University of Malawi
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Determinants of Child Nutrition in Malawi

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Abstract: This paper investigates factors that determine child malnutrition in Malawi using data from the first Integrated Household Survey (IHS1) conducted in 1998. The study finds that child malnutrition worsens with age until a certain critical age when it starts to improve as the child grows older and that boys are more at risk than girls. We also find evidence that child malnutrition is more prevalent in children that fall sick regularly; in households with male heads that have very low education levels; in households with female heads that have high education levels; and in households that draw water from a well, regardless of the fact that it is protected or not. Child malnutrition improves as total daily per capita consumption and expenditure increases, but this goes on up to some critical level beyond which child malnutrition starts to worsen.

1. Introduction

Widespread malnutrition among under-five children is one of the significant problems facing children in the developing countries besides the many other problems, which include high infant and under-five mortality rates, lack of education, safe water and sanitation and HIV/AIDS. UNICEF (2002) observes that while severe and moderate malnutrition fell from 32 percent in 1990 to 27 percent in 2000 in developing countries, the trend in Africa, particularly Sub-Saharan Africa, has been increasing and the absolute number of malnourished children has increased in the continent. The problem of malnutrition in Africa has worsened in recent years following increasing levels of poverty and the HIV/AIDS pandemic. In Malawi the available statistics are appalling: half of the children below the age of five years are too short for their age (stunted); 25 percent are too thin for their age (underweight); 5 percent are too thin for their height (wasted). Among children aged

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between three to 36 months, Malawi has the largest population of stunted children in Sub-Saharan Africa (Africa Regional DHS Nutrition and Family Health Analytical Initiative Project, 1994).

Although increased risk of dying is the most serious consequence, under-nutrition has other significant health and economic effects that include increased risk of illness and lower level of cognitive development, which results in lower educational attainment (NSO and Macro, 1994). This paper attempts to identify factors that are associated with high malnutrition in Malawi and explore the importance of poverty using data from the first Integrated Household Survey (IHS1). The paper is organized as follows. The next section presents a situation analysis of child nutrition in Malawi. Section 3 presents the conceptual and empirical framework. Section 4 outlines data sources and measurement of variables. Section 5 presents empirical results on determinants of under-five nutrition in Malawi. Section 6 provides concluding remarks.

2. Child Nutrition in Malawi

Malnutrition is one of the health problems affecting children in Malawi and malnutrition rates (weight-for-age) for children under five years are in the intermediate range of 15 percent and 30 percent. There are several causes that have been attributed to a number of factors including national and household food insecurity, frequent infections, poor eating habits, heavy workloads and poor nutrition of mothers, HIV infections leading to frequent illness (GoM/NSO/CSR, 1996). The problem of malnutrition in Malawi is also exacerbated by the high incidence of poverty, with 52.4 percent of the population living below the poverty line and 22 percent living in ultra-poverty (GoM/NSO/WB, 2005).

Table 1 shows the trend in the nutritional status of children between 1992 and 2004. Three protein-energy malnutrition indicators have been used in Malawi: stunting (low height-for-age) representing chronic malnutrition, wasting (low weight-for-height) representing acute malnutrition and underweight (low weight-for-age) describing the overall measure of malnutrition.[1] The progress in the three indicators of nutritional status of children has been mixed. Stunting marginally fell from 48.7 percent in 1992 to 48.3 in 1995 but increased by more than 10 percentage points in 1998 and fell to 49 percent in 2000. Using data from the two demographic surveys, it is apparent that stunting has remained relatively stable despite the

[1] GoM/NSO/CSR (1996) note that wasting is a very sensitive indicator; and its levels can change rapidly with food availability or disease prevalence.

many economic reforms implemented by the authorities that might have uplifted the status of the population.

