (2006) finds mixed evidence regarding the correlation between dietary diversity and child anthropometrics. However, the majority of studies reviewed find a positive correlation. Yet it remains unclear if dietary diversity reflects the quantity (caloric intake) or the dietary quality (nutrient density) of food consumed or a combination or both.

To date only a few studies analyze food insecurity and undernourishment in Cambodia. Most studies (FAO 1999, Murshid 1998, NIPH, NIS and ORC Macro 2006, and Tickner 1996) are rather descriptive and do not disentangle underlying economic effects related to food security and undernourishment. Ecker and Diao (2011) descriptively analyze the change of food security and undernutrition indicators over time and in relation to GDP. In addition, they compare Cambodia to its South East Asian peers Bangladesh, China, India, Lao PDR, Thailand, and Vietnam. While Cambodia remains one of the poorest countries with high prevalence of undernutrition they acknowledge that more detailed household and individual level analysis regarding food security and undernutrition is necessary. Kristensen (2001) descriptively evaluates how regional cooperation of the countries in the Lower Mekong Delta contributes towards reducing poverty through ensuring food security, especially highlighting the importance of fish as the major source of animal protein.

Fujii (2010) uses the small-area estimation technique to infer information of child nutrition status combining the 2000 Cambodia Demographic Health Survey with the 1998 individual level Cambodia National Population Census. Individual and household level analysis are not possible in this set-up as the Demographic Health Survey cannot be linked to individuals from the National Population Census. The results at commune level suggest that natural disasters and prevalence of serious diseases, e.g. malaria and diarrhea, affect children's nutrition status adversely.

Hong and Mishra (2006) give a very detailed description of child undernourishment based on the 2000 Cambodia Demographic and Health Survey. They find that even after controlling for child and mother specific characteristics household wealth is a main driver of child undernutrition. However, as they do not have household income or consumption values their wealth indicator is based on asset variables and thus might not fully reflect the wealth situation of the households. In addition, the authors do also not observe different income

generating activities, livelihood strategies, or overall food security indicators at the household level.
A recent World Bank (WB 2014) report shows that despite improvements in child undernourishment until 2000 wasting and malnutrition increased in the past years. This is partly rooted in malnutrition of adult females which has adverse consequences for children as they typically are born with extremely low birth weights. Regression analysis confirms that socioeconomic indicators, e.g. wealth and mother's education, impact on child malnutrition.

Section III: Data Set and Methods

The data set used is part of a novel two period household panel survey collected in May 2013 and 2014 in the Cambodian province of Stung Treng. The original survey from 2013 contained 600 households which were sampled in a two-stage sampling procedure. In the first step, 30 villages were selected from the list of all 129 rural villages in the province with probabilities proportional to their size measured as the number of households. In the second step, 20 households were randomly chosen from each village's household list. This results in equal probability for each household in the province to be part of the sample and it is based on the procedures described by Hardeweg et al. (2013) and the United Nations (2005). The survey consists of two modules: (i) a household questionnaire covering household and individual level data on income and consumption components, agricultural production, shocks, assets, health, food security, education, and housing; and (ii) a village level questionnaire capturing village level characteristics such as employment opportunities, population size, and access to general services (education, banking, etc.). Responses to the former were given by the household head and/or spouse and covered the reference period of one year, while the latter was answered by the village head or deputy.
The household survey was administered in Khmer by a mixed-gender team of 15 enumerators. All of them had previous experience with socio-economic household surveys and participated in a one week training before starting the survey. Two thirds of the team were from the capital Phnom Penh, the rest were recruited locally in Stung Treng.

Child undernutrition is captured as: (i) stunting – in terms of height-for-age, (ii) underweight – as weight-for-age, and (iii) wasting – in terms of weight-for-height. All three indicators are based on child age, height, and weight measured by the enumerators during the survey. We use standard deviation scores (z-scores) to compare the children to the international reference population established by the WHO (1986). Following the WHO guidelines our values are standardized according to the following formula:

$$Z_i = \frac{a_i - m_r}{sd_r}$$

where Z is the standardized z-score, i represents the individual observation and r refers to the reference population. The score is derived by first subtracting the median value of the reference population (m_r) from the observed value (a_i) and second dividing this by the standard deviation of the reference population (sd_r). Following the standards of the WHO (De Onis and Bloessner 1997) we define <-2 as the cut-off point for moderate and severe undernutrition and <-3 as the cut-off point for severe undernutrition for all three indicators. We restrict the sample to biologically plausible values, i.e. z-scores > |6| for height-for-age, <-6 and >5 for weight-for-age, and >|5| for height-for-weight are excluded (Vollmer et al. 2014). Note, in the regression we use two different specifications. In the household level regression we use the z-scores itself and in the undernutrition model we use a dummy

variable with the cut-off of <-2 applied to differentiate normal versus undernourished children. In the descriptive part we also use an indicator variable which can take on the values 0 (no undernutrition), 1 (moderate undernutrition), and 3 (severe undernutrition).

