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Family Structures and Children's Nutritional Status in Tanzania

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Abstract

The 1996 Tanzania Demographic and Health Survey (TDHS) data is used to examine the factors that affect the nutritional status of children age three years and under. The logistics regression model was used to determine the effects of marriage structures, household food security, regional zones and place of residence on the nutritional status of children. The analysis was based on 3,498 children aged not more than three years and whose weights and heights were measured. The results show that the nutritional status of children is largely associated with the age of the child, food availability, maternal education, place of residence, whether the child is born single or twin and the regional zone. In order to improve the nutritional status of these children, it is suggested that public health interventions be introduced where they are not existent and improved upon where they are already in place.

1. Introduction

The nutritional status of children is an outcome of many interrelated factors such as economical, environmental, political, educational, cultural and food security factors. Other factors include household composition, feeding practices, and infections. However, the main cause of malnutrition is said to be the lack of access to food, that is, food security.

Aggregate data at national level show that Tanzania produces enough food to supply domestic requirements, and that the average food consumption per capita exceeds recommended minimum allowances for energy and protein intake. Yet, there are many households whose children suffer from malnutrition despite surplus food production. In fact, it was revealed that regions with high rates of child deaths also have high levels of food production, while several regions which are said to be food deficit have relatively better child survival rates (URT, UNICEF, 1990).

An overwhelming evidence shows that the lack of access to food is the major cause of malnutrition in the third world, Tanzania being one of them. A Protein-Energy Malnutrition (PEM) survey conducted by UNICEF in 1986 indicates that the problem of malnutrition in Tanzania is still serious. Although improvements in national food availability since 1984 has helped to reduce the incidences of malnutrition among children in some regions, the level is still too high even in regions of surplus food production like Ruvuma. Yet, it is not readily known how the

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levels of malnutrition among children under three years of age change with the family/household structure.

The results presented in both the 1991/92 and 1996 Tanzania Demographic and Health Surveys (TDHS) do not show how the nutritional status of children varies with household characteristics. In both the 1991/92 and 1996 TDHS, the results are presented according to demographic characteristics (child's age, sex, birth order number, and previous birth interval); and socioeconomic characteristics (residence, region, and mother's education).

In this paper, therefore, we use the 1996 TDHS data to examine the relationship between the existing family and marriage structures in Tanzania, and the nutritional status of children under three. A multiple logistic regression model is used to determine how family and marriage structures are related with the nutritional status of children aged between 1 and 35 months.

The results from this analysis are expected to help in the identification of the type of households/families in which children are most likely to suffer from severe or moderate malnutrition so that deliberate steps can be taken to improve household food availability. This can be done, for example, by providing the necessary assistance to the affected households. The results will also help in the formulation of some strategies and policies to alleviate poverty at the family or household level where malnutrition is most acute.

2. Literature Review

As a result of the Arusha Declaration of 1977 and subsequent Government and Party (then TANU and later on CCM) policy pronouncements, most of the Tanzania's political energies and economic resources were concentrated in the pursuit of socialism and self-reliance, or as is commonly known in Kiswahili, "*Ujamaa na Kujitegemea*". The principle of self-reliance was meant to lead the country to self-sufficiency in food, not only by meeting domestic needs, but also lessening the country's dependency on primary commodity imports (World Bank, 1985). Since independence—and more so after the food crisis of the 1980s—the Government started becoming more concerned with food security.

The action taken to improve food production in Tanzania has mainly emphasized increased national food production. The Government and the Party have encouraged farmers to use artificial fertilizers, oxen ploughs, irrigation where possible, new crop varieties, etc., most of which the poor farmers, who form the majority, have no access to. Although the response at national level had been quite encouraging during the late 1980s (*Tanzania Economic Trends (TET)*, 1988), it still remains true that the poor farmers who cannot afford to buy the artificial fertilizers, those that do not own land, or even those who do not own ploughs and the needed oxen to pull the ploughs, are still out there with their poor children suffering from food insecurity. When they are hungry, they have no money with which to buy food even when available in the market at favourable prices. Consequently, their children and wives continue to suffer from malnutrition despite record national food crop surpluses.

Malnutrition and diseases usually co-exist. For example, a sick child suffering from malnutrition experiences more prolonged and severe diseases, and the risk of

death or impeded development are higher. The risk of death from common childhood diseases increases rapidly with increasing severity of malnutrition. The fatality rate of children suffering from severe malnutrition is very high in Tanzania (URT/UNICEF, 1990).

Protein-energy malnutrition (PEM) is a situation where there is inadequate intake and/or utilization of nutrients to fulfil requirements in a given physiological and social content. If the energy intake is too small and the body reserves are insufficient, people—and more so children—suffer from malnutrition (URT/UNICEF, 1990). For this reason, PEM is known to be a proximate determinant of child mortality, and when in its severe form, PEM is diagnosed by clinical signs as well as by extremely low values in anthropometric indicators of linear growth (weight-for-age) and/or soft tissue (weight-for-height) (Haaga *et al*, 1990). Moderately low values of anthropometric indicators are considered to be evidence of 'mild to moderate' PEM.

