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Determinants of Nutritional Status of Preschool Children from Rural Households in Kaduna and Kano States, Nigeria

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Abstract: The study evaluated the nutritional status of preschool children; identified the influencing factors and estimated the degree of responsiveness of nutritional status index to changes in causal variables. Conducted in five villages selected from Kaduna and Kano States of northern Nigeria, the study used data from selected rural households and anthropometric measurements of preschool children resident therein. Household data were collected using structured questionnaire administered by trained enumerators. The relevant software was used to calculate nutritional status indexes while a two-limit tobit regression analysis, in which the long-term index of height-for-age entered as a dependent variable, was conducted to assess the influence of the explanatory variables on nutritional status. Tobit decomposition framework was used to estimate the elasticities. Results revealed that the proportions of children with either moderate or severe nutritional problems were 61, 17 and 40% using the height-for-age, weight-for-height and weight-for-age measures respectively. Soybean consumption ($p<0.01$), mother's education ($p<0.01$), mother's position among housewives ($p<0.05$) and child's height ($p<0.01$) were positively related to the child's nutritional status. Also, mother's age ($p<0.01$), child's age ($p<0.01$) and dependency ratio ($p<0.05$) had negative influence on nutritional status. A 10% increase in dependency ratio and child's mother's age would result to a 1.70 and 0.46% increases in total elasticity of children malnutrition. Proportionate percentage increases in mother's position among wives in the household, mother's level of education and household's consumption of soybean-related food would elicit a total of 0.03, 1.15 and 0.26% decreases respectively in elasticity of malnutrition. Decomposition of the elasticity coefficients revealed that marginal changes in all factors would increase or decrease the probability of intensity of children malnutrition more than they would increase or decrease the probability of prevalence. Policy options that would promote formal education for women, home use of soybean and reduction in dependency ratio are recommended to achieve meaningful improvement in nutritional status.

Key words: Determinants, nutritional status, preschool children, rural households, Nigeria

INTRODUCTION

Prevalence of malnutrition has remained a problem of considerable magnitude in most developing countries (Devi and Geervani, 1994). Malnutrition causes both emotional and physical suffering (Smith and Haddad, 2000) and is responsible for more than one-half of all children's deaths worldwide (Pelletier *et al*., 1995). Adults who survive malnutrition as children are less physically and intellectually productive and suffer from higher levels of chronic illness and disability (Smith and Haddad, 2000). In sub-Sahara Africa, including Nigeria, evidence from past studies shows that as at 1995, about 31.4 million children under age five, representing 31.1% of the total children in that age group were underweight (Smith and Haddad, 2000). The figure represents an increase of 12.9% point over the 1970's estimate of 18.5 million in the region. The 31.1% share of underweight children <5 years in sub-Sahara Africa in 1995 also represented a worrisome increase over the 28.8% in 1990.

In Nigeria prevalence of malnutrition among rural preschool children and nursing mothers has also been widely reported (IITA, 1999; Okoruwa, 1997; Owolabi *et al*., 1996; Lanipekun *et al*., 1992; Root *et al*., 1987). Empirical investigations have identified the problems of high levels of poverty (FOS, 1999) and food insecurity (Olayemi, 1996), which have prevailed among the low-income population in the midst of rising prices, including high cost of meat, as well as high costs of living and dearth of animal protein among the causes of malnutrition. Among the major steps taken towards tackling the problem of malnutrition was the propagation of use of soybean, including the introduction of improved production and utilization innovations among households (IITA, 1999; Okoruwa, 1997; Manyong *et al*., 1998).

The laudable efforts notwithstanding incidence of malnutrition has persisted among children, suggesting that the factors that account for differences in the nutritional status have not been properly elucidated. The objectives of this study is to evaluate the nutritional status of preschool children, determine the factors that influence nutritional status and estimate the degree of responsiveness of nutritional status index to changes in the variables. It is expected that the findings from the study would serve as a guide to policy makers, extension staff, food nutritionists and households seeking to achieve some meaningful improvement in children's nutritional status in Nigeria.

