Prevalence and Determinants of Malnutrition among Under-five Children of Farming Households in Kwara State, Nigeria

Raphael Olanrewaju Babatunde (Corresponding author)
Department of Agricultural Economics and Farm Management
University of Ilorin, P.M.B. 1515 Ilorin, Kwara State, Nigeria
Tel: 234-803-288-9769 E-mail: ralphag20@yahoo.com

Funke Iyabo Olagunju
Department of Agricultural Economics and Extension
Ladoke Akintola University of Technology P.M.B. 4000 Ogbomoso
Oyo State, Nigeria
Tel: 234-803-391-8373 E-mail: olagfunk@yahoo.com

Segun Bamidele Fakayode
Department of Agricultural Economics and Farm Management
University of Ilorin, P.M.B. 1515 Ilorin, Kwara State, Nigeria
Tel: 234-806-023-6283 E-mail: segun_fakayode@yahoo.com

Foluke Eunice Sola-Ojo
Department of Animal Production
University of Ilorin, P.M.B. 1515 Ilorin, Kwara State, Nigeria
Tel: 234-803-821-7248 E-mail: mofesola1@yahoo.com

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Abstract

Prevalence of malnutrition among under-five children is very high in many developing countries of the World. As a step towards reducing the prevalence, there is need to identify the important determinants of malnutrition in the specific context. This study examined the prevalence and determinants of malnutrition among under-five children of farming households in Kwara State, Nigeria. Descriptive and regression analyses were used to analyze anthropometrics data collected from 127 children selected randomly from 40 rural villages in the State. Descriptive results indicate that 23.6%, 22.0% and 14.2% of the sample children were stunted, underweight and wasted respectively. Regression analysis shows that the significant determinants of malnutrition were gender and age of child, education and body mass index of mother, calorie intake of the households, access to clean water and presence of toilet in the households. To reduce the present high rate of malnutrition in the area, the study suggests the targeting of women with education programmes and provision of clean water, including the enforcement of healthy environment in the rural areas.

Keywords: Farming households, Malnutrition, Nutritional status, Stunting, Underweight, Wasting

1. Introduction

Reducing malnutrition among children under the age of five remains a huge challenge in developing countries of the World. An estimated 230 million under-five children are believed to be chronically malnourished in developing countries (Van de Poel et. al., 2008). Similarly, about 54% of deaths among children of this age group are believed to be associated with malnutrition in developing countries (FAO, 2008). In Sub-Saharan Africa, 41% of under-five children are malnourished and deaths from malnutrition are increasing on daily basis in the region (FAO, 2008). Malnutrition is widespread in Nigeria, especially in the rural areas. This is partly due to inadequate food and nutrient supply. The 2003 Nigeria Demographic and Health Survey revealed that 38% of under-five children in Nigeria are stunted, 29% underweight and 9.2% wasted (Ajieroh, 2010). The 2004 Food Consumption and Nutrition Survey reported similar trends with 42% stunted, 25% underweight and 9% wasted (Ajieroh, 2010). These surveys indicated significant variation between the rural and urban areas with children from rural areas worse affected by malnutrition.

Malnutrition is insufficient, excessive or imbalance consumption of dietary energy and nutrients. It manifests in different forms, such as under nutrition, over nutrition and micronutrients malnutrition (Smith and Haddad, 1999). Malnutrition in early childhood is associated with functional impairment in adult life as malnourished children are physically and intellectually less productive when they become adults (Smith and Haddad, 1999). Children that are malnourished tend to have increased risk of morbidity and mortality and often suffer delayed mental development, poor school performances and reduced intellectual achievement.

Many empirical studies have looked into issues of food security and nutrition in Nigeria (e.g. Babatunde et al., 2007). However, little effort had been devoted to examining the determinants of malnutrition among under-five children of farming households. What is more common is a baseline survey of malnutrition among selected population of children to establish the proportion that is malnourished. This is the research gap which this study hopes to fill. An understanding of the determinants of malnutrition is imperative if the current high rate of malnutrition is to be reduced. The study can provide information that can be used for nutritional surveillance and targeting programmes that would focus more on populations most affected. The study also makes important contribution to literature by analyzing nutritional status as a non-monetary measure of poverty which is a recent innovation in the literature. This is based on the argument that nutritional status is a different dimension of welfare (capability deprivation) from income and expenditure. In addition, individual well-being in the form of nutritional status can be directly observed as opposed to household well-being. Monetary comparisons of welfare over time are hampered by the absence of reliable and verifiable deflators, and information collected in surveys is often inadequate to solve this problem (Kabubo-Mariara, et al 2006).