Both the 1991/92 and 1996 TDHS results show that there is a considerable chronic malnutrition among Tanzanian children under five years of age. For example, the 1991/92 results show that 47 percent of children under five were found to be stunted (shorter than their age), and 20 percent were severely stunted. The 1996 TDHS results show that 43 percent of the under fives were found to be stunted, and 18 percent were severely stunted. These data indicate that chronic malnutrition is still a major public health problem in Tanzania. Although improvements in national food availability since 1984 has helped to reduce the incidence of malnutrition among children in some regions, the level is still too high even in regions of surplus food production like Ruvuma.

Other causes of high child mortality rates are related to flows of resources that determine household food security, the availability of labour for child care, and other household and community characteristics (URT/UNICEF, 1990). The bulk of people who suffer from seasonal and semi-permanent food insecurity problems are said to be in the rural areas. Their poverty or food insecurity problems are mainly of poor or inappropriate allocation of resources of production such as land, labour, and capital, resulting into low agricultural production. One of the factors that leads to the increase in child deaths is poverty. Because of large family sizes, fathers are unable to meet the basic requirements for their children (Omari, 1997), a situation which results in many cases to severe malnutrition among children under five. However, it is not apparent whether malnutrition is caused by large household sizes or by the fact that the fathers of these households are poor.

Another factor that is said to contribute towards malnutrition of children under five is the quality of food and feeding frequency. The most common staple in Tanzania is maize, which is usually prepared as stiff porridge (*ugali*) for adults, and as thin gruel (*uji*) for children. Rice, cassava, bananas, sorghum, millet, sweet potatoes and Irish potatoes are also commonly consumed. Beans, which are rich in carbohydrates and proteins, are basic elements in the diets of many Tanzanians. Fruits, vegetables, and animal products provide a variety of vital nutrients. Over 70 percent of energy intake and between 40% and 70% of protein intake comes from cereals and other starchy staples.

Dietary surveys reveal the existence of a number of common food habits to both the selection and preparation of food. Protein requirements are more fulfilled than

energy requirements. There is a significant variation in the consumption of animal protein and cooking fat (URT/UNICEF, 1990). It is established that, on the average, a Tanzanian consumes 2,417 calories and 61.7 grams of protein daily. The majority of the population lives in rural areas and depends on agriculture, using mainly human power. The calories requirement for agricultural work is higher than the minimum requirement (Bender & Smith, 1997). Since the distribution of food consumption is not equal, there is a significant proportion of the population that does not consume a calorie-adequate diet. Children under five, pregnant women, and lactating mothers are the most vulnerable groups in the population (Amani, *et al, 1988*).

3. Family Structures

In Tanzania, there are two predominant family structures that are basically a result of the types of marriage systems that exist. These family structures are monogamy and polygamy (Omari, 1997). The 1991/92 Tanzania Demographic and Health Survey (TDHS) results show that 24.5 percent of the interviewed women had never been married, 47.4 percent were monogamously married, 18.0 percent were polygamously married, and only 10.2 percent were either widowed, divorced or separated. As many as 27.5 percent of women from the mainland are married polygamously, as compared with only 25.2 percent of the women from the isles whose marriages are polygamous according to the 1991/92 TDHS results. On the other hand, the 1996 TDHS results show that 21.3 percent of the men from the isles have more than one wife, as compared to 14.8 percent of their counterparts in the mainland (1996 TDHS).

Furthermore, the 1996 TDHS results show that 23.2 percent of the interviewed women had never married, 59.9 percent were currently married, 6.7 percent were living together, and 10.1 percent were either widowed, divorced, or separated. Both the 1991/92 and 1996 TDHS results show that rural women are more likely to be in polygamous marriages than those in the urban. Although it is known—and simple economics show—that a polygamous man is unable to meet all the demands from the various social units he heads (Omari, 1997) due to the large size of his family, it is not really clear whether indeed levels of malnutrition among the children vary with the type of marriage.

Apart from polygamous and monogamous households, there are households that are headed by female single parents. Single female parent households are becoming popular in Tanzania. For example, the 1996 TDHS show that 21.8 percent of households in Tanzania are headed by single females parents, most of which are from urban areas. In particular, the 1991/92 TDHS results show that 17.1 percent of the households were headed by females in Dar es Salaam, 18.5 percent in other urban areas, and 19.9 percent in the rural areas. The 1996 TDHS results show that females headed 23.3 percent and 21.3 percent of the households in urban and rural areas respectively.

This paper examines the children's nutritional status in relation to the family/household structure. This is very important because single family units are among the population groups to which social policies to alleviate poverty should purposely be developed (Omari, 1997). Some policies may have to be updated or modified to take care of women and children who are in polygamous unions.

4. Data and Methodology Used

Regression methods have become an integral component of any data analysis concerned with describing the relationship between a response variable, and one or more explanatory variables. When the outcome variable is dichotomous, taking values 1 or 0, the logistic regression model has become the standard method of analysis (Hosmer & Lemeshow, 1989).