Household food security is assessed by using commonly applied indicators including the FCS, HIFAS, HHS, CSI and rCSI. For a more detailed description of the individual indicators see e.g. Maxwell et al 2014, Meise 2014, Hoddinott and Yohannes 2006.
The construction of the FCS is based on the technical report issued by the World Food Program (WFP, 2008) and involves fife steps. First, the individual food items reported by the household for the past seven days are grouped into nine food groups[2]. Second, the frequencies of consumption are summed within each group with a maximum value of seven for each group. Step three obtains the weighted values for each food group to reflect the different nutrition and caloric values associated. Fourth, the sum overall food group scores is taken to create the food consumption score (FCS). Finally, to assess households' food security general thresholds are applied for classification. [3] Even though the FCS is used as the main food security indicator in the World Food Program, Lovon and Mathiassen (2014) argue that data collection issues may result in weak correlation between the FCS and caloric intake. We still use the FCS as our main food security indicator to allow comparability with other studies and because of its prominence in the World Food Program.
Using a reference period of four weeks the Household Food Insecurity Access Scale (HFIAS) is derived from a set of questions related to food availability and household behavior (Coates Swindale and Bilinsky 2007). Each question can be answered with never (=0), rarely (=1), sometimes (=2), and often (=3). From the questions the average HFIAS score is calculated in two steps. First, the score for each household is calculated by summing the frequency of non-availability across all questions. The lower the individual score the more food secure is the respective household. Second, the score of all households is created and divided by the number of households in the sample to reach the average score. The Household Hunger Scale (HHS) is closely related to the HFIAS and consists of a subset of questions that are robust to different cultural settings (Maxwell et al. 2014).
The Coping Strategies Index (CSI) and reduced Coping Strategies Index (rCSI) measure behavior or coping strategies employed by people who do not have access to enough food. The indicators is based on a set of questions that ask how frequently the household uses a certain strategy (e.g. go to bed hungry, borrow from a friend) (Maxwell and Caldwell 2008).

In a first step we descriptively compare household's food security status according to the different food security indicators. Further, we analyze the different levels of child malnutrition.
In a second step we explore the relationship between household characteristics and the FCS and the anthropometric measures utilizing an ordinary least squares (OLS) and logistic regression. According to the literature socio-economic household characteristics including household wealth, composition, education level, and income sources as well as geographic differences are related to a household's food security status (Knueppel et al. 2009). In addition mother and child specific characteristics including mother's education, health indicators, child age, and birth order, are important for child undernutrition (Nguyen et al. 2013). In order to assess the influence of shocks experienced by the household in the past year we also include a shock dummy variable (Fuji 2010).

[2] The nine food groups are: main staple, pulses, vegetables, fruit, meat and fish, milk, sugar, oil, and condiments (WFP, 2008).
[3] Since the households in our sample frequently used oil and sugar we applied the higher cutoffs suggested by the World Food Program for households who consume oil and sugar (WFP, 2008).

To compare the influence of household level characteristics on household food security, measured as the FCS, to undernutrition at child level our first model, run as an OLS, has the following form:

$$FCS_{ik} = \beta_0 + \beta_1 shock_i + \beta_2 H_i + \beta_3 W_i + \beta_4 V_k + \beta_5 D_i + \varepsilon_{ik},$$

where i identifies the household and k the village. The shock variable is a binary variable which indicates if a household experienced a shock in the past year. H is a vector of household head characteristics including gender, years of education, age, and ethnicity. In addition, W is a vector of household wealth indicators such as assets, household income quintiles, and major income generating activities e.g. Tropical Livestock Units (TLU) per capita, income from agriculture, and days gone fishing. To reduce the number of variables we performed a principal component analysis of the asset variables (land and asset holdings). V is a village level measure of market access measured by the distance in minutes needed to reach the next town. Finally, we include geographic dummies (D) for the different municipal areas, Sesan, Siem Bouk, Stung Treng, and Siem Pang, to control for regional differences against the base group of households situated in the municipality of Thala Barivat.
In a second model we further include child and mother specific characteristics to explain undernutrition at the child level. Here we use a OLS regression to detect how the different factors influence the z-scores and a logistic regression to determine the likelihood of stunting, underweight, and wasting.