The objective of this paper is to examine the prevalence and determinants of malnutrition among under-five children of farming households in Kwara State of Nigeria. Kwara State was chosen for this study because under nutrition and poverty are prevalent in the State. For example, the nationwide food consumption and nutrition survey conducted in 2004 indicated that the State is among the six poorest in Nigeria in terms of prevalence of undernourishment and income poverty (NBS, 2006). Apart from this, there are no recent studies that have empirically analyzed the determinants of malnutrition among under-five children of farming households in the State. To achieve the objective of the study, three main indicators of child malnutrition was used; stunting, underweight and wasting. By taking anthropometric measurements of sex, age, height and weight, and using them to generate Z-scores, the study estimated the prevalence of stunting, underweight and wasting among under-five children of selected farming households. In the regression analysis, the three malnutrition indices were regressed against several child-specific, households and socioeconomic variables.

The remaining parts of this paper are arranged as follows. Section 2 presents a brief analytical framework of the determinants of child malnutrition. Section 3 discusses the data and methodology, while section 4 discusses the results. Section 5 concludes the paper with a discussion of the policy implications.

2. Analytical framework

Studies of determinants of children's nutritional status follow the household production framework of Becker (1965) and Strauss and Thomas (1995). Starting with a simple household utility maximizing model, we assume that a household has preferences that can be characterized by the utility function, U which depends on consumption of a vector of commodities, X, leisure, L, and the quality of children represented by their nutritional status, N:

$$U = u(X, L, N) \tag{1}$$

Where N is measured using standardized anthropometric measures of height for age z-score (*haz*), weight for age z-score (*waz*) and weight for height z-score (*whz*). The assumption in such a model is that good nutrition, as represented by the vector of nutritional status of children is desirable in its own right, and it is likewise assumed that households make consumption decisions on the basis of reasons other than nutrition (Pitt and Rozenzweig, 1995).

Household utility is maximized subject to several constraints, including a time specific nutrition production function and income constraints. Guided by the underlying determinants, the reduced form nutritional function for each child can be derived as:

$$N_i = n(C, W, H, Z, \varepsilon) \tag{2}$$

Where *C* is consumption, *W* is a vector of child-specific characteristics; *H* is a vector of household specific characteristics; *Z* is a vector of health variables and ε is the child-specific disturbance term. The reduced form model can enable us to capture the total impact of child, household and health characteristics rather than their impact conditional on a set of choice variables through a structural model (Strauss and Thomas, 1995).

The specified nutritional production function allows us to estimate the following equations:

haz_i = f(child characteristics, household characteristics, health characteristics, ε_{ha})
waz_i = f(child characteristics, household characteristics, health characteristics, ε_{wa})
whz_i = f(child characteristics, household characteristics, health characteristics, ε_{wh})

Where i denote the i^{th} group (defined by year, region or gender), ε_{ha}, ε_{wa} and ε_{wh} are random error terms assumed to be uncorrelated with the covariates included in the reduced form nutritional outcome models.

Individual child characteristics include age and gender of the child. Household level characteristics can be divided into parental characteristics and other household characteristics. Parental characteristics include height of the mother, age, education, and marital status. Height of the mother captures both the genetic effects and the effects resulting from family background characteristics not captured by maternal education. Maternal education is expected to improve nutrition through altering the household preference function and also through better child care practices. Other household characteristics include household structure, per capita income, asset position, number of dependents and headship. The structure of the household enable us to test whether presence of older siblings may improve a child's nutritional status, and also whether presence of more adult women, holding household size and age composition of the household constant improve the nutritional status of a child (Sahn and Stifel, 2003). Previous studies have also included a vector of other household characteristics such as religion, ethnicity and even occupation of the household head, depending on availability of data. Health variables represent access to immunization and health care as well as environmental factors such as water and sanitation (Strauss and Thomas 1995).