The logistic regression model was used to find the associations between marriage structures and children's nutritional status. Household food security, regional zones, and place of residence are also examined in terms of the nutritional status of children using the same models.

In this analysis, children under three years of age are classified according to whether they suffer from malnutrition (stunted or wasted) or not. That is, the dependent variable $Y = 1$ if the child is stunted, and $Y = 0$ otherwise. A similar definition is used for wasted children. The dichotomous measures of anthropometric indices will then be examined through the multiple logistic regression model. The advantage of using this model is that it removes the problem of heteroscedasticity, which plagues the ordinary least squares model when the dependent variable is dichotomous (Mbago, 1997).

The independent variables will therefore be age and sex of the child, *de facto* place of residence, total size of the household members, marital status of the mother (single, married, monogamous or polygamous marriage), mother's education, mother's age, region of residence, food availability, sex of head of the household, and rank of mother in the marital structure. Other variables are birth order number, preceding birth interval, succeeding birth interval, sex of the head of the household, and food availability.

The 1996 TDHS data are used to determine the relationship, if any at all, between the family structures and the nutritional status of children aged between 1 and 35 months, inclusively. The family structures will be grouped according to marital status of the mothers and, therefore, whether the mother is windowed, divorced, separated, a single parent or married monogamous or polygamous. The relationship between the nutritional status of children under three years and household food availability, regional zones, and place of residence will also be examined.

As has already been stated, the dependent or response variables are the three anthropometric indices. We shall denote the independent variables by the vector $\mathbf{X}^T = (x_1, x_2, ..., x_k)$ in which k is the number of the independent variables under consideration. The dependent variable will be denoted by Y, which measures the presence or absence of malnutrition. Then the conditional probability of Y given X will be denoted by $P(Y=1/X) =$. Then the logit of the multiple logistic regression model will be given by the equation

$$\pi(X) = \frac{e^{g(X)}}{1 + e^{g(X)}} \quad \text{in which}$$

$$g(X) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_k x_k \, 1.$$

For some discrete or nominal independent variables, a collection of design or dummy variables will be used.

5. Basic Indicators of Nutritional Status

Evaluation of nutritional status is based on the rationale that in a well-nourished population, the distribution of height and weight of children of a given age will be approximately normal. In other words, about 68 percent of the children will have a weight or height within 1 standard deviation (SD) of the median for that age. About 14 percent of the children will have a weight or height within 1 or 2 standard deviations from the median of that age. Out of the remainder, 2 per cent will have a weight or height less than 2 standard deviations from the median of that age. In this report, the nutritional status of children is analysed and evaluated in comparison with the commonly used U.S. National Centre for Health Statistics (NCHS) standard.

There are three important indicators commonly used to determine the nutritional status in infants and children, that is 'height-for age', 'weight-for height' and 'weight-for-age', which are also known as stunting, wasting and underweight respectively. These are explained as follows:

- *Stunting,* also defined as height-for-age, is a measure of linear growth. Children who are more than 2 standard deviations (-2 SD) below the median of the NCHS reference population are considered short for their age, or simply, 'stunted', a condition which reflects the cumulative effect of past or chronic malnutrition; and is a result of inadequate food intake over a long period of time and/or repeated episodes of illness, particularly diarrhoea. If the child is below minus three standard deviations (-3 SD) from the median of the reference population, s/he is said to be severely stunted.
- *Wasting,* defined as weight-for-height, describes the current nutritional status. Children who are below -2 SD from the median of the reference population are considered 'wasted', or too thin for their height, a condition that reflects acute or recent nutritional deficit. As with stunting, children whose weight-for-height is below -3 SD from the median of the reference population are considered to be severely wasted. Wasting represents the failure to receive adequate nutrition in the period immediately preceding the survey, and may be the result of recent episodes of illness, especially diarrhoea.
- *Underweight,* defined as weight-for-age, is a compose index of weight-for-height and height-for-age and, therefore, does not distinguish between acute malnutrition (wasting) and chronic malnutrition (stunting). For this reason, it is used as a general indicator of a population's health status.

In this analysis, we shall use only the first two measures of the nutritional status of children.

6. Bivariate Analysis

6.1 Introduction

This report is a result of a secondary analysis of the 1996 TDHS data. In the TDHS, all children whose mothers were interviewed and who were born since January of 1991

were weighed using a digital scale with an accuracy of 100 grams. Their standing height (for children aged 24 months and older) or recumbent length (for children under 24 months) were also measured using the Shorr height board. Out of the 6188 children aged under five, 92 percent (or 5,693 children) were weighed and/or measured. However, only 5226 (or 92 percent) children under five years of age were weighed as well as measured. This analysis is based on 3498 children under three years of age.

The dependent variables used are: *stunted, severely stunted, wasted,* and *severely wasted.* In the analysis, height-for-age, and weight-for-height, are used in calculating the percentage of children who are stunted and wasted for each level of the independent variables.