Table 1 Trend in the Nutritional Status of Under-Five Children, 1992 – 2004 (Percent)

Indicator	1992 (DHS)	1995 (MIS)	1998 (IHS)	2000 (DHS)	2004 (IHS)
Stunting	48.7	48.3	59.1	49.0	43.2
Wasting	5.4	7.0	9.3	5.5	4.6
Underweight	27.2	29.9	29.6	25.4	22.0

Notes: DHS = Demographic and Health Survey, MIS = Multiple Indicators Survey, IHS = Integrated Household Survey

Sources: NSO (2002), GoM/NSO/CSR (1996), NSO and ORC Macro (1994, 2001), GoM/NSO/World Bank (2005)

Similarly, the indicator of acute malnutrition (wasting) shows a similar trend increasing in the last half of the 1990s and falling but above the 1992 level in 2000. It should be noted however, that the late 1990s was characterised by episodes of drought or bad weather, although the surveys were conducted during the years with normal weather conditions. The overall measure of malnutrition improved marginally from 27.2 percent in 1992 to 25.4 percent in 2000, but the late 1990s show that malnutrition increased in Malawi. Chirwa and Zakeyo (2003) note that the marginal worsening of nutritional indicators match the trends in food production and per caput supply of the main staple food in Malawi, and shows that economic reforms have not improved the quality of life for a large proportion of the population. If one compares between 1998 and 2004 using the two integrated household surveys, underweight fell from 29.6 percent to 22 percent.

Although there was some improvement in the nutritional status of the country's children between 1998 and 2004, the overall position remains that children in Malawi are generally malnourished (GoM, 2002). Recent figures reveal that child malnutrition is more entrenched in poor households, in rural areas and among girls. Table 2 shows the proportion of children that were underweight in 2004. A higher proportion of children were underweight among poor households than among those in non-poor households. There are gender differences, with underweight being more prevalent among boys than among girls whether based on poverty status or urbanisation. Malnutrition is also slightly higher among children in the rural areas than with children in the urban areas

Table 2 Proportion of Underweight Children in Malawi 2004 (percent)

	Malawi	Poor	Non-Poor	Urban	Rural
Boys	23.4	24.6	22.1	22.5	23.5
Girls	20.6	21.2	19.8	18.2	20.8
Total	22.0	22.9	20.9	20.4	22.2

Source: GoM/NSO/World Bank (2005)

In view of the problems of malnutrition and its impact on human capital development, promoting good nutrition is one of the sub-goals in achieving pro-poor economic growth (GoM, 2002). Government identifies the immediate cause of malnutrition as inadequate dietary intake, which is caused by a combination of underlying factors including household food insecurity, poor child-feeding and care practices, and inadequate education and lack of knowledge. In order to deal with the problem of malnutrition, the Government's strategies include promoting exclusive breastfeeding, complementary feeding and feeding during illness and convalescence; promoting dietary diversification, capacity building for the coordination of nutrition interventions and implementation of targeted nutrition programmes such as school feeding programmes (GoM, 2002).

3. Conceptual and Empirical Framework

The determinants of nutritional status are modelled using the standard household utility maximisation model by specifying a production function for child nutritional status (Behrman and Deolalikar, 1988; Strauss and Thomas, 1995). A household is assumed to maximise a joint utility function comprising the nutrition of each household member, food and non-food purchases, food from own production and leisure or labour supplied to the market, which can be expressed as

$$U_h = f_h(N, F, C, L; X_h, \xi) \tag{1}$$

where N is the aggregate nutritional status outcome of individuals of the households, F is food consumption, C is non-food consumption, L is leisure, X_h are exogenous household specific characteristics and ξ is a stochastic term representing unobservable heterogeneity in preferences.

According to UNICEF (2000), nutrition is not determined by food availability alone, but also by access to basic social services, quality of home based care for young children, infant feeding patterns,

morbidity and other factors. Following UNICEF (1990) and Engle et al. (1999) the nutritional outcome of individual i measured by standard anthropometric measures can be represented as

$$N_i = f_i(CB_i, H_i, E_h, K_i^h; \varepsilon) \tag{2}$$

where CB_i is the caring behaviour directed towards the individual i, H_i is the health status, E_h is the household environment and K_i^h is the dietary intake of individual i from the calorie available at the household (h) level and ε are unobservable characteristics. The household demand for calories is a function of income (Y_h), price of food and non-food products (P_h) and other exogenous factors (Z_h) and can be expressed as

