Determinants of Nutrition Outcomes in Under-five Children: Experiences from Malawi

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Abstract:

Nutrition disorders in under-five children continue to be one of the most important development concerns for Malawi government and its development partners. Tackling such a crisis requires an initial understanding of its underlying drivers. This study therefore, examines the determinants of malnutrition in under-five children in Malawi using econometric based tools. We use 2010/2011 Malawi's Third Integrated Household Survey data. Three anthropometric indices are derived to establish child nutrition status and Logit model is used to examine the relationship between the nutrition status and the socioeconomic, institutional, and demographic characteristics of the children. About 11.4% were found to weight too little for their height (wasting), 30.6% were weighing too little for their age (underweight) and about 48% were too short for their age (stunted). The results establish evidence that nutrition status in under-five children is strongly associated with maternal education, location, water quality, growth monitoring, number of daily meals, dependency ratio and household size. The paper concludes by drawing the policy implications of the present findings.

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Keywords: Stunting, Wasting, Underweight

Introduction

The world is currently experiencing both a food and a financial crisis. These are linked in complex ways through their implications for food security, financial and economic stability. It has been revealed that because the developing countries are more integrated within world markets, the latest food and financial crises will have stronger effects on those countries than during previous crises. The impacts are also varied across different household types within the developing world [1]. Approximately, 27% of under-five children in the developing world are malnourished, and this is responsible for about half of the 10 million deaths each year of under-five children [2]. For those who survive a malnourished childhood are less physically and intellectually productive later in their life and suffer from more chronic illness and disability; and this has vast implications for their earnings as adults [3, 4]. Chronic malnutrition is usually measured in terms of growth retardation,

and large scale development programs such as the Millennium Development Goals (and the current Sustainable Development Goals) have also picked up the importance of the under-five children's nutritional status as indicators for evaluating progress [5, 6, 7].

Narrowing down to Malawi, nutrition disorders continue to be a silent crisis in Malawi despite efforts by government and partners to improve the situation. This poses a serious challenge to the attainment of the national growth and development goals as set in the Malawi Growth and Development Strategy (MGDS). According to the Third Integrated Household Survey (IHS3), one in every three children under-five years of age in Malawi were underweight (30 percent) with 1 percent being severely under-weight. Almost three in every five children under the age of five years (48%) were stunted, less than a third of these (14 percent) were severely stunted. Stunting prevalence in under-fives living in rural areas was 48 percent and significantly higher than that in urban areas at 44 percent [8]. These statistics have not changed much from the Multiple Indicator Cluster of 2006 [9].

Empirical studies have been done in Malawi to assess the prevalence of malnutrition in under-fives [10]. But these studies have failed to provide fundamental answers to the empirical question: Do socio-economic, institutional and demographic factors play a major role in the determination of nutrition outcomes of under-five children in Malawi. Thus, socio-economic and demographic influence on malnutrition and undernourishment has been greatly neglected with limited literature documenting the effects of these factors on the nutrition status of under-five children. This study therefore commits to provide an answer to the aforementioned empirical question by using econometric instruments.

Methodology

Data Sources

The study uses the Third Integrated Household Survey (IHS3) data collected in 2010-2011 by the National Statistical Office (NSO) in Malawi. The survey collected data on the demographic, anthropometric, education, income, expenditure and employment characteristics of households among others. The survey collected information from a representative sample of 12,271 households (10,038 rural households and 2,233 urban households). Within the 12,271 households,

there were 7810 under-five children whose data was used for analyses in this study. The sampling design was representative at both national and district level hence the survey provides reliable estimates for those areas. A stratified two-stage sample design was used. At the first stage, the primary sampling units (PSUs), which were the census Enumeration Areas (EAs) were selected. A total of 768 EAs were selected with probability proportional to size (PPS) within each district. In the second stage, a random systematic sampling was used to select 16 primary households and 5 replacement households from the household listing for each sample EA. To better facilitate higher quality data and increase timely availability of data during the data capture process, computer assisted field entry and double entry were used among others [11]. The data was analyzed using STATA (version 13.0) with a zanthro program for anthropometric analyses [12].