6.2 Prevalence of Malnutrition

The prevalence of malnutrition in Tanzania is high. In particular, 40 percent of the children under three years of age are stunted (height-for-age), and about 9 percent are wasted (weight-for-height) as Table 6.1 shows. Furthermore, out of the stunted children, 16 percent are severely stunted (that is, below -3 SD from the reference median). Out of the wasted children, about two percent are severely wasted.

Table 6.1: Stunting and Wasting by Zone and Type of Residence: Percentage of Malnourished Children Under Three Years by Regional Zones and Type of Residence

Zone and residence	Stunted		Wasted		Number of children
	Severe	*Moderate*	*Severe*	*Moderate*[1]	
Coastal	16.2	42.4	1.6	8.4	690
Northern	15.9	35.4	1.6	7.7	443
Highlands	12.1	35.0	2.4	9.6	1299
Lake	19.8	39.9	1.7	9.5	277
Central	19.2	47.9	2.2	8.1	475
Southern Highlands	23.5	52.6	0.2	6.5	315
Southern	P<.00005	P<.00005	NS	NS	
	X^2=34.92	X^2=52.45			n=3498
Residence					
Urban	11.9	31.9	2.0	9.1	628
Rural	16.8	42.1	1.8	8.5	2870
	P<.0005	P<.00005	NS	NS	
	x^2=9.31	X^2=22.21			n=3498
Total	**16.0**	**40.2**	**1.8**	**8.6**	

[1]Includes children who are below -3 SD from the median of the reference population.
NS means 'Not significant.'

6.3 Geographic Variations

As Table 6.1 shows, there are significant geographic variations in the proportion of stunted children in Tanzania. Southern regions (Ruvuma, Lindi, and Mtwara) have a prevalence of stunted children of about 53 percent, out of which about 24 percent are severely stunted. This indicates that about one in every four children under three is severely stunted in the Southern zone. In the Southern Highlands (Mbeya, Iringa, and Rukwa), out of the 48 percent of the malnourished children who are stunted, 19 percent are severely stunted. The Coastal, Northern Highlands, Lake and Central zones have malnutrition prevalence of (with percentages of severely stunted children in brackets) 42(16), 35(16), 35(12), and 40(20) percent, respectively. Differences in wasting range from 7 percent in the Southern zone, to almost 10 percent in the Lake and Central zones. However, severe wasting ranges from less than 1 percent in the Southern zone to more than 2 percent in the Southern Highlands. These results show that zones that are known to be the main producers of maize (Northern Highlands, Southern, Central and Northern Highlands) have also registered high levels of the prevalence of malnutrition.

When differentiated according to place of residence, malnutrition is seen to be more prevalent in rural areas than in urban areas. In particular, 42 percent of children under three residing in the rural areas suffer from malnutrition, out of which 17 percent are severely stunted. On the other hand, 32 percent of the urban children under three years of age are malnourished, while 12 percent of them are severely stunted. Similar, but not significant variations in wasting are seen between the rural and the urban children under the ages of three years.

Pattern of Malnutrition According to Demographic Characteristics

Table 6.2 shows the proportion of children under three suffering from stunting and wasting. The prevalence of stunting is seen to rise from 11 percent among children under six months, and more than doubles when the children reach the ages of between 6 and 11 months. The percentage of stunted children attains a peak of about 59 percent as the children reach the ages of between 18 and 23 months. Thereafter, the prevalence drops down sharply to 51 percent as the children reach the ages of between 30 and 35 months. As shown in Table 6.2, the relationship between the age of the child and stunting is seen to be significant. Similar conclusions about severe stunting can be drawn from the same table.

Furthermore, we see in Table 6.2 that stunting for children under three years of age is a greater problem than wasting in Tanzania. However, wasting cannot be ignored completely as more than 14 percent of the children between 12 and 17 months of age are wasted. We may therefore conclude from these results that the most critical period of vulnerability to malnutrition for children in Tanzania is during the first 23 months of their lives. Both severe and moderate stunting do not seem to be related with birth order number of a child. Although moderate wasting does not seem to be associated with birth order number, severe wasting is, as shown in Table 6.2.

Table 6.2: Nutritional Status of Children by Demographic Characteristics: Percentage of Malnourished Children Under Three Years by Demographic Characteristics