$$K_h = f(Y_h, P_h, Z_h) \tag{3}$$

In this study, we are interested in investigating the determinants of child nutritional status using equation (2). In our empirical estimation of equation (2), we include a welfare index to capture the effect of poverty on the availability of calories at household level. The welfare index is calculated as the daily total per capita consumption and expenditure reported by the household. Estimation of equation (2) by ordinary least squares (OLS) is likely to yield biased estimates due to the endogeneity of the welfare index in the nutritional status equation. For example, the poor nutritional status of children in the household may reflect the lack of adequate calories available to the household that may in turn affect the health status of adults. The poor health of adults may negatively affect their income earning potential and demand for calories that may adversely affect the nutritional status of the children and members of the household. In order to account for the endogeneity of welfare and nutritional outcomes, we will use the two-stage least squares (2SLS) procedure, in which welfare will be instrumented by household's durable assets in addition to other exogenous variables.

The status of child nutrition is measured using anthropometric measures of Height for Age Z-scores (HAZ) to capture stunting, Weight for Age Z-scores (WAZ) to determine underweight and Weight for Height Z-scores (WHZ) to assess wasting. The Z-scores are age-standardised normalised growth curves used to compare children of all ages. They express the nutritional status of a child in standard deviations from a median. Typically, a US National Centre for Health Statistics (NCHS) standard reference population, which is

recommended by the World Health Organisation (WHO), has been used as a reference population in many studies (see, for example, Maxwell et. al., 1998, Tharakan et. al., 1999, Mackinnon, 1995, Marini and Gragnolati, 2003). For instance, the Weight for Age Z-score of the i^{th} child is computed as the difference between weight of the child W_i and the median weight of a standard group of healthy children of the same age and sex within the population W_s. This difference is in turn divided by the standard deviation of the weight of that same group of children of the same age and sex within the population ($StDev$).

$$WAZ = \frac{W_i - W_s}{StDev} \tag{4}$$

Thus, a WAZ of zero implies that the WAZ is coinciding with the weight of the median child of the same age and sex in a standard group of healthy children. Similarly, a WAZ of -1 implies that the WAZ is one $StDev$ below the mean child of the same age within the population. Each of the three anthropometric measures provides different information about growth and body composition of the child used to assess his nutritional status. WHZ measures the child's current nutritional status. When a child is more than two standard deviations below the weight-for-height NCHS standard reference mean (i.e. WHZ > -2SD), the child is characterised as wasted or too thin for his height, a condition reflecting acute malnutrition.

HAZ measures linear growth. When a child is more than two standard deviations below the height-for-age NCHS reference population median (i.e. HAZ > -2SD), the child is described as stunted or too short for his age, a condition that reflects chronic malnutrition. Finally, WAZ is a composite index of weight-for-height and height-for-age and thus does not distinguish between acute under-nutrition (wasting) and chronic under-nutrition (stunting) (NSO and Macro, 2001). Weight-for-age is considered a good indicator of population nutritional status because it captures aspects covered in both height-for-age and weight-for-height measures. A child may be underweight for his age because he is wasted or stunted or because he is both wasted and stunted.

4. Data and Definition of Variables

The data used in this study was collected by the National Statistical Office (NSO, 1998) in the 1997-98 Integrated Household Survey (HIS) throughout the country. Data was collected on various issues,

particularly for purposes of establishing the extent of poverty in Malawi. In addition to household characteristics, cropping patterns, income and expenditure, participation in the labour market, anthropometric data from under-five children were also collected in the integrated household survey. The data also contain a welfare indicator and poverty indices based on consumption and expenditure data.

Dependent variables in our nutritional status model are anthropometric measures of weight-for-age Z-scores (WAZ) representing the overall measure of malnutrition (underweight), height-for-age Z-scores (HAZ) as an indicator of chronic malnutrition (stunting) and weight-for-height Z-scores (WHZ) representing acute malnutrition (wasting). On each of these indicators, we excluded outliers outside the 1 percent and 99 percent percentiles consequently leading to 5221, 4373 and 4272 under-five children in the WAZ, HAZ and WHZ models, respectively.

