AFRICA NUTRITION

The Nutritional Status of Mothers and Children in Sub-Saharan Africa

Part 1: Cross-Country Comparison of Maternal and Child Nutritional Status in Sub-Saharan Africa

Part 2: Factors Influencing the Nutritional Status of Mothers and Children in Sub-Saharan Africa

DRAFT

Combined reports based on the
Demographic and Health Surveys

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U.S. Agency for International Development
AFR/SD/HRD and G/PHN/HN

Macro International, Inc.

Food Security and Nutrition Monitoring Project

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II: Factors Influencing the Nutritional Status of Mothers and Children in Sub-Saharan Africa

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October 1996

Prepared with support from the U.S. Agency for International Development, Bureau for Global Programs, Field Support and Research, Office of Health and Nutrition under The Food Security and Nutrition Monitoring Project (IMPACT), Contract No. DAN-5110-Q-00-0014-00, Delivery Order No. 1. Copies of this report may be obtained by contacting the Demographic and Health Surveys, Macro International, at the above address, or by telephone at (301) 572-0200, or by fax at (301) 572-0999.

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ACKNOWLEDGMENTS

The author would like to thank Kathleen McDavid of Tulane University, with whom he has corresponded since beginning this study, for her discussions and suggestions and for discovering a number of programming errors. He would also like to thank Pat Haggerty, Siân Curtis, and Ann Blanc of Macro International for their theoretical and methodological suggestions.

EXECUTIVE SUMMARY

Child and maternal malnutrition are among the most serious problems facing the countries of sub-Saharan Africa, estimated in this study to be about 36 million children stunted, 29 million underweight and 9 million wasted (excluding South Africa) and approximately 16 million women 15 to 49 years of age who are malnourished. Utilizing individual country and pooled data collected during the Demographic and Health Surveys for 22,596 mothers and 33,390 mother-child pairs, exploratory investigations of the explanatory factors for maternal and child nutrition and the links between them are made based on an expanded conceptual framework that explicitly incorporates maternal nutritional status. In particular, this study searches for answers to the following questions: 1) Do mothers and children suffer from malnutrition in substantial numbers? 2) What are the key factors associated with maternal and child nutritional status and malnutrition? 3) Are there key factors that are common between children and their mothers? 4) Is maternal nutritional status related to child nutritional status? 5) Are there any special factors that influence well-nourished mothers to have malnourished children and allow malnourished mothers to have well-nourished children? 6) To what extent can food insecurity be distinguished from feeding practices as factors in child malnutrition?

In spite of not having direct measures of important factors, such as food security, quality and availability of child care, the disease environment and interuterine growth, both bivariate and linear and logistic regression analyses confirm that maternal nutritional status is strongly linked to that of the child even after controlling for a substantial number of potentially confounding factors. Moreover, the analyses show that there are several common factors that explain both maternal and child malnutrition, such as the economic situation of the household, measured as household assets, access to health care, education of both the mother and her husband. In addition, children's nutritional status is also explained in part by feeding practices and disease prevalence. Work status affects mothers and their children in opposite directions.

Surprising, and in some way disturbing, findings relate particularly to feeding practices, since the analyses indicate that early (under four months of age) feeding of solid foods is beneficial to height and that breast-feeding beyond four months may be detrimental, even for children of families who are in the lower half of the household asset distribution. These findings clearly need to be researched much more extensively than is possible here.

Analyses of malnourished children of well-nourished mothers and well-nourished children of malnourished mothers shows that some of the factors have interaction effects. If the mother is malnourished, the use of health care services as proxied by medical assistance at delivery, greater father's education and living in an urban area improves the long-term nutritional status of children of malnourished mothers more than those of well nourished mothers. However, the use of bottle feeding and having a short birth interval increase their chances of being stunted. In addition, a larger number of children under age five in the household increases acute malnutrition among children more for malnourished mothers. On the other hand, having a fever or a lower level of living worsens the nutritional status of children of well-nourished mothers more than those of malnourished

mothers. If the mother's nutritional status can be taken as a proxy for food availability, then some of the detrimental effects can be overcome by education and access to health care services; in contrast they are exacerbated by improper feeding and fertility behavior and having more children to care for. But even having food available (as evidenced by a well nourished mother) does not overcome living in an unhealthy environment.

A contrast between "typical" families at each end of the socioeconomic spectrum, highlights the very large differences that can occur in nutritional status for both mothers and children. Mothers at the lower end are three and a half times more likely to be malnourished than their upper-end counterparts, and their children are up to fifty percent more likely to be wasted and up to fourteen times more likely to be stunted.

The results of these analyses clearly show that improving maternal nutrition status has benefits far beyond the mother herself. However, identifying nutritionally high-risk groups by mother's status alone is not sufficient since many children, even of well-nourished mothers, are nutritionally at risk.

Part I

Cross-Country Comparison of Maternal and Child Nutritional Status

I.1 Introduction

Malnutrition is one of the most important health and welfare problems among infants, young children and women in sub-Saharan Africa, resulting in serious health and economic consequences for both the individual, the family, and the nation. Malnutrition results in increased risk of illness and death.[1] In addition malnutrition can result in a lower level of cognitive development, which results in lower educational attainment (Brozek and Schurch, 1984). In adulthood, the accumulated effect of malnutrition can be a reduction in the ability to care for one's children and family, decreased work productivity and increased absenteeism in the workplace, both of which reduce individual and national lifetime earning potential (World Bank, 1993). Malnutrition also has biological intergenerational effects: infants born to women who themselves are malnourished or who were malnourished during early childhood are smaller than infants born to better nourished women (Villar and Rivera, 1988). Infants who are born of low birth weight are at greater risk of morbidity and mortality compared to normal birth weight infants (IOM, 1985).

The Demographic and Health Survey (DHS) program, sponsored by the United States Agency for International Development and carried out by the DHR division of Macro International, Inc., has from its start in 1984 included measurements of weight and height of young children on nationally representative bases in order to ascertain the extent of protein-energy malnutrition. Later on anthropometry of the mothers of these children was also obtained, and the incorporation of electronic scales helped to improve the accuracy of weight measurement. To date, anthropometry of young children has been carried out in 65 national surveys and of mothers in 35 surveys. In sub-Saharan Africa, 31 national surveys included child anthropometry and 19 included maternal anthropometry. Some of these surveys were repeats for the country, while for others the data has yet to be released. James et al. (1996) and P.S. Shetty et al. (1994) discuss the value of collecting maternal anthropometric data, especially in relation to child malnutrition.

For sub-Saharan Africa, the USAID Africa Bureau and Office of Health and Nutrition contracted the DHR division of Macro International to analyze and produce several types of reports for these data: Chart books and briefing packets summarizing the levels of malnutrition and key factors, Country Nutrition Reports presenting an in-depth look at the nutrition situation of the country utilizing the DHS and other data sources, and Analysis Reports which include comparative and special studies of nutritional situations.

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[1]Although the association between malnutrition and death has been recognized for many years, recently a method has been developed to estimate the contribution of malnutrition to the mortality of children under five years of age (Pelletier, 1993). One of the important findings in this work is that not only severe malnutrition is shown to raise mortality risks but also moderate and even mild malnutrition do so.

I.2 Data Sources

The data for this study come from the Demographic and Health Surveys phase II and phase III for Burkina Faso, the Central African Republic, Ghana, Kenya, Malawi, Niger, Namibia, Senegal, Zambia and Zimbabwe. The questionnaires used for the surveys are for the most part standard in the sections that are relevant to this study, except there are some differences in ascertaining feeding behaviors, noted below.

The DHS surveys are nationally-representative based on scientifically-drawn random samples and consist of face-to-face interviews with women of reproductive age (15 to 49 years) to gather information on a variety of reproductive and health topics: fertility, family planning, actual and desired general socio-economic characteristics, maternity care, infant feeding, child health, infant and child mortality, and anthropometry to assess nutritional status.

During the DHS surveys, children under five-years of age (except Central African Republic, Ghana, and Zimbabwe, which included children under three) who were children of interviewed women were weighed and measured for length/height. The mothers of these children were also weighed and measured. The anthropometry was done by trained personnel using specially designed electronic scales and Schorr height/length boards. Using this information, nutritional status is ascertained by relating actual height-for-age, weight-for-age, and weight-for-height to the CDC/NCHS/WHO reference standard for children to get the child's position in number of standard deviations from the mean of the reference distribution (Z-score).

Nutritional status for women is ascertained using the body mass index (BMI), calculated as weight in kilos divided by the square of height in centimeters. For malnutrition, cut-offs are used at a Z-score of two standard deviations below the mean for children and a BMI under 18.5 for women.

Table I.1 shows the number of children and women interviewed and used in the analysis in each survey. To be used in the analysis, a child needed to be both weighed and measured, have a mother both weighed and measured, and have reasonable values for both the mother and the child. Both the raw information and the calculated indexes were checked for impossible values and gross inconsistencies. Cases with these errors and children with incomplete (month and year) birth dates are excluded from this study.

In order to get a large data set to study subgroups, the individual country data sets were pooled, retaining country identification to allow for control of country-to-country variation.

Table I.1
Number of Women and Children for Maternal-Child Nutritional Analysis

Survey	Children		Women	
	Interviewed	Used in Analysis[1]	Interviewed	Used in Analysis[2]
Burkina Faso	6302	4245	6354	2889
Central African Rep.*	2836	2302	5884	1814
Ghana*	2168	1811	4562	1568
Kenya	6062	4681	7540	2915
Malawi	4512	3207	4850	2012
Niger	7094	4009	6503	2587
Namibia	3814	2421	5421	1716
Senegal	5581	3849	6310	2452
Zambia	6211	4860	7060	2931
Zimbabwe*	2328	2005	6128	1712
Pooled	46,908	33,390	60,612	22,596

* Surveys with asterisk included only children under 3 years for anthropometry. Other surveys included children under 5 years.

[1] Children who were weighed and measured and whose mothers were weighed and measured, who had complete year and month birth dates and who passed screening for inconsistent and implausible values.

[2] Mothers weighed and measured of children who were weighed and measured and had complete year and month birth dates, and who passed screening for inconsistent and implausible values.

I.3 Children's Nutritional Status

I.3.1 Height for Age

Children's chronic nutritional status, as measured by the height-for-age z-score on the NCHS/CDC/WHO reference standard is shown as a distribution in Table I.2 for the 10 individual surveys and the pooled data set. As seen in Figure I.1, distribution of height-for-age z-scores of the sub-Saharan children are displaced far to the left of the standard, indicating that most children are much shorter for their age than would be the case in a well-nourished population. From Table I.3, the mean z-score for height-for-age is -1.4 standard deviations for all children. In a well-nourished population the mean z-score would be close to zero. For the individual countries, the height-for-age z-scores range from close to -1.0 sd (Zimbabwe[2], Senegal and Ghana[1]) to about -2 sd for Malawi.

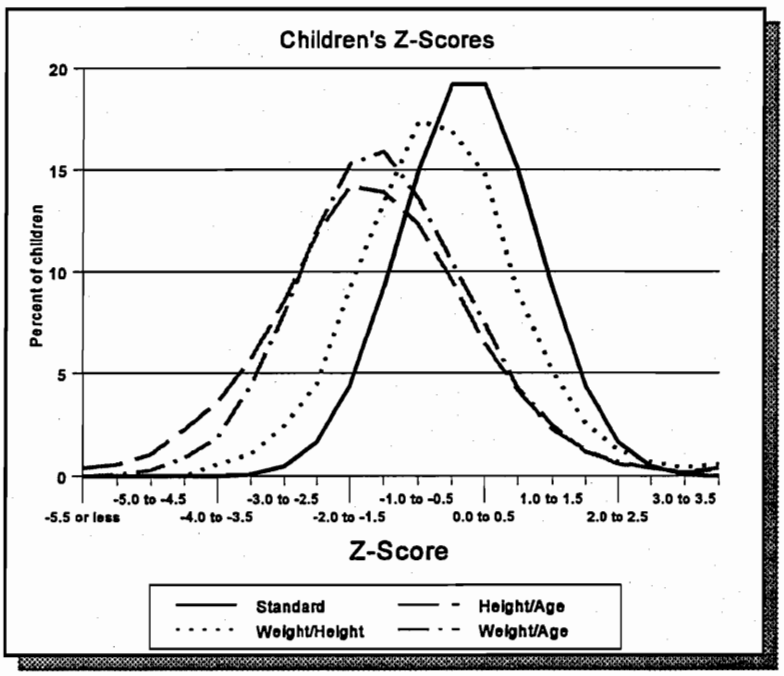

Figure I.1 Children's Nutritional Status

In the pooled data set about one-third of children are stunted (with z-scores two or more standard deviations below the mean of the reference). The expected proportion for a well-fed population is about 2 percent. For the individual countries the proportions range from 22 percent (Zimbabwe) to almost 50 percent (Malawi). Very few children (2 percent or less) can be considered overtall, i.e. over 2 standard deviations above the mean of the reference.

I.3.2 Weight for Height

Children's acute nutritional status, measured by the weight-for-height z-score on the NCHS/CDC/WHO reference standard is shown as a distribution in Table I.4. Figure I.1 shows the distribution of weight-for-height z-scores which are displace to the left relative to the standard but not as much as for height or weight for age. From Table I.3, the mean z-score for weight-for-height is seen to be about -0.4 standard deviations for all children. Since weight-for-height is a measure

[2] Since the height-for-age varies tends to increase with the child's age, Central African Republic, Ghana and Zimbabwe will tend to have lower scores since only children under 3 years were included in these surveys.

of acute malnutrition, z-scores tend to be closer to the reference standard than either height- or weight-for-age scores. For the individual countries, the weight-for-height z-scores range from almost zero (Malawi) to -0.7 (Burkina Faso).

In the pooled data set about 9 percent of children are wasted (with z-scores two or more standard deviations below the mean of the reference). Again the expected proportion below -2 sd for a well-fed population is about 2 percent. For the individual countries the proportions wasted range from a little over 5 percent in Malawi, Zambia and Zimbabwe to about 15 percent in Niger, with over 10 percent wasted in Burkina Faso and Ghana. For most countries few children can be considered chubby, i.e. over 2 standard deviations above the mean of the reference. In Malawi, however, close to 7 percent of children are chubby.

I.3.3 Weight for Age

Weight-for-age measures neither chronic nor acute nutritional status but is rather a combination of the two. Generally, it follows the pattern for height-for-age except where wasting is very prominent. The distributions of children according to the weight-for-age Z-score is given in Table I.5. Figure I.1 shows that the distribution of weight-for age is similar to that of height for age, and is substantially displaced to the left of the reference standard.. From Table I.3, the pooled data has a mean weight-for-age z-score of about -1.2 sd. The mean z-scores for weight-for-age range from -0.7 (Zimbabwe) to -1.7 for Niger. Five of the countries have mean z-scores near the pooled average (Central African Republic, Ghana, Malawi, Namibia and Zambia).

Underweight is the term used for children who fall below the cut-off of 2 standard deviations below the mean of the reference. In the pooled data set, a little over one quarter of the children are underweight. Zimbabwe has the lowest percent of children underweight (16%), and Niger and Burkina Faso, the highest percents (43% and 33%, respectively). Overweight (for age) is not a problem in these African countries as less than 3% of children are more than 2 standard deviations above the reference mean.

Combining the wasted and stunted statuses for the children produces the Waterlow Classification, also shown in Table I.3. Overall, in the pooled data set, only 60 percent of children are neither stunted nor wasted. The majority are only stunted but about 3 percent are both wasted and stunted, indicating they are both acutely and chronically malnourished. Malawi is the country with the lowest percent of children normal or above (49%) but it is closely followed by Niger (52%), which has the highest percent of children both stunted and wasted (7%).

Table I.2
Percent Distribution of Children by Height-for-Age Z-Score

Survey	Z-Score of Reference Standard																			
	-5.5 or less	-5.5 to -5.0	-5.0 to -4.5	-4.5 to -4.0	-4.0 to -3.5	-3.5 to -3.0	-3.0 to -2.5	-2.5 to -2.0	-2.0 to -1.5	-1.5 to -1.0	-1.0 to -0.5	-0.5 to 0.0	0.0 to 0.5	0.5 to 1.0	1.0 to 1.5	1.5 to 2.0	2.0 to 2.5	2.5 to 3.0	3.0 to 3.5	3.5 or more
Standard	0.0	0.0	0.0	0.0	0.0	0.1	0.5	1.7	4.4	9.2	15.0	19.2	19.2	15.0	9.2	4.4	1.7	0.5	0.1	0.0
Burkina Faso	0.2	0.4	1.3	1.9	3.5	6.0	8.5	11.6	13.1	12.1	11.5	9.6	7.5	5.7	3.4	2.3	0.7	0.4	0.1	0.3
C.A. R.	0.5	0.8	1.3	2.5	3.4	5.8	7.7	12.0	13.0	13.4	11.5	10.7	6.8	5.2	3.0	1.0	0.9	0.0	0.2	0.3
Ghana	0.4	0.3	1.0	1.4	2.3	3.6	7.2	9.9	13.5	12.6	13.6	13.4	8.7	5.9	2.7	1.4	0.9	0.2	0.2	0.3
Kenya	0.3	0.5	1.1	1.9	3.1	5.7	9.6	11.3	15.5	15.6	12.7	7.8	6.2	3.9	1.8	1.1	0.5	0.4	0.3	0.7
Malawi	0.8	1.2	1.9	4.2	6.3	9.0	11.2	15.0	14.0	11.6	9.9	7.2	2.9	2.1	1.4	0.5	0.4	0.2	0.1	0.1
Niger	0.6	1.3	2.0	3.6	5.1	6.2	9.2	11.7	13.0	12.3	11.2	8.3	6.0	3.9	2.3	1.9	0.6	0.4	0.2	0.2
Namibia	0.3	0.2	0.6	1.0	2.5	3.8	8.4	11.7	15.3	15.0	14.5	10.7	6.7	3.9	2.0	1.0	0.6	0.6	0.3	0.7
Senegal	0.3	0.3	0.6	1.8	2.5	4.3	5.8	9.5	12.8	14.8	14.7	12.1	8.8	5.2	3.4	1.5	0.6	0.5	0.2	0.3
Zambia	0.5	0.5	0.9	2.8	3.6	7.0	10.4	14.3	16.3	15.0	11.0	8.4	4.6	2.1	1.0	0.7	2.2	2.2	0.1	0.4
Zimba-bwe	0.0	0.2	0.4	0.5	2.0	3.1	5.5	10.0	14.7	16.2	14.2	11.7	9.2	5.9	3.1	1.8	0.8	0.2	0.3	0.3
All	0.4	0.6	1.1	2.3	3.6	5.7	8.6	11.9	14.2	13.9	12.3	9.6	6.5	4.2	2.3	1.3	0.6	0.4	0.2	0.4

Table I.3
Indices of Children's Malnutrition

Country	Height for Age				Weight for Age				Weight for Height				Waterlow Classification			
	Percent			Mean Z-Score	Percent			Mean Z-Score	Percent			Mean Z-Score	Percent			
	Stunted	Normal	Over-tall		Under-weight	Normal	Over-weight		Wasted	Normal	Chubby		Normal or above	Stunted only	Wasted only	Stunted & Wasted
Burkina Faso	33.3	65.1	1.5	-1.29	32.8	65.6	1.6	-1.34	13.3	85.1	1.6	-0.73	58.1	28.5	8.5	4.8
C.A. R.	34.0	64.6	1.4	-1.39	27.4	71.2	1.4	-1.19	7.1	90.6	2.3	-0.43	61.4	31.4	4.6	2.6
Ghana	26.2	72.2	1.6	-1.13	27.7	71.0	1.3	-1.21	11.5	66.6	1.8	-0.65	65.9	22.6	7.9	3.6
Kenya	33.4	64.7	1.8	-1.42	22.7	75.3	2.0	-1.06	6.0	90.5	3.5	-0.24	63.0	31.1	3.6	2.4
Malawi	49.7	49.5	0.8	-1.96	27.7	70.2	2.1	-1.21	5.4	87.9	6.7	-0.01	49.4	45.1	2.9	2.6
Niger	39.7	58.9	1.5	-1.59	42.9	56.1	1.1	-1.67	15.1	83.8	1.1	-0.90	52.1	32.8	8.3	6.8
Namibia	28.5	69.3	2.2	-1.24	26.6	72.2	1.2	-1.15	8.7	88.0	3.3	-0.45	65.7	25.6	5.8	2.9
Senegal	25.0	73.3	1.7	-1.10	22.5	75.6	1.8	-1.06	8.6	88.8	2.6	-0.47	69.0	22.4	6.0	2.6
Zambia	40.0	59.1	0.9	-1.67	25.4	73.5	1.1	-1.20	5.2	92.0	2.8	-0.21	57.1	37.8	3.0	2.2
Zimbabwe	21.6	76.8	1.6	-1.01	15.8	82.0	2.2	-0.74	5.5	90.3	4.2	-0.14	73.9	20.6	4.4	1.1
All	34.3	64.2	1.5	-1.42	27.7	70.7	1.6	-1.21	8.7	88.4	2.9	-0.43	60.3	31.0	5.4	3.3