Background Characteristics	Stunted		Wasted		Number of children
	Severe	*Moderate*[1]	*Severe*	*Moderate*[1]	
Child's age					
< 6 months	2.8	10.7	2.4	5.5	597
6 -11	7.3	26.6	1.6	6.6	647
12 - 17	16.2	45.4	2.1	14.1	629
18 - 23	25.7	59.4	2.2	12.6	607
24 - 29	21.8	51.9	1.2	6.3	533
30 - 35	24.8	51.3	1.4	5.9	485
	p<.00005	p<.00005	NS	p<.00005	
	X^2=197.64	X^2=421.19		X^2=55.00	n=3498
Child's sex					
Male	16.1	40.9	1.9	9.6	1778
Female	15.8	39.6	1.8	7.6	1720
	NS	NS	NS	P<.1	
				X^2=4.44	n=3498
Birth order					
First birth	15.1	40.5	2.9	9.1	760
Second	14.4	38.3	1.5	8.1	1133
3rd or more	17.4	41.5	1.6	8.8	1605
	NS	NS	p<.1	NS	
			X^2=5.70		n=3498
Preceding birth interval					
< 2 years	20.4	42.2	1.9	8.0	911
2+ years	15.7	40.4	1.5	8.8	2136
	p<.1	NS	NS	NS	
	X^2=5.35				n=3047
Succeeding birth interval					
< 2 years	26.7	44.6	1.3	6.3	628
2+ years	23.9	49.6	1.7	3.9	2870
	NS	NS	NS	NS	n=3498
Child is twin					
Singleton	15.3	39.4	1.9	9.6	1778
Twin	44.1	74.1	0.0	7.6	1720
	p<.00005	p<.00005	NS	p<.1	
	X^2=38.12	X^2=41.60		X^2=4.44	n=3498
Total	**16.0**	**40.2**	**1.8**	**8.6**	**3498**

[1] Includes children who are below -3 SD from the median of the reference population.
NS means 'Not significant'.

Sex of a child does not seem to be important in determining malnutrition except, perhaps, when it comes to moderate wasting, in which 10 percent of male children are moderately wasted compared with only 8 percent of the female children. Both

preceding and succeeding birth intervals are seen to be independent of the nutritional status of children.

However, Table 6.2 shows that 44 percent of the twin children are severely stunted, compared with only 15 percent of the those children who are born single. Severe wasting does not seem to be a very significant factor, although some attention should be paid to moderate wasting in which 10 and 8 percent of the singleton and twin children respectively are wasted.

Table 6.3 shows that mother's age is not influential in determining the nutritional status of children except when it comes to moderate stunting. Furthermore, the table shows that the percentage of stunting children under three years of age increases with the age of the mother.

Table 6.3 Nutritional Status of Children by Demographic Characteristics
Percentage of Malnourished Children Under Three Years by Household Characteristics

Household Characteristics	Stunted		Wasted		Number of children
	Severe	*Moderate*[1]	*Severe*	*Moderate*[1]	
Mother's age					
10 - 19 years	14.1	38.2	1.6	7.8	295
20 - 24	14.5	39.4	2.6	8.0	988
25 - 29	15.5	39.3	1.7	7.8	925
30 - 34	16.5	38.5	0.9	8.5	635
35 - 39	19.5	41.4	1.3	10.2	404
40 - 44	20.2	51.4	3.0	12.8	180
45 - 49	15.0	51.1	2.4	13.0	80
	NS	$p<.05$ $X^2=15.48$	NS	NS	
Food availability					
Enough	15.0	37.8	1.9	8.4	1592
Not enough	16.7	42.4	1.7	8.8	1863
	NS	$p<.05$ $X^2=7.54$	NS	NS	
Sex of hh head					
Male	15.9	40.2	1.8	8.5	2964
Female	16.2	40.4	2.0	9.5	534
	NS	NS	NS	NS	
Mother's education					
None	18.7	45.4	1.7	10.6	980
Primary	15.3	39.1	1.9	8.0	2391
Secondary+	7.6	22.1	1.4	5.8	117
	$p<.05$ $X^2=12.38$	$p<.00005$ $X^2=27.98$	NS	$p<.05$ $X^2=7.21$	
Total	16.0	40.2	1.8	8.6	3498

[1] Includes children who are below -3 SD from the median of the reference population.
NS means 'Not significant'.

Household food security is seen to play an important role in influencing the nutritional status of children under three. As would be expected, children from households in which food is always available suffer less from stunting or wasting than those from households in which food availability is uncertain. In particular, 38 percent of the children from households in which food is always enough suffer from stunting, compared with 42 percent of those children from households in which food availability is not certain. However, household food security has an insignificant influence on severe stunting, wasting, and severe wasting as Table 6.3 shows.

Table 6.3 further shows that sex of the head of the household is not related with the nutritional status of children under three years.

Maternal education, in particular, is a powerful predictor of a child's malnutrition status. As is indicated in Table 6.3, the proportions of malnourished and severely malnourished children under three decline with increasing level of maternal education. In particular, the prevalence of malnutrition decreases from 45 percent for children born to mothers with no education, to 22 percent for children born to mother with at least secondary education. The percentage of severely stunted children declines from 19 percent of the children born to mothers with no education to 8 percent for the children born to mothers with at least secondary education. Similar conclusions concerning wasting can be drawn. However, severe wasting does not seem to be associated with the mother's education.

6.4 Nutritional Status of Children According to Mother's Marital Status

When classified according to the mother's marital status as is done in Table 6.4, children in households in which mothers are currently married suffer less from malnutrition than those from households in which mothers are divorced, widowed, or have never been married. For example, 40 percent of the children whose mothers are currently married were found to be moderately stunted, compared with 44 and 45 percent of the children born to mothers who have never been married and mothers who are widowed respectively. The results from Table 6.4 further show that 8 percent of the children from households in which mothers are currently married suffer from moderate wasting, compared with 10 percent of those whose mothers have never been married, and 11 percent whose mothers are widowed. All the same, marital status does not seem to be very important in determining the nutritional status of children under three years.