3. Data and methodology

3.1 The study area

This study was conducted in Kwara State, north central Nigeria. Kwara State was chosen for this study because it is among the six poorest in Nigeria in terms of undernourishment and income poverty. About 83% of the population of the State classified themselves as being poor (NBS, 2006). The State lies between latitudes 7° 45′ N and 9° 30′ N of the equator and longitudes 2°30′E and 6° 25′E of the equator. It shares boundaries with Osun, Oyo, Ondo, Kogi, Niger and Ekiti states. Kwara State shares an international boundary with the Republic of Benin in the west. The State has a population of about 2.37million people (NPC, 2006) out of which farmers account for about 70%. The average population density of the state as at 2006 was about 73 people per square kilometer. There are a total of 1,258 rural communities in Kwara State (NPC, 2006). Based on agro-ecological and cultural characteristics, the state is divided into four agricultural zones –zones A, B, C and D, by the Kwara State Agricultural Development Project (KWADP).

A humid tropical climate prevails over the state and it has two distinct seasons; the wet and dry seasons. The wet season last between April and October during which there is rain and the dry season with no rain is between November and March. The state is primarily agrarian with great expanse of arable land and rich fertile soils. The soil types are ferrisols on loose sandy sediments, while the soils are reddish to the north and yellowish-brown to the south. These soil types are less leached and are suitable for growing different types of crops. The State has a total land area of about 32,500km^2, which is about 3.5% of the total land area of the country, which is put at 923,768km^2 (KWSG, 2006). Approximately 25% of the land area of Kwara State is use for farming.

The farming system in the state is characterized by low quality but surplus land, low population density and mostly cereal-based cropping pattern. Kwara State has a large lowland areas that are often flooded and waterlogged during the rainy season but retain enough moisture during the dry season for fadama production. The typical cropping systems in the state are maize-based system, yam-based system, cassava-based system and rice cultivation in areas located along river Niger, the major river in the state. Agricultural production is largely peasant and small-scale relying heavily on the use of manual labour equipped with crude implements, while fertilizers, mechanical implement, improved seeds and agrochemicals are also used to some extent. Landholding in the state is very small and most of the households have less than two hectares of land for farming. Farm enterprises are generally small in size, so that – in spite of own production most households are net buyers of food, at least seasonally (KWSG, 2006).

3.2 Data collection

A three-stage random sampling technique was used to select the sample respondents for the analysis. Eight out of the 16 local government areas in Kwara State were randomly selected in the first stage. Then, five villages were randomly chosen from each selected local government area, and finally, six households were sampled in each of the resulting 40 villages, using complete village household lists provided by the local authorities. Thus, a total of 240 households in all were selected. Personal interviews were carried out with the household head, usually in the presence of the spouse or other family member responsible for preparing the family meals. A standardized questionnaire was used that covered information on household expenditure, consumption, farm and off-farm income, socioeconomic characteristics, and various institutional and village variables. Farm income covers commodity sales and subsistence production, both valued at local market prices. Respondents were asked to specify in detail all inputs used, outputs obtained, and prices for the different crop and livestock activities over the 12-months period prior to the survey. Non-farm income and other income were recorded separately for all household members, also covering a 12-months period, in order to avoid a seasonality bias. After cleaning the data, 20 of the questionnaires were found unsuitable for analysis.

Food consumption data was collected at the household level and it covers 105 food items. Quantities consumed include food from own production, market purchases, and out-of-home meals and snacks. While also here it would be desirable to have annual data that are free from seasonality effects, it is well known that the accuracy of food consumption data is negatively correlated with the length of the recall period (Bouis, 1994). Hence, we decided to use a 7-day recall in our survey. The survey was carried out in the lean season, during which household food consumption is often below the annual average. Therefore, the calorie intake variable might be somewhat underestimated. Food quantities consumed at the household level were converted to calories using the locally available food composition table (Oguntona and Akinyele, 1995). Resulting calorie values were divided by the number of Adult Equivalent (AE) in a household, in order to obtain the per capita calorie intake. This value was again divided by the 7-days recall period to obtain per capita daily calorie intake of each household. We define a food secure household as one whose daily calorie intake per AE is greater than or equal the minimum daily calorie requirement for adult men of 2500 kcal (FAO/WHO/UNU, 1985). Households with lower calorie intakes are considered to be undernourished. Anthropometric data of gender, age, height and weight were collected from children that are under the age of five. In the 220 sampled households, there were 127 children below the age of five from whom anthropometrics measurements were taken.