Table I.4
Percent Distribution of Children by Weight-for-Height Z-Score

Survey	Z-Score of Reference Standard																			
	-5.5 or less	-5.5 to -5.0	-5.0 to -4.5	-4.5 to -4.0	-4.0 to -3.5	-3.5 to -3.0	-3.0 to -2.5	-2.5 to -2.0	-2.0 to -1.5	-1.5 to -1.0	-1.0 to -0.5	-0.5 to 0.0	0.0 to 0.5	0.5 to 1.0	1.0 to 1.5	1.5 to 2.0	2.0 to 2.5	2.5 to 3.0	3.0 to 3.5	3.5 or more
Standard	0.0	0.0	0.0	0.0	0.0	0.1	0.5	1.7	4.4	9.2	15.0	19.2	19.2	15.0	9.2	4.4	1.7	0.5	0.1	0.0
Burkina Faso	0.0	0.0	0.0	0.0	0.9	1.9	3.6	7.0	12.5	15.8	17.8	15.0	12.8	6.2	3.2	1.8	0.4	0.4	0.1	0.6
C.A. R.	0.0	0.0	0.0	0.0	0.3	0.8	2.3	3.8	9.1	14.2	18.5	17.0	14.7	10.0	4.5	2.6	2.0	0.0	0.1	0.2
Ghana	0.0	0.0	0.0	0.0	0.6	1.7	3.2	6.0	12.1	15.2	16.9	16.1	13.4	7.1	3.6	2.2	0.7	0.5	0.2	0.4
Kenya	0.0	0.0	0.0	0.0	0.3	0.9	1.8	2.9	6.4	11.8	17.6	18.0	16.9	10.4	6.0	3.3	1.7	1.0	0.4	0.5
Malawi	0.0	0.0	0.0	0.0	0.5	1.0	1.3	2.7	5.7	10.4	14.8	15.6	16.9	12.5	8.2	3.8	2.8	1.4	1.0	1.6
Niger	0.0	0.0	0.0	0.0	1.1	1.6	4.5	7.9	15.0	17.1	18.3	15.4	9.9	5.1	2.0	1.0	0.5	0.3	0.1	0.2
Namibia	0.0	0.0	0.0	0.0	0.6	0.9	2.5	4.6	10.5	13.5	17.7	17.4	12.6	8.5	5.3	2.5	1.6	0.8	0.2	0.6
Senegal	0.0	0.0	0.0	0.0	0.6	1.1	2.6	4.3	9.2	14.2	18.6	17.4	14.5	8.0	4.8	2.2	1.1	0.6	0.4	0.4
Zambia	0.0	0.0	0.0	0.0	0.5	0.6	1.4	2.7	5.8	11.2	17.3	19.4	17.6	11.2	6.5	3.1	1.3	0.5	0.5	0.5
Zimba-bwe	0.0	0.0	0.0	0.1	0.2	0.5	1.9	2.8	6.6	11.1	15.5	16.4	17.7	11.5	6.7	4.8	2.0	1.1	0.7	0.4
All	0.0	0.0	0.0	0.0	0.6	1.1	2.5	4.5	9.2	13.4	17.4	16.9	14.8	9.0	5.1	2.6	1.3	0.7	0.4	0.6

Table I.5
Percent Distribution of Children by Weight-for-Age Z-Score

Survey	Z-Score of Reference Standard																			
	-5.5 or less	-5.5 to -5.0	-5.0 to -4.5	-4.5 to -4.0	-4.0 to -3.5	-3.5 to -3.0	-3.0 to -2.5	-2.5 to -2.0	-2.0 to -1.5	-1.5 to -1.0	-1.0 to -0.5	-0.5 to 0.0	0.0 to 0.5	0.5 to 1.0	1.0 to 1.5	1.5 to 2.0	2.0 to 2.5	2.5 to 3.0	3.0 to 3.5	3.5 or more
Standard	0.0	0.0	0.0	0.0	0.0	0.1	0.5	1.7	4.4	9.2	15.0	19.2	19.2	15.0	9.2	4.4	1.7	0.5	0.1	0.0
Burkina Faso	0.0	0.1	0.6	1.2	2.1	5.3	10.2	13.4	15.1	15.5	12.1	9.3	6.5	3.7	2.5	0.9	0.6	0.4	0.4	0.2
C.A. R.	0.0	0.2	0.3	0.7	1.9	4.4	8.7	11.1	14.9	14.9	14.4	10.5	7.6	5.5	2.1	1.2	1.2	0.0	0.1	0.2
Ghana	0.2	0.2	0.6	1.0	1.8	4.4	7.8	11.8	15.1	15.0	13.4	11.4	7.3	4.9	2.9	1.2	0.7	0.2	0.1	0.3
Kenya	0.0	0.1	0.1	0.5	1.5	3.7	6.6	10.1	15.2	17.1	14.7	11.4	8.0	4.8	2.9	1.3	1.0	0.5	0.2	0.4
Malawi	0.0	0.0	0.4	0.9	2.0	4.4	8.1	11.8	16.3	15.2	13.2	10.5	7.7	3.8	2.6	1.0	0.9	0.6	0.2	0.4
Niger	0.1	0.3	0.6	2.2	4.3	7.6	11.5	16.2	14.9	13.9	10.4	7.3	4.6	3.1	1.3	0.5	0.4	0.3	0.2	0.3
Namibia	0.0	0.1	0.1	0.5	1.5	3.6	7.4	13.3	15.3	15.8	13.6	10.6	8.7	4.2	2.4	1.6	0.6	0.3	0.1	0.3
Senegal	0.0	0.0	0.2	0.6	1.3	3.5	6.2	10.7	15.5	16.4	14.7	11.7	8.9	4.5	2.5	1.6	0.9	0.4	0.2	0.2
Zambia	0.0	0.0	0.2	0.7	1.4	3.4	7.5	12.1	16.4	17.7	14.5	10.7	7.6	3.4	2.4	0.8	0.5	0.1	0.3	0.2
Zimba-bwe	0.0	0.0	0.1	0.2	0.6	2.2	4.2	8.5	13.0	15.9	15.6	12.9	10.5	7.8	4.1	2.4	1.0	0.7	0.3	0.2
All	0.0	0.1	0.3	0.9	1.9	4.4	8.0	12.1	15.3	15.9	13.6	10.5	7.5	4.3	2.5	1.2	0.7	0.4	0.2	0.3

I.4 Mothers' Nutritional Status

In the DHS surveys only the mother's acute nutritional status can only be ascertained using weight-for-height. While height can be used to ascertain the likelihood of problems of giving birth due to small pelvis size (WFPHA, 1983; Krasovec and Anderson, 1991), short stature may be the result of stunting far into the past and thus no longer represents even a chronic condition of malnourishment. The Quetelet body mass index (BMI) is used as the indicator of acute nutritional status (calculated as weight in grams divided by the square of height in centimeters).

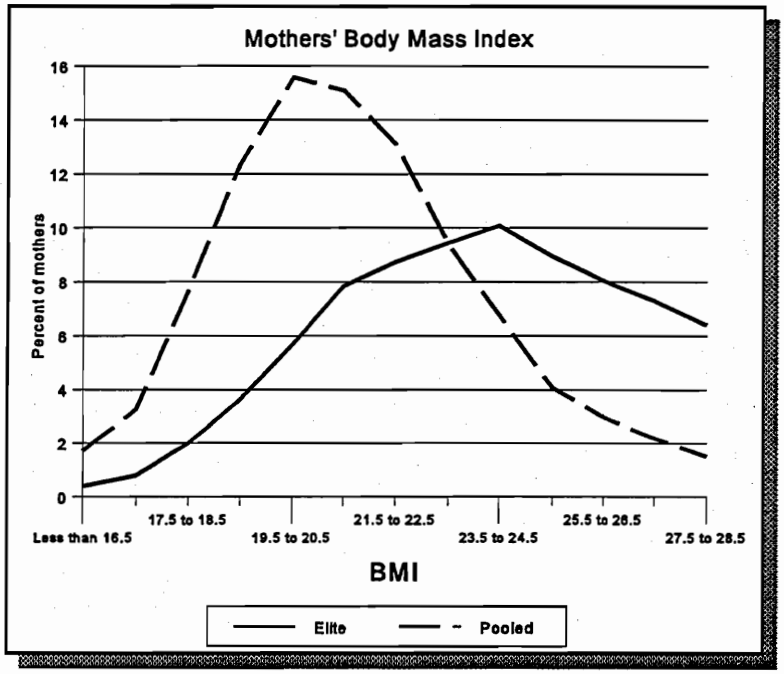

Figure I.2 Mothers' Acute Nutritional Status

The distribution of BMI scores is given in Table I.6 and shown in Figure I.2. From Table I.7, the mean BMI is 21.7 for all women. In a well-nourished population of the less developed countries, the mean would be 23.8[3]. Women with BMIs below 18.5 are classified as wasted. Almost 13 percent of women in the pooled data set fall into this category. Zimbabwe is the country with the lowest proportion wasted, about 6%, and Niger has the highest proportion, 18 percent. The Central African Republic and Namibia have more than 15% of mothers who are wasted.

While higher proportions of mothers are wasted than are children, they also have far higher proportions chubby. Overall, about 9 percent of the women are classified as chubby (BMI above 26.0). The chubbiest mothers come from Zimbabwe and Namibia, which also had a high proportion of wasted mothers, with both about 17% of mothers falling into this over nourished category.

[3]This mean is calculated on the basis of relationships found in a study of elite women in less developed countries (Rutstein and Nestel, 1996). A representative value in an industrialized country is 25 (Bray, 1979).

Table I.6
Percent Distribution of Mothers by BMI

Survey	Body Mass Index													
	Less than 16.5	16.5 to 17.5	17.5 to 18.5	18.5 to 19.5	19.5 to 20.5	20.5 to 21.5	21.5 to 22.5	22.5 to 23.5	23.5 to 24.5	24.5 to 25.5	25.5 to 26.5	26.5 to 27.5	27.5 to 28.5	28.5 or more
Burkina Faso	1.7	3.3	8.9	14.1	19.2	16.7	13.7	8.8	5.2	2.6	2.0	1.1	.8	1.9
C.A. R.	1.9	4.0	9.9	13.6	18.2	15.5	13.2	8.7	6.1	2.7	2.2	1.1	0.5	2.4
Ghana	1.0	3.1	7.3	13.0	15.6	16.8	12.1	9.1	7.3	3.8	2.6	2.0	1.4	4.8
Kenya	1.0	2.6	6.1	10.3	15.3	14.8	15.3	10.3	7.7	4.6	3.1	2.5	2.0	4.4
Malawi	0.9	2.5	6.0	11.0	16.6	16.7	14.8	12.1	7.8	4.8	2.8	1.7	0.7	1.7
Niger	2.7	4.8	10.2	18.1	16.7	15.0	10.5	7.1	4.6	3.0	1.8	1.9	1.0	2.5
Namibia	2.6	4.1	8.4	9.4	12.8	14.2	10.4	8.3	6.1	4.6	3.8	2.6	2.6	10.1
Senegal	2.4	4.0	8.0	11.7	13.1	13.0	11.1	9.7	7.3	4.9	3.6	2.7	1.5	6.9
Zambia	1.5	2.6	7.0	12.9	14.3	15.0	13.6	9.5	6.8	4.4	3.5	2.5	2.1	4.4
Zimbabwe	0.4	1.2	4.0	7.2	12.4	13.0	14.6	10.9	10.1	6.5	5.0	4.3	2.3	8.2
All	1.7	3.3	7.7	12.4	15.6	15.1	13.1	9.4	6.8	4.1	3.0	2.2	1.5	4.1

Table I.7
Indices of Mothers' Malnutrition

Country	Weight for Height BMI			
	Percent of Mothers			Mean
	Wasted	Normal	Chubby	
Burkina Faso	13.8	81.5	4.6	21.6
C.A. R.	15.8	79.2	5.0	21.7
Ghana	11.4	79.1	9.5	21.8
Kenya	9.7	80.0	10.3	22.2
Malawi	9.5	85.4	5.1	21.6
Niger	17.7	76.0	6.3	20.9
Namibia	15.1	68.0	16.8	22.8
Senegal	14.4	72.8	12.8	22.7
Zambia	11.1	78.4	10.5	22.0
Zimbabwe	5.5	77.5	16.9	23.1
All	12.6	78.3	9.1	21.7

I.5 Discussion: The existence of malnutrition

Using the DHS data, nutritional status is assessed by anthropometric measurements, specifically height (length) and weight. In some countries arm circumference has been taken of mothers, but has not been generally used for maternal status. Chest circumference has not been used for children. The use of height and weight to ascertain nutritional status is limited since some forms of malnutrition may not be indicated by anthropometry. In particular, ascertaining micronutrient status has recently added to the survey instruments in the form of HemoCue screening for anemia (so far only in Kazakstan and Peru) and by testing the iodine fortification of the family's salt (several countries).

In order to utilize anthropometric data (height and weight) to assess nutritional status of children who grow throughout childhood at differing rates according to age, it is necessary to compare with a reference standard. There are three standards based on these measurements: height given age, weight given height and weight given age. The first is taken to represent skeletal growth and thus chronic nutritional status. The second is taken to represent body mass given an amount of skeletal growth and is taken to represent acute status. The last represents a combination of both chronic and acute status. Given that it is easier to measure weight than height, the last has been commonly used but may not represent distinct relationships.

These standards, based on U.S. children, have been adopted internationally, and are used to represent the distributions of heights and weights in a well-nourished population. The reference standards provide for three measures of position on reference standard scale: percentile, percent of median, and z-score. The z-score, used here, is a specific child's position on the normalized reference scale in terms of number of the standard deviations of that scale above or below the mean[4]. Using the standards, malnourished children are defined as those whose position on the reference scale is more than two standard deviations below the mean (i.e. < -2sd). The term used to represent chronically malnourished children (< -2sd on the height/age scale) is stunted, that for acutely malnourished children (< -2sd on the weight/height scale) is wasted, and that for the weight for age is underweight.

To assess the nutritional status of women the ratio of height to the square of weight is used. This is known as the Quetelet body mass index (BMI). Other measures of nutritional status exist, such as Rohrer body mass index (weight divided by height cubed) and the Metropolitan Life Insurance

[4]The reference standard distribution was normalized to have a mean value of zero and a standard deviation value of one.

Company's ideal weight for given heights[5]. These indices have been created generally with the purpose of determining who is overweight or obese rather than underweight. However, a cutoff of 18.5 for the BMI has been used to indicate an underweight status. The weight-for-height indices essentially measure acute nutritional status. There is no commonly used indicator for adult chronic nutritional status.

From tables I.2 through I.5, it was seen that the distributions of nutritional status of children in sub-Saharan Africa are substantially shifted to the left of that of children who form the international reference standards, indicating low levels of nutrition, both chronically and acutely. This situation is summarized by height-for-age, weight-for-age and weight-for-height z-score means all far below the mean of the reference standards. Indeed, the DHS surveys found that, in the pooled data set of the ten countries studied, approximately one in three children were stunted and one in eleven were wasted. Projecting these figures to children under five years of age of all countries of sub-Saharan Africa (excluding South Africa), gives estimates of about 36 million children stunted, 29 million underweight and 9 million wasted. Thus malnutrition is a major problem affecting millions of African children. Pelletier's recent work has shown that even mild and moderate malnutrition contributes substantially to infant and child mortality (Pelletier et al., 1993).

Maternal malnutrition is also a major problem in sub-Saharan Africa. Almost 13 percent of mothers in the ten countries studied are wasted with body mass index values of less than 18.5. This translates to approximately 16 million women 15 to 49 years of age who are malnourished, also a major problem for themselves and their families.

[5] Other standards that have been suggested are one that extrapolates the NCHS/CDC/WHO reference standard on child weight-for-height beyond the 18 years of age cut-off (Geissler and Miller, 1985) and a defacto standard based on an elite group of mothers from the DHS surveys (Nestel and Rutstein, 1996).