$$U_{jik} = \beta_0 + +\beta_1 shock_i + \beta_2 C_j + \beta_3 M_j + \beta_4 H_i + \beta_5 W_i + \beta_6 V_k + \beta_7 D_i + \varepsilon_{ijk},$$

where j identifies each child below five years, i identifies the household, and k the village. The shock variable contains two binary variables indicating whether the household experienced an economic or weather related shock in the past year. In addition to the aforementioned vectors this regression includes a vector of child (C) and mother specific (M) characteristics. The former includes the child's gender and the age of the child in months. The latter includes the mother's age, Body Mass Index (BMI) and education.
Examining the residuals and their leverage the regressions in model one and two appear to be well behaved according to Cox D and studentized residuals (Greene 2012 p. 175). The overall F tests (Wooldridge 2010 p. 60) reveal that the coefficients are jointly significant, except for regression (4) displayed in table 3. The variance inflation factor indicates that multicollinearity is not present. For the z-scores the second model including child and mother specific characteristics performs significantly better according to the Akaike and Bayesian Information Criterion (Greene 2012 p. 179). We use heteroscedasticity robust standard errors for all models.

Section IV: Results

Food secure households with undernourished children

The basic analysis of classifying households into major food security indicators shows that the different indicators capture different aspects of food security (see table 1). While the large majority of households appear to be food secure according to the FCS and the HHS, the HFIAS and the CSI classify only 0.34 to 3.26 percent of the households as food secure. These findings are very much in line with findings from Maxwell et al. (2014) in Ethiopia.
Turning to the estimates of anthropometrics for children under five, displayed in table 2, it becomes evident that stunting, underweight and wasting are still wide-spread. While stunting

is more prominent amongst boys, underweight and wasting appears more frequently for girls. This could hint at a potential gender bias regarding the intra-household food allocation.

Table 1: Household food security status according to major food security indicators

Indicator	% of households classified as food secure	mildly/ moderately food insecure	severely food insecure
FCS	86.3	12.16	1.54
HFIAS	0.34	26.03	73.46
HHS	98.28	1.54	0.17
CSI	3.26	96.05	0.69
rCSI	60.03	39.45	0.51

Source: Own calculations

Table 2: Malnutrition in children under five

		total	male	female
stunting	**N**	251	127	124
normal (%)	114	45.42	40.94	50.00
moderate (%)	55	21.91	20.47	23.39
severe (%)	82	32.67	38.58	26.61
underweight	**N**	259	130	129
normal (%)	161	62.16	61.54	62.79
moderate (%)	58	22.39	23.85	20.93
severe (%)	40	15.44	14.62	16.28
wasting	**N**	250	127	123
normal (%)	193	77.20	79.53	74.80
wasting (%)	40	16.00	14.17	17.89
severe wasting (%)	17	6.80	6.30	7.32

Source: Own calculations

Influence of household level characteristics on FCS and undernutrition

The regression results, shown in table 3, support our claim that the correlations between the FCS and household and village characteristics are substantially different than the correlations between anthropometrics and these characteristics. Columns (1) and (2) depict the results for the household FCS score including all households (1) and only those with valid child anthropometrics (2). Columns (3) to (5) show the results for the different z-scores at the child level. For the FCS regression we find that shocks have a large and significant negative impact on the level of household food security while household head characteristics such as education and age are positively associated with the FCS score. The type of income generating activities appear to be relevant for the household food security status. While households with more agricultural wage workers seem to have a lower FCS the day's gone fishing significantly improve a households food security. Given that fish is a major source of animal proteins this finding underlines the importance of small scale fishing in the region. The wealth indicators show that households in poorer income quintiles have lower FCS scores. Similarly larger assets and land holdings have a positive effect. Assets in terms of animals consumed or sold (TLU) appear to be negatively and significantly correlated with the FCS. The regional dummies reveal that food security differs across the province. While Siem Bouk appears to be considerably better off, Siem Pang, situated in the North bordering Lao PDR, is worse off. In addition remoteness and credit rationing in the village decreases the household's food security.

Turning to the z-scores we observe that shocks and household size are only relevant for the weight-for-height ratio. Interestingly, a larger household size has a negative effect on the weight-for-height ratio while it has a positive effect on the FCS score. This hints at the fact that even though the variety and frequency of food consumed at the household level is good, the intra-household allocation of food matters. As expected, household head characteristics and income generating activities appear to be largely irrelevant across all three scores. Income inequality seems to matter for the height-for-age score whereas assets have a positive influence on weight-for-age and weight-for-height scores. The regional dummies depict that there are some geographic differences but no clear pattern emerges.