The explanatory variables fall into child characteristics, household characteristics and endowments and community variables. The child characteristics include the gender of the child, the age of the child and child illness. Gender of child is captured by a dummy variable equal to 1 for female child and zero for male child. If there are gender biases in the care of children, we expect male children to better nourish than female children if male children are favoured and the converse is true. There is evidence elsewhere that female children tend to be better nourished than male children. For example, McKinnon (1995) finds that female children had better weight-for height than male children in Uganda. Similarly, Garrett and Ruel (1999) find that girls' nutritional status is better than boys' by 0.36 Z-scores. The age of the child has an upper bound of five years and is measured in months. However, the relationship between nutrition and age may be curvilinear and we therefore include age squared as one of the explanatory variable.[2] Older children can, at least to some extent, take the initiative of finding food for themselves when there is little or no food in their homes. One possibility is where these older children would play and eat at their neighbours' place while their younger siblings, who are unable to do the same, are going without food at home. The illness of the child is captured by a dummy variable equal to 1 if the child was reported ill in the last two weeks preceding the survey. Illness reflects access to health services and environmental sanitation, which have implications for child survival, growth and development.

[2] Many empirical studies find this curvilinear relationship between age and nutritional status; for example, see Garrett and Ruel (1999).

We expect that the children that fall ill are likely to be malnourished.

The household characteristics include the welfare index, gender of head of household, marital status of household head, education of father or male head, education of mother or female head, land sizes and production of own food. The welfare index is measured as daily per capita consumption and expenditure, and captures the effect of poverty on child nutritional status. It is well-recognized that poverty is both a cause and a consequence of malnutrition. Owing to this endogeniety, the welfare index is predicted by household variables such as household size, education and per capita land holdings. We also include a squared welfare index to capture the non-linearity of welfare on malnutrition. The gender of the household head is measured by a dummy variable equal to 1 for female headed households and zero for male headed households. Similarly, the marital status of the household head is measured by a dummy variable equal to 1 for married household heads; otherwise it is equal to zero.

The education of father/male head and mother/female head are measured by dummies representing six education categories, with no education as the reference category: junior primary school, senior primary school, junior secondary school, senior secondary school, graduate and other post-secondary education. Within the conceptual framework of nutrition, the caregivers' characteristics are important in determining nutritional outcomes (Engle et al, 1999). Education affects care giving practices through the ability to process information, ability to acquire skills and the ability to model behaviour. It can be hypothesized, therefore, that educated parents or caregivers are associated with high child nutritional status as they are better able to use health care facilities and ensure high standard of environmental sanitation. However, Glick and Sahn (1998) note that women, as a result of their high education levels, tend to join the working population, an activity that makes them not to have adequate time for breastfeeding and preparing nutritious foods for their children, or making use of public services that would enhance the nutrition status of their children.

The production of own food is measured by a dummy variable equal to 1 if the household produces its own food. In rural areas, production of own food is an indicator of food security and we hypothesize that the more food secure the household the higher the nutritional status of children. Maxwell et al (1998) find evidence in favour of the hypothesis that the nutritional status of children from farming households is significantly better than that of children from non-farming households in Uganda. Smith and Haddad (2001) also find evidence of a positive relationship between national food

availability and nutritional status of children in developing countries. This variable is also complemented by land holding sizes measured by two dummy variables, with less than 0.7 hectares as a base category. Land holding sizes of between 0.7 and 1.0 hectare capture intermediate households that just produce enough food crops while land sizes of more than 1 hectare represent farmers that more than produce adequate food for the household.

The community variables include water sources and the residence of the household. The water source is measured by dummy variables for protected well, unprotected well, tap water and other sources of water. The base category is river or lake sources of water. This captures the effect of sanitation on child nutrition and good potable water is likely to enhance the nutrition status of children. The residence of households is measured by a dummy variable equal to 1 for households in the urban areas and zero in rural areas. Nutrition education may be more available in urban areas, and therefore we expect better child nutrition outcomes in the urban areas.