3.3 Anthropometric analysis

Anthropometry is a technique that uses human body measurements to draw conclusion about the nutritional status of individuals and population. Anthropometry is more often applied to pre-school children below the age of 5 years. To carry out anthropometric analysis, several variables such as child's age, sex, height and weight. These measurements are used in generating indices such as, height-for-age, weigh-for-age and weight-for-height. The indices generated were compared with standard reference values of the United States National Center for Health Statistics (NCHS) to obtain the *Z*-scores. Specifically the height-for-age *Z*-score, for example is given as: $Z = X- \mu/\sigma$ Where *X* is the child's height-for-age, μ is the median height-for-age of the reference population of children of the same age and sex group, σ is the standard deviation of the reference population.

From the z-scores, the nutritional status of the child was determined. For this study, three indices of malnutrition among all the sampled children were determined. These are stunting, underweight and wasting. Stunting refers to a low height-for-age. It is a measure of chronic or long-term malnutrition in children and a good indicator of cumulative growth retardation. Children whose height-for-age *Z*-score is below minus 2 standard deviation from the median of the reference population are classified as stunted. Underweight denotes a low weight-for-age and it is a measure of combination of chronic and acute malnutrition. Children having weight-for-age *Z*-score less than minus 2 standard deviation from the median of the reference population are regarded as underweight. Wasting represents a low weight-for-height and it is a measure of acute malnutrition, an indicator of short-term fluctuation in nutritional status. It is commonly use in emergency situation to assess nutritional deficiency when the age of the child is not known and children with weight-for-height *Z*-score that are less than minus 2 standard deviation from the median of the reference population are classified as wasted. The prevalence of malnutrition – using these indices, was also examined among under-five children for different household income quartiles. This is with a view of finding the relationship between children malnutrition and household income. The anthropometric analysis was carried out by using the NutriSurvey software for emergency nutrition assessment.

3.4 Regression analysis

For the purpose of analyzing the determinants of malnutrition, we specify a child malnutrition model represented as:

$$Mi = \alpha_0 + \alpha_1 C + \alpha_2 H + \alpha_3 V + \varepsilon \quad (3)$$

Where *Mi* is the malnutrition indices, *C* is vector of child-specific variables, *H* is vector of household variables and *V* is vector of child health and other variables, and *ε* is the random error term. We used three indices of malnutrition earlier mentioned: Stunting, underweight and wasting. The malnutrition index takes value 1 for a malnourished child and 0 otherwise. Since the dependent variable is dichotomous, the Logit estimation technique was used to analyze the data. Furthermore, we used a cluster correction procedure for model estimation, so that robust standard errors were reported. Given our multi-stage random sampling approach, with household observations clustered by villages, this approach takes care of potential intra-cluster correlation of the error term and produces a consistent variance-covariance matrix. Regression analysis was carried out by using the STATA analytical software.

4. Results

4.1 Descriptive statistics of selected households and child variables

Table 1 shows sample statistics and description of selected household and child variables. The results show that of the 127 children in the sample households, 52% were male, while 48% were female. The mean age of children was approximately 50 months. Ninety percent of the households were headed by men and 10% were headed by women. The mean age of household head in the sample was 59 years, indicating that household heads in the area were relatively old.

The average household size was 5 adult equivalents. This is consistent with the national average household size reported by NBS (2006). The dependency ratio was 54%, though with a wide standard deviation across the sample households. The low dependency ratio is probably due to the low population density of the State. An average household head in the sample have approximately 7 years of schooling, while the spouses have 3 years of schooling. Table 1 also shows that total household income is approximately ₦30,000 naira per capita (250 US$) per year from all income sources. This is however lower than the national average of ₦45,250 in Nigeria, but still a reasonable figure for households located in rural areas of Nigeria (NBS, 2006). The average household income figure further confirms the level of poverty in the State as discussed earlier. The mean daily per capita household calorie supply was 2427.5 kcal, which is slightly below the 2500 kcal recommendation, but still in line with another recent study for rural Nigeria (Aromolaran, 2004). The asset variable shows that the average household in the sample has productive assets worth about 74 thousand naira. The body mass index of mothers is an indication of the overall nutrition quality of the mother and has important implications for the child health and nutrition. The study shows that the average body mass index of the child mother in the sample was 22.4. This is slightly higher than the 18.5 recommended cut off point. Clean water and toilet facilities are indicators of healthy environment which can improve child health and nutrition. Our results show that about 65% of the households have access to clean water, while 56.6% have sanitary toilet in their house.