MATERIALS AND METHODS

Study area and data collection: The survey was conducted in Kaduna and Kano States of Nigeria. Kaduna lies between latitudes 9°04'-11°50'N and longitude 6°09'-10°41'E. Kano lies between latitudes 10°33'-12°37'N and longitude 7°34'-9°25'E. Five villages were selected for the study. Three of the selected villages are in Kaduna State, which has the guinea savanna ecology with annual rainfall range of 600-1200 mm. The other two villages are in Kano State with the sudan savanna ecology and annual rainfall range of 300-600 mm. A random sampling technique was used to select 511 preschool children of ages 0-59 months. The children's ages were recorded and approximated in months. Anthropometric measurements of weights and standing heights for children 24-59 months of age or recumbent lengths for infants 0-23 months were also taken. The weights of the children were measured using a standard platform-type bathroom scale of 160 kg capacity. Care was taken to ensure that children being measured were barefooted, wore light outfits and carried nothing in their pockets before standing at the centre of the platform. The weights were read and recorded to the nearest 0.1 kg.

The standing heights of the children were measured using the measuring ruler, which were preferred for their ease of use. The children being measured were made to stand erect with feet at right angles, heels on the ground, back flat against the wall and eyes looking straight ahead and without shoes (Cerdeña *et al.*, 2001). The 12-inch ruler was then gently placed to make contact with the child's head touching the hair to make angle 90 degrees with the measuring ruler. The measurements of the height were taken and recorded to the nearest 0.1 cm. For measurement of recumbent length the wooden length board was used. The child was laid on the board, with head positioned firmly against the fixed headboard and eyes looking vertically. The knees were extended by firm pressure and feet flexed at right angles to the lower legs (Cerdeña *et al.*, 2001). Like the standing heights, recumbent lengths were read and recorded to the nearest 0.1 cm. Structured questionnaire administered on the children's mothers by trained enumerators was used to obtain the relevant household data on the children.

Empirical tobit model: To determine and quantify the relationship between nutritional status of children and the explanatory variables a two-limit tobit regression analysis was applied. This method, which follows Tobin (1958), was initially presented by Rosett and Nelson (1975), discussed in Maddala (1983) and applied by Fernandez-Cornejo *et al.* (2001). The two-limit tobit is appropriate when the observed dependent variable lie between 0 and 1. The model can be expressed as:

$$y^* = \beta' X_i + e_i \qquad (1)$$

where:

y^* = A latent variable that is unobserved for values <0 and >1

X_i = An (nxk) matrix of the explanatory variables that includes factors affecting nutritional status among children

β_i = A (kx1) vector of unknown parameters

e_i = An independent normally distributed error term with zero mean and constant variance (σ^2), that is, $e_i \sim N(0, \sigma^2 I)$ and I = 1, 2... n, where n is number of observations

Denoting y_i, the height-for-age z-scores index of nutritional status of children, as the observed dependent (censored) variable, we have:

$$y_i = \begin{Bmatrix} 0 & \text{if} & y_i^* \le 0 \\ y^* & \text{if} & 0 < y_i^* < 1 \\ 1 & \text{if} & y^* \ge 1 \end{Bmatrix} \qquad (2)$$

Using the 2-limit tobit, the nutritional status index was regressed against proxies for the explanatory variables hypothesized to influence the nutritional status of children.

The disturbance term of the tobit model is a function of the independent variables, hence attempting to estimate the functional form using the Ordinary Least Squares (OLS) method will produce biased and inconsistent estimates (Wu, 1992). If the unobserved y_i^* is assumed to be normally distributed, the estimation of the tobit model can be performed using the Maximum Likelihood Estimation (MLE) method. The likelihood function is expressed as:

$$L = \prod_{y^* > T}(1 - G_i)\prod_{y^* \le T}\frac{1}{2\pi\sigma^2}e\left[-\frac{1}{2\sigma^2}(y_i - \beta X_i)^2\right] \qquad (3)$$

where:

G_i = The distribution function of τ_i.

The resultant coefficients of the likelihood function are consistent, asymptotically efficient, unbiased and normally distributed.

The tobit decomposition framework: Elasticity refers to the degree of responsiveness. The elasticities were calculated at the mean values of the explanatory variables included in the empirical tobit model. The total effect of a change in each explanatory variable of the tobit model can be decomposed using the tobit decomposition framework (McDonald and Moffit, 1980). Two effects of a given variable change can be distinguished (Adesina and Baidu-Forson, 1995; Adesina and Zinnah, 1993) the effect on the probability of malnutrition and effect on the intensity of malnutrition for children that already have nutritional problems.