5. Empirical Results

5.1 Descriptive Statistics

Table 3 shows descriptive statistics of the variables included in the nutrition models, showing Z-scores and their corresponding means and standard deviations for WAZ, HAZ and WHZ. The mean Z-scores show that stunting is the greater of the malnutrition problems with a Z-score of –2.1703 and a standard deviation of 1.902, followed by underweight with a Z-score of –1.2082 and a standard deviation of 1.327. Wasting, on the other hand, is not statistically identified as commonplace. In fact, the Z-score of 0.2692 suggests that on the average, under-five children in Malawi tend to be too fat for their height, albeit marginally.

The child characteristics show that at least 51 percent of children in the sample are female and the average age of children in the sample is 34 months and at least 38 percent of children in the sample were ill in the last two weeks preceding the survey. With respect to household characteristics, about 18 percent of the household heads are female and 46 percent are married. The levels of education of the father/male head and the mother/female head is low among sample households. At least 52 percent of fathers/male heads have some primary education and only 12 percent have post-primary education. Similarly, only 46 percent of mothers/female heads had some primary education and only 2 percent have post-primary education.

With respect to community characteristics, the largest proportion of the sample use unprotected wells (at least 32 percent) while relatively fewer people use taps and protected wells. With 90 percent of the population living in rural areas where infrastructure is mostly underdeveloped, most Malawians have limited or no access to safe drinking water. Land holding for most households is in excess of one hectare. A majority of the households in the sample (at least 60 percent) in Malawi produce their own food.

Table 3 Means and standard deviation of variables

	WAZ		HAZ		WHZ	
Variables	Mean	S.D	Mean	S.D	Mean	S.D
WAZ	-1.2082	1.327	-	-	-	-
HAZ	-	-	-2.1703	1.902	-	-
WHZ	-	-	-	-	0.2692	1.723
Female child	0.5081	0.500	0.5209	0.500	0.5178	0.500
Male Child	0.4919	0.500	0.4791	0.500	0.4822	0.500
Age of child (months)	33.78	16.45	34.30	16.44	34	16.4
Age of child squared	1411.8	1143.4	1446.7	1146.5	1439	1141.3
Child ill in last two weeks	0.3836	0.486	0.3789	0.485	0.3818	0.486
Welfare index	10.2438	13.568	9.8406	10.47	9.8897	10.597
Welfare index squared	288.98	4564.6	206.33	1584.0	210.73	1606.6
Female household head	0.1843	0.388	0.1885	0.391	0.1837	0.387
Married household head	0.4649	0.499	0.4645	0.499	0.4635	0.499
Father/Male head education:						
Primary 1 – 4	0.1631	0.369	0.1694	0.375	0.1706	0.376
Primary 5 – 8	0.3563	0.479	0.3537	0.478	0.3563	0.479
Secondary 1 – 2	0.0627	0.242	0.0564	0.231	0.0563	0.231
Secondary 3 – 4	0.0595	0.237	0.0566	0.231	0.0550	0.228
Graduate	0.0074	0.086	0.0062	0.079	0.0066	0.081
Post-Secondary – Other	0.0041	0.064	0.0036	0.060	0.0034	0.058
Mother/Female head education:						
Primary 1 – 4	0.1977	0.398	0.2029	0.402	0.2030	0.402
Primary 5 – 8	0.2645	0.441	0.2571	0.437	0.2610	0.439
Secondary 1 – 2	0.0292	0.168	0.0260	0.159	0.0263	0.160
Secondary 3 – 4	0.0166	0.128	0.0144	0.119	0.0129	0.113
Graduate	0.0028	0.053	0.0022	0.047	0.0027	0.052
Post-Secondary – Other	0.0024	0.049	0.0022	0.047	0.0023	0.048
Water source:						
Protected well	0.2180	0.413	0.2242	0.417	0.2255	0.418
Unprotected well	0.3266	0.469	0.3326	0.471	0.3434	0.475
Tap water	0.2702	0.444	0.2587	0.438	0.2501	0.433
Other water sources	0.0846	0.278	0.0795	0.271	0.0790	0.270
Urban	0.1060	0.308	0.0893	0.285	0.0847	0.278
Produces own food	0.6031	0.489	0.6179	0.486	0.6216	0.485
Land size category:						
Land size 0.7 – 1.0 ha	0.1272	0.333	0.1308	0.337	0.1274	0.333
Land size > 1.0 ha	0.4767	0.500	0.4927	0.500	0.4985	0.500
Observations	5221		4373		4272	