APPENDIX

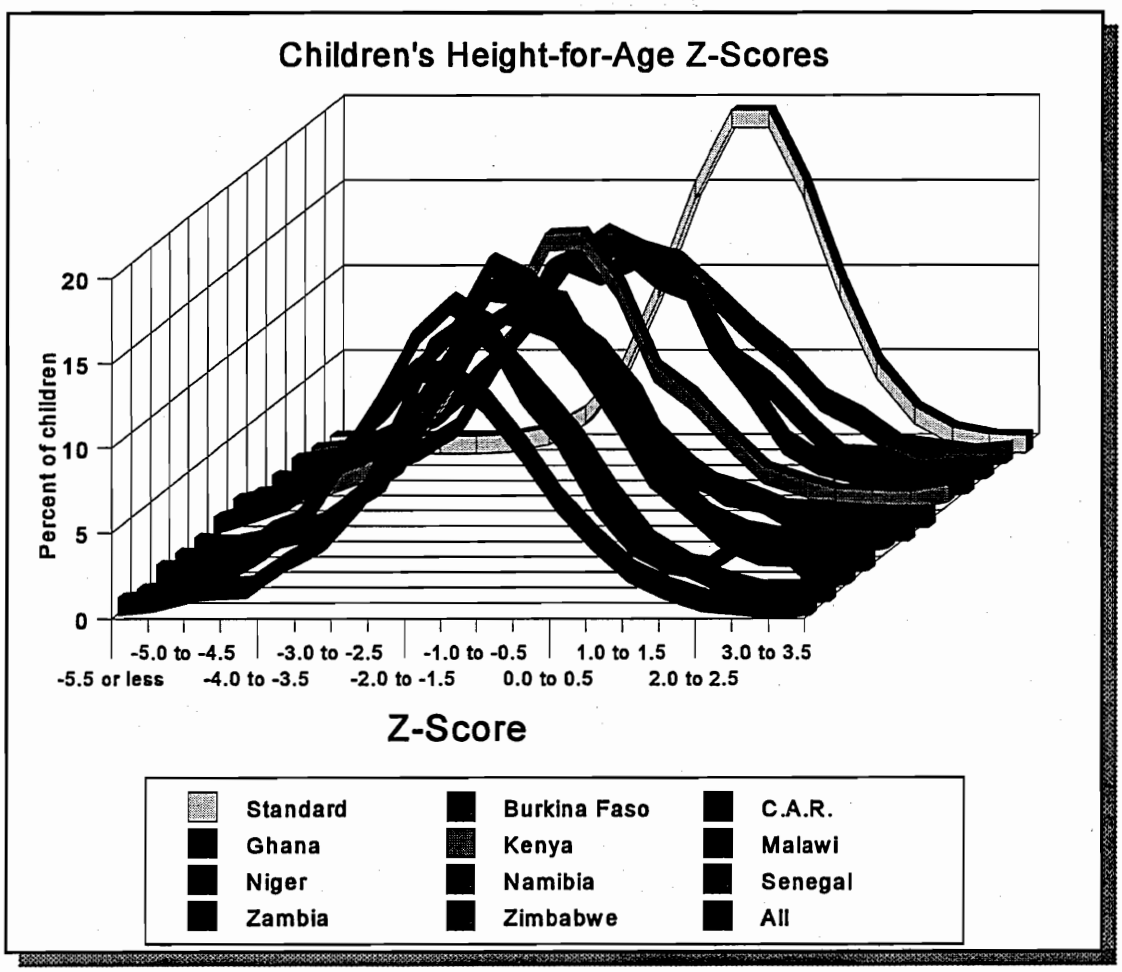

Figure I.A1 Children's Chronic Nutritional Status by Country

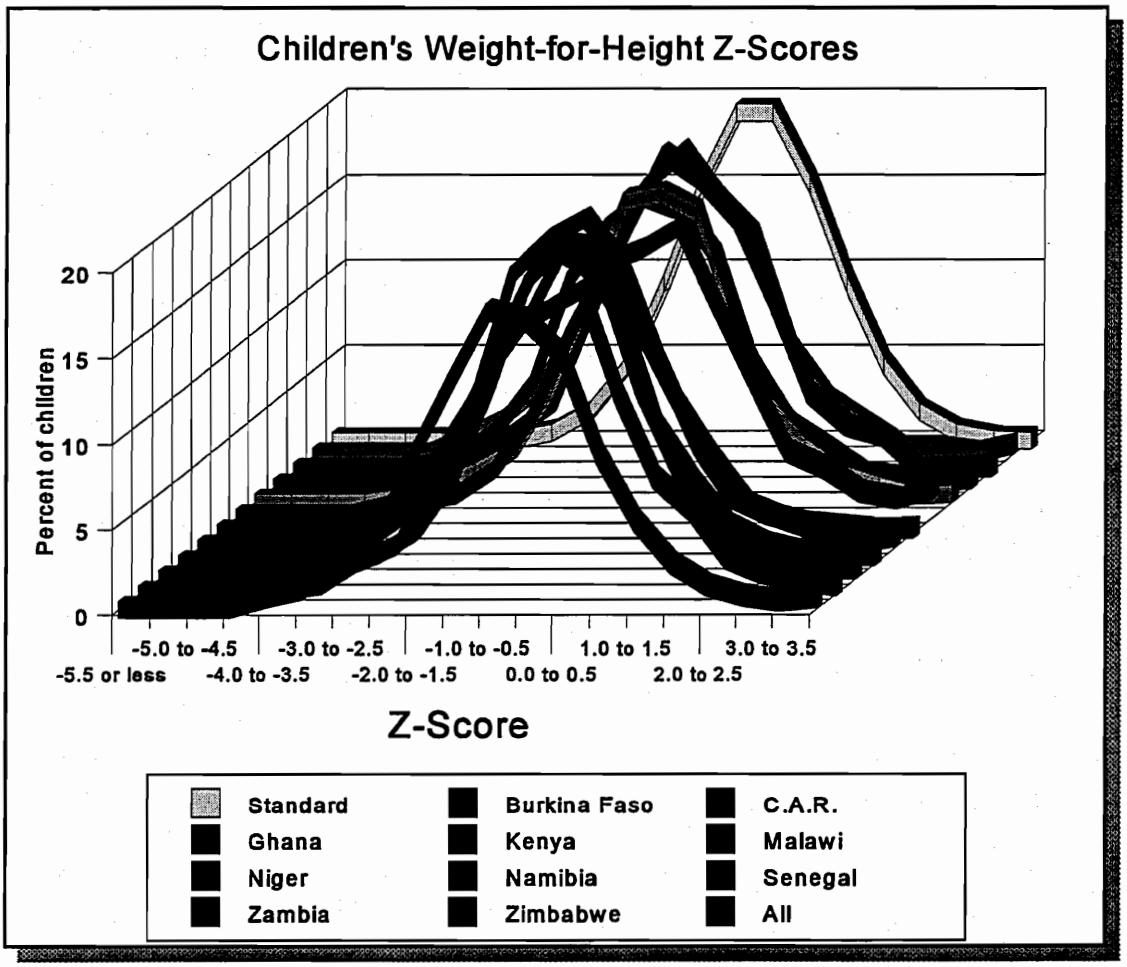

Figure I.A2 Children's Acute Nutritional Status by Country

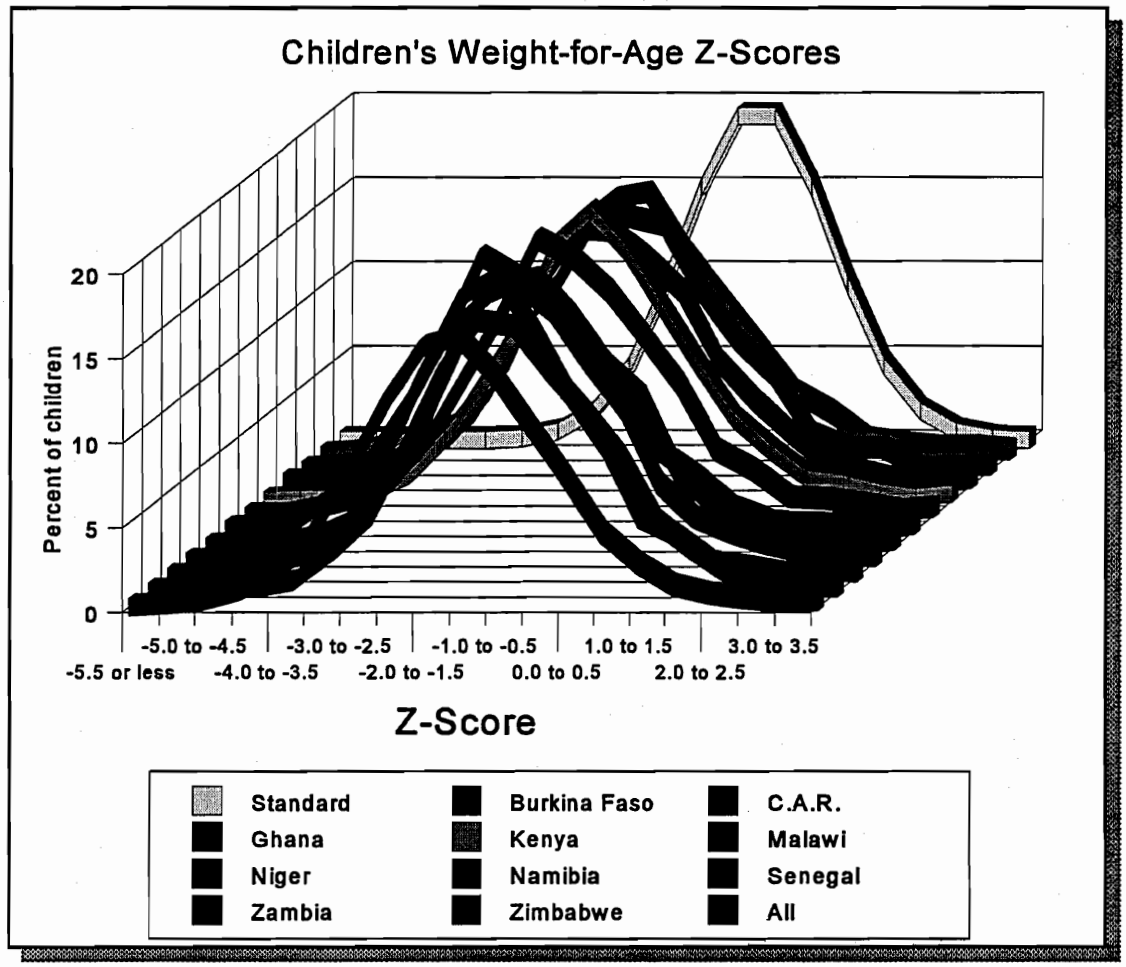

Figure I.A3 Children's Weight-for-Age Status by Country

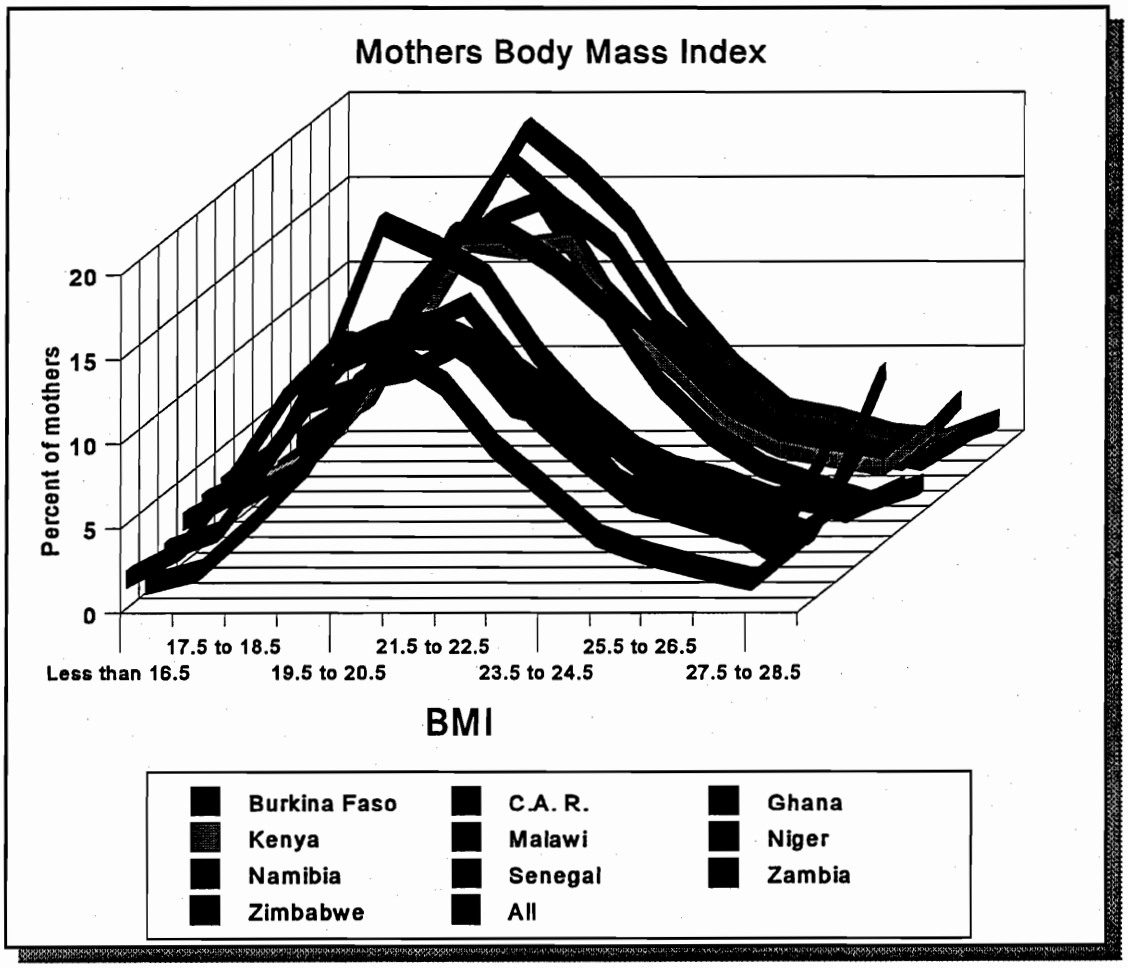

Figure I.A4 Mother's Acute Nutritional Status

Part II

Factors Influencing the Nutritional Status of Mothers and Children in Sub-Saharan Africa

1. Introduction

Malnutrition is a direct result of both inadequate intake of food and infectious disease. Inadequate food intake is a consequence of insufficient food at the household level and improper feeding practices. Infectious diseases, particularly diarrhea, acute respiratory illness, malaria and measles, result from inadequate health care, insufficient water supplies and poor environmental sanitation (Jamison, 1993). Poor sanitation puts infants and young children at risk of increase incidence, duration and severity of illness (Haggerty et al., 1994; Clemens and Stanton, 1987). Infectious diseases compromise nutritional status through loss of appetite, reduced dietary intake, poor nutrient absorption, increased nutrient loss, and increased energy requirements (Brown et al., 1990; Dickin et al., 1990; Rosenberg et al., 1977; Rahaman and Wahed, 1983). In environments where infectious diseases are common, children typically suffer recurrent infections and are unable to recover fully from a single bout of illness. The result is weakened immunity and increased susceptibility to malnutrition. When both malnutrition and infection are present, the result is an interaction that is biologically more detrimental than the sum of the separate effects of each (Scrimshaw et al., 1968).

Both inadequate intake of food and prevalence of disease reflect underlying social and economic conditions at the household, community, and national levels (Moore and Favin, 1990).

1.1 Conceptual Frameworks

Figure II.1, based on the UNICEF conceptual framework (Jonsson, 1995) reflects the relationships among variables and mechanisms that lead to childhood malnutrition. Political, socio-economic, environmental and cultural factors, operating at national and community levels together with poverty at the household level ultimately affect the nutritional status of children. For the current study, a drawback of this framework is that it does not explicitly take into account the factors affecting maternal nutrition nor the effect that maternal nutrition

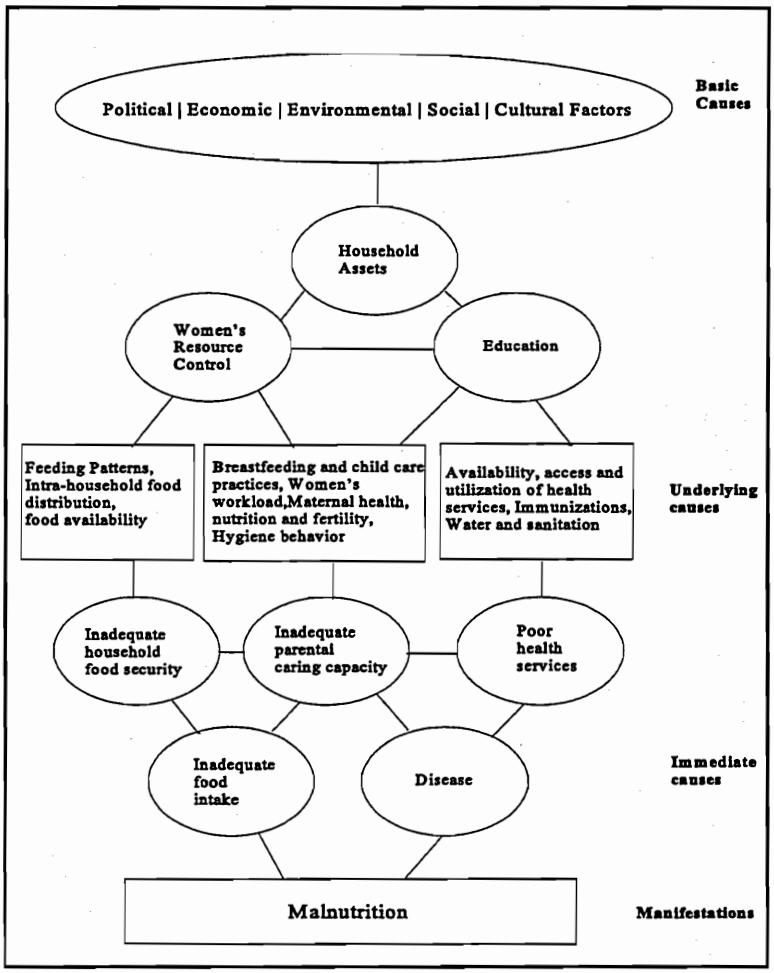

Figure II.1 UNICEF's Causes of Children's Malnutrition

status has on child nutritional status.

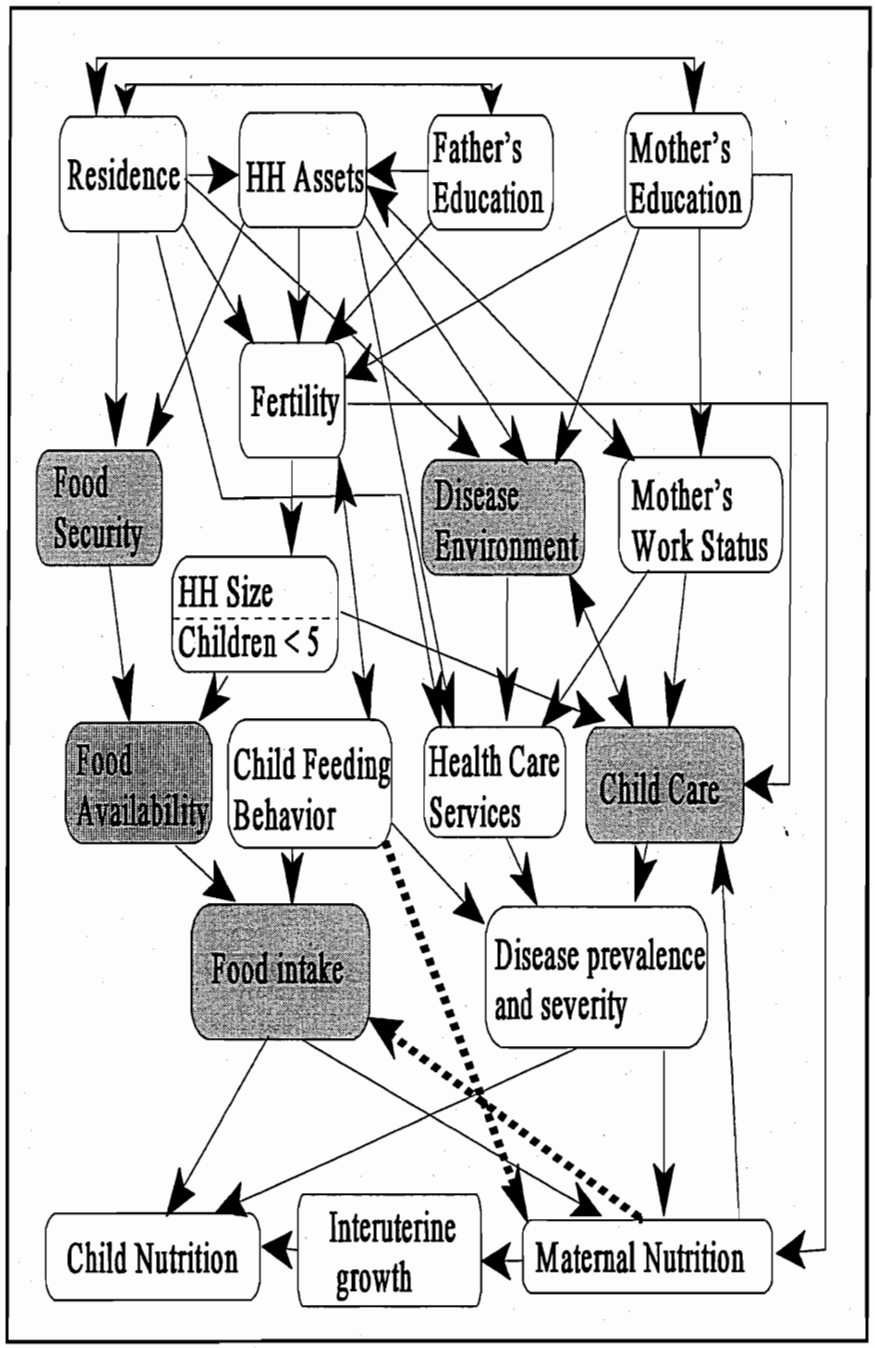

Figure II.2 Conceptual framework for analysis of maternal and child malnutrition

In Figure II.2, the UNICEF conceptual framework has been adapted to allow for the incorporation of maternal nutritional status and to include more explicitly factors that are measured in the DHS surveys. Shaded boxes are those concepts not measured or proxied in the DHS datasets. Double-arrowed lines indicate that there are relationships in both directions, such as that between mother's work status and household assets. Dotted lines indicate relationships that are more speculative.

In this framework, there are three related manifestations of malnutrition: child malnutrition, mother's malnutrition and reduced interuterine growth. Poor maternal nutritional status is directly related to reduced interuterine growth, which in turn, is related to birth weight and child nutritional status after birth (Godfrey et al., 1996; Krasovec and Anderson, 1991; IOM, 1990; Villar and Rivera, 1988; Kramer, 1987; Hytten, 1980; Lechtig et al., 1975a and 1975b).

In the DHS surveys, both child and maternal anthropometry is used to assess nutritional status. However, interuterine growth is not measured but proxied by size at birth, reported by the mother at the time of the survey.[6]

Working upwards in the framework from the manifestations, the immediate causes of malnutrition are disease prevalence and severity[7] and inadequate food intake, which affect both mothers and children.

Mother's malnutrition may possibly affect the adequacy of food intake by the child, specifically the quality and quantity of breast milk. R. Perez-Escamilla et al. (1995) found that maternal body mass index (BMI) was positively associated with birth weight and milk energy density. In multivariate analyses, though, they found that birth weight was positively associated with milk volume and negatively with milk energy density but that maternal anthropometric status was not a significant predictor of milk volume or infant energy intake when birth weight and milk energy density were included in the models. The conclude that infant characteristics, such as birth weight and the ability to self regulate intake in response to milk energy density, mediate the relationship between maternal anthropometric status and lactation performance. Since this relationship is less certain, it is shown by a broken line.

The next two rows of boxes indicate intermediate causes of malnutrition (called underlying causes in the UNICEF framework) while the top row indicates the socio-economic context of the household. Food availability, here meant to convey the amount of food available to the household, and child feeding behavior (breast feeding, use of complementary foods, etc.) combine to affect food intake and protection from disease (Cohen et al., 1994; Sachdev et al., 1991; Lutter et al., 1990; de Carvalho et al., 1983). These in turn are affected by food security, the ability to obtain food and household size, which is determined by household income (proxied by assets) and residence. Frequent breast feeding may also drain the mother's nutritional stores, as indicated by the broken line linking child feeding behavior and maternal nutrition.