Suppose $E(y_i)$ is the expected value of the dependent variable, y_i, across all observations and $E(y_i^*)$ is the expected value for children that are nutritionally safe. Suppose also that $\Phi(Z)$ is the probability that a child falls below the threshold, where Φ is a cumulative normal distribution function and $Z = X_i\beta_i/\sigma$. It is possible to state the relationship between the variables as:

$$E(y_i) = \Phi(Z).E(y_i^*) \tag{4}$$

where the variables are as already defined.

If Eq. (4) is differentiated with respect to every $x_i \in X$, we have

$$\frac{\delta E(y_i)}{\delta X_i} = \Phi(Z)\left\langle\frac{\delta E(y_i^*)}{\delta X_i}\right\rangle + E(y_i^*)\left\langle\frac{\delta \Phi(Z)}{\delta X_i}\right\rangle \tag{5}$$

Multiplying through by $X_i/E(y_i)$, the relation in (5) can be converted into elasticity form as:

$$\frac{\delta E(y_i)}{\delta X_i}\cdot\frac{X_i}{E(y_i)} = \Phi(Z)\left\langle\frac{\delta E(y_i^*)}{\delta X_i}\right\rangle\cdot \frac{X_i}{E(y_i)} + E(y_i^*)\left\langle\frac{\delta \Phi(Z)}{\delta X_i}\right\rangle\cdot\frac{X_i}{E(y_i)} \tag{6}$$

Equation (6) can be rearranged by substituting $\Phi(Z)\bullet E(y_i^*)$ for $E(y_i)$. The right hand side changes and the resultant Eq. (7) is

$$\frac{\delta E(y_i)}{\delta X_i}\cdot\frac{X_i}{E(y_i)} = \Phi(Z)\left\langle\frac{\delta E(y_i^*)}{\delta X_i}\right\rangle\frac{X_i}{\Phi(Z)E(y_i^*)} + E(y_i^*)\left\langle\frac{\delta \Phi(Z)}{\delta X_i}\right\rangle\frac{X_i}{\Phi(Z)E(y_i^*)}$$

$$\frac{\delta E(y_i)}{\delta X_i}\cdot\frac{X_i}{E(y_i)} = \left\langle\frac{\delta E(y_i^*)}{\delta X_i}\right\rangle\cdot\frac{X_i}{E(y_i^*)} + \left\langle\frac{\delta \Phi(Z)}{\delta X_i}\right\rangle\cdot\frac{X_i}{\Phi(Z)} \tag{7}$$

It follows from Eq. (7) that the total elasticity of a change in any of the explanatory variables can be decomposed into two effects to reflect a change in elasticity of the expected intensity of malnutrition for children with nutritional problem and change in the elasticity of the probability of prevalence of malnutrition.

Variables in the empirical tobit model: The dependent variable is the Child's Nutritional Status (CH_NUTS). It is used in this study to represent the Height-for-Age Z-scores (HAZ) index. HAZ index is preferred to the Weight-for-Height Z-score (WHZ) and Weight-for-Age Z-score (WAZ) indices because it depicts prevalence of long-term growth faltering or stunting. The WHZ is a condition that usually reflects severely inadequate food intake and infection happening at present (wasting) while WAZ, a condition of underweight, is a synthesis of HAZ and WHZ. Although calculated for all surveyed children, WHZ and WHZ were not used in the tobit analysis because our interest is on the determinants of long-term nutritional status. The raw z-scores values were censored and two-limit tobit model was used to analyze the determinants of the nutritional status.

Theory and empirical evidence gleaned from past studies guided our selection of the explanatory variables included in the empirical tobit analysis. Some variables were also included based on their hypothesized relationship with the dependent variable (Chianu and Tsujii, 2004). Past studies have demonstrated that nutritional status of children is determined by a complex interaction of several factors (Devi and Geervani, 2004; Mbago and Namfua, 1991; Sanginga *et al*., 1999; Owolabi *et al*., 1996). Following Sanginga *et al*. (1999), it is hypothesized that nutritional status is a function of the demographic characteristics of the child, socio-economic characteristics of the household from which the child was extracted and availability and consumption of protein-related foods. The definition and measurement of the explanatory variables are presented in Table 1. The variables are discussed below.