5.2 Multivariate Analysis

Table 4 presents results from the 2SLS regression analysis of WAZ, HAZ and WHZ. The model statistics show that the R-squared ranges from 2 percent in the HAZ model to 7 percent in the WAZ model. The F-statistics show that the hypothesis that all the slope coefficients are equal to zero, except the constant, in each model is rejected at the 1 percent significance level.

5.2.1 Child Characteristics

All child characteristics, the sex of the child, age of the child and illness of the child, are statistically significant in all the three models. We find evidence that the female child is better nourished than is the male child in all the three measures, implying the possibility of the existence of some form of discrimination in favour of female children in the households. This supports earlier evidence in other studies in Africa (Maxwell et al (1998) in Uganda; Garrett and Ruel (1999) in Mozambique and Glick and Sahn (1998) in West Africa).

The relationship between age of child and nutritional status of children is curvilinear with the coefficient of the age of a child being negative and that of age squared being positive and statistically significant at 5 percent level. This indicates a U-shaped relationship in which malnutrition in under-five children worsens with age; but that is only up to some critical age beyond which a child's nutrition status improves as the child grows older. The critical ages at which we start observing a positive relationship are 34 months for underweight, 43 months for stunting and 35 months for wasting. The critical age reflects a turning point by which a child is now in a position to take the initiative of finding food for himself when there is little or no food in the household. One of his options is to play and eat at the neighbours place. Another is to collect edible foodstuffs, including wild fruits, outside the home. We also find that childs' health that may reflect access to health services is an important determinant of nutritional status. The coefficient is negative and statistically significant at the 1 percent level in the WAZ and HAZ model and at the 5 percent level in the WHZ model.

Table 4 Determinants of Nutritional Status of Children 2SLS Models, under 5 years

	WAZ		HAZ		WHZ	
Variables	β	t	β	t	β	t
Female child	0.1755[a]	4.93	0.1720[a]	2.98	0.1184[a]	2.29
Age of child (months)	-0.0273[a]	-5.16	-0.0172[b]	-2.03	-0.0630[a]	-7.79
Age of child squared	0.0004[a]	5.73	0.0002[b]	2.06	0.0009[a]	8.05
Child ill in last two weeks	-0.1825[a]	-4.89	-0.1661[a]	-2.71	-0.1184[b]	-2.17
Welfare index*	0.0122[a]	5.02	0.0064	1.16	0.0110[b]	2.17
Welfare index squared	-0.00002[a]	-4.02	$-0.5x10^{-5}$	-0.12	-0.00005	-1.47
Female household head	-0.0166	-0.29	0.1010	1.02	-0.0296	-0.35
Married household head	0.0107	0.30	0.0468	0.81	0.0266	0.51
Father/Male head education:						
Primary 1 – 4	-0.1110[c]	-1.76	-0.0138	-0.14	-0.0618	-0.71
Primary 5 – 8	0.0663	1.16	0.1736[c]	1.93	0.0403	0.52
Secondary 1 – 2	0.2046[b]	2.03	-0.2867[c]	-1.84	0.4669[a]	2.97
Secondary 3 – 4	0.1681	1.59	-0.1092	-0.63	0.1049	0.62
Graduate	-0.1306	-0.48	0.1735	0.41	0.1199	0.27
Post-Secondary – Other	-0.2961	-1.13	0.1352	0.28	-0.8466	-1.54
Mother/Female head education:						
Primary 1 – 4	0.0546	1.01	-0.0139	-0.17	-0.0040	-0.06
Primary 5 – 8	0.0270	0.49	-0.0678	-0.78	0.0927	1.18
Secondary 1 – 2	0.1957	1.62	0.3654[c]	1.69	0.0913	0.40
Secondary 3 – 4	0.4356[b]	2.36	0.5685[c]	1.82	0.0992	0.32
Graduate	-0.1446	-0.32	0.0929	0.11	-1.9506[b]	-2.39
Post-Secondary – Other	-0.0516	-0.14	-0.5495	-0.66	0.6282	0.93
Water source:						
Protected well	-0.0896	-1.30	0.1652	1.59	-0.2001[b]	-2.08
Unprotected well	-0.0498	-0.76	0.1967[b]	2.03	-0.1786[b]	-1.96
Tap water	0.0908	1.30	0.1875[c]	1.78	-0.1386	-1.38
Other water sources	0.0582	0.68	0.1470	1.09	-0.1393	-1.03
Urban	0.2820[a]	3.71	0.1913	1.59	0.4433[a]	3.53
Produces own food	0.0244	0.57	0.2325[a]	3.58	-0.1737[a]	-2.87
Land size category:						
Land size 0.7 – 1.0 ha	-0.0797	-1.29	0.0529	0.56	-0.1266	-1.38
Land size > 1.0 ha	-0.0488	-1.07	-0.0790	-1.12	-0.0218	-0.33
Constant	-1.0981[a]	-9.83	-2.4035[a]	-13.3	1.1972[a]	7.14
R-squared	0.0617		0.0175		0.0474	
F-statistics	11.67		2.79		6.31	
Prob > F	[0.000]		[0.000]		[0.000]	
Observations	5221		4373		4272	