Epidemiological construct

Logit model was used to examine the determinants of malnutrition among under-five children. In this study, Z – score of -2 were used as the under-five malnutrition cut-off point. The anthropometric indices used for malnutrition in this study were three dimension: stunting, wasting and underweight. The share of the sample falling below the malnutrition cut-off point was classified as malnourished for a given dimension. Following World Health Organization (WHO) [13], the usual z-score was used to carry out the analysis of child's malnutrition as presented below:

$$z = \frac{X_i - \mu_k}{\sigma_k}, \text{ i=1, ..,3}$$

Where X_i is Height for Age (Stunting), Weight for Age (Underweight) or Weight for Height (Wasting); $\delta_{k,}$ is the corresponding standard deviation, μ_k the Median height for reference WHO.

The computed indices were used to classify the children into wasting, underweight and stunted. For indices below the cut-off point were recoded as 1 to signify presence of malnutrition and the indices above the cut-off point were recodes as 0 for absence of particular malnutrition problem. This was done to make the logit model estimable as it requires bernolli outcome in the dependent variable. Three Logit models fitted are stated implicitly as:

$$Y_1 = \ln\left(\frac{P_i}{1-P_i}\right) = \beta_{10} + \beta_{11}X_{11} + \cdots + \beta_{1k}X_{1k} + \varepsilon_{1i}$$

$$Y_2 = \ln\left(\frac{P_i}{1-P_i}\right) = \beta_{20} + \beta_{21}X_{21} + \cdots + \beta_{2k}X_{2k} + \varepsilon_{2i}$$

$$Y_3 = \ln\left(\frac{P_i}{1-P_i}\right) = \beta_{30} + \beta_{31}X_{31} + \cdots + \beta_{3k}X_{3k} + \varepsilon_{3i}$$

Where the variables are as defined in the table 1 below:

Table 1: Definition of Selected Household and Child Variables, Malawi, 2010-2011

	Variable name	Definition
Household size	X_{i1}	Household size
Age of household head	X_{i2}	Age of household head in years
Gender of household head	X_{i3}	1=Male, 0=Female
Dependency ratio	X_{i4}	household Dependency ratio[1]
Primary education	X_{i5}	1= Primary education, 0= Otherwise
Secondary education	X_{i6}	1= Secondary education, 0= Otherwise
Tertiary education	X_{i7}	1= Tertiary education, 0= Otherwise
Toilet	X_{i8}	Presence of toilet (1=yes, 0=no)
Clean water	X_{i9}	Access to clean water (1=yes, 0=no)
Urban	X_{i10}	(1=Urban, 0=Rural)
Number of daily meals for adults	X_{i11}	How many meals are taken by adults per day in your household?
Number of daily meals for children	X_{i12}	How many meals are taken by children per day?
Participation in nutrition program	X_{i13}	(1=yes, 0=no)
Participate in underfive clinic	X_{i14}	Child participates in an under-five clinic?)1=yes, 0=no)
Sex of the child	X_{i15}	Sex of child (1=male, 0=female)
stunting	X_{i16}	Stunted child (1 =yes, 0=No)
underweight	X_{i17}	underweight child (1 =yes, 0=No)
wasting	X_{i18}	wasting child (1 =yes, 0=No)

*mother's education level

[1] proportion of dependents (non-economically active members) in the household

Results

Descriptive analysis of data regarding age of the household head shows that sample household heads' age averaged 36.35 years. About 84% of the sample households were male-headed and the remaining (16%) were female-headed. The survey shows that the average dependency ratio was 1.2, thus, each economically active person in a family supported more than one economically inactive person. About 70% of the mothers have never attended formal education, the remaining have attended primary (11%), secondary (17%) or post-secondary (2%) education. With regard to hygiene and sanitation, about 90% have toilet facilities around their homes and 79% have access to portable clean water supply. Proportion of sample male and female children were almost 50% respectively. The average age of children was found to be 32.4 months. About 75% of the mothers were participating in growth monitoring (under-five clinic) while about 9% participated in other nutritional programs. A summary of anthropometric statistics reveal that prevalence of child malnutrition is high. About 11.4% were found to weigh too little for their height (wasting), 30.6% were weighing too little for their age (underweight) and about 48% were too short for their age (stunted) (Table 2).