DEPRAT is the dependency ratio, defined as the proportion of household members that aged 0-15 years and above 65 years (dependants) to those that aged 16-65 years, which reflect the working population (Chianu and Tsujii, 2004). It is expected that a child selected from a household with high dependency ratio is likely to have low nutritional status than one from a household with low dependency ratio. This is because increasing number of dependants will increase pressure on household's resources for food consumption. Since, more mouths would be fed the household consumption expenditure would increase and for low-income households that could lead to use of coping strategies for survival. Fall in nutritional status would result, hence we hypothesized that dependency ratio was inversely related to nutritional status.

Table 1: Descriptive statistics for the variables used in the empirical tobit model

Variable	Definition and measurement	Expected sign	Mean (n=498)	SD	Min.	Max.
CH_NUTS	Child nutritional status, measured from haz index; it is (=0 if HAZ=0; =HAZ if 0<HAZ<1; =1 if HAZ=1).	Dependent variable	6.17E-02	0.23	0.00	1.00
DEPRAT	Defined and measured as the proportion of household members aged 0-15 years and above 65 years (dependants) to those aged 16-65 years (workers).	-	0.58	0.18	0.00	0.83
FMINCO	Incomes earned by household from all farming activities, in the previous year, including livestock farming but excluding processing (measured as natural logarithm of actual Nigerian Naira (N)[++] values].	+	9.61	1.01	7.16	12.44
ACCSAW	Measure of the household's access to safe water (coded as: 2=if household has access to safe water (borehole or tap water), 1=if otherwise).	+	1.03	0.17	1.00	2.00
MO_AGE	Age of the child's mother (in years)	+	28.62	7.50	14.00	60.00
HHTYPE	Type of household from which the child was drawn (1=monogamous, 2=polygamous).	-	1.78	0.41	1.00	2.00
MO_POSIT	Mother's position among wives married to the male household head (1=first wife, 2=second wife, 3=third wife, 4=fourth wife).	-	1.49	0.65	1.00	4.00
MO_EDU	Mother's level of educational attainment (coded 0=no education, 1 = Islamic education, 2 = Primary education attempted or completed, 3 = Secondary education attempted or completed, 4 = Higher education attempted or completed.	+	1.16	0.64	0.00	4.00
MEAT_CO	Household consumption of meat or meat product in the 6 weeks preceding the survey (dummy: 1 if meat was consumed; 0 if no meat was consumed)	+	0.36	0.48	0.00	1.00
QCONS	Per day equivalent of quantity of soybean consumed by the household (measured in kg.).	+	0.13	0.28	0.00	2.33
CH_AGE	The age of the child rounded up to months.	-	32.55	18.11	0.00	59.00
CH_GEN	The gender of the child (dummy: 0=male, 1=female)	+	0.52	0.50	0.00	1.00
CH_WGT	The weight of the child (in kg.), measured by appropriate methods (Cogill 2003) using bathroom scale	+	11.23	4.22	3.00	25.00
CH_HGT	The height of the child (cm); measured using the measuring ruler and tailoring rule.	+	82.20	15.38	49.00	125.00
SICNES	Number of days the child was sick in the 6 weeks preceding the survey	-	2.67	5.39	0.00	45.00

[++] The exchange rate was Nigerian N140/US$1.00, Source: Field Survey data, 2003

FMINCO is the farm income of household. It is defined as all incomes earned by household from all farming activities, including livestock farming but excluding processing. It entered the model as natural logarithm of actual Nigerian Naira (N) values earned in the year preceding the survey. It was expected that increase in the FMINCO will raise the household purchasing power and standard of living and consequently improve the food and nutritional status of household members.

ACCSAW measures the household's access to safe water. It was included in the study as an indicator of good health condition. It was coded as 2, if household had access to safe source of drinking water, like borehole and/or tap water and 1, if otherwise. It had been argued that improving the water quality would reduce the incidence of various illnesses (Smith and Haddad, 2000). It is therefore expected that the nutritional status of household members will be improved if household had access to safe drinking water and a positive relationship was accordingly hypothesized.

MO_AGE is the child's mother's age, measured in years. Better nutritional status was expected for children mothered by more elderly women. In the study area, it was a common practice for young girls to be given out for marriage during or in some cases before attaining their teenage years. Consequentially, most of the newly married women would not have the necessary exposure and experience to address the complex food and nutrition security problems of their children. Such experiences were gathered and built upon many years after marriage through playing direct motherly roles and learning from more matured women. Because of this we hypothesized a positive relationship between mother's age and nutritional status of the children.