4.2 Prevalence of malnutrition

The lower part of table 1 shows children nutritional status and prevalence of malnutrition. The results show that the mean height-for-age, weight-for-age and weight-for-height Z-scores were 0.455, -0.586 and -0.991 respectively. Looking at the standard deviations, the results indicate that the mean height-for-age z-score and weight-for-height Z-score show more variations that the mean weight-for-age Z-score. On the average, the nutritional status results suggest that children in the sample households have problem of malnutrition, but the average Z-scores were higher than minus 2 standard deviation from the median score for the reference population.

Results of table 1 further show that 23.6% of the children were stunted, with Z-scores below minus 2 standard deviation from the median of the reference population as defined by the United State National Center for Health Statistics (NCHS). This implies that 23.6% of under-five children in the study area are suffering from chronic malnutrition. This prevalence of stunting is however lower than the national average of 38% recorded during the 2003 Nigeria Demographic and Health Survey (Ajieroh, 2010). It is also lower than the 42% recorded during the Nigeria Food Consumption and Nutrition Survey in 2004 (Ajieroh, 2010). Twenty-two percent of the children were underweight, while 14.2% are wasted. While the percentage of underweight children in our sample is lower than the national average of 29%, the percentage of wasted children is slightly higher than the national average of 9.2%.

In table 2, we present income, child nutritional status and prevalence of malnutrition according to income quartiles. The results show that, households in the high income quartile consume more calories and subsequently have a lower prevalence of under nourishment. Similarly, child nutritional status increase with increasing household income. Prevalence of child malnutrition decrease with increased household income implying that richer households are likely to have a lower incidence of child malnutrition. Prevalence of severe malnutrition - defined as number of children with Z-scores below minus 3 standard deviation from the median of the reference population, also showed similar patterns among the sample children. Overall, these descriptive results suggest that children from households with higher per capita income are less likely to suffer from malnutrition (Sarmistha, 1999).

4.3 Determinants of malnutrition

In this section we present the result of the regression analysis of the determinants of malnutrition among the sample children. As mentioned earlier, we used a Logit model to regress stunting, underweight and wasting against the same set of explanatory variables. The dependent variable in each case is a dummy which equals one if the child is malnourished and zero otherwise. Since the Logit model relies on the maximum likelihood estimation procedure, the resulting parameter estimates represent the probability that a child will be malnourished. A positive sign on a parameter implies that the variable will lead to increased malnutrition, while a negative sign indicate that the variable will reduce malnutrition. To safe the degree of freedom, we used only nine explanatory variables that are considered important to children malnutrition. For the three regressions, the goodness of fit of the model is adequate and consistent with other studies on nutritional status (Kabubo-Mariara et al., 2006). The model is also comparable to other studies like Smith, Ruel and Ndiaye (2005) which used the individual child Z-scores as the dependent variable and employed an ordinary least square (OLS) regression approach.

The results of the analysis of the determinants of malnutrition are presented in table 3. Column 1 of table 3 shows the estimation results of the determinants of stunting (chronic malnutrition). The results show that age of child is positively related to the probability of stunting, implying that other things being equal, older children are more likely to be stunted. This finding is consistent with those of other previous studies in different countries (Sarmistha 1999, Kabubo-Mariara et al 2006). This result is plausible considering that many of the younger children are still been breastfed, and chronic malnutrition sets in only after weaning (Babatunde and Qaim, 2010). Mother's education has a significant negative relationship with incidence of stunting; suggesting that improved mother's education will reduce the level of child malnutrition. This result is consistent with the findings of Webb and Block (2004), which highlighted the importance of human capital investment in improving children nutritional status. Educated mothers are better aware about the nutrition requirements of their children and they usually provide improved health care as a result of their awareness.