The presence or absence of the father in a household is seen in Table 6.4 to come out as a less important factor in determining the nutritional status of children. Although the variations are not significant, the results show that 39 percent of the children from households in which fathers live with their mothers are stunted compared with 42 percent of those whose fathers do not stay with their mothers.

Type of marriage does not seem to significantly influence the nutritional status of children aged below three years of age except when severe stunting is concerned. Table 6.4 does not indicate any relationship between wasting, severe wasting, and stunting and type of marriage. Perhaps that is why the mothers' rank in the marriage structure does not show any influence on the nutritional status of children under three years of age as Table 6.4 shows.

Table 6.4: Nutritional Status of Children by Household Characteristics
Percentage of Malnourished Children Under Three Years by Demographic Characteristics

Background Characteristics	Stunted		Wasted		Number of children
	Severe	*Moderate*[1]	*Severe*	*Moderate*[1]	
Mother's marital status					
Never married	21.0	44.0	3.0	9.6	230
Married[2]	15.5	39.5	1.6	8.4	3005
Widowed[3]	16.6	45.2	3.2	11.1	262
	NS	NS	NS	NS	
Husband lives in house					
Yes	15.6	39.3	1.6	8.4	2730
No	14.2	41.7	1.6	7.7	263
	NS	NS	NS	NS	
Type of marriage					
Monogamous	14.2	38.6	1.5	8.6	2208
Polygynous	19.0	41.8	1.9	7.5	734
	P<.005 X^2=9.47	NS	NS	NS	
Mother's rank					
First	16.8	44.6	1.4	7.7	275
2nd +	20.3	50.2	2.2	7.4	458
	NS	NS	NS	NS	
Total	**16.0**	**40.2**	**1.8**	**8.6**	**3498**

[1] Includes children who are below -3 SD from the median of the reference population.
[2] Includes both married and those living together.
[3] Includes those who are widowed, divorced and not living together.

7. Multivariate Analysis

The factors identified as being important in the bivariate analysis are summarized in Table 7.1. Factors that are significantly associated with the nutritional status of children under three years of age are indicated by YES, while those which are not significant are indicated by NO.

Based on Table 7.1, the following variables were used to develop the four models to explain childhood malnutrition in Tanzania. Only those variables that were significant in the bivariate associations are included in the respective models as shown in Table 7.1.

SZONE: 1=Coastal 2=N. Highlands, 3=Lake, 4=Central, 5=S. Highlands, 6=Southern

HW1: 1=0-5 months, 2=6-1, 3=12-17, 4=18-23, 5=24-29, 6=30-35.

V102: 1=Urban, 2=rural

BORD: 1=First, 2=2nd and or more

B4: 1=Male, 2=female

B0: 1=Singleton (not twin), 2=twin

B11: 1=< 2 years, 2=2+ years

B12: 1=< 2 years, 2=2+ years

V013: 1=15-19, 2=20-24, 3=25-29, 4=30-34, 5=35-39, 6=40-44, 7=45-59

V106: 1=None, 1=Primary, 2=secondary +

V505: 1=Monogamy, 2=Polygamy

S127: 1=Enough, 2=not enough.

V504: 1=Yes, 2=No.

Table 7.1: Factors Significantly Associated with Nutritional Status of Children Under Three

Variable	Description	Model 1: Severe stunting	Model 2: Stunting	Model 3: Severe wasting	Model 4: Wasting	Comments
SZONE	Regional zone	YES	YES	NO	NO	
V102	Place of residence	YES	YES	NO	NO	
HW1	Age of child	YES	YES	NO	YES	
B4	Sex of child	NO	NO	NO	YES	
BORD	Birth order number	NO	NO	YES	NO	
B11	Preceding birth interval	YES	NO	NO	NO	
B12	Succeeding birth interval	NO	NO	NO	NO	Dropped out
B0	Child is twin	YES	YES	NO	YES	
V013	Mother's age	NO	YES	NO	NO	
S127	Food availability	NO	YES	NO	NO	
V151	Sex of head of household	NO	NO	NO	NO	Dropped out
V106	Mother's education	YES	YES	NO	YES	
V501	Mother's marital status	NO	NO	NO	NO	Dropped out
V504	Husband stays home	NO	NO	NO	NO	
V505	Type of marriage	YES	NO	NO	NO	
V506	Mother's rank in polygynous mariage	NO	NO	NO	NO	Dropped out

Model 1: Regression Equation for Severely Stunted Children

Having found correlates of the nutritional status of children under three years of age, a multiple logistic regression was used to determine the relative importance of these factors; and to eliminate those that do not contribute significantly to explaining variance in the nutritional status of children. The dependent variable in this model was 'severe stunting'; and the independent variables were age of child, regional zones, child is twin, place of residence, mother's education, and food availability. The results are shown in Table 7.2.