Overall, we observe that despite the similar trends for the influence of shocks, income inequality, and assets, those household characteristics that appear to be correlated with food security have no association with child anthropometrics. This means even if households are categorized as food secure children continue to be malnourished.

Table 3: OLS Results of Food Security and Malnutrition

VARIABLES	(1) FCS (all)	(2) FCS (restricted)	(3) Weight-for-age	(4) Height-for-age	(5) Weight-for-height
Shock	-2.906**	-2.603	-0.245	0.125	-0.525
	(1.143)	(2.261)	(0.282)	(0.328)	(0.325)
Household size	1.208***	0.0504	-0.0705	0.0802	-0.165**
	(0.275)	(0.539)	(0.0625)	(0.0845)	(0.0764)
Age head (in years)	0.0799**	0.257***	0.00791	0.00270	0.00788
	(0.0389)	(0.0907)	(0.00745)	(0.00971)	(0.0101)
Education head (in years)	0.307*	0.387	0.0106	0.0334	-0.0180
	(0.170)	(0.345)	(0.0339)	(0.0466)	(0.0446)
Party hh head (dummy)	-1.990**	-1.450	0.283	0.182	0.234
	(0.990)	(1.911)	(0.190)	(0.260)	(0.269)
Risk aversion head (indicator)	0.434**	0.132	-0.0229	0.00516	-0.0319
	(0.179)	(0.333)	(0.0314)	(0.0455)	(0.0488)
Agricultural worker (nr. of members)	-1.650***	-2.887***	0.0484	0.134	-0.0501
	(0.422)	(0.771)	(0.0841)	(0.127)	(0.133)
Days gone fishing	0.0238***	0.0252***	-0.00202**	-0.00191	-0.00118
	(0.00499)	(0.00925)	(0.00101)	(0.00147)	(0.00151)
Income Quintile 1	-8.643***	-5.295	-0.0876	-0.952**	0.694
	(1.844)	(3.456)	(0.337)	(0.440)	(0.476)
Income Quintile 2	-3.479**	-4.383	0.130	-0.601	0.734*
	(1.727)	(3.513)	(0.286)	(0.390)	(0.428)
Income Quintile 3	-4.746***	-6.575**	0.368	-0.259	0.620
	(1.567)	(3.304)	(0.288)	(0.381)	(0.401)
Income Quintile 4	-1.082	-0.335	-0.0417	-0.513	0.306
	(1.539)	(3.543)	(0.289)	(0.403)	(0.403)
Assets (PCA)	1.058**	0.407	0.168*	-0.145	0.364**
	(0.493)	(0.954)	(0.0880)	(0.138)	(0.150)
Tropical livestock units pc	-6.143***	-1.949	-0.109	0.148	-0.0773
	(2.279)	(7.642)	(0.665)	(0.943)	(0.959)
Distance to town (minutes)	-0.253***	-0.181	-0.0192	0.00834	-0.0383**
	(0.0673)	(0.126)	(0.0142)	(0.0204)	(0.0187)
Credit rationing (dummy)	-0.200**	-0.625	-0.0671	-0.0599	-0.0557
	(0.0850)	(0.546)	(0.0478)	(0.0815)	(0.0969)
Sesan (dummy)	-0.356	0.682	0.651**	0.457	0.465
	(1.477)	(2.772)	(0.303)	(0.393)	(0.405)
Siem Bouk (dummy)	4.447***	5.561**	0.797***	0.259	0.771*
	(1.489)	(2.642)	(0.253)	(0.416)	(0.420)
Siem Pang (dummy)	-6.039***	-6.507*	0.221	-0.382	0.793**

	(1.606)	(3.345)	(0.279)	(0.400)	(0.375)
Stund Treng (dummy)	-1.957	-2.530	0.618**	0.505	0.461
	(1.300)	(2.791)	(0.279)	(0.370)	(0.386)
Constant	53.49***	55.40***	-1.408***	-3.045***	0.622
	(2.941)	(6.142)	(0.541)	(0.780)	(0.751)
Observations	583	196	250	250	250
Adjusted R-squared	0.323	0.309	0.0822	-0.0103	0.0137
F test	11.99	5.948	1.846	1.100	1.507

Robust standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1. Further control variables: female_head, ethnicity (dummy, 1=khmer), white collar worker (nr of hh members), days gone hunting, days gone logging, drinking water (indicator), sanitation (indicator)

Influence of child and mother specific characteristics on undernutrition

Table 4 is divided into two panels. The first panel shows the influence of mother and child specific characteristics on the z-scores, the second panel depicts the probability of underweight, stunting, and wasting. As before, shocks, here divided into weather and economic shocks, have a negative influence on the z-scores. Especially weather shocks have a significant and negative influence on weight-for-age and weight-for-height scores. The gender of the child does not appear to be relevant for individual z-scores. Therefore, we conclude that there exists no specific gender bias related to undernutrition in our sample. Older children exhibit comparatively lower z-scores meaning that undernourishment increases with age. Mother specific characteristics appear to play a significant role. Mothers who are healthier (higher BMI) and have higher education obviously have a positive impact on their child's anthropometrics.