Health care services, which mediates the effects of the disease environment, affect the prevalence and severity of diseases. The availability of health care services is affected by area of residence and the household's ability to pay for services (proxied by household assets). It can also be more available depending on the work status of the mother, since many jobs, especially those in urban areas, allow access to social security health services or company-provided services, especially in

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[6]While birth weight was asked in sub-Saharan countries, most were not weighed at birth. The size at birth of children was reported by the mother in terms of "very small, smaller than average, average, larger than average, and very large". See Boerma et al. for a discussion of the correlation between reported birth size and birth weight.

[7] Many studies have examined the link between diarrhea and growth. See, for example, Rosenberg, Solomons and Schneider (1977), which examines the link through intestinal malabsorption. For feeding practices during diarrhea see Lanata et. al., 1992; Huffman et. al., 1991, Huffman and Combest, 1990; Lutter et al., 1990; Brown et. al. 1990; and Hoyle, Yunus, and Chen, 1980.

urban areas. Mother's employment can also raise her status and decision power and her control over household resources to benefit herself and her children (Manun'Ebo et al., 1994; Hoddinot and Haddad, 1992; Leslie, 1989).

The availability of child care depends on the mother's work status and, if working, whether another person can care for the child, as well as on the number of children in the household (especially those under five years of age). The quality of child care depends on the mother's education but her ability to provide adequate child care is reduced if she is malnourished (Wallace, 1992). The disease environment and child care mutually affect each other. In one direction, an unhealthy environment will demand much more time for child care. In the other, the quality of child care (especially hygiene) will affect the child's exposure to disease.

The disease environment of the household is affected by residence, especially the provision of potable water and sanitation (Esrey et al., 1985), knowledge of disease causes and proper hygiene procedures (proxied by mother's education), and household income (proxied by assets) which determines the ability to have properly constructed dwellings with adequate services and to purchase cleaning products.

The box labeled fertility represents the number and spacing of births. Frequent short birth intervals do not allow the mother to recover her nutritional reserves between births further deteriorating her status. High parity in itself may also be detrimental with regard to the mother and interuterine growth. Moreover, high parity and frequent short birth intervals increase the number of household members who need to be fed and the number of children under age five who compete for the mother's time. The occurrence of a new pregnancy usually forces the weaning of the breast feeding child.

Fertility is affected by many factors, including residence (accessability of family planning), household assets and education. In addition, child feeding behavior affects fertility through the breast feeding-amenorrhea link and possibly postpartum abstinence (Perez et al., 1992 and 1996).

Higher level factors, such as the cultural, political, economic, and physical environments are not shown in this framework but affect many of the relationships and factors that are indicated. In the modeling and analyses to follow, they will be taken account of only through the use of dummy variables indicating country.

1.2 Some Previous Studies

The factors influencing maternal nutritional status and its relationship to child nutritional status have been studied by a number of researchers, especially in other regions of the world. Bhuiya and Mostafa (1993) studied 1048 mothers in rural Bangladesh, using multivariate analysis with age, education, parity, number of dead children, religion family type, family size and household land owned as explanatory factors. They found that education was related to weight, height and body mass index and that Moslems were on average in better condition than Hindus even after controlling

for the other factors. Rahman et al. (1993), in a small-scale study of two urban hospitals and a community out-patient clinic in Bangladesh, found that children's weight for age was associated with the body mass index of the mother, socio-economic status of the family and breast-feeding status of the child after adjusting for several prognostic factors using multivariate analysis. In the urban slums of Dhaka, Bangladesh, Baqui et al. (1994) found that mother's weight, BMI and mid-upper-arm circumference were positively correlated with years of schooling and household economic status, that mother's height was positively correlated with schooling but not household economic status, and that both height and weight were negatively correlated with the number of child deaths. Mock et al. (1994) have studied the intra-household correlations between maternal and child nutritional status in rural Guinea in the context of strategies for screening for household nutritional risk. Christian et al.(1989) also found that mother's height, weight for height and months of lactation had significant relationships with infants weight for age and that mothers' height and working status affected infants height for age.

In a review article, Neumann and Harrison (1994) describe the relationships between maternal nutritional status and weight gain during pregnancy in different populations. The effects of maternal nutrition are not confined to young children. In a study of women 80 years of age and over in England and Wales, Ariouat and Barker (1993) found that poor maternal nutrition linked through retarded fetal and infant growth has effects much later in life, particularly a higher risk of cardiovascular disease.

1.3 Purpose

The purpose of this exploratory report is to examine maternal and child nutritional status in sub-Saharan Africa in a search for answers to some related questions:

1) What are the key factors associated with maternal and child nutritional status and malnutrition?

2) Are there key factors that are common between children and their mothers?

3) Is maternal nutritional status related to child status?

4) Are there any special factors that influence well-nourished mothers to have malnourished children and allow malnourished mothers to have well-nourished children?

5) To what extent can food insecurity be distinguished from feeding practices as factors in child malnutrition?

These questions will first be investigated through univariate and bivariate methodologies. Then multivariate techniques will be applied in an attempt to disentangle correlated relationships between the explicative factors and maternal and child malnutrition.

In the second section of this report the selection of variables to represent the factors in the conceptual framework is discussed. The third section investigates the relationship between child and maternal

malnutrition. The fourth section of the report examines bivariate relationships between single explicative factors and malnutrition, and the fifth does so in a multivariate context. A discussion of the results is presented in the sixth section. The findings and their implications are summarized in the last section. Appendices include detailed and supporting tables and figures.

2. Variables

2.1 Dependent variables

For children, the dependent variables in the study are z-scores on the NCHS/CDC/WHO reference standards for height-for-age, weight-for-age, and weight-for-height (WHO, 1981)[8]. The first indicates the child's chronic nutritional status, the third the child's acute status, and the second the child's overall status. Cut-off points of two standard deviations below the mean (-2 sd) are used to indicate malnourished children, termed stunted, underweight and wasted, respectively.

For mothers, the Quetelet body mass index (weight divided by height squared) represents acute nutritional status (WHO, 1974). There is no corresponding chronic nutritional status indicator for adults in the data set. No adjustment in the BMI has been made for pregnancy. However, an indicator of pregnancy is included in the analyses of all women, and in other analyses only non-pregnant women were included. Following James, Ferro-Luzzi, and Waterlow (1988), mothers are considered to be malnourished (chronically energy deficient--called wasted here) if their BMI score is less than 18.5.

For children and mothers: a combined nutritional status indicator (COMBO) was created with the following categories:

1. Neither malnourished.
2. Mother only malnourished (BMI < 18.5).
3. Child only malnourished (Z-score below -2sd for height-age, weight-age or weight-height).
4. Both mother and child malnourished.

2.2 Independent variables

Explanatory variables are grouped according to the person most directly affected: the child, the mother, or both. Note that this grouping is not absolute since many of the mother's variables (such as mother's age) may also affect the child, as well as some of the child's variables affecting the mother (such as birth interval).

Child Characteristics:

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[8] Also see Keller, 1983; WHO, 1979 and 1981; Waterlow et al., 1977; U.S. Food and Nutrition Board, 1974. Habicht et al. (1974) discuss the disregarding of ethnic differences in the growth of young children.

Age (HW1): Age at measurement in months (continuous and grouped). There is a well-documented relationship between age and stunting and underweight. Wasting is also related to age but it is less defined than stunting or underweight.

Birth order (BORD): Twins and triplets have the same birth order (continuous and grouped). Women with more experience are expected to be better able to care for their children; however, in poor nutritional situations, maternal depletion is expected to increase with birth order.

Multiple Births (TWIN): Whether the child comes from a multiple birth. Because of the additional pre- and post-natal burden of multiple births, both biologically and in child care, it is expected that children of multiple births will have lower nutritional status than singletons.

Sex (B4): (dichotomous). There may be biological and/or child care differences according to the sex of the child.

Birth Size (BIRTHSIZ): Whether the child was small or very small at birth according to the mother's recollection. (dichotomous). Small and very small children are expected to have lower nutritional status at very young ages, especially in height- and weight-for-age but are not expected to be different at other ages.

Birth Weight (BIRTHWT): (continuous). Children of low birth weight are expected to have lower heights and weights for age during the first months of life. However, many children were not weighed at birth, especially those born without medical assistance, so that there is a substantial probability of selection bias (richer and/or mothers with problems having more medical assistance).

Birth Interval (B11): Number of months between the birth of the child and that of the preceding child (continuous and dichotomous). Children born close together create a large biological and child care burdens both pre- and post-natally that can result in reduced nutritional status (the extreme being a multiple birth). Disease transmission may also be increased.

Prenatal Care (PRENATAL): Whether the mother was seen by a medical provider during the pregnancy of the child (dichotomous).

Delivery Assistance (ASSIST): Whether the mother was assisted by a medically-trained person during the delivery of the child (dichotomous).

Prenatal care and delivery assistance by medically-trained persons can affect nutritional status of both mothers and children in several ways. They assess the mother's status during pregnancy and may counsel her on how to better feed herself and her child. A woman who has prenatal care or delivery assistance is more likely to bring her child in for a post-natal check-up during which visit the child would be nutritionally assessed and the mother receive nutritional advice. In the opposite direction, mothers who deliver in "baby-unfriendly" hospitals and clinics may tend to use bottles more and breast-feed less. In addition, there is a selectivity among the women who use medical

services during pregnancy and delivery. In many countries, poorer women are less likely to use the services unless they have a health problem, so that the women who do use are the richer women, who we expect would have less nutritional problems, and women with health problems, who we expect would have greater nutritional problems.

Diarrhea: If the child had diarrhea in the preceding two weeks the survey (dichotomous).

Fever: If the child had a fever in the two weeks preceding the survey (dichotomous).

Cough: If the child had a cough in the two weeks preceding the survey (dichotomous).

Acute Respiratory Infection (ARI): If the child had a cough associated with rapid, difficult breathing in the two weeks preceding the survey (dichotomous).

Illness is generally associated with lowered nutritional status, due to reduced appetite, the inability to fully utilize consumed nutrients, the increased energy requirements to fight off the illness, and perhaps, changes in diet as a treatment for the illness[9].

Any Vaccination (ANYVAC): If child received any of the following vaccinations: BCG, DTP, Polio, Measles (dichotomous).

Fully Vaccinated (FULLVAC): If child received all of the following vaccinations: BCG, three doses of DTP and Polio, Measles (dichotomous).

Vaccination status is taken as an indicator of contact with health services during infancy and early childhood. Since it is expected that contact with services would help correct incipient nutritional problems, vaccination status should be positively related to nutritional status.

Breast-feeding Status (BREAST): If child is currently being breast-fed (dichotomous).

Water: If child received plain water during the preceding 24 hours (dichotomous).

Milk or Formula (MILKS): If child received non-breast milk or infant formula during the preceding 24 hours. In DHS II surveys for children other than the last born, whether other milk or formula has been started (dichotomous).

Other Liquids (LIQUIDS): If child received liquids other than plain water and milk/formula, such a juice, sugar water, soft drinks, herb tea, tea, beer, clear broth, etc., during the preceding 24 hours.

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[9] For the accuracy of DHS recall data on illness prevalence, see Boerma et al. (1991). For surveys in general, see Matrorell et al. (1976).

In DHS II surveys for children other than the last born, whether other liquids have been started (dichotomous).

Solid and Semi-solid Foods (SOLIDS): If child received solid or mushy foods, such as cereals, soups, stews, fruits, vegetables, legumes, grains, meat, fish, eggs, cheese, etc. during the preceding 24 hours. In DHS II surveys for children other than the last born, whether solid or mushy food has been started (dichotomous).

Bottle Feeding (BOTTLE): If child drank from a bottle with a nipple in the preceding 24 hours (dichotomous). Not available for non-last children in DHS II surveys.

Acceptably Fed (ACCFED): Whether child was properly, acceptably or improperly fed according to child's age (trichotomous and dichotomous).:

Age under 4 months:

Proper:	Exclusively breast-fed.
Acceptable:	Received plain water
Improper:	Received any liquid other than plain water or any solid/mushy food. Fed with a bottle.

Age 4 to 6 months:

Proper:	Exclusively breast-fed. Received plain water.
Acceptable:	Received any liquid other than milk/formula or any solid/mushy food.
Improper:	Received milk/formula. Fed with a bottle.

Age 7 to 11 months:

Proper:	Received solid/mushy food.
Acceptable:	Received liquids including milk/formula.
Improper:	Did not receive solid/mushy food. Fed with a bottle.

Age 12 + months:

Proper:	Received any liquids and solid/mushy food.
Acceptable:	Fed with a bottle.
Improper:	Did not receive solid/mushy food.

Proper infant feeding should be positively related to nutritional status of children. What is proper depends on the age of the child. Both individual food groups and feeding behavior will be examined in relation to nutritional status, as well as a combined index variable that takes account of proper feeding at different ages. Mother's nutrition status may be related to children's feeding in a couple of ways. Breast-feeding, especially for prolonged periods, may deplete the mother, and food availability may affect both what the child is fed and the mother eats.

Wantedness of Birth (UNWANTED): Whether the mother wanted another child at the time of conception (dichotomous). Mothers who did not want a child at the time of conception may have

reached that decision because of being unable to adequately care for and/or feed an additional child (or even her existing children).

Mother's Characteristics:

Age (V012): Mother's age in years (continuous). With age, metabolism slows and weight may be more easily gained so an inverse relationship with mother's nutritional status is expected. Younger mothers may also be less experienced and in worse economic conditions than older mothers leading to deteriorated child nutritional status.

Number of Living Siblings (LIVING): (continuous). The ability to care for a child and food availability would be expected to decrease with an increase in the number of living siblings.

Mortality Experience (MORTEXP): Whether any of the child's siblings have died (dichotomous). Mortality experience can indicate past nutritional problems and other deleterious situations that affect current nutritional status.

Education (V133): Mother's education in single years completed (continuous).

Literacy(MUMLIT): Whether mother can read (dichotomous).

Husband's Education (V715): Husband's education in single years (continuous).

Both the mother's and father's education and literacy can increase knowledge of proper child care and feeding practices and change attitudes relating to use of health services and preventive measures. It is expected that nutritional status will increase with education. Where the mother is uneducated the father's education become important.

Working (V714): Whether mother is currently working (dichotomous).

Away: Whether mother works away from home (dichotomous).

Minder: If child under 3 years is cared for by someone other than the mother while mother works (dichotomous).

Women who work and especially those who work away from home are less able to provide proper child care to their children, including breast-feeding. On the other hand, they may bring in additional income to the family that increases food availability and some types of employment may provide improved access to health services. It is expected that the effect of women's employment depends on the age of the child, being detrimental at the youngest ages and beneficial at older ages.

Mother malnourished (MUMMAL): If mother is below 18.5 BMI (dichotomous).

A malnourished mother reflects the scarcity of food in the family and may interfere with her capacity to adequately breast-feed her child and to provide child care.

Household and Areal Characteristics:

HH Members (V136): Number of household members.

HH Under 5 (V137): Number of children under 5 years in household.

As the number of household members increases, particularly of children under five years of age, so may the strains on food resources and child care. In addition, disease transmission may be greater. It is expected that the greater the household size, the worse is nutritional status of both women and children. However, in the other direction, a larger number of working adults and older children may increase income and thus food availability.

Urban (PCTURB): If residing in an urban area (dichotomous).

The costs and availability of food and of health services are expected to be better in urban than rural areas, leading to better nutritional status.

Level of Living (ASSETS): Index of household possessions and services to gauge level of living. It is the sum of the following scores:

Drinking Water Supply:	4 if piped into residence, yard or bottle water 3 if other piped supply 2 if from well, tanker truck 1 if from surface or other source
Type of Toilet:	4 if own flush toilet 3 if shared flush toilet 2 if pit toilet/latrine 1 if no toilet (field, bush)
Principal Flooring:	4 if finished flooring other than cement (parquet, tiles, vinyl or asphalt, carpeting) 3 if cement 2 if rudimentary (wood planks, palm, bamboo) 1 if natural (dirt, sand, dung)
Type of Vehicle:	4 if car, truck 3 if motorcycle 2 if bicycle 1 if no vehicle
Electricity:	1
Radio:	1
Television:	1
Refrigerator:	1

The household asset index is an indirect measure of income and should be related to food availability. However, since components of the index are consumer durables and long-term services, the current family economic situation may not be as well proxied as that of the past. It is thus expected that the consume index would be more related to chronic nutritional status than acute status.

3. Combining Mother's and Child's Nutritional Status

The association between the mother's and the child's nutritional status is presented in Table II.1. In this table, the child is classified by Waterlow classification (normal, stunted, wasted, both stunted and wasted) according to whether the mother is chubby (BMI greater than 26.0), normal, or wasted (BMI below 18.5) in weight-for-height. There is a clear association between the mother's and the child's status: chubby mothers have more children who are normal or above than do normal weight-for-height mothers who in turn have more normal or above children than do wasted mothers. However, even when the mother is chubby or normal, there is substantial undernourishment among their children. For the pooled data set, about one in four children of chubby mothers is undernourished (26%). At 50 percent, wasted mothers have about twice as many of their children undernourished as do chubby mothers, and normal weight-for-height mothers have about 62% of their children undernourished. While all three categories of undernourishment in the Waterlow classification increase with lower nutritional status of the mother, there is a big increase in stunting between the chubby and normal maternal categories and a big increase in wasting (and stunted and wasted) between the normal and wasted maternal categories (Figure II.3).

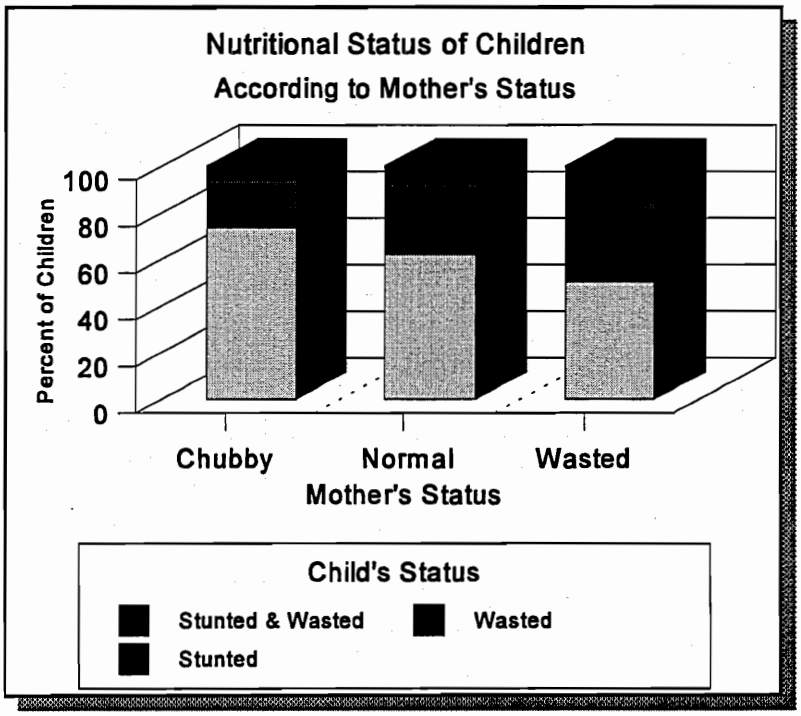

Figure II.3 Nutritional Status of Children according to Mother's Status

Table II.1
Combination Index of Mother's and Child's Nutritional Status

Country	Mother is Chubby (BMI> 26.0)				Mother is Normal (BMI 18.5 to 26.0)				Mother is Wasted (BMI < 18.5)			
	Child is				Child is				Child is			
	Normal or Above	Stunted	Wasted	Stunted & Wasted	Normal or Above	Stunted	Wasted	Stunted & Wasted	Normal or Above	Stunted	Wasted	Stunted & Wasted
Burkina Faso	73.2	16.4	7.1	3.4	60.6	26.8	8.7	3.9	44.0	34.0	12.3	9.7
C.A. R.	69.9	25.3	3.0	1.9	64.2	29.3	4.5	2.1	57.0	32.1	5.7	15.9
Ghana	75.6	15.6	7.5	1.3	66.4	22.0	8.1	3.4	58.4	25.3	8.4	7.9
Kenya	73.9	21.8	3.1	1.2	64.3	30.3	3.2	2.1	52.5	34.5	8.2	4.8
Malawi	56.5	40.2	1.9	1.5	49.8	45.5	2.6	2.2	41.5	44.4	6.2	7.9
Niger	67.5	21.0	8.3	3.3	54.5	31.7	8.1	5.7	44.1	31.9	12.2	11.8
Namibia	78.1	14.7	6.2	1.0	67.5	25.3	5.0	2.2	47.3	35.0	9.6	8.1
Senegal	80.0	12.7	6.1	1.1	69.7	22.2	5.6	2.5	58.8	27.8	9.2	4.3
Zambia	66.0	30.3	2.8	0.9	58.5	36.7	2.8	2.0	50.5	42.0	4.3	3.2
Zimbabwe	78.6	16.6	3.7	1.1	75.1	20.1	4.3	0.5	62.0	28.0	5.4	4.6
All	73.5	20.3	4.9	1.3	61.9	30.1	5.2	2.8	50.2	33.9	8.8	7.1

4. Bivariate Relationships with Nutritional Status

Since the prime purpose of this investigation is to study the relationship and interaction of mother's and child's nutritional status, data files for each country were created that contain both children's and mother's variables. Each child is represented as a case in these data sets with mother's variables added to the child's case. Thus mothers may be represented more than once if two or more of her children were weighed and measured (and passed the data quality screening). A child is only represented once. The data sets of each country were combined into a pooled data set.