The important determinants of severe stunting are shown in Table 7.2 to be *age of child, child is twin, regional zones,* and *type of residence.* The risk of a child becoming severely stunted increases with his/her age from the age of 0 to 29 months. The risk drops down slightly when the child reaches the age of 24-29.

Table 7.2: Estimates of Logistic Regression Equation for Severely Stunted Children Under Three Years of Age

Variable and category	Coefficient	Standard error	Statistical significance	Odds ratio
Age of child				
0-5 months	-3.0388	0.4221	0.0000	0.0479
6-11	-1.3766	0.2292	0.0000	0.2524
12-17	-0.4329	0.1891	0.0000	0.6486
18-23	-0.0240	0.1803	0.0221	0.9763
24-29	-0.2315	0.1902	0.8940	0.7933
30-35	0.0000		0.2235	
Mother's education				
None	1.0223	0.6193	0.1258	2.7795
Primary	0.8339	0.6126	0.0988	2.3022
Secondary +	0.0000		0.1735	
Child is twin				
Singleton	-1.2933	0.2770	0.0000	0.2744
Twin	0.0000			1.0000
Regional zone				
Coastal	-0.6835	0.2431	0.0000	0.5049
N. Highlands	-0.5073	0.2484	0.0049	0.6021
Lake	-1.2826	0.2244	0.0411	0.2773
Central	-0.4642	0.2782	0.0000	0.6286
S. Highlands	-0.7382	0.2508	0.0952	0.4780
Southern	0.0000		0.0032	1.0000
Type of residence				
Urban	-0.5282	0.2137	0.0135	0.6162
Rural	0.0000			1.0000
Enough to eat				
Enough	0.1294	0.1266	0.3068	0.8786
Not enough	0.0000			1.0000
Constant	0.3260	0.7140	0.6479	
Model X^2	242.843		0.0000	
df	17			
No of cases	3430			

Maternal education does not seem to be a significantly important determinant of severe stunting for children under three years of age. However, it makes a difference whether a child is born as a twin or not. In this analysis, a child born as a twin is more likely to be severely stunted than a child who is born as a singleton as Table 7.2 shows.

Severe stunting shows variations across regional zones. For example, if we take the Southern Zone as a reference, we notice that children from the Lake Zone, Southern Highlands, Coastal, Northern highlands and Central zones are 0.2773, 0.4780, 0.5049, 0.6021 and 0.6286 respectively less likely to be suffering from severe stunting than those from the Southern zone. In other words, children from the Southern zone are 3.6 0(1/0.773), 2.1(1/0.4780), 1.98(1/0.5049), 1.66(1/0.6021) and 1.59(1/0.6286) times more likely to suffer from severe stunting compared to those from the Lake, Southern Highlands, Coastal, Northern Highlands and Central zones respectively.

Model 2: Regression Equation for Stunted Children Under Three Years of Age

The dependent variable in this model was *stunting* and the independent variables were *age of child, regional zones, child is twin, place of residence, mother's education,* and *food availability.* The results are shown in Table 7.3.

Table 7.3: Estimates of Logistic Regression Equation for Stunted Children Under Three Years of Age

Variable and category	Coefficient	Standard error	Statistical significance	Odds ratio
Age of child				
0-5 months	-2.2326	0.1670	0.0000	0.1073
6-11	-1.0876	0.1315	0.0000	0.3370
12-17	-0.1698	0.1254	0.0000	0.8438
18-23	-0.3812	0.1270	0.1757	1.4640
24-29	-0.0410	0.1390	0.0027	1.0418
30-35	0.0000		0.7526	1.0000
Mother's education				
None	0.9545	0.2536	0.0002	2.5973
Primary	0.7146	0.2449	0.0002	2.0434
Secondary +	0.0000		0.0035	1.0000
Child is twin				
Singleton	-1.4925	0.2771	0.0000	0.2248
Twin	0.0000			1.0000
Regional zone				
Coastal	-0.5033	0.1529	0.0000	0.6045
N. Highlands	-0.8059	0.1654	0.0010	0.4467
Lake	-0.9829	0.1412	0.0000	0.3742
Central	0.7013	0.1838	0.0000	0.4959
S. Highlands	0.2747	0.1619	0.0001	0.7598
Southern	0.0000		0.0897	1.0000
Type of residence				
Urban	-0.4842	0.1087	0.0000	0.8517
Rural	0.0000			1.0000
Enough to eat				
Enough	-1.1605	0.0782	0.0400	0.8517
Not enough	0.0000			1.0000
Constant	1.5401			
Model X^2	613.237		0.0000	
df	15			
No of cases	3424			

As was the case with severe stunting, the risk of stunting is clearly seen in Table 7.3 to increase with the age of the child. Children under 6 months of age have the lowest risk of stunting. Children aged between 6 and 11 months are 0.3370 times less likely to be stunted compared to those aged 30-35 months (reference category). This is to say that children aged 30-35 months are 2.97(1/0.3370) times more likely to be stunted than those aged between 6 and 11 months. Similarly, children aged less than 6 months and between 12 and 17 months are respectively 0.1073 and 0.8438 times less likely to be stunted compared to those aged 30-35 months. However, children aged 18-23 and 24-29 months are respectively 1.464 and 1.0418

times more likely to be stunted than those aged 30-35 months as is clearly be seen in Table 7.3.