HHTYPE refers to type of household from where the child comes. It was coded as: if a child was from a monogamous household and if from a polygamous household. It was expected that the nutritional status of children from monogamous homes would be better than those from polygamous households. This is because the children from monogamous homes were likely to receive better parental care and attention than what would obtain in an average polygamous home where loyalty could be often divided and distractions ensued.

The variable MO_POSIT refers to the mother's position among wives married to the male household head. The variable was measured as: if child's mother was the first wife, if she was the second, if the third and if she was the fourth wife. It was expected that the senior and more elderly mothers would be more experienced and as such better equipped to handle the nutritional problems of their children or wards. Following from the definition, it was hypothesized that MO_POSIT is inversely related to nutritional status of the child.

MO_EDUC is the level of education of the child's mother. It was measured using code 0 for no education: for Islamic education, for Primary education attempted or completed, for Secondary education attempted or completed and for Higher education attempted or completed. We hypothesized that mother's education was directly related to the child's nutritional status following empirical evidence that higher education increases women's care giving resources and improves their child care practices (Maxwell *et al.,* 2000).

MEAT_CO refers to household consumption of meat or meat products. It entered the empirical tobit model as a dummy measured as: if household consumed meat in the last 6 weeks preceding the survey and 0 if otherwise. As a source of animal protein, it was expected that meat consumption will have positive influence in the nutritional status of children. Consequently, it was hypothesized that meat consumption and nutritional status of preschool children are positively related.

An alternative source of protein is soybean (*Glycine max* (L.) Merill). Soybean has high protein content and balance of amino acids, a significant biological value among plant proteins (Owolabi *et al.,* 1996). Elsewhere, it was observed that soybean's 40% protein content and nutritional value was highest compared with other legumes and some high-protein foods (Singh *et al.,* 1987). It was expected that the nutritional status of a children whose mother produced and consumed soybean at home would be better compared than those whose mothers did not. On the premise of this argument the variable QCONS, which reflects the quantity of soybean consumed by household in the last six weeks preceding the survey, measured in kilograms, was included in the empirical model. It was hypothesized that soybean consumption was positively related to nutritional status of children selected from such household.

Among the individual child's demographic characteristics included in the study was CH_AGE, the age of the child, which was measured in months. An inverse relationship was hypothesized between age and nutritional status of children. Younger children were expected to have better nutritional status than the older children following the commonly observed pattern in the developing countries, explained by better child care and better feeding practices for younger children and exposure of the older children to relatively harsh environment (Sanginga *et al.,* 1999).

CH_GEND refers to the gender of the child. Drawing from evidence from previous studies (Sanginga *et al.,* 1999; Mebrahtu, 1994; Strauss, 1990; Svedberg, 1990) it was hypothesized that gender was positively related to nutritional status of children. Girls were expected to have better nutritional status than boys. CH_WGT is the weight of the child, measured in kilograms. CH_HGT is the height of the child, measured in centimetres. It was expected that both weight and height would be positively associated with better health and nutrition conditions. A malnourished child was likely to be more underweight or stunted compared with a well-nourished child of the same age. SICNESS entered the model as a proxy for the child's morbidity condition. It was measured as the number of days the child was in ill-health in the 6 weeks preceding the survey. It was hypothesized that sickness and nutritional status of the child would be inversely related.

The Epi Info™ Version 3.2.2 software was used to calculate the height-for-age, weight-for-age and weight-for-height nutritional indexes of children while the Limited Dependent (LIMDEP) Variable Version 7.0 Statistical Package was used to generate the maximum likelihood estimates of the explanatory variables included in the tobit model.

RESULTS

Prevalence of malnutrition: The anthropometric indices of weight-for-age, height-for-age and weight-for-height are presented in Table 2. The proportions that had either moderate or severe nutritional problems were 61% using height-for-age, 40% using weight-for-age and 17% using weight-for-height z-scores. The results imply the existence of high rates of prevalence of malnutrition among sampled children. According to Cerdeña *et al.* (2001), prevalence of malnutrition rate of 5% and above should be considered of significance and detrimental to public health.