Notes: Superscripts *a*, *b* and *c* indicate that variables are statistically significant at the 1 percent, 5 percent and 10 percent levels, respectively.

* The welfare index is instrumented by household characteristics including land per capita, education of household head/father and mother.

5.2.2 Household Characteristics

The households characteristics that are statistically significant determinants of the nutritional status of children include poverty, education of female/male head and mother and father, and production of own food. The index for welfare has a positive relationship to all the measures of nutritional status of children, but it is only statistically significant in the WAZ and WHZ models only, implying that underweight and wasting improve with welfare. There is, however, a caveat against taking this as a rule, because a square of the welfare index depicts a negative sign, showing that there is a critical level of welfare at which the positive relationship between a child's nutritional status and welfare is reversed. However, the inverted U-shape relationship is only valid for underweight, and the critical level of welfare is MK305.00 of total daily per capita consumption and expenditure in April 1998 prices[3] for underweight. Thus, below this critical welfare levels, underweight improves as total daily per capita consumption and expenditure increases, and beyond the critical welfare value, the reverse occurs. It may be argued that below the critical values, households are mindful of providing for the basic food requirements, with material things being regarded as of secondary importance. However, beyond the critical values, the material things start to get consideration to the extent that a conflict with the provision of the basic food requirements emerges and the household tends to compromise in favour of the former.

The education levels of parent or household heads play different roles in the nutritional status of under-five children. For male-headed households, junior primary education only (standards 1 – 4) has a negative relation to the Z-scores, but it is only statistically significant at the 10 percent level in determining underweight. Accordingly, it can be argued that male household heads with only junior primary school education are susceptible to having underweight children. Fathers/male household heads that have gone up to senior primary school (standards 5 – 8), on the other hand, tend to foster improved nutrition among children, but the relationship is only significant with respect to stunting. At junior secondary school education level, the coefficients show that fathers/male household heads tend to be associated with stunted children but not children that are underweight or wasted. Senior secondary school education (forms 3 - 4) for the male household heads, in contrast, is only positively related to weight-for-age. Thus,

[3] See GoM (2000) and NEC/NSO/IFPRI (2001) for a detailed presentation and computation of the welfare index.

fathers/male household heads that have attained up to senior secondary school education would usually not be associated with underweight children. Graduate education and post secondary education of fathers/male household heads have no significant relation to nutritional status among children. On the whole, the level of education for fathers/male household heads is vital in determining child nutrition status. At high education levels, the father/male household head becomes more knowledgeable in childcare issues. This relationship, however, is only observed up to senior secondary education, beyond which it becomes irrelevant, confirming that graduate education is a luxury, at least in so far as reducing child nutrition is concerned.