Mother's education here plays an important role in determining the risk of stunting. As would be expected, children born to mothers with no education at all are 2.6 times more likely to be stunted than those whose mothers have at least secondary education. On the other hand, children born to mothers with primary education are twice as much more likely to suffer from stunting as those whose mothers have at least secondary education.

Other variables that are important in determining the risk of stunting for children under three years of age are *child is twin, regional zones, type of residence,* and *food availability.* Here, children from households in which food is always available are less likely to be stunted, compared to those from households in which food availability in uncertain.

Model 3: Regression Equation for Severely Wasted Children Under Three Years

The dependent variable in this model was *severe wasting* and the independent variables were *age of child, mother's education, regional zones, birth order number* and *food availability.* The results are shown in Table 7.4.

Table 7.4: Estimates of Logistic Regression Equation for Severely Wasted Children Under Three Years Of Age

Variable and category	Coefficient	Standard error	Statistical significance	Odds ratio
Age of child				
0-5 months	0.5504	0.4689	0.6877	1.7339
6-11	0.1496	0.4947	0.2405	1.1613
12-17	0.3797	0.4745	0.7624	1.4618
18-23	0.3020	0.4837	0.4236	1.3526
24-29	0.1712	0.5596	0.5324	0.8426
30-35	0.0000		0.7596	1.0000
Mother's education				
None	0.1324	0.8451	0.8972	1.1416
Primary	0.2428	0.7983	0.8725	1.2748
Secondary +	0.0000		0.7610	1.0000
Regional zone				
Coastal	1.9654	1.2754	0.3740	7.1377
N. Highlands	2.0548	1.2916	0.1233	7.8055
Lake	2.4204	1.2479	0.1116	11.2507
Central	2.1078	1.3190	0.0524	8.2302
S. Highlands	2.3289	1.2744	0.1100	10.2666
Southern	0.0000		0.0676	1.0000
Enough to eat				
Enough	0.0545	0.2597	0.8337	1.0560
Not enough	0.0000			1.0000
Constant	-6.6181			
Model X^2	13.711		0.0000	
df	13			
No of cases	3371			

Table 7.4 shows that none of the independent variables considered in this case is important in determining the risk of severe wasting for children under 3 years of age.

Model 4: Regression Equation for Wasted Children Under Three Years of Age

The dependent variable in this model was 'wasting' and the independent variables were *Age of child, mother's education, regional zones, type of residence* and *food availability.* The results are shown in Table 7.5.

Table 7.5: Estimates of Logistic Regression Equation for Wasted Children Under Three Years of Age

Variable and category	Coefficient	Standard error	Statistical significance	Odds ratio
Age of child				
0-5 months	-0.0383	0.2693	0.0000	0.9624
5-11	0.1810	0.2531	0.8869	1.1985
12-17	1.0239	0.2288	0.4744	2.7840
18-23	0.8400	0.2331	0.0000	2.3163
24-29	0.1217	0.2669	0.0003	1.1294
30-35	0.0000		0.6483	1.0000
Mother's education				
None	0.8600	0.4244	0.0092	2.3633
Primary	0.4981	0.4128	0.0427	1.6457
Secondary +	0.0000		0.2275	1.0000
Regional zone				
Coastal	0.1860	0.2733	0.7066	1.2044
N. Highlands	0.1123	0.2962	0.4962	1.1189
Lake	0.3198	0.2510	0.7045	1.3768
Central	0.3935	0.3115	0.2027	1.4821
S. Highlands	0.1880	0.2879	0.2066	1.2068
Southern	0.0000		0.5138	1.0000
Type of residence				
Urban	0.2287	0.1673	0.1715	1.2570
Rural	0.0000			1.0000
Enough to eat				
Enough	-0.0388	0.1262	0.7586	0.9620
Not enough	0.0000			1.0000
Constant	-4.2178			
Model X^2	71.099		0.0000	
df	16			
No of cases	3424			

Results from Table 7.5 show that the only important variables in determining whether a child under three years of age is wasted or not are *child's age* and *mother's education.*

9. Summary and recommendations

The nutritional status of children is largely associated with age of the child, food availability, maternal education, place of residence, whether the child is born single or twin, and regional zone. Because the risks of both stunting and wasting remain

high throughout the first 23 months before starting to decline, public health interventions should be introduced where they are not existent; and improved upon where they are already established. Thus, in order to improve child nutritional status, the following are the main recommendations:

- As a long-term measure, the government should double its efforts to educate girls, the future mothers, to at least secondary education. With a good education, a mother is more likely to plan her pregnancies and to take a better care of her children.
- Nutritional programs should be established to prevent and treat both moderate and severe malnutrition in Tanzania.
- Reproductive health programs should be strengthened to assist mothers in planning their pregnancies so as to increase the duration of breast-feeding, and therefore increase birth interval to at least two years.

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