Our results also revealed that probability of stunting will decrease with better body mass index of child's mother. This is expected as body mass index represents an indicator of the nutritional status of the mothers and their ability to adequately breastfeed their children. Calorie intake of the household is negatively related to the probability of stunting among the sample children. This suggests that children from households that have access to more calories (i.e. food secure) are less likely to be stunted. This finding agrees with past literatures that have shown that the nutritional status of a child is related to the overall nutritional status of the household (Smith and Haddad, 1999). Having toilet in the household has a significant negative effect on the probability of stunting. This is not surprising as better sanitary conditions lower the risk of infectious diseases and malnutrition. Similarly, access to clean water reduces the incidence of stunting among the sample children. Clean water and toilet are health variables that have been shown in the literatures to contribute to improved nutritional status of children (Armar-Klemesu et. al 2000).

Column 2 in table 3 shows the determinants of underweight among the sample children. The significant determinants of underweight include, gender of child, education of mother, body mass index of mother and access to clean water. The gender variable revealed that male children are more likely to be underweight, compared to their female counterpart. The results suggest that, other things being equal, improvement in the education of mother, better body mass index and access to clean water will reduce the probability of a child being underweight. Column 3 of table 3 shows that male and older children are more likely to be wasted. This result is consistent with Kabubo-Mariara et al 2006. Better education by mothers will reduce the probability of wasting among under-five children. Similarly, children born to mothers with high body mass index are less likely to be wasted. Calorie intake of the household also influences the incidence of wasting in a significant and negative way. This is not surprising as other things being equal; a well-fed family will produce a well-nourished child (Smith and Haddad, 1999). As in the case of stunting, presence of toilet and access to clean water improve the nutritional status of children and reduce the probability of wasting.

5. Conclusions

Studies that analyze the determinants of malnutrition among under-five children are rather scanty in Nigeria. The available ones were based on direct Z-scores using ordinary least square regressions. In this paper, we examined the prevalence and determinants of malnutrition among under-five children of farming households in Kwara State of Nigeria. Descriptive and regression techniques were used to analyze anthropometrics data collected from

127 children. Regression analysis was based on three binary malnutrition indices estimated using Logit regression.

The major findings of this paper are as follows. With regards to the prevalence of malnutrition, we found that 23.6%, 22.0% and 14.2% of the sample children were stunted, underweight and wasted respectively. These figures though lower but are comparable to the national averages for Nigeria. Descriptive analysis of the data indicates that children from richer households were less malnourished than those from poorer households. This underscores the importance of household income in child nutritional status. The regression analysis revealed that child's variables (age and gender), mother's variables (education and nutrition) and health variables (clean water and toilet) were the significant determinants of child malnutrition. We found that, other things being equal, male and older children are more likely to be malnourished. This is probably due to increased attention being paid to female children, as well as reduced care and attention for older and weaned children. Mother's education and body mass index are significant in all our regression models pointing to the fact that child nutrition will improve with increased mother's education and nutrition. Clean water and availability of toilet also reduce the probability of malnutrition. This is in line with previous research in other countries. Household size and dependency ratio do not have any significant effects on malnutrition in our sample.

The results of this study have important policy implications for reduction of child malnutrition in Nigeria. First, the fact that maternal education came out clearly as a significant determinant shows that women education is important to reducing malnutrition and therefore the need for effective targeting of women for education programmes. To a large extent, women are responsible for feeding and caring for young children. The quality of feeding and care given to the children would reflect the level of education of the mother when other factors are fixed. What is needed therefore is to target pregnant women with specific education and health care programs. These specific education and health programs could be included in the formal education curriculum in order to make them reach teenage girls even before their first pregnancy. Second, the provision of clean water for rural households should be taken seriously by government. Clean water will prevent the spread of water-borne diseases that can negatively affect the health and nutrition of young children. Rural households should be encouraged to provide sanitary toilets in their homes. Government can make laws that would compel rural households to observe clean and healthy environment. Finally, it is important to interpret the results of this study cautiously, given the types of data used in the analysis. For instance, child specific and health related data such as birth weight, birth order, access to vaccination and duration of breast feeding were not available in our data set. These variables have been shown to be important for child nutritional status. Moreover, our sample size of 127 under-five children is relatively small. Including more child specific and health related variables, and increasing the sample size, might produce a more robust results.