In order to examine the relationships between the combination of mother's and child's nutritional status and potentially explanatory characteristics in a comparative fashion, a means comparison was employed as the simplest, most understandable methodology[10]. Under this methodology, the explanatory variables are used in either their continuous or dichotomous forms and percents and means are calculated for each category of combination indicators of mother's and child's nutritional status. The categories of the full combination indicator are: Neither Malnourished, Only Mother Undernourished (less than 18.5 BMI), Only Child Malnourished (Z-score under 2 sd below reference mean on height-for-age, weight-for-height and/or weight-for-age), and Both Mother and Child Malnourished. The two other combination indicators combine mother's status with the child's stunting status (< -2sd in height-for-age) and with the child's wasting status (< -2sd in weight-for-height). The means and percents of the explanatory variables are tested for significance ($p<.01$, .05, and .10) and measured for strength of association (η^2, eta-squared, a measure of variance explained similar to Pearson's r^2 but for bivariate relationships in which the independent variable is categorical and the dependent is continuous).

4.1 Full Combination Nutritional Status Indicator

Tables II.2a through II.2d present the results of the significance tests and degree of association for the full combination nutritional status indicator for individual countries and in the pooled data set. Table II.2d presents the results for additional characteristics only for the pooled data set.

Table II.2a shows that the full combination indicator significantly discriminates children and that practically all socio-economic and household variables are significantly related with the full combination indicator in all countries and the pooled data set: percent urban, years of mother's education, the asset index and its components. The exceptions are the asset index and drinking water supply in the Central African Republic and drinking water supply in Zimbabwe. Flooring type is only significant at the 10% level in the Central African Republic. For the pooled data set full combination indicator is associated strongest with the asset index ($\eta^2 > .03$) and next strongest with education, flooring, and electricity ($\eta^2 > .02$).

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[10] Alternatively multinomial logits could have been employed but this was thought to be overly complicated and more difficult to interpret.

Table II.2b shows the significance levels and association between the full nutritional status combination indicator and the mother's and child's demographic characteristics. For the pooled data set, owing to its large number of cases, all the variables (mother's age, number of living siblings, percent with dead siblings, child's age, percent female, birth order, birth interval and whether child was unwanted at conception) have significant relationships; for the individual countries no variable in always significant, the closest being child's age, which is not significant in Namibia. For the pooled data set, only child's age has a strong association ($\eta^2 = .03$).

Table II.2c shows the significance levels and association between the full nutritional status combination indicator and maternal care and health status. The four variables relating to pregnancy and birth, medical prenatal care and delivery assistance and birth size and weight, are have significant relationships in all or all but one country and have η^2s over .01. In the pooled data set the combination of both medical prenatal and delivery assistance has an even greater association with an η^2 over .02 (Table II.2d). Prevalence of diarrhea and fever and being acceptably fed are significant in most countries but not all and the associations are weak. Prevalence of cough is not significant in most countries nor in the pooled data set.

Some additional variables related only in the pooled data set are shown in Table II.2d. Among specific vaccinations only Measles has an η^2 over 0.01. Indicators for any and all vaccinations (BCG, Measles and three doses of DPT and Polio) are also not highly related to the full combination nutritional indicator. Other variables which were tested are the number of household members, the number of children under five years of age in the household, whether the mother is working, works away from the home, whether the child is taken care of by someone other than the mother while she works and whether the child comes from a multiple birth. All were not strongly related to the full combination indicator and have η^2 of 0.003 or less.

The percent or mean of each explanatory variable are shown in Table II.3 for the categories of the full combination nutritional status indicator. Since most of these variables are correlated and will be further investigated with multivariate analysis, the differentials are not discussed in detail.

Table II.2a
Significance of Bivariate Relationships with Full Combination Nutritional Status Indicator

Country	Combin-ation	Percent Urban	Education	Consume	Water	Toilet	Vehicle	Flooring	Electricity	Radio	Television	Fridge
Burkina Faso	***	***	***	***	***	***	***	***	***	***	***	***
C.A. R.	**	***	***	--	--	***	***	*	***	***	***	***
Ghana	***	***	***	***	***	***	**	***	***	***	***	***
Kenya	***	***	***	***	***	***	**	***	***	***	***	***
Malawi	***	na	***	***	***	***	***	***	***	***	na	na
Niger	***	***	***	***	***	***	***	***	***	***	***	***
Namibia	***	***	***	***	***	***	***	***	***	***	***	***
Senegal	***	***	***	***	***	***	**	***	***	***	***	***
Zambia	***	***	***	***	***	***	***	***	***	***	***	***
Zimbabwe	***	***	***	***	--	***	**	***	***	***	***	***
All	***	***	***	***	***	***	***	***	***	***	***	***
All-Eta^2	na	.016	.024	.033	.015	.019	.004	.024	.022	.010	.016	.013

-- Not Significant
* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Table II.2b
Significance of Bivariate Relationships with Full Combination Nutritional Status Indicator

Country	Mother's Age	Living Siblings	Mortality Experience	Unwanted	Child's Age	Percent Male	Birth Order	Birth Interval
Burkina Faso	**	--	***	--	***	*	--	***
C.A. R.	--	--	--	--	***	--	--	***
Ghana	--	**	***	--	***	**	***	--
Kenya	--	***	***	*	***	***	***	***
Malawi	*	--	--	--	***	--	--	**
Niger	***	***	***	--	***	**	***	***
Namibia	--	**	*	--	--	--	**	--
Senegal	***	***	**	***	***	***	***	--
Zambia	**	***	***	--	***	--	***	*
Zimbabwe	**	**	***	--	***	--	***	*
All	***	***	***	***	***	***	***	***
All-Eta^2	.002	.002	.006	.001	.030	.002	.003	.002

-- Not Significant
* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

TableII.2c
Significance of Bivariate Relationships with Full Combination Nutritional Status Indicator

Country	Medical Prenatal Care	Medical Delivery Assistance	Birth Weight	Birth Size	Diarrhea	Fever	Cough	Feeding
Burkina Faso	**	***	***	***	***	***	--	--
C.A. R.	***	***	***	***	***	***	--	***
Ghana	***	***	***	--	**	**	--	**
Kenya	***	***	**	***	***	--	--	***
Malawi	***	***	***	***	--	--	--	***
Niger	***	***	***	***	***	***	*	***
Namibia	***	***	***	***	***	***	**	**
Senegal	***	***	***	***	*	**	--	***
Zambia	***	***	***	***	***	***	--	--
Zimbabwe	--	***	***	***	*	--	--	***
All	***	***	***	***	***	***	--	***
All-Eta^2	.012	.018	.016	.010	.005	.003	.000	.001

-- Not Significant
* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Table II.2d
Significance of Bivariate Relationships with Full Combination Nutritional Status Indicator

Country	BCG	DPT 1	DPT 2	DPT 3	Polio 1	Polio 2	Polio 3	Measles	Full Vaccina-tion	Any Vaccina-tion
All	***	***	***	***	***	***	***	***	***	***
All-Eta^2	.002	.003	.004	.003	.003	.004	.005	.012	.006	.002

Country	Mother's Literacy	No. of HH Members	No. of Children Under Five	Mother Working	Mother Works Away	Child has a Minder	Child of a Multiple Birth	Prenatal and Delivery Assistance
All	***	*	***	***	***	***	***	***
All-Eta^2	.017	.000	.001	.001	.001	.001	.003	.021

-- Not Significant
* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

4.2 Stunting and Wasting Combination Nutritional Status Indicators

Table II.4 presents the η^2 measure of association for the stunting and combination wasting indicators along with those of the full indicator for comparison. In most respects the association of explanatory variables is similar between the full and stunting indicators. The wasting indicator shows far weaker associations with the explanatory variables. For the full indicator, the most associated explanatory variables are Household Asset Index, Child's Age, Mother's Education and Prenatal and Delivery Care, in order of association. For the stunting indicator, the highest associated variables are Child's Age, Asset Index, Mother's Education, Prenatal and Delivery Care, and Urban Residence. For the wasting indicator, the most associated variables are Mother's Education or Literacy (tied), Asset Index, and Prenatal and Delivery Care. Child's Age is not very associated with the wasting indicator, but diarrhea and fever in the preceding two weeks more associated than with the full indicator or the stunting indicator.

Table II.3
Percents and Means for Explanatory Variables by Full Combination Nutritional Status Indicator

Explanatory Variable	Mother and Child Normal or Above	Mother Under-nourished	Child Under-nourished	Both Under-nourished
Percent Urban	30.0	22.8	19.4	15.6
Mean Consumption Index	8.8	7.8	7.6	7.2
Mean Years of Mother's Education	3.8	2.7	2.8	2.0
Percent of Children with Literate Mothers	48.6	36.1	38.3	27.4
Mean Mother's Age in Years	28.6	27.7	28.9	28.6
Mean Number of Living Siblings	2.8	2.4	2.8	2.6
Percent of Children with Dead Siblings	34.6	34.6	42.4	41.2
Percent of Children Unwanted	9.2	6.6	8.3	7.4
Mean Child's Age in Months	21.6	21.0	27.7	26.9
Percent of Children Male	48.7	48.5	53.0	52.6
Mean Birth Order	4.1	3.7	4.3	4.0
Percent with Preceding Birth Interval of Less than 24 Months	16.3	13.7	19.8	19.1
Percent of Children whose Mothers received Medical Prenatal Care	81.6	74.0	73.8	66.8
Percent of Children whose Birth was Medically Assisted	53.6	43.1	41.6	33.8
Percent of Children with Both Prenatal and Delivery Care	52.1	41.8	39.9	32.3
Mean Birth Weight in kg.	3.21	3.11	3.04	2.95
Percent of Children who were Small or Very Small at Birth	16.9	21.7	23.7	30.2
Percent of Children From a Multiple Birth	2.0	1.8	3.7	3.4

Explanatory Variable	Mother and Child Normal or Above	Mother Under-nourished	Child Under-nourished	Both Under-nourished
Percent of Children with Diarrhea in Preceding 2 Weeks	19.8	21.3	25.5	28.1
Percent of Children with Fever in Preceding 2 Weeks	38.2	40.3	44.1	43.6
Percent of Children with ARI in Preceding 2 Weeks	16.8	16.9	16.7	17.4
Percent of Children Acceptably Fed	62.3	62.1	65.9	64.9
Percent of Children Fully Vaccinated	43.4	39.4	51.1	45.4
Percent of Children with Any Vaccination	84.4	78.7	84.2	80.1
Mean Number of Household Members	8.7	8.9	8.6	8.9
Mean Number of Children Under 5 Years of Age in Household	2.4	2.5	2.5	2.6
Percent of Children whose Mothers are Currently Working	52.8	48.9	52.4	48.3
Percent of Children whose Mothers Work Away from Home	34.9	30.5	35.3	31.2
Percent of Children who are Cared For by Someone when the Mother is Working	24.1	20.0	21.9	19.4

Table II.4
Association for Explanatory Variables
for Full, Stunting and Wasting Combination Nutritional Status Indicators

Explanatory Variable	Full Association η^2	Stunting Association η^2	Wasting Association η^2
Percent Urban	.016	.016	.004
Mean Consumption Index	.033	.033	.011
Mean Years of Mother's Education	.024	.020	.015
Percent of Children with Literate Mothers	.017	.014	.015
Mean Mother's Age in Years	.002	.002	.001
Mean Number of Living Siblings	.002	.003	.002
Percent of Children with Dead Siblings	.006	.006	.001
Percent of Children Unwanted	.001	.001	.001
Mean Child's Age in Months	.030	.048	.004
Percent of Children Male	.002	.001	.000
Mean Birth Order	.003	.003	.002
Percent with Preceding Birth Interval of Less than 24 Months	.002	.003	.000
Percent of Children whose Mothers received Medical Prenatal Care	.012	.010	.009
Percent of Children whose Birth was Medically Assisted	.018	.017	.008
Percent of Children with Both Prenatal and Delivery Care	.021	.019	.010
Mean Birth Weight in kg.	.016	.015	.006
Percent of Children who were Small or Very Small at Birth	.010	.008	.008
Percent of Children From a Multiple Birth	.003	.003	.001

Explanatory Variable	Full Association η^2	Stunting Association η^2	Wasting Association η^2
Percent of Children with Diarrhea in Preceding 2 Weeks	.005	.002	.008
Percent of Children with Fever in Preceding 2 Weeks	.003	.002	.005
Percent of Children with ARI in Preceding 2 Weeks	.000	.000	.000
Percent of Children Acceptably Fed	.001	.001	.001
Percent of Children Fully Vaccinated	.006	.010	.002
Percent of Children with Any Vaccination	.002	.002	.005
Mean Number of Household Members	.000	.001	.001
Mean Number of Children Under 5 Years of Age in Household	.001	.001	.001
Percent of Children whose Mothers are Currently Working	.001	.001	.001
Percent of Children whose Mothers Work Away from Home	.001	.001	.001
Percent of Children who are Cared For by Someone when the Mother is Working	.001	.001	.001

5. Multivariate Analyses of Nutritional Status

As seen from the univariate analyses above, although child nutritional status is strongly related to maternal status, there are large discrepancies in nutritional status as well. By looking at the combination of mother's and child's status, a goal of this study is to separate the effects of food unavailability from inappropriate infant feeding in contributing to malnutrition. A second goal is to investigate whether maternal and child nutritional statuses are related, once socioeconomic and other determining factors are accounted for.

Given that this investigation is exploratory in nature, several types of relationships will be investigated: the first set of regressions examine the factors that explain mother's BMI score and the percent of mothers who are below 18.5, indicating maternal wasting. The second set of analyses looks at children's chronic nutritional status for all children together. These analyses also compare the explanatory variables for children's nutritional status between mothers who are well-fed and mothers who are malnourished. It is presumed that well-fed mothers are not in a food scarcity situation and that the factors that lead to their children being malnourished are more behavioral in terms of feeding and child care than are mothers who are malnourished, indicative of food unavailability. The third set of analyses examines children's acute nutritional status. The final set of regressions investigate the interactions between mother's nutritional status and explanatory factors of the child's status. In these analyses, both ordinary least-squares linear regressions on child's Z-scores and mother's BMI and logistic regressions on well-nourished-malnourished dichotomies are employed.

5.1 Maternal Nutritional Status

Regressions on maternal nutritional status as measured by BMI and maternal wasting as measured by a BMI less than 18.5 are shown in table II.5. The variables hypothesized to related to maternal status and tested in the regression models are prenatal care and assistance at delivery of the last child, time since the last birth, parity, the interval between the last two births, vaccination status of the last child (proxying use of health services), age, education, work status measured by whether working and working away from home, family burden by whether someone else minds the young children when working away from home, the number of children under five years of age in the household and the total number of household members, and socioeconomic status, measured by husband's education, asset index and urban residency. The regression for maternal BMI is linear, and the regression for maternal wasting is logisitic. The effects move in opposite directions for the two regressions given the opposite direction of the dependent variables, higher BMI being good status and wasting being bad status. Another difference is that the effects of the linear regression are expressed as additions to and subtractions from the mean BMI while those of the logistic regression are expressed as increasing or decreasing the relative odds of being wasted compared to the base category (categorical variables) or to zero (continuous variables). The fit of the linear regression is given by the amount of variance explained (Pearson's R^2). The given set of explanatory variables explains about 15 per cent of variance in individual mothers' BMI. For the logistic regression fit, the ratio of model to total

Table II.5
Mothers's Body Mass Index and Wasting:
Coefficients and Effects from Linear and Logistic Regression

Explanatory Variable	BMI (Weight/Height^2)		Wasting (BMI<18.5)	
	Regression Coefficients	Estimated Effects	Relative Odds	Estimated Effects (Relative Odds)
Prenatal Care	ns		ns	
Assistance at Delivery	+.3459	0.35	.8166	0.82
Time since Birth	ns		1.0045	1.14
Parity	+.1919	1.04	.9400	0.71
Birth Interval	+.0054	0.20	ns	
No. of Breast Feeds	ns		ns	
Any Vaccination	ns		ns	
Full Vaccination	ns		1.1847	1.18
Age	+.0144	0.21	ns	
Education	+.0615	0.48	.9684	0.78
Working	+.2088	0.21	ns	
Works away	ns		.7780	0.78
Child has minder	+.1535	0.15	ns	
Husband's Education	+.0372	0.32	.9649	0.74
No. of HH members	-.0143	-0.15		
No. Members Under 5	ns		ns	
HH Assets	+.2201	1.53	.9423	0.66
Urban	+.4055	0.41	ns	
Fit	R^2=0.147		Model/Total χ^2=.033	
N	22233			

ns Not significant at 5% level

χ^2 (-2 log likelihood) is used as a proxy for Pearson's R. Thus approximately 3 per cent of the variance in likelihood of wasting is explained by the model.

As the regressions contain both dichotomous and continuous explanatory variables, comparing the raw regression coefficients becomes problematic since the scale of the continuous variables affects the relative size of their coefficients. For example, while the dichotomous variables such as having medical assistance at birth vary from zero to one in one jump (yes or no), continuous variables change in small increments such as age which ranges from 15 to 49 years by single years. In order to compare the coefficients of explanatory variables with differing scales, one approach is to use beta coefficients, which are the number of standard deviations of change in the dependent variable, given a one standard deviation change in the explanatory variables. This approach is usually used for continuous variables with divergent scales. In the present case, there are two drawbacks to this approach: 1) the calculation of standard deviations for dichotomous variables is questionable, especially if the distribution is quite skewed and if there is little variance in the explanatory variable because most cases have the same value, then the effects of a change in the explanatory variable will appeared to be reduced; 2) no actual case can have the value of the standard deviation of a dichotomous variable. As an alternative, the following approach is adopted: for dichotomous variables use the regression coefficient, which represents the change from being in the category to being out of it; for continuous variables, use a two-standard deviation change in the explanatory variable multiplied by regression coefficient to approximate a category change in the dichotomous and to compensate for scale differences. The selection of two standard deviations rather than some other number is somewhat arbitrary but, since for normally distributed variables a two standard deviation spread around the mean includes about two-thirds of the cases, this choice would appear to be reasonable for comparison with the dichotomous effects. The significant explanatory factors are ranked according to their approximate effects in Table II.6.

Ten variables significantly affect mother's BMI, while eight affect wasting. The strongest effect is that of the asset index for which a two standard deviation change increases the BMI value by 1.5 points and decreases the relative odds of wasting by about one-third. Parity, or number of children ever born, increase BMI by about 1.0 points and decreases the odds of wasting by almost 30 percent. Other variables which increase the BMI score and decrease the odds of wasting are education of the mother and her husband and assistance at the delivery of the last child. Working and having someone to mind the children while working increases BMI by about 0.2 each, while working away from home decreases the odds of maternal wasting by about 22 percent. BMI increases somewhat with mother's age but age is not significantly associated with wasting. Being in an urban area increases the BMI score by about 0.4; it is not related to wasting, however. An increase in the number of household members decreases BMI, perhaps due to greater scarcity of food, but is not related to wasting. Two variables were found to increase the odds of being wasted although they are not significantly related to BMI: the time since the last birth and the last child being fully vaccinated. These results are unexpected in their direction.