Table 2: Socio-demographic and anthropometric characteristics of subjects, Malawi, 2010-2011

Characteristic	n (%)	Mean±SD
Household size		5.6 ± 2.02
Age of a child (Months)		32.4±16.5
Age of household head (Years)		36.1±11.3
Gender of household head		
Male	6,561 (84)	
Female	1,249 (16)	
Dependency ratio		1.2 ±0.4
Mother Education		
None	5,473 (70.1)	
Primary education	834 (10.6)	
Secondary education	1,335 (17.1)	
Tertiary education	160 (2.0)	
Presence of Toilet	7104 (90.7)	
Access to Clean water	6158 (78.7)	

Characteristic	n (%)	Mean±SD
Residents		
Urban	1,233 (15.7)	
Rural	6,577 (84.2)	
Number of daily meals for adults		2.53 (0.56)
Number of daily meals for children		2.82 (0.64)
Participation in nutrition program	714 (9.1)	
Participation in under-five clinic	5,878 (75.2)	
Sex of the child		
Male	3,901 (49.95)	
Female	3,909 (50.05)	
Anthropometry		
Wasting	891 (11.4)	
Underweight	2394 (30.6)	
Stunting	3763 (48.1)	

The results of the models indicate that out of the fifteen predictors, twelve were found to significantly influence nutrition outcomes in under-five children. Those factors that did not influence nutrition outcomes include age of household head, gender of household head and presence of toilet. The results of the model are presented in Table 3. Overall, the performance of models was significant, that is the included variables significantly explained the likelihood of children being found under given nutrition outcomes (χ^2 with $p<0.01$).

Table 3: Marginal effects after Logit Models for Nutrition outcomes, Malawi, 2010-2011

Variables	Stunting		Underweight		Wasting	
	Coefficients	p-value	Coefficients	p-value	Coefficients	p-value
Household size	0.01983	0.054	0.0115**	0.011	-0.3213***	0.000
Age of household head	-0.0019	0.279	0.0003	0.851	0.0004	0.711
Gender of household head	0.0341	0.504	-0.0109	0.841	0.0341	0.291
Dependency ratio	0.0191	0.362	0.0197	0.373	0.0341***	0.009
Maternal Primary education	-0.0344	0.556	-0.0926	0.133	-0.1881***	0.000
Maternal Secondary education	-0.0166***	0.002	-0.0264***	0.000	-0.1013***	0.002

Maternal Tertiary education	-0.0383**	0.016	-0.0544***	0.004	-0.0442***	0.000
Toilet	-0.0871	0.144	-0.0013	0.977	-0.0570	0.153
Clean water	-0.0422	0.337	-0.1029	0.095	-0.0655**	0.019
Urban	0.1191***	0.000	-0.1270**	0.036	0.0711**	0.048
Number of daily meals for adults	-0.0037	0.927	-0.0356	0.406	-0.0983***	0.000
Number of daily meals for Children	-0.0133***	0.000	-0.0421***	0.000	-0.0694***	0.002
Participation in nutrition program	-0.0263***	0.000	-0.1563**	0.019	-0.0210***	0.000
Participate in under-five clinic	-0.0114***	0.005	-0.2509***	0.000	-0.0461	0.083
Sex of the child	-0.0546	0.175	-0.0119***	0.001	-0.1093***	0.000
Diagnostics	Wald χ^2 (15) = 1092 Prob > chi2 = 0.0000***		Wald χ^2 (15) = 530.44 Prob > chi2 = 0.0000***		Wald χ^2 (15) = 387.14 Prob > chi2 = 0.0000***	

***=significant at 1%, **=significant at 5%

Discussion

Household size was positively related to underweight in under-five children ($p<0.05$). This means that children from larger household sizes were more likely to be underweight. Probably, this is to do with competition over limited food resources by household members. This is further unpacked by looking at the dependency ratio as household size alone may not reveal much on independence of household members in providing for their own economic needs. The finding show that households with many dependents were likely to have wasted children ($p<0.01$). More dependents in the households may imply competition for food, in turn, there is reduced per capita quantity and quality of food for children and other household members. A further analysis showed that among the options which the rural households used to cope with food shortage included reducing number and quantity of meals per day. Such coping mechanisms have a negative effects nutrition outcomes. This is further evidenced by a divergent relationship between number of meals taken by children and malnutrition status ($p<0.01$). Those who didn't have adequate number of meals in a day were likely to be malnourished because their food intake did not match with their body demands. As a result, their body weight could not increase proportionally to their age and height.