Determinants of nutritional status of preschool children: The results of the empirical model characterizing the nutritional status of children are presented in Table 3. Most of the included explanatory variables had the expected signs and all variables without expected signs were not significant. Seven or 47% of the included variables were significant in explaining children's nutritional status. Soybean consumption (QSCON), level of education of the child's mother (MO_EDU) and child's height (CH_HGT) were significant each at 1%. They also gave the expected positive signs, suggesting that increases in these variables resulted to improvement in the nutritional status of children. Furthermore, the child's mother's age (MO_AGE) and child's own age (CH_AGE) were both significant at 1%, but had surprising negative signs. Also showing unpredicted negative sign, although significant only at 5%, is the child's mother's position among women married to the male household head (MO_POSIT). Dependency ratio (DEPRAT) was equally significant at 5% and had the expected negative sign.

Table 2: Nutritional status of preschool children

Measure of nutritional status	Classification	Percentage of children
Weight-for-age (n = 506)+	Underweight	39.72
	Normal	57.12
	Overweight	3.16
Height-for-age (n = 498)+	Stunted	61.45
	Normal	37.15
	Tall	1.40
Weight-for-height (n = 492)+	Wasted/thin	17.07
	Normal	70.94
	Overweight	11.99

+Difference between reported number (n) and sampled 511 children were children whose weight-forage, height-for-age and weight-for-height could not be classified. Source: Field Survey data, 2003

Table 3: Factors influencing the nutritional status of children

Variable	Coefficient	SE	t-value
Constant	-9.79E-04***	1.488E-04	-6.578
DEPRAT	-5.86E-05**	2.055E-05	-2.851
FMINCO	-7.15E-06	6.261E-06	-1.142
ACCSAW	4.28E-05	2.927E-05	1.462
MO_AGE	-3.24E-07***	7.459E-08	-4.403
HHTYPE	1.93E-05	1.565E-05	1.233
MO_POSIT	3.44E-07**	1.441E-07	2.387
MO_EDUC	1.97E-05***	5.359E-06	3.676
MEAT_CO	1.02E-05	1.210E-05	0.843
QSCON	3.99E-05***	1.066E-05	3.743
CH_AGE	-1.24E-05***	1.601E-06	-7.743
CH_GEND	-1.58E-05	1.138E-05	-1.387
CH_WGHT	1.27E-06	2.545E-06	0.499
CH_HGHT	1.497E-05***	1.88E-06	7.962
SICNESS	6.47E-08	7.988E-07	0.081
Log Likelihoods function	-62.85		
Pseudo R^2	0.33		
Conditional Mean	-0.0002		
Scale factor for Marginal Effect	0.0001		
Number of observations	498		

***= Significant at 1%, **= significant at 5%, Source: Field Survey data, 2003

Elasticities of probability of prevalence and intensity of malnutrition among children: The tobit decomposition framework presented in Eq. (4) through Eq. (7) was used to compute the probability of elasticity of prevalence and intensity of malnutrition for children who already have low nutritional status. Apart from child's age and height, for which elasticities would not make sense, elasticities were calculated and decomposed for every other significant variable. The result is presented in Table 4. It reveals that marginal changes in all variables brought about higher changes in elasticity of intensity more than it brought about in the elasticity of probability of malnutrition. In explaining the elasticities it should be noted that since the dependent variable was the child's nutritional status index, increase in variables that have positive influence on this index will lead to a reduction in malnutrition and vice versa.

For household's consumption of soybean (QSCON), a 10% increase in per day equivalent of soybean or soybean products consumed by the household would result to a decrease of 0.001% in the elasticity of probability of malnutrition and decrease of 0.259% in the elasticity of intensity of malnutrition for children that already had nutritional problem. This implies that the total decrease in elasticity of malnutrition resulting from a 10% increase in household's consumption of soybean products was 0.260%. In the case of dependency ratio, a 10% increase in the ratio of dependants to the working members of the household will result to a total of 1.704% increase in the elasticity of malnutrition. This comprises of a 0.005% increase in elasticity of probability and a 1.699% increase in the elasticity of intensity of malnutrition for children already suffering from nutritional problem. Mother's age is also inversely related to child's nutritional status. The results show that a 10% increase in the age of the child's mother will result to a 0.002% increase in elasticity of probability and a 0.464% increase in the elasticity of intensity of malnutrition for children who already have poor nutritional status. Thus, the total change in elasticity resulting from a 10% change in mother's age is 0.466%. For mother's position among wives in the households, a 10% increase will lead to an infinitesimal 0.0001% decrease in the elasticity of probability and 0.026%