Table II.6
Ranking of Maternal Nutrition Effects

Change in BMI	Linear Regression on BMI	Relative Odds	Logistic Regression on Wasting
> 1.00	HH Assets 1.53 Parity 1.04	< 0.60	
0.76 to 1.00		0.69 to 0.60	HH Assets 0.66
0.51 to 0.75		0.79 to 0.70	Parity 0.71 Husband's Educ. 0.74 Educ. 0.78 Works Away 0.78
0.26 to 0.50	Educ. 0.48 Urban 0.41 Delivery Assistance 0.35 Husband's Educ. 0.32	0.89 to 0.80	Delivery Assistance 0.82
0 to 0.25	Working 0.21 Age 0.21 Minder 0.25	1.00 to 0.90	
0 to -0.25	No. HH members -0.15	1.01 to 1.10	
		1.11 to 1.20	Time since birth 1.14 Full Vaccination 1.18
		>1.20	

5.2 Child Nutritional Status

Table II.7 shows directional and significance indicators for explanatory variables with child's height-for-age z-score as the dependent variable. Table II.8 does the same for weight for height[11]. A selected set of explanatory variables is included in the initial regressions presented in both tables. The first column includes all children; the second includes singly-born children with non-pregnant mothers; the third and fourth columns include singly-born children whose mothers are well-fed and malnourished (less than 18.5 BMI), respectively, and are not pregnant.

5.2.1 Height for Age

For all children, as well as those of well-fed and malnourished mothers, prenatal care and assistance at delivery are positively associated with stature. These variables may be proxies for current well-baby and curative health care. Being small at birth is associated with small stature later. The child's age is also negatively associated with stature since nutritional problems have a cumulative impact

[11]Because weight for age combines the effects of chronic and acute indicators, results for regressions on weight for age are not shown given here. Also see Ruel, Rivera and Habicht (1995) for the utility of using weight for age instead of height for age in nutritional assessment.

on stature. Being of a high birth order leads to shortness, except among malnourished mothers where there is no significant relationship, but longer birth spacing leads to taller children. The first column shows that multiple births are also detrimental to height for age. Being a boy also has a negative impact, according to current reference standards. Among singleton children with non-pregnant mothers and with well-nourished mothers having one of your siblings die is associated with

Table II.7
Child's Height-for-Age Z-Score:
Direction of Effects from Linear Regression

Explanatory Variable	Height for Age			
	All Children	All Children except Multiple Births and with Pregnant Mothers	Children with Well-fed Mothers	Children with Malnourished Mothers
Prenatal Care	+	+	+	ns
Assistance at Delivery	+	+	+	+
Birth Size	-	-	-	-
Child's Age	-	-	-	-
Birth Order	-	-	-	ns
Birth Interval	+	+	+	+
Multiple Birth	-	ni	ni	ni
Male	-	-	-	-
Has dead sibling	ns	ns	-	ns
Pregnancy unwanted	ns	ns	ns	ns
Acceptably Fed	-	-	-	ns
Any Vaccination	-	-	-	-
Full Vaccination	-	-	-	-
Diarrhea	-	-	-	-
Fever	-	-	-	ns
Cough-ARI	ns	ns	ns	ns
Mum's age	+	+	+	ns
Mum's BMI	+	+	**ni**	**ni**
Pregnant	-	ni	ni	ni

Explanatory Variable	Height for Age			
	All Children	All Children except Multiple Births and with Pregnant Mothers	Children with Well-fed Mothers	Children with Malnourished Mothers
Mother's Education	ni	+	+	+
Mother working	ni	ns	ns	ns
Mum works away	-	-	-	-
Child has minder	ns	+	ns	ns
Father's Education	ni	ns	+	ns
No. of HH members	ni	ns	ns	ns
No. Members Under 5	ni	ns	ns	ns
HH Assets	+	+	+	+
Urban	+	ns	ns	ns
R^2	.180	.186	.183	.147
N	33321	28995	25516	3479

+ Increases Z-score
- Decreases Z-score
ns Not significant at 5% level
ni Not included in regression

Note: First column includes pregnant mothers and children of multiple births. Other columns exclude pregnant mothers and children of multiple births.

short stature. Whether another child was wanted by the mother at the time of conception is not significantly associated with stature. There are three very surprising results in table II.7: being acceptably fed and vaccinated is negatively associated with stature. These results hold for both well-nourished and malnourished mothers and will be investigated in more detail below.

As might be expected, recent diarrhea and fever have negative impacts on nutritional status, even chronic status, but cough or acute respiratory infection does not. Diarrhea can cause a lack of the ability to utilize nutrients in the food and the restriction of foods. Fever can cause lack of appetite and use of energy stores for fighting the illness rather than growth.

Mother's age is positively associated with stature except for malnourished mothers. Experience with child rearing and better socio-economic conditions may increase with age of mother, but in situations of food scarcity these may not be enough to overcome malnourishment among children.

Mother's nutritional status, even though only measured acutely, is positively associated with the child's chronic nutritional status. Given that a state of acute malnourishment among women takes a longer time to develop than among children, the association with chronic status is not unexpected. Undernourishment among mothers may indicate a lack of food for children as well and poor nutritional status of the mother during pregnancy may also impact the fetus that carries through after birth. Current pregnancy in the mother also impacts negatively on the child.

Child nutritional status is affected negatively if the mother works away from home, but among well-nourished mothers, having someone else to mind the child during work is positive.

The socio-economic indicators of the asset index and urban residence are positively related to stature, probably from better food security, better knowledge of good child care and feeding practices and greater use of health services.

Among all children and children with well-nourished mothers about 18% of the variance in height-for-age z-score is explained by this set of explanatory variables. About 14% of the variance is explained for children with malnourished mothers (about 12% of children).

5.2.2 Weight for Height

As seen in Table II.8, fewer variables have significant relationships with child's acute nutritional status than with chronic status. Among all children assistance at delivery is positively associated with weight for height but prenatal care is not. One interpretation may be that delivery assistance is more associated with care for acute health problems and that prenatal care is more associated with preventive health care. Small size at birth is associated negatively with acute status for both children with well- and malnourished mothers, but not for all children together. The child's age is negatively associated with nutritional status, but univariate distributions indicate a curvilinear relationship not modeled here. Birth order is negatively related to weight only for all children. Birth interval in not significantly related to acute nutritional status and neither is mortality experience. Being a boy is detrimental to status for children with well-fed mothers but not for those with malnourished mothers.

Again as puzzling as for chronic status, being acceptably fed and vaccinated appear to negatively impact on weight for height. Recent diarrhea and fever, though, have the expected negative impact, but cough and ARI are not related to acute status.

Mother's age is negatively related to weight for well-fed mothers, also some what puzzling.

Mother's nutritional status is positively associated with weight for height as well as for height for age, again as expected.

Both pregnancy and wantedness during pregnancy are detrimental to acute nutritional status when all children are considered.

Working away from home does not affect acute status but having someone else to care for the child while the mother works is positively associated with weight for height among children with well-fed mothers. The asset index is also positively associated with acute status among these children.

This set of explanatory variables explains between 8 and 11 percent of the variance in the weight-for-height z-score.

Table II.8
Child's Weight-for-Height Z-Score:
Direction of Effects from Linear Regression

Explanatory Variable	Weight for Height			
	All Children	All Children except Multiple Births and with Pregnant Mothers	Children with Well-fed Mothers	Children with Mal-nourished Mothers
Prenatal Care	ns	ns	ns	ns
Assistance at Delivery	+	+	+	ns
Birth Size	-	-	-	-
Child's Age	-	-	-	-
Birth Order	-	ns	ns	ns
Birth Interval	ns	ns	ns	ns
Multiple Birth	-	ni	ni	ni
Male	-	-	-	ns
Has dead sibling	ns	ns	ns	ns
Pregnancy unwanted	-	ns	ns	ns
Acceptably Fed	-	-	-	-
Any Vaccination	-	-	-	ns
Full Vaccination	-	-	-	-
Diarrhea	-	-	-	-
Fever	-	-	-	-
Cough-ARI	ns	ns	ns	ns

Explanatory Variable	Weight for Height			
	All Children	All Children except Multiple Births and with Pregnant Mothers	Children with Well-fed Mothers	Children with Mal-nourished Mothers
Mum's age	ns	-	-	ns
Mum's BMI	+	+	**ni**	**ni**
Pregnant	-	ni	ni	ni
Mother's Education	ni	+	+	+
Mother working	ni	ns	ns	ns
Mum works away	ns	ns	ns	ns
Child has minder	+	ns	ns	ns
Father's Education	ni	ns	ns	ns
No. of HH members	ni	-	-	ns
No. Members Under 5	ni	ns	ns	ns
HH Assets	+	ns	+	ns
Urban	ns	ns	ns	ns
R^2	.106	.109	.090	.086
N	33321	28995	25516	3479

+ Increases Z-score
- Decreases Z-score
ns Not significant at 5% level
ni Not included in regression

Note: First column includes pregnant mothers and children of multiple births. Other columns exclude pregnant mothers and children of multiple births.

5.3 Child Nutritional Status by Age

Although the feeding variable ACCFED was constructed taking into account the age of the child, its unexpected negative relation with nutritional status and that of vaccination prompted a more detailed analysis that separates children by age and feeding into each of its components. Thus regressions on child's z-scores were run separately for age groups under four months, four to six months, 7 to 11 months, 12-23 months and 24+ months, corresponding approximately to age groups with differing feeding and vaccination recommendations. In addition, because the impact of proper feeding may be greatest at lower living levels, the regressions were rerun selecting families with

asset indexes below the mean of the index for all families. The results of the regressions are shown in tables II.9 to II.15.

5.3.1 Height-for-Age

Table II.9 shows the direction of effects and significance of explanatory variables for age-group regressions on height-for-age z-score for all children and children of low-asset families. The regression coefficients and estimated effects are shown in table II.10.

As might have been expected the number of significant variables and the amount of variance explained increases with age, because height-for-age reflects cumulative effects and the higher age categories contain more cases. The R^2s rise from 11 to 15% according to the age of the child.

Maternal nutritional status, as measured by body mass index, is positively related to the child's nutritional status at all ages, except for children 4-6 months from low-asset families, even after controlling for a host of possibly confounding effects. This relationship could be due to several factors: better prenatal nutritional status of the mother, especially of micronutrients, may allow the child to grow at a faster rate both pre- and post-natally; mother's BMI may be indicative of nutritional and health care knowledge and practice that carries over to the child; poor maternal status may indicate food shortages that impact on children's feeding and the ability to provide adequate health and child care.

Prenatal care and delivery assistance are positively related with stature at ages over 6 months. Since this is not close to birth, these variables are probably acting as proxies for the use of health services in general. Being small at birth and being male are consistently negatively related with stature. Also the older the child, the farther behind he/she falls behind the reference standard, to be expected since stature shows the cumulative effects of malnutrition. Being of high birth order is usually negatively associated with chronic nutritional status. At the older ages, a longer birth interval is positively associated with nutritional status. Both these variables appear to indicate that available child care is associated with nutritional status. Further evidence is given by whether the mother work, works away, and number of children under 5 in the household, which are also negatively related to nutritional status at the older ages.

The feeding variables are of particular interest in this set of regressions, given their unexpected relationship with nutritional status when combined into a single index. They have been separated into whether breast-feeding, given water, milk or formula, other liquids, solids and use of a bottle for feeding.

Being breast-fed has a negative impact on chronic nutritional status as measured by stature at all ages above three months, even among the low-asset families. This result is clearly not as expected and needs further investigation. Feeding a child solid foods, however, has a positive relationship with stature, even at the youngest age group, also not as expected. (Note the non-significance of breast-feeding for children less than 4 months of age and of solid foods for children 24+ months of age is

probably due to lack of variance since almost all children breast-feed at the youngest age group and almost all children get solid foods at the highest age group.)

Bottle feeding has a negative impact on stature for all children 4 to 23 months and even for children 12-23 months in the low-asset group. Even though bottle feeding is not significant at the lowest age group, children given milk or formula at less than four months of age are taller.

Overall there is little difference in the direction of the feeding variables between the all children regressions and the regressions selecting only the families with below average assets.

Table II.9
Child's Height-for-Age Z-score:
Direction of Effects from Linear Regression
for All Children and Children of Low Asset Families

Explanatory Variable	All Children					Low Assets				
	Less than 4 mos.	4-6 mos.	7-11 mos.	12-23 mos.	24+ mos.	Less than 4 mos.	4-6 mos.	7-11 mos.	12-23 mos.	24+ mos.
Prenatal Care	ns	ns	+	ns	+	ns	ns	+	ns	ns
Assistance at Delivery	ns	ns	+	+	+	ns	ns	ns	+	+
Birth Size	-	-	-	-	-	-	-	-	-	-
Child's Age	-	-	-	-	-	-	-	-	-	-
Birth Order	+	-	ns	ns	-	ns	-	ns	ns	-
Birth Interval	ns	ns	+	+	+	ns	ns	ns	+	+
Male	-	-	-	-	-	-	ns	-	-	-
Has dead sibling	ns	ns	ns	ns	ns	ns	ns	ns	-	ns
Breast-fed	ns	-	-	-	-	ns	-	-	-	-
Water	ns	ns	+	ns	ns	ns	ns	ns	ns	+
Milk/Formula	+	ns	ns	ns	ns	ns	ns	ns	ns	ns
Bottle	ns	-	-	-	ns	ns	ns	ns	-	ns
Liquids	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Solids	+	+	+	+	ns	+	+	+	+	ns
Any Vaccination	ns	ns	ns	ns	ns	+	ns	ns	ns	ns
Full Vaccination	+	+	ns	ns	ns	ns	+	ns	ns	ns
Diarrhea	ns	ns	ns	-	-	ns	ns	ns	-	-

Explanatory Variable	All Children					Low Assets				
	Less than 4 mos.	4-6 mos.	7-11 mos.	12-23 mos.	24+ mos.	Less than 4 mos.	4-6 mos.	7-11 mos.	12-23 mos.	24+ mos.
Fever	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Mum's age	ns	+	ns	ns	+	ns	+	ns	ns	+
Mum's Years of Education	ns	+	ns	ns	+	ns	ns	ns	ns	+
Mum's BMI	+	+	+	+	+	+	ns	+	+	+
Mum works	ns	ns	ns	ns	ns	ns	ns	ns	-	ns
Mum works away	ns	ns	ns	ns	-	ns	ns	ns	ns	-
Child has minder	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Dad's Years of education	ns	ns	ns	+	24	ns	ns	ns	ns	ns
No. Under 5 in HH	ns	ns	ns	-	ns	ns	ns	ns	-	ns
No. of HH members	ns	ns	ns	ns	ns	ns	ns	ns	+	ns
HH Assets	ns	+	+	+	+	ns	ns	ns	+	+
Urban	ns	ns	+	+	ns	ns	ns	+	ns	ns
R^2	.113	.141	.151	.154	0.15	.098	.119	.125	.130	.098
N	2771	2435	3574	6918	13297	1528	1350	1949	3686	6843

+ Increases Z-score
- Decreases Z-score
ns Not significant

Table II.10
Child's Height-for-Age Z-Score by Age Group:
Linear Regression Coefficients and Approximate Effects

Explanatory Variable	All Children (excluding multiple births and pregnant mothers)									
	Less than 4 mos.		4-6 mos.		7-11 mos.		12-23 mos.		24+ mos.	
	B	Effect	B	Effect	B	Effect	B	Effect	B	Effect
Prenatal Care	ns		ns		+.13	0.13	ns		+.08	0.08
Assistance at Delivery	ns		ns		+.14	0.14	+.11	0.11	+.11	0.11
Birth Size	-.48	-0.48	-.54	-0.54	-.56	-0.56	-.37	-0.37	-.29	-0.29
Child's Age	-.1325	-0.26	-.1558	-0.25	-.1153	-0.33	-.0921	-0.63	-.0085	-0.18
Birth Order	+.0247	+.13	-.0426	-0.23	ns		ns		-.0523	-0.05
Birth Interval	ns		ns		+.0029	0.10	+.0037	0.13	+.0042	0.15
Male	-.17	-0.17	-.17	-0.17	-.26	-0.26	-.16	-0.16	-.08	-0.08
Breast-fed	ns		-.51	-0.51	-1.09	-1.09	-.55	-0.55	-.57	-0.57
Water	ns		ns		+.20	0.20	ns		ns	
Milk/Formula	+.16	+.16	ns		ns		ns		ns	
Bottle	ns		-.23	-0.23	-.37	-0.37	-.22	-0.22	ns	
Liquids	ns		ns		ns		ns		ns	
Solids	+.22	+.22	+.24	+.24	+.18	0.18	+.10	0.10	ns	
Full Vaccination	+.77	+.77	+.90	+.90	ns		ns		ns	
Diarrhea	ns		ns		ns		-.16	-0.16	-.28	-0.28
Fever	ns		ns		ns		ns		ns	

Explanatory Variable	All Children (excluding multiple births and pregnant mothers)									
	Less than 4 mos.		4-6 mos.		7-11 mos.		12-23 mos.		24+ mos.	
	B	Effect	B	Effect	B	Effect	B	Effect	B	Effect
Mum's age	ns		+.0277	0.39	ns		ns		+.0274	0.38
Mum's Years of Education	ns		+.0189	0.15	ns		ns		+.0296	0.23
Mum's BMI	**+.0455**	**+.28**	**+.0270**	**0.17**	**+.0299**	**0.20**	**+.0304**	0.20	**+.0303**	**0.22**
Mum works	ns		ns		ns		ns		ns	
Mum works away	ns		ns		ns		ns		-.06	-0.06
Child has minder	ns		ns		ns		ns		ns	
Dad's Years of education	ns		ns		ns		+.0112	0.09	.0156	0.13
No. Under 5 in HH	ns		ns		ns		-.0345	-0.10	ns	
No. of HH members	ns		ns		ns		ns		ns	
HH Assets	ns		+.0205	0.14	+.0394	0.26	+.0306	0.21	+.0495	0.35
Urban	ns		ns		+.21	0.21	+.11	0.11	ns	
R^2	.113		.141		.151		.149		0.154	
N	2771		2435		3574		6918		13297	

B is OLS regression coefficient
Effect is regression coefficient for dichotomous variables and two standard deviation effect of continuous variables
ns Not significant

Vaccination status is related to stature at for children up to six months of age. Full vaccination, which includes BCG usually given at birth, three doses of DPT and Polio and Measles, is positively related for all children under 6 months and for children of low-asset families at 4 to 6 months. Since measles vaccination is usually given around eight months of age, this relationship is puzzling.[12] Vaccination status may be proxying for use of health services or socioeconomic status over and above that controlled for by maternal care and the asset index.

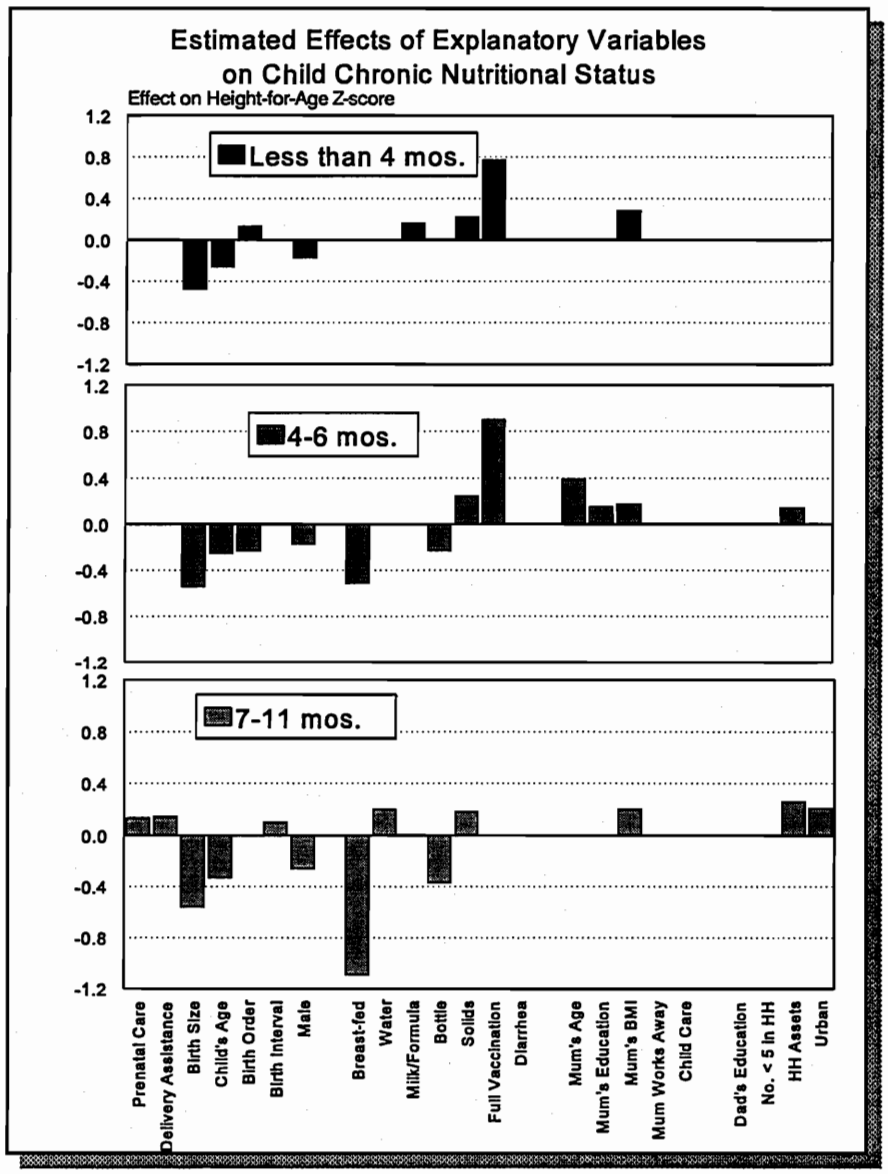

Figure II.4 Effects of Explanatory Factors on Child's Height for Age

Having had diarrhea in the preceding two weeks is negatively associated with stature for children one year of age and older. Neither fever nor acute respiratory infection are related to stature.