The differences in nutrition status of children occurring due to education levels between male and female household heads are quite notable. Primary school education of the mother/female household head has no relationship at all to child nutritional status. Secondary education of the mother/female household head, on the other hand, is positively related to weight-for-age and height-for-age but has no significant relationship with weight-for-height. 'Other post secondary education' among the mothers/female household heads has no relationship to child nutrition while graduate education has a statistically significant negative relationship with weight-for-height. Thus, graduate mothers/female household heads are more likely to be associated with children who are too thin for their height or wasted. Huffman (1997) argues that the time spent by women in activities such as food preparation, beast-feeding, collecting water and fuel, and seeking preventative and curative medical care is an important input into the production of infant or child health. The evidence in this study, therefore, reconfirms the Glick and Sahn (1998) hypothesis that women, as a result of their high education levels, tend to join the working population, an activity that makes them not have adequate time for breastfeeding and preparing nutritious foods for their children, or making use of public services that would enhance the nutrition status of their children.

There are no statistically significant relationships between land categories and the nutritional status of under-five children, although most of the coefficients are negative. However, production of own food has mixed effects. Production of own food is important in reducing chronic malnutrition (stunting), with the coefficient being positive and statistically significant at the 1 percent levels. With respect to acute malnutrition (wasting), production of own food tends to be associated with wasting, and the coefficient is statistically significant at the 1 percent level. These mixed results may be a reflection of the measurement of the variable, which does not take

into account the adequacy and quality of food that is produced by the households.

5.2.3 Community Characteristics

The community variables included in the model, water source and urbanisation, have mixed effects on the nutritional status of under-five children. An interesting finding is that the presence of protected and unprotected wells has the same negative impact on weight-for-height among children. It may be argued, therefore, that as long as the water source is a well, whether it is protected or not, it encourages wasting among children. Tap water and unprotected wells, on the other hand, are positively associated with height-for-age, and the coefficients are statistically significant at the 10 percent and 5 percent levels, respectively.

The results show that urbanisation has a positive effect on the nutritional status of children, with the coefficients being statistically significant at the 1 percent level for underweight and wasting. Thus, living in the urban has a significant positive effect in avoiding wasting and underweight compared to living in rural areas. This urban bias reflects the differential access to health facilities and health information relative to the rural areas. The positive effects of urbanisation may also reflect the relatively better income opportunities for households and education of parents compared with the rural areas.

6. Conclusions and Policy Recommendations

This study set out to identify factors that affect the nutritional status of under-five children in Malawi using data from a national integrated household survey conducted in 1998. Using three anthropometric measures of nutrition, WAZ for underweight, HAZ for stunting and WHZ for wasting, it is shown that stunting is the greater of the malnutrition problems followed by underweight. The statistics further show that on the average, children in Malawi tend to be too fat for their height, although marginally. The multivariate analysis shows that child malnutrition is a function of child age, gender, sickness, education of household head (with minor differences occurring for male and female headed households), welfare, water source and whether the household produces its own food or not.

Several policy issues emerge from the results of this study. First, we find that child characteristics – sex, age and illness – are important determinants of children nutritional status across all three anthropometric measures of nutrition. Most importantly, the

evidence points to a bias in favour of female children, maybe due to differential care or feeding habits. While in many other aspects, such as education, biases are more pronounced against female children, nutritional messages have to emphasize gender balance in care and feeding practices.

Secondly, the U-shape relationship between age and nutritional status of children, suggests the need to ensure that malnutrition intervention is more concentrated in early childhood when children's nutrition status is seen to worsen with age. Thirdly, the significance of higher education levels, at least secondary education, for both male and female parents or household head, suggests that assimilation of nutritional messages may require more than basic education to be more effective. Although, the focus of education policy is to achieve basic education (completion of primary education), the results suggests that encouraging secondary education among mothers/female headed households is critical for nutrition enhancing child care practices. Finally and most important of all, measures must be put in place to improve people's living conditions with the ultimate objective of pulling them out of poverty.

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