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Table 1. Descriptive statistics and definition of selected household and child variables

Variable	Description	Mean	SD
Sex of child	Gender of child (male = 1, female = 0)	0.52	0.50
Age of child	Age of child (months)	49.7	8.64
Gender	Gender of household head (male = 1, female = 0)	0.90	0.31
Age	Age of household head (years)	59.10	6.80
Household size	Number of household members in adult equivalents (AE)	5.08	1.31
Dependency ratio	Ratio of dependants to total household size (ratio)	54.0	81.9
Education of head	Number of years of schooling of household head (years)	6.89	3.93
Education of mother	Number of years of schooling of child's mother (years)	3.01	3.24
Total income	Total household income per annum (naira/AE)	30245.74	23416.34
Calorie intake	Household calorie intake in kcal/AE/day	2427.5	704.0
Assets	Value of household productive assets (naira)	73761.8	53154.0
Body mass index	Body mass index of child's mother	22.4	42.7
Clean water	Dummy for access to clean water (yes = 1, no = 0)	0.65	0.48
Toilet	Dummy for presence of toilet (yes = 1, no = 0)	0.566	0.497
HFA_Z	Child height-for-age Z-scores	0.455	2.64
WFA_Z	Child weight-for-age Z-scores	-0.586	1.40
WFH_Z	Child weight-for-height Z-scores	-0.991	1.88
Stunting (%)	Children whose height-for-age *Z*-score is below -2 SD	23.6	-
Underweight (%)	Children whose weight-for-age *Z*-score is below -2 SD	22.0	-
Wasting (%)	Children whose weight-for-height *Z*-score is below -2 SD	14.2	-

Notes: Official exchange rate in 2006: 1 US dollar = 120 naira; SD is standard deviation. AE is adult equivalent.

Table 2. Income, nutritional status and prevalence of malnutrition by income quartiles

	All households	Income quartiles			
		First	Second	Third	Fourth
Total income (naira/AE)	30245.7	13862.7	23877.2	36826.9	46416.1
Calorie intake (kcal/day/AE)	2427.5	1893.3	2049.6	2548.4	3218.6
Prevalence of under nourishment (%)	60.9	89.1	83.6	23.6	14.5
Height-for-age *Z*-score	0.456	-0.299	0.469	1.16	0.543
Weight-for-age *Z*-score	-0.586	-1.01	-0.808	-0.291	-0.127
Weight-for-height *Z*-score	-0.991	-0.974	-1.32	-1.13	-0.436
Stunting (%)	23.6	33.3	25.7	12.9	21.4
Severe stunting (%)	6.3	9.1	8.6	6.5	0.0
Underweight (%)	22.0	30.3	25.7	9.7	3.6
Severe underweight (%)	7.1	12.1	8.6	6.5	0.0
Wasting (%)	14.2	27.3	14.3	9.7	3.6
Severe wasting (%)	11.8	21.2	11.4	9.7	3.6

Note: Official exchange rate in 2006: 1 US dollar = 120 naira. AE is adult equivalent.

Table 3. Logit model determinants of child malnutrition

Variables	Malnutrition Indices		
	(1) Stunting	(2) Underweight	(3) Wasting
Constant	-8.143** (-2.41)	-4.210*** (-3.32)	-6.240** (-2.11)
Household size	0.431 (0.32)	0.008 (1.09)	0.907 (0.55)
Gender of child	0.121 (1.02)	0.509** (2.02)	0.920** (2.11)
Age of child	0.137*** (3.01)	1.06 (0.62)	1.121* (2.01)
Education of mother	-0.761*** (-2.83)	-0.043*** (-3.01)	-0.812*** (-4.23)
Body mass index of mother	-0.422*** (-4.26)	-1.28** (-2.44)	-0.033* (-1.89)
Calorie intake of household	-111.2** (-2.01)	-319.7 (-1.28)	-218.4*** (-3.00)
Dependency ratio	0.048 (1.16)	-0.910 (-0.64)	0.721 (0.08)
Presence of toilet	-0.192** (-2.43)	0.401 (0.221)	-0.092*** (-3.06)
Clean water	-0.071*** (-2.90)	-0.087** (-2.11)	-0.576** (-2.03)
Log-likelihood	-44.95	-26.38	-76.12
Pseudo R^2	0.521	0.481	0.601

Notes: The number of observations in all models = 127. Figures in parentheses are *t*-values.

*, **, *** statistically significant at the 10%, 5%, and 1% level, respectively.