Socioeconomic status, as measured by family assets and maternal education, is mostly related positively to height-for-age in the regressions for all children 4 months of age and above. Neither variable is significantly related to stature of children under four months. For children from poorer families, however, these variables are significantly related to stature only for children above 12 and 23 months, respectively. Urban residence is positively related to height-for-age

[12] A forthcoming study on the relationship between measles vaccination and nutritional status shows that measles vaccination interacts with wealth such that it is related to wasting only for poorer families and is not related to stunting (Haggerty and Stewart, 1996).

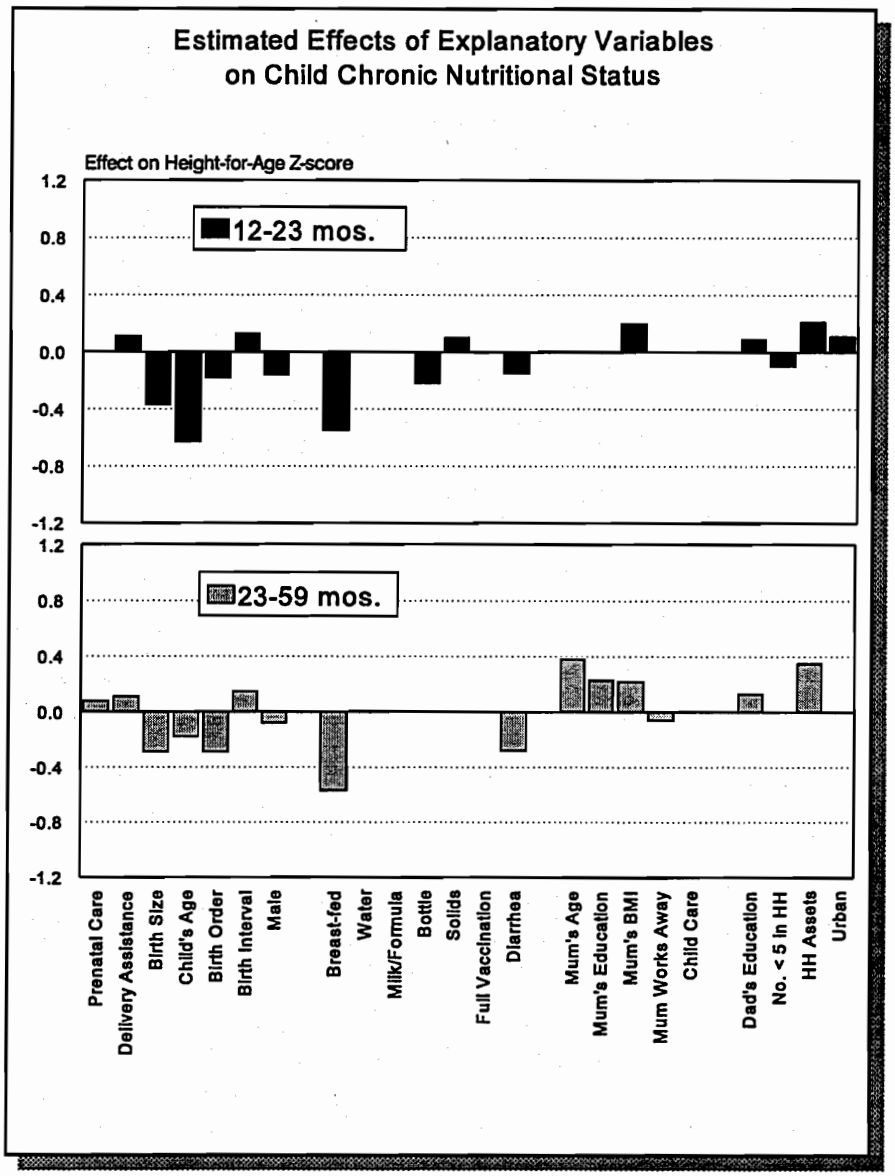

Figure II.4 (continued)

for children in the middle age groups, 7-11 and 12-23 months for all children and only 7-11 months for poorer children.

5.3.2 Height-for-Age Rank of Effects

Table II.11 contains the regression coefficients and estimated effect on height-for-age z-scores, according to age of child, for children of all asset index levels, ranked by strength of effect. Figure II.4 presents the effects graphically. As the regressions contain both dichotomous and continuous explanatory variables, comparing the raw regression coefficients becomes problematic since the scale of the continuous variables affects the relative size of their coefficients. For example, while the dichotomous variables such as having medical assistance at birth vary from zero to one in one jump (yes or no), continuous variables change in small increments such as mother's age which ranges from 15 to 49 years by single years. In order to compare the coefficients of explanatory variables with differing scales, one approach is to use beta coefficients, which are the number of standard deviations of change in the dependent variable, given a one standard deviation change in the explanatory variables. This approach is usually used for continuous variables with divergent scales. In the present case, there are two drawbacks to this approach: 1) the calculation of standard deviations for dichotomous variables is questionable, especially if the distribution is quite skewed and if there is little variance in the explanatory variable because most cases have the same value, then the effects of a change in the explanatory variable will appeared to be reduced; 2) no actual case can have the value of the

standard deviation of a dichotomous variable. As an alternative, the following approach is adopted: for dichotomous variables use the regression coefficient, which represents the change from being in the category to being out of it; for continuous variables, use a two-standard deviation change in the explanatory variable multiplied by regression coefficient to approximate a category change in the dichotomous and to compensate for scale differences. The selection of two standard deviations rather than some other number is somewhat arbitrary but, since for normally distributed variables a two standard deviation spread around the mean includes about two-thirds of the cases, this choice would appear to be reasonable for comparison with the dichotomous effects.

From Table II.11 and Figure II.4, it can be clearly seen that the number of factors that significantly affect stature rises with age. Seven variables (other than child's age, which is a structural control) significantly affect stature of children of less than four months of age and thirteen variables do so for children over two years of age.

For the youngest children the greatest positive effect is that of full vaccination adding almost 0.8 z-scores. This is a surprising finding since the recommended age for measles vaccination is about 8 months so that relatively few children would be fully vaccinated so early in life. The strength of full vaccination continues into age group four-to-six months where it adds nine-tenths of a z-score.

Table II.11
Children's Height-for-Age Z-Score by Age Group:
Ranking of Effects of Explanatory Variables

Change in Z-Score	<4 months	4-6 months	7-11 months	12-23 months	24+ months
>.60	Full Vaccination .77	Full Vaccination .90			
.40-.60					
.20-.40	BMI .28 Solids .22	M age .39 Solids .24	HH Assets .26 Urban .21 Water .20 BMI .20	HH Assets .21 BMI .20	M Age .38 HH Assets .35 M Educ. .23 BMI .22
0-.20	Milk .16 Birth Order .13	BMI .17 M educ. .15 HH Assets .14		Assist .11 Urban .11 Solids .10 F Educ. .09	B Int .15 F Educ. .13 Assist .11 Prenatal .08
0--.20	Male -.17			No. < 5 .10 Male -.16 Diarrhea -.16	Away -.06 Male -.08

Change in Z-Score	<4 months	4-6 months	7-11 months	12-23 months	24+ months
-.20--.40		Bottle -.23 Birth Ord -.23	Male -.26 Bottle -.37	Bottle -.22 Birth Size -.37	Diarrhea -.28 Birth Size -.39
-.40--.60	Birth Size -.48	Breast -.51 Birth Size -.54	Birth Size -.56	Breast -.55	Breast -.57
<-.60			Breast -1.09		

Mother's nutritional status is relatively important to stature as it adds between about 0.2 to 0.3 z-scores to child's stature for a two standard deviation increase in mother's BMI. Being of small or very small at birth, which may be related to the mother's prenatal nutritional status, is substantially negatively related to stature, decreasing the z-score by about 0.4 to 0.6 depending on age. This variable, reported by the mother at the time of interview when the child's anthropometry was done, may in part be affected by the current status, even though it correlates well with birth weight where available. Birth weight was not used in the model since a majority of children were not weighed at birth.

The results for feeding variables are quite puzzling: on the one hand getting solids and non-breast milk early in the first year of life increases stature by about 0.2 z-scores and receiving breast milk at 4 to 6 months of age and over decreases stature considerably, from one-half to a full z-score. These findings are contrary to recommended practice of exclusive breast-feeding for children under four months, considered optimal for this age, and continuing breast-feeding well into the second year of life. Although consideration of socio-economic differences in health care were controlled through including the asset index, mother's and father's education and prenatal care and delivery assistance in the regressions, perhaps there is still some correlation left which confounds both the feeding and vaccination results. Further investigation is therefore warranted, but is beyond the scope of this report. Use of a bottle to receive foods is detrimental to stature for children 4 to 23 months, having an effect between about -0.2 to -0.4 z-scores. This is in line with recommended feeding practice.

As expected, higher values of the socio-economic variables add to the stature z-score for children four months and older. The effect of the socio-economic variables increases with the age of the child. A two-standard deviation increase in the asset index adds between about 0.1 to about 0.3 z-scores to stature between age groups 4 to 6 months and 24+ months, respectively. Education, either mother's or father's adds between 0.1 to 0.2 z-scores for a two-standard deviation increase in the number of years of education. Urban residence is significant for children in the latter half of the first year of life, adding 0.1 to 0.2 z-scores to stature. Taken together a two-standard deviation change in each of the socio-economic variables would add between 0.3 to 0.8 z-scores to stature, the older the child the greater the effect.

Illness and health care affect stature significantly for children 12 months of age or more. Children who have had diarrhea in the two weeks preceding the anthropometry were shorter by -0.2 to -0.3 z-scores than children who were not so affected. Prevalence of fever did not affect stature. Prenatal care and assistance at birth increased stature by about 0.1 z-scores each. Since this effect comes about a year or more after birth, any direct effect is probably null, but the relationship likely is proxying for greater access to health care, which is not measured directly in the DHS data.

Child care has a small effect on stature as measured by proxies: the number of children under five years of age and if the mother works away from home decrease the height-for-age z-score by about -0.1 for child one year of age and two years and over, respectively. Mother's age, which may proxy for child-raising experience increases stature by about 0.4 in two separated age groups, 4 to 6 moths and 24+ months.

Another inconsistency is shown by birth order: children of higher birth order due better when under four months of age and due worse when 4 to 6 months of age. Compared to the reference standard, male children are more likely to be shorter than are female children at four out of the five age groups, the effect ranging from about -0.1 to -0.3 z-scores.

5.3.3 Stunting

Another way of viewing chronic nutritional problems beyond general stature is to concentrate on those who are most malnourished. In this case instead of using the entire range of z-scores, a cut-off point of two z-scores below the mean of the reference standard is used to determine stunting. The variables and factors that explain stunting may be different from those that explain the entire height-for-age distribution and for those that are the same may differ in the amount by which they affect the dependent variable. Since the dependent variable is dichotomous, logistic regressions were run to assess the effects of the explanatory variables (Table II.12). The interpretation of the coefficients of these variables is different from that of linear regression. In linear regression, the coefficients are added (or subtracted) to get the predicted z-score. In logistic regression, the dependent variable is the odds of belonging to a group. The coefficients of the explanatory variables are then the

Table II.12
Child's Stunting by Age Group:
Logistic Regression Coefficients and Approximate Effects

Explanatory Variable	All Children (excluding multiple births and pregnant mothers)									
	Less than 4 mos.		4-6 mos.		7-11 mos.		12-23 mos.		24+ mos.	
	Relative Odds	Effect	Relative Odds	Effect	Relative Odds	Effect	Relative Odds	Effect	Relative Odds	Effect
Prenatal Care	0.5814	0.58	0.6066	0.61	0.6413	0.64	0.8189	0.82	0.8624	0.86
Assistance at Delivery	0.6489	0.65	ns		ns		0.7968	0.80	0.8513	0.85
Birth Size	2.7752	2.78	2.5716	2.57	2.3305	2.33	1.7489	1.75	1.5170	1.52
Child's Age	1.7198	2.89	1.4068	1.74	1.1772	1.59	1.1229	2.21	1.0072	1.16
Birth Order	ns		ns		ns		ns		1.0066	1.04
Short Birth Int	ns		1.2534	1.25	1.1278	1.13	ns		1.2340	1.23
Male	ns		ns		1.5970	1.60	1.3595	1.36	1.0866	1.09
Has dead sibling	ns		ns		ns		1.1890	1.19	ns	
Breast-fed	ns		ns		ns		1.5397	1.54	1.7868	1.79
Water	ns		ns		ns		ns		0.9112	0.91
Milk/Formula	ns		ns		ns		ns		ns	
Bottle	ns		ns		1.4987	1.50	1.4575	1.46	ns	
Liquids	ns		ns		ns		ns		ns	
Solids	ns		0.6806	0.68	0.7351	0.74	ns		ns	
Any Vaccination	ns		0.6193	0.62	ns		ns		ns	
Full Vaccination	ns		ns		ns		ns		ns	

Explanatory Variable	All Children (excluding multiple births and pregnant mothers)									
	Less than 4 mos.		4-6 mos.		7-11 mos.		12-23 mos.		24+ mos.	
	Relative Odds	Effect	Relative Odds	Effect	Relative Odds	Effect	Relative Odds	Effect	Relative Odds	Effect
Diarrhea	ns		ns		ns		1.1671	1.17	1.3494	1.35
Fever	ns		ns		ns		ns		ns	
Mum's age	ns		ns		ns		0.9882	0.85	0.9566	0.54
Mum's Years of Education	ns		0.9185	0.52	0.9573	0.71	0.9782	0.84	0.9568	0.71
Mum's BMI	**0.9279**	**0.63**	**0.9475**	**0.71**	**0.9457**	**0.69**	**0.9624**	0.77	**0.9581**	**0.73**
Mum works	ns		ns		ns		ns		ns	
Mum works away	ns		ns		ns		1.1306	1.13	1.1787	1.18
Child has minder	ns		ns		ns		ns		ns	
Dad's Years of education	ns		ns		ns		0.9707	0.78	0.9766	0.82
No. Under 5 in HH	ns		ns		ns		1.0831	1.27	1.0409	1.06
No. of HH members	ns		ns		ns		ns		ns	
HH Assets	ns		ns		0.9105	0.53	0.9520	0.72	0.9248	0.58
Urban	ns		ns		ns		ns		ns	
Model/Total χ^2	0.098		0.100		0.093		0.082		0.090	
N	2771		2435		3574		6918		13297	

B is OLS regression coefficient
Effect is regression coefficient for dichotomous variables and two standard deviation effect of continuous variables
ns Not significant

proportion by which the odds are increased or decreased multiplicatively, i.e the odds ratio.[13] Under logistic regression, the proportion of variance explained cannot be directly assessed; we have used the ratio of the model to total χ^2 to approximate it.

Table II.13 shows the rank of the effects of the factors significant in explaining whether or not a child is stunted. For dichotomous variables, the odds ratios shown are the exponentiated coefficients, as discussed above. For continuous variables, whose coefficients are affected by the variables scale, the odds ratios have been calculated for a two standard deviation change in the explanatory variable. Odds ratio effects below 1.0 decrease the likelihood of being stunted, while those above one increase the likelihood. Because of the nature of proportions, a given numeric value does not have proportional effects above and below one. Thus an odds ratio of 0.33 decreases the odds to one-third while one of 3.0 triples the odds.

Only four variables significantly explain stunting at less than four months. They are small or very small birth size, which almost triples the likelihood of stunting, and prenatal care, delivery assistance, and a two standard deviation increase in mother's nutritional status, which reduce the likelihood of stunting between 35 and 42 percent. It is interesting to note that all these variables can be related to prenatal growth. Birth size and mother's BMI are also highly related to stunting at the other ages. Small size at birth increases the likelihood of being stunted between 54 and 133% even at ages over four months. As noted before, part of this relationship may be due to a post-hoc evaluation. Also at ages over 4 months, a two standard deviation increase in mother's BMI reduces the probability that the child is stunted by between 23 and 31 percent. With increasing age, prenatal care and delivery assistance weaken in their effects on stunting until they achieve only about a 15% reduction in stunting for children two years of age and over.

Over four months of age, the feeding variables become significant. Receiving solid or mushy foods reduces stunting by almost one-third at 4 to 6 months and one-fourth at 7 to 11 months. Using a baby bottle at 7 to 23 months increases the odds of stunting by about one-half. Breast-feeding of children one year of age and over increase the likelihood of stunting by 54 to 79 percent.

Education affects the odds of stunting starting with children age four months. At four to six months of age a mother's education decreases stunting the most, a two standard deviation increase in years of schooling reducing the likelihood of stunting by about one-half. At older ages mother's education reduces stunting between 16 and 29 percent. Father's education, perhaps more related to economic status and thus food availability, affects children after the first birthday, reducing stunting by about 20% for a two standard deviation increase in years. Another measure of economic status is the asset index. It is among the most important predictors of stunting for children above age six months, decreasing the odds of being stunted between 28 and 47 percent. Mother's age reduces the odds of

[13] For calculation of the regression the actual dependent variable is the log of the odds so that the coefficients are exponentiated to get the odds ratios.

being stunted by 15 percent for children one year of age and by 46% for children two years of age and over (two standard deviation increase).

Table II.13
Child's Stunting
Ranking of Effects of Explanatory Variables

Estimated Relative Odds Effects	<4 months	4-6 months	7-11 months	12-23 months	24+ months
< 0.60	Prenatal Care 0.58	M Educ. 0.52	HH Assets 0.53		M Age 0.54 HH Assets 0.58
0.69 to 0.60	Mother's BMI 0.63 Assistance 0.65	Prenatal Care 0.61 Any Vaccination 0.62 Solids 0.68	Prenatal Care 0.64 Mother's BMI 0.69		
0.79 to 0.70		Mother's BMI 0.71	M Educ. 0.71 Solid 0.74	HH Assets 0.72 Mother's BMI 0.77 F Educ. 0.78	M Educ. 0.71 Mother's BMI 0.73
0.89 to 0.80				Assistance 0.80 Prenatal Care 0.82 M Educ. 0.84 M Age 0.85	F Educ. 0.82 Assistance 0.85 Prenatal Care 0.86
1.00 to 0.90					Water 0.91
1.01 to 1.10					Birth Order 1.04 No. <5 in HH 1.06 Male 1.09
1.11 to 1.20			Short Birth Int. 1.13	Works Away 1.13 Diarrhea 1.17 Dead Sibling 1.19	Works Away 1.18
1.21 to 1.30		Short Birth Int. 1.25		No. <5 in HH 1.27	Short Birth Int. 1.23
1.31 to 1.40				Male 1.36	Diarrhea 1.35
>1.40	Birth Size 2.78	Birth Size 1.74	Bottle 1.50 Male 1.60 Birth Size 2.33	Bottle 1.46 Breast-fed 1.54 Birth Size 1.75	Birth Size 1.52 Breast-fed 1.79
Model/Total χ^2	.098	.100	.093	.082	.090
N	2771	2435	3574	6918	13297

Among the demographic characteristics of children, being male and having a short preceding birth interval both increase the odds of being stunted in three of the four age groups over four months of age. Being male increases the odds of stunting by 60 percent for children 7 to 11 months of age. The amount of the increase in the odds declines to 36 percent and 9 percent at one year of age and

two years and over, respectively. Being born after a short birth interval increases the odds of stunting between 12 and 25 percent for ages 4-6, 7-11 and 24+ months. It is not a significant factor for children 12-23 months.