Table 4: Decomposition of elasticity of malnutrition

	Coefficients of elasticity		
Variable	Elasticity of probability of malnutrition (a)	Elasticity of intensity of malnutrition (b)	Total elasticity (c = a + b)
QSCON***	8.40681E-05	0.025935	0.026019
DEPRAT**	0.000550859	0.169940	0.170491
MO_AGE***	0.00015029	0.046364	0.046515
MO_POSIT**	8.307290E-06	0.002563	0.002571
MO_EDU***	0.000370373	0.114260	0.114630

***= Significant at 1%, **= significant at 5%, Source: Field Survey data, 2003

decrease in the elasticity of intensity of malnutrition for children that ready have poor nutritional status. In all, the total elasticity resulting from a 10% change in mother's position among other wives married to the household head will be 0.026%. For mother's level of education, a 10% increase in the child's mother's level of education attainment will result to total decrease in elasticity of malnutrition by 1.146%. This is mostly accounted for by decrease in elasticity of intensity calculated as 1.142% as against decrease in elasticity of intensity calculated to be 0.004%.

DISCUSSION

The study finds a significant and positive relationship between soybean consumption and nutritional status of children, which underscores the relevance of soybean in promoting household food and nutrition security. This result corroborates the earlier study on the food intake of children in northern Nigeria, which found that soybean accounts for about 34.40 percent of children's protein intake (Owolabi *et al.,* 1996). Another study had also showed that the average per capita consumption of soybean products is positively and significantly related to both long-term nutritional status of children and household food security (Sanginga *et al.,* 1999). The significance of this variable is of interest because soybean has been variously adopted by women for making different types of local food recipes, especially *awara,* a form of cheese spiced with pepper that had become a good source of food and income for women in the area (Ojiako, 2006).

Contrarily, an inverse significant relationship was established between nutritional status and dependency ratio. This finding makes sense considering that increases in the number of dependants are expected to result to reduction in both the quantity and quality of food available for intake in the rural poor households. Similar finding had been reported in the southern guinea savanna (Sanginga *et al.,* 1999). Households usually respond to conditions of limited resources and food insufficiency by adopting various forms of coping strategies or fallback mechanisms (Maxwell, 1995), which on themselves have negative effect on household members' nutritional status. The implication of this finding is that in a quest to achieve meaningful improvement in nutritional status policy thrust should be directed towards either reducing the number of dependants per household or creating more jobs to enable as many who fall within the working population to be gainfully employed or a combination of both measures.

The significance and direct relationship of the child's mother's education concurs with the assertion that maternal schooling is strongly associated with good child care and good health (Maxwell *et al.,* 2000). More education for women is associated with higher levels of household food availability, higher quality diets, better care practices and behaviours and better nutritional outcomes. This finding makes a good case for the use of educational empowerment and capacity building of women as a means of promoting food and nutritional status of children in particular and household members in general.

The child's age is significant with the hypothesized inverse relationship with nutritional status. This could partly be explained by the fact that more attention and time were often devoted to child care and feeding practices of infants and younger children in an average African household. By implication, the elderly children were subjected to harsher conditions, including child labour and abuse, which were often mistaken for training. In the course of the study it was observed that majority of the children of school age were, rather than being enrolled in schools, used for farm work, hawking and other forms of child labour. The situation was pathetic considering the negative effect of child labour on the intellectual development of the affected child.

The negative sign associated with the child's mother's age implies that the higher the age of the mother the less the nutritional status of the child under her care. In other words, children living with older mothers had less nutritional status than children living with younger mothers. Although unexpected, this could be linked to likelihood of better paternal attention and support for younger women and their children, which had been a common practice among typical rural African polygamous households. The child's mother's position among women married to the male head of household had unexpected positive sign, suggesting that children living with junior wives in the household hierarchy have better nutritional status than children living with senior wives. This tends to agree with the sign associated with the child's mother's age and could also result from the likelihood of better paternal attention and support for younger wives.

Conclusion: The results from this study point to high rate of prevalence of malnutrition among children in the studied area in northern Nigeria. Household consumption of soybean and soybean products, dependency ratio, child's mother's age, education and position in the household were among the significant factors that explain nutritional status of children. The study particularly identified the vital role women and mothers could play in promoting nutritional status of children and households in the rural communities. Majority of significant explanatory variables are related to the children's mothers and their characteristics. We recommend use of policy tools that are capable of promoting formal education for women, home use of soybean and reduction in dependency ratio in the quest to achieve meaningful improvement in nutritional status of children in the rural communities.

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