Education status of the mothers was an important predictor of the child nutrition regardless of which ever the level (primary, secondary and tertiary). Children from mothers that went to school were more likely to be free from malnutrition than for mothers who never attended school. The finding could imply that education improved mothers' general nutritional knowledge as Malawian primary education curriculum has subjects that enlighten learners on health and nutrition issues. Whereas, with education at secondary level or beyond widens the opportunities of a mother to be employed and in turn find adequate income to finance her improved child care practices. Similar relationship between education and nutrition status in children was established by [14] and [15].

Malnutrition was more likely to occur in children in the urban area, and also those that did not have access to clean water ($p<0.05$). With regard to urban area, the finding is strange because urban residents are usually better off than their rural counterparts in terms of their income and purchasing power. Although they are able to afford the required quantities of food, the quality in terms of nutritive value is usually compromised. For example, it is common for care givers to buy fizzy drinks and junk foods for their children in urban area. Whereas, in rural area, children have access to cheap and locally available foods like groundnuts and soy porridge as part of their daily feeding habits which are usually nutritious. These can contribute to the malnutrition differential between the urban and the rural areas. With regard to clean water, contaminated water is a potential source of infections that increase diarrhea cases in under five children. Such ailments, causes loss of body nutrients and water. This coupled with loss of appetite results in loss of body weight and in turn malnutrition.

Children who participated in under-five clinic for growth monitoring and nutrition programs were more likely to be better nourished than those who didn't participate. This is probably because care givers have access to a package of nutritional messages that accompany growth monitoring at under-five clinics. In addition, at growth monitoring the care giver knows the growth performance of the child and the growth monitoring personnel are able to give specific advice in cases of poor growth performance. On the other end, children attending nutritional programs have access to supplement foods in cases where their growth performance of off-zone. This accounts for increased likelihood of children been nourished if they attend such programs.

Conclusions and implications

The overall objective of the study was to determine the influence of child specific attributes on malnutrition outcomes of under-five children in Malawi. The study focused on three main malnutrition outcomes which are stunting, wasting and underweight. To this end, the study has established evidence that malnutrition in under-five children in Malawi is influenced by household size, the household dependency ratio, the education level of the child's mother, access to clean water, the residence of the household, number of meals taken, the child's participation in nutrition programs and growth monitoring and the sex of the child.

Several policy issues arise from this study. First, it can be recommended that child nutrition programs by different development actors and under-five growth monitoring be promoted especially in rural areas where mothers may walk longer distances to under-five clinics. With the increasing number of Community Based Child Care centers (kindergartens) in rural areas, the care givers at the centers can be trained in growth monitoring so that they can advise mothers of the enrolled children about their growth performance. The finding that children who drink cleaner water are more nourished is very important to the health sector. Although infrastructure development of cleaner water sources to meet the current demand may not be feasible in the short term, the sector may invest in advocacy for use of water treatment chemicals. The complementary option could be to subsidize the price of water treatment chemicals in order to stir up demand for the same after awareness campaigns. The rural – urban differential in malnutrition of under-five pointed to the fact that the urban children though having needed quantities of food, the quality of the same worsens the nutrition outcomes. This finding suggest the need for advocacy on the effect of food quality on child's nutrition status in urban area. Since the urban resident are difficult to reach with messages, use of bill boards could serve as an option to relays such messages to urban child care takers.

Conflict of interest: Authors have no conflicts of interest.

Authors contributions: The first author conceived the research idea, devised the analytical methods and analysed the data and consolidated the final manuscript, the second author and third authors participated in analysis and interpretation of the findings.

Ethical consideration: In this study, the data is used with authorization from World Bank and Malawi's National Statistical Office. The presented findings do not provide location information to reveal the identity of survey respondents. Neither does the paper contain results (map or other form) that would allow communities or individuals to be identified.

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