Turning to the probability for a child to be underweight, stunted, or wasted we find similar results. Children are significantly at risk of being underweight, if the household experienced an economic shock in the past year. In addition, weather shocks increase the probability for a child to be categorized as wasted. Similar to the z-scores, older children are more likely to be underweight or stunted. Mother's health and education decrease the likelihood for underweight and stunting.

Table 4: Influence of child and mother specific characteristics on Z-scores and probability of undernutrition

	OLS regression			Logit regression		
VARIABLES	(1) Weight-for-age	(2) Height-for-age	(3) Weight-for-height	(4) Underweight	(5) Stunting	(6) Wasting
Weather shock (dummy)	-0.375**	-0.0238	-0.544*	0.505	-0.249	0.831*
	(0.174)	(0.264)	(0.294)	(0.377)	(0.350)	(0.436)
Economic shock (dummy)	-1.084	-1.349	-0.0939	3.313***	0.355	1.688
	(0.935)	(1.295)	(0.892)	(1.152)	(1.453)	(1.459)
Age child (in months)	-0.0217***	-0.0239***	-0.0106	0.0317***	0.0226**	0.00345
	(0.00548)	(0.00745)	(0.00745)	(0.0107)	(0.00891)	(0.0117)
Gender child (dummy, 1=female)	-0.239	0.227	-0.332	0.303	-0.399	0.443
	(0.166)	(0.223)	(0.239)	(0.330)	(0.283)	(0.349)
Birth order child	0.335	1.211***	-0.633**	-0.526	-0.871**	0.753*
	(0.227)	(0.280)	(0.303)	(0.378)	(0.388)	(0.455)

Age mother (in years)	0.0108	0.0256**	-0.00690	-0.00221	-0.0286**	0.0176
	(0.00784)	(0.0105)	(0.0106)	(0.0146)	(0.0138)	(0.0157)
Education mother (indicator)	0.178*	0.474***	-0.177	-0.181	-0.525***	0.271
	(0.107)	(0.144)	(0.140)	(0.200)	(0.192)	(0.213)
BMI mother	0.0658**	0.0593	0.0274	-0.184**	-0.00410	-0.0674
	(0.0305)	(0.0451)	(0.0471)	(0.0730)	(0.0542)	(0.0732)
Constant	-2.653***	-4.466***	0.298	1.846	0.881	-1.833
	(0.787)	(1.095)	(1.109)	(1.635)	(1.360)	(1.746)
Observations	248	248	248	248	248	248
R-squared	0.258	0.197	0.157	0.204	0.104	0.158
chi2	0.185	0.119	0.0745	49.64	29.20	40.94

Robust standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1. Other controls: household size, party head (dummy, 1=yes), income quintile dummies, asset factor, TLU per capita, distance to town, credit rationing, regional dummies

Conclusions and Outlook

Our results confirm that according to dietary diversity measures households in Stung Treng appear to be able to meet their basic food security needs. However, the CSI and HIFAS point towards more food insecurity among households with respect to perception and coping measures. Children below five are found to continue to suffer from stunting and malnutrition. Thus, there seems to be latent food insecurity for children probably based on intra household resource allocation issues. In addition, quantitative evaluation of food security from a households perspective shows that people are not aware of malnutrition and deficiency issues since for them having enough rice means that they are food secure. Thus, due to its cultural dimension it will be difficult to change people's diet and food consumption pattern. In order to improve the situation it is important that policy makers are aware of the latent food insecurity, especially for children, in rural Cambodia.

OLS regression analysis confirms that household food security levels seem to be different from individual food security levels, at least for children under five. While the FCS is positively correlated with household head education, age and household income generating activities, the child anthropometrics are not influenced by these characteristics. Children's nutrition status seems to be rather driven by their mother's health and education status. Economic distress in form of shocks at the household level, however, does influence both, food security and children's malnutrition. Therefore, policies should aim at increasing food aid for vulnerable households as well as invest more into child related benefits e.g. providing school feeding.

Further analysis especially looking at gender specific issues as well as tracking food security and undernutrition over time is necessary to get a more detailed understanding of household internal dynamics.

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