Three variables are have significant effects only for children one year of age or older: the number of children in the household, whether the mother works away from home and whether the child had diarrhea in the preceding two weeks. All increase the likelihood of being stunted. The largest effect is that of recent diarrhea for children two years and older, being 35% more likely to be stunted. The mother working away from home increases the odds of being stunted by 13 and 18 percent, respectively, for children ages 12 to 23 months and 24 months and over.

Variables with small and/or inconsistent effects are having any vaccination (38% decrease in odds of being stunted at 4-6 months), having a dead sibling (19% increase at 12-23), getting plain water (9% decrease at 24+), birth order (4% increase in the odds at 24+ for a two standard deviation increase in order).

Judged by the ratio of the model to total chi-square terms, the explanatory power of the models to predict stunting at each age group is fairly low, ranging from 8 to 10 percent of "variance" explained. However, predicting individual likelihood of stunting is difficult and depends on many individual circumstances that were not measured.

5.3.4 Weight for Height

The significance and direction of effects of the explanatory variables of the linear regression on child's weight-for-height z-score according to age are given in Table II.14 for all children and for children from families with less than the mean score on the asset index. Fewer variables are significant for acute status than for chronic status, and this is reflected in the R^2s which vary from 8 to 14 percent of variance explained. Since in general the results do not vary substantially between all children and poorer children, only the all children results will be discussed.

The mother's nutritional status is positively associated with the weight-for-height z-score of the child at all ages and being small at birth is negatively associated with weight-for-height but this latter relationship may be due to a post-hoc evaluation.

Probably representing use of health services, neither prenatal care nor delivery assistance are significantly related to thinness except that prenatal care is unexpectedly inversely related for children two years of age and above.

Among the demographic variables, neither birth order nor birth interval are associated with thinness. Being male is negatively associated with weight-for-height during between six months and two years of age, while having a dead sibling increases weight-for-height among children two years and older.

Being breast-fed is negative for children over one-year of age. For children age one year, using a bottle and receiving solid foods is positively related to weight-for-height. For younger children at 4 to 6 months of age, getting solids is negatively related to weight-for-height as is getting liquids other than milk or water at under four months.

Receiving any vaccination is not related to body mass and being fully vaccination is surprisingly negatively related but only for children in the latter half of the first year of life. Having had diarrhea and/or fever in the preceding two weeks is each negatively associated with weight-for-height in three of the five age groups. Neither illness affects the youngest children.

Table II.14
Child's Weight-for-Height Z-Score by Age Group:
Direction of Effects from Linear Regression for All Children and Children of Low Asset Families

Explanatory Variable	All Children					Low Assets				
	Less than 4 mos.	4-6 mos.	7-11 mos.	12-23 mos.	24+ mos.	Less than 4 mos.	4-6 mos.	7-11 mos.	12-23 mos.	24+ mos.
Prenatal Care	-	ns	ns	ns	-	ns	ns	ns	ns	ns
Assistance at Delivery	ns	ns	ns	ns	ns	-	ns	ns	ns	ns
Birth Size	-	-	-	-	-	-	-	ns	-	-
Child's Age	+	-	-	ns	ns	+	-	-	ns	+
Birth Order	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Birth Interval	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Male	ns	ns	-	-	ns	ns	ns	-	-	-
Has dead sibling	ns	ns	ns	ns	+	ns	ns	ns	ns	+
Breast-fed	ns	ns	ns	-	-	ns	ns	ns	-	-
Water	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Milk/Formula	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Bottle	ns	ns	ns	+	ns	ns	ns	ns	+	ns
Liquids	-	ns	ns	ns	ns	-	ns	-	ns	ns
Solids	ns	-	ns	+	ns	ns	ns	ns	+	ns
Any Vaccination	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Full Vaccination	ns	ns	-	ns	ns	ns	ns	ns	ns	ns
Diarrhea	ns	-	ns	-	-	ns	-	ns	-	-
Fever	ns	ns	-	-	-	ns	-	-	-	-

Explanatory Variable	All Children					Low Assets				
	Less than 4 mos.	4-6 mos.	7-11 mos.	12-23 mos.	24+ mos.	Less than 4 mos.	4-6 mos.	7-11 mos.	12-23 mos.	24+ mos.
Mum's age	ns	-	ns	ns	ns	ns	-	-	ns	ns
Mum's Years of Education	ns	+	+	ns	ns	ns	ns	+	+	+
Mum's BMI	+	+	+	+	+	+	+	+	+	+
Mum works	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Mum works away	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Child has minder	ns	ns	ns	ns	+	ns	ns	ns	ns	ns
Dad's education	+	ns	+	+	ns	ns	ns	ns	ns	ns
No. Under 5 in HH	ns	ns	-	ns	-	ns	ns	ns	ns	-
No. of HH members	ns	ns	ns	-	ns	ns	ns	ns	ns	ns
HH Assets	ns	ns	ns	+	ns	ns	ns	ns	ns	ns
Urban	ns	ns	ns	ns	ns	ns	ns	ns	+	ns
R^2	.086	.124	.130	.136	.108	.095	.118	.103	.126	.138
N	2771	2435	3574	6918	13297	1528	1350	1949	3686	6843

+ Increases Z-score
- Decreases Z-score
ns Not significant

The work status and child care variables are not significantly related to weight-for-height except that for the children two years of age and over having someone to mind the child while the mother works is positively related.

Mother's and father's education increases weight-for-height in three and one age groups, respectively but is not significant for the youngest and oldest children. The asset index is positively related to weight-for-height only for children age one year and urban residence is not significantly related.

The number of children under five years in the household and the total number of household members increase thinness at ages above 6 months, perhaps reflecting decreased food availability during the time children are requiring supplementation.

5.3.5 Weight for Height Size and Rank of Effects

Mother's nutritional status as measured by the body mass index is consistently the most important explanatory factor in children's weight-for-height. It increases in importance as the child becomes older, adding over +0.1 of a z-score for a two standard deviation change in BMI for children under four months of age to over +0.3 for children one year of age and older (Tables II.15 and II.16). Its effects may be through several mechanisms, reflecting prenatal nutritional status, adequate breast-feeding, ability to give child care and reflecting family food availability, with the various mechanisms operating at different levels according to the age of the child.

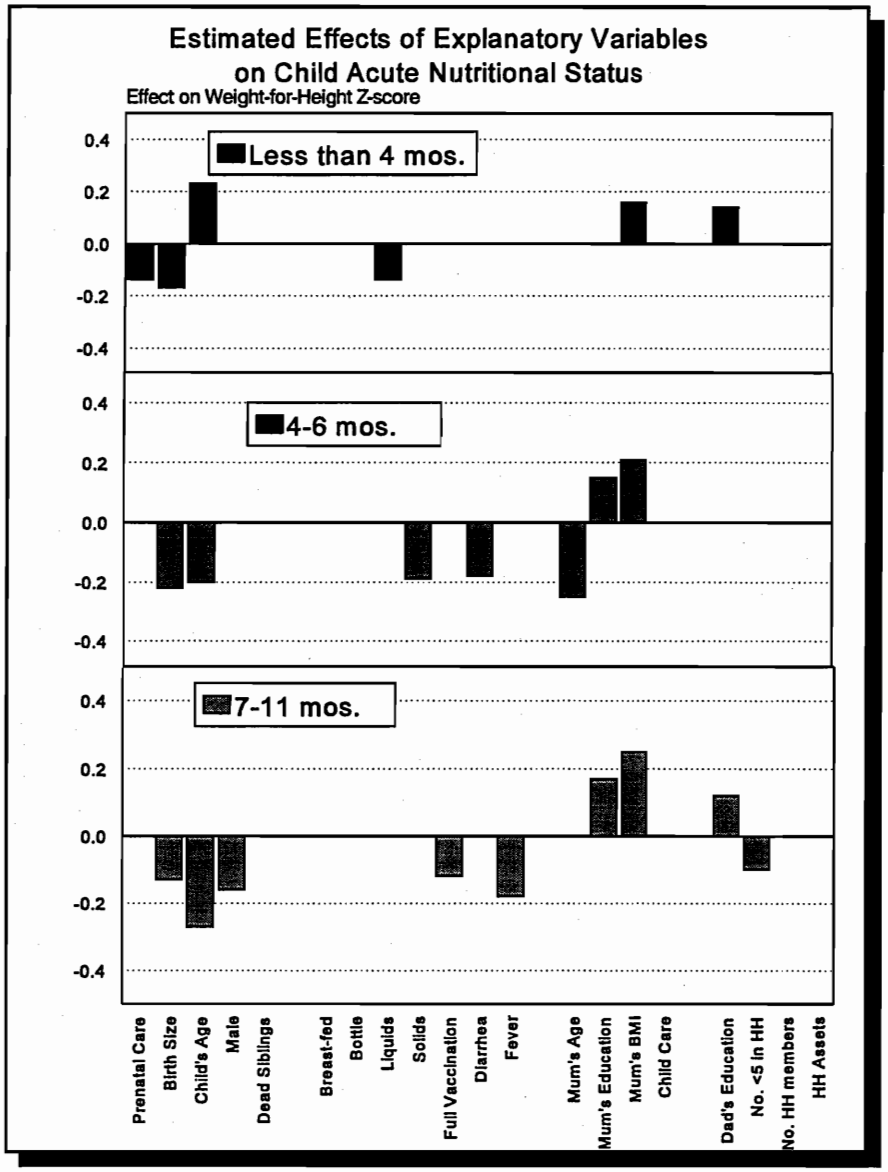

Figure II.5 Effects of Explanatory Factors on Child's Weight for Height

On the negative side, small size at birth consistently worsens weight-for-height, and its impact also increases with the age of the child, from about -0.2 children under four months to -0.3 for children one year and over. Since the impact of natal status should decrease with time, this contrary relationship could reflect a post-hoc evaluation more than actual recall of birth size. Regressions were run excluding size at birth (not shown) with no change in the other coefficients.

For children above age four months, recent illness in the form of diarrhea and fever has a moderately negative impact on weight-for-height. At four-to-six months diarrhea decreases weight-for-height z-score

by about 0.2, as does fever at 7-11 and 12-23 months. The effect of diarrhea declines to -0.1 for children one year and above as does fever for children two years and above.

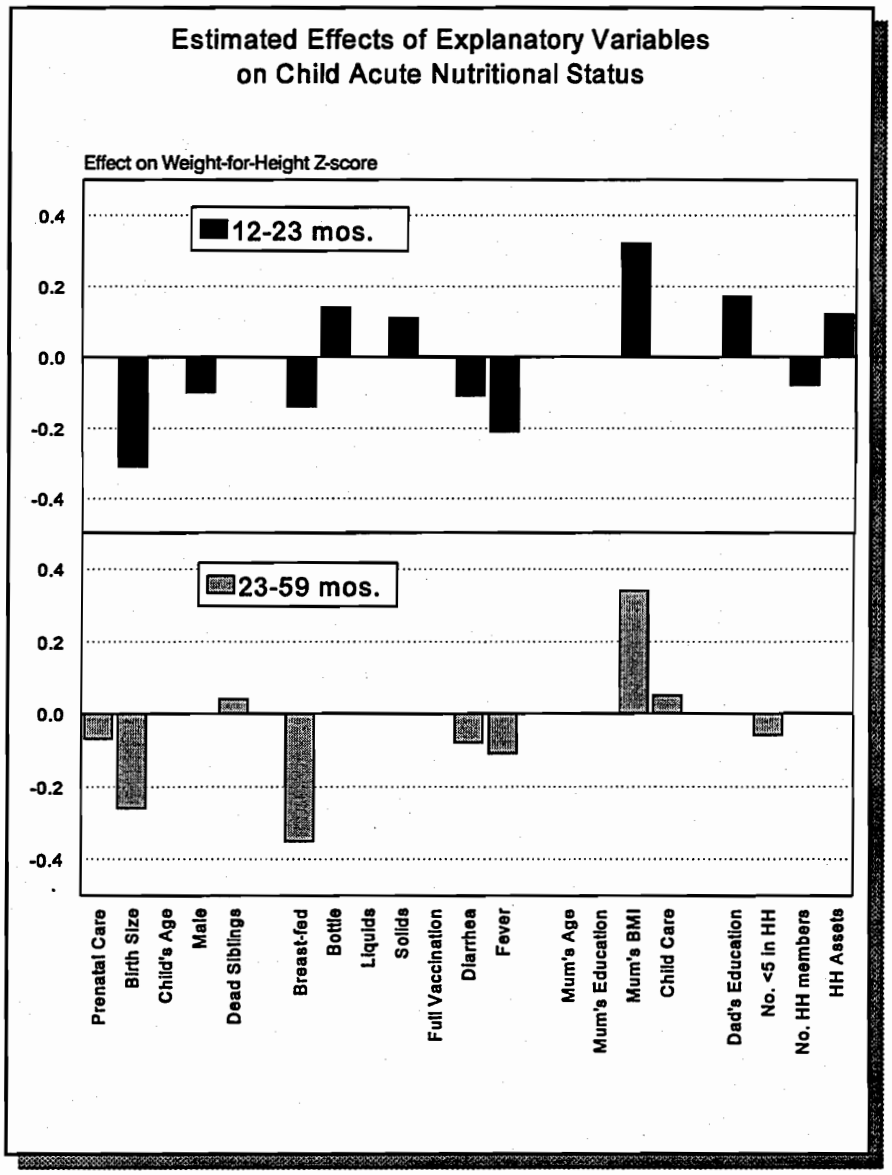

Figure II.5 (Continued)

Table II.15
Child's Weight-for-Height Z-score:
Linear Regression Coefficients and Approximate Effects

Explanatory Variable	All Children (excluding multiple births and pregnant mothers)									
	Less than 4 mos.		4-6 mos.		7-11 mos.		12-23 mos.		24+ mos.	
	B	Effect	B	Effect	B	Effect	B	Effect	B	Effect
Prenatal Care	-.14	-0.14	ns		ns		ns		-.07	-.07
Birth Size	-.17	-0.17	-.22	-0.22	-.13	-0.13	-.31	-0.31	-.26	-.26
Child's Age	.1154	0.23	-.1241	-0.20	-.0934	-0.27	ns		ns	
Male	ns		ns		-.16	-0.16	-.10	-0.10	ns	
Dead Siblings	ns		ns		ns		ns		.04	.04
Breast-fed	ns		ns		ns		-.14	-0.14	-.35	-.35
Bottle	ns		ns		ns		.14	0.14	ns	
Liquids	-.14	-0.14	ns		ns		ns		ns	
Solids	ns		-.19	-0.19	ns		.11	0.11	ns	
Full Vaccination	ns		ns		-.12	-0.12	ns		ns	
Diarrhea	ns		-.18	-0.18	ns		-.11	-0.11	-.08	-.08
Fever	ns		ns		-.18	-0.18	-.21	-0.21	-.11	-.11
Mum's age	ns		-.0175	-0.25	ns		ns		ns	
Mum's Years of Education	ns		.0190	0.15	.0218	0.17	ns		ns	
Mum's BMI	**.0258**	**0.16**	**.0333**	**0.21**	**.0374**	**0.25**	**.0476**	0.32	**.0466**	**.34**
Child has minder	ns		ns		ns		ns		.05	.05

Explanatory Variable	All Children (excluding multiple births and pregnant mothers)									
	Less than 4 mos.		4-6 mos.		7-11 mos.		12-23 mos.		24+ mos.	
	B	Effect	B	Effect	B	Effect	B	Effect	B	Effect
Dad's Years of education	.0163	0.14	ns		.0141	0.12	.0221	0.17	ns	
No. Under 5 in HH	ns		ns		-.0312	-0.10	ns		-.0195	-.06
No. of HH members	ns		ns		ns		-.0070	-0.08	ns	
HH Assets	ns		ns		ns		.0184	0.12	ns	
R^2	.086		.124		.130		.136		.108	
N	2771		2435		3574		6918		13297	

B is OLS regression coefficient
Effect is regression coefficient for dichotomous variables and two standard deviation effect of continuous variables
ns Not significant

Table II.16
Children's Weight-for-Height Z-Score by Age Group:
Ranking of Weight-for-Height Regression Effects

Change in Z-Score	<4 months	4-6 months	7-11 months	12-23 months	24+ months
>.30				BMI .32	BMI .34
.21 to.30		BMI .21	BMI .25		
.11 to.20	BMI .14 Prenatal .14 F Educ. .14	M Educ. .15	M Educ. .17 F Educ. .12	F Educ. .17 Bottle .14 HH Assets .12 Solids .11	
0 to.10					Minder .05 Dead Sibs .04
0 to-10			No. <5 HH -.10		No. <5 HH -.06 Prenatal -.07 Diarrhea -.08
-.11 to -.20	Birth Size -.17	Diarrhea -.18 Solids -.19	Full Vacc -.12 Birth Size -.13 Male -.16 Fever -.18	Diarrhea -.11 Breast -.14	Fever -.11
-.21 to -.30		Birth Size -.22 M Age -.25		Fever -.21	Birth Size -.26
<-.30				Birth Size -.31	Breast -.35

Also for children above four months, feeding patterns influence weight-for-height. Getting solids at ages 4 to 6 months has a -0.2 impact on weight-for-height z-score at odds with its positive impact on height-for-age (see above). However, children age 12-23 months do better by about 0.1 if they are given solids, as expected. Breast-feeding has a negative impact on children one year of age and older being especially strong at almost -0.4 for children 24 months and over.

Parent's education has a mildly positive impact on thinness up to two years of age varying from above +0.1 to almost +0.3 z-scores for both parents combined. Neither parent's education predominates, father's being significant in three age groups and mother's in two.

Other variables, such as bottle feeding, number of children under five in the household, prenatal care, sex, asset level, if a sibling has died, and whether the child is cared for by someone else when the mother works have small and/or inconsistent relationships with weight-for-height indicating their relatively small importance.

5.3.6 Wasting

It can be seen from Table II.17 that fewer factors included in the statistical models significantly affect wasting than affected stunting. No explanatory variables are significant for children under four months of age, due perhaps to the very small incidence of wasting in this age group. In general the number of variables that are significant and their explanatory power increases with age up to ages 12 to 23 months and then declines. This pattern follows the pattern in wasting incidence by age.

For children above six months of age, the mother's nutritional status affects their likelihood of being acutely malnourished, and this effect increases with the age of the child. For a two standard deviation increase in mother's BMI score, there is a 30% reduction in the odds of wasting at 7 to 11 months of age and 42% and 56% at 12-23 months and 24+ months, respectively. It is likely that both the mother's and child's status are being jointly affected by food availability, which cannot be measured directly in the DHS surveys.

Feeding variables affect wasting in all age groups above four months, but with differing effects according to type and age group. At age 4 to 6 months getting solid foods increases the likelihood of being wasted by 80 percent. This is interesting since for this same age group getting solid foods decreased the likelihood of stunting. Also in this age group getting plain water cuts the odds of being wasted in half. Getting solid foods at 12-23 months, however, decreases the odds of wasting by 19%.

For children two years of age and over, being breast-fed more than doubles their odds of being wasted. This result is quite startling, since breast-feeding is felt to be protective for diseases that can lead to acute malnutrition. It is possible that women whose child is wasted tend to wait longer to wean them off the breast than children who are doing well nutritionally in order to protect them. Getting liquids other than milk or plain water at 12-23 months of age also increases the odds of wasting by almost 40%.

As expected recent illness increases the likelihood that a child will be wasted. This occurs for children over six months of age. At age 7 to 11 months, having diarrhea increases the odds for wasting by 27% while having a fever increases them by 36%. For one-year olds, the effect of recent illness is amplified to an increase in odds of 55% for fever and 39% for diarrhea. At two years of age and over, diarrhea again increases the odds of wasting by 39% but fever is not significant.

Education is the only socioeconomic variable that affects wasting. For children 4 to 6 months of age, a two standard increase in mother's education as measured by years of schooling decreases the odds of being wasted by 43 percent, and father's education affects children age 12 months and over, decreasing the odds by about one fourth. Other household and economic variables are not found to significantly affect wasting. Being small at birth almost doubles the odds of being wasted for children 12 months of age and over, again probably due to post-hoc evaluation. Being male increases the chances of wasting only for children 7 to 11 months, and higher birth order increases the odds only for children 12 to 23 months of age.

Table II.17
Child's Wasting by Age Group:
Logistic Regression Coefficients and Approximate Effects

Explanatory Variable	All Children (excluding multiple births and pregnant mothers)									
	Less than 4 mos.		4-6 mos.		7-11 mos.		12-23 mos.		24+ mos.	
	B	Effect	B	Effect	B	Effect	B	Effect	B	Effect
Prenatal Care	ns		ns		ns		ns		ns	
Birth Size	ns		ns		ns		1.8446	1.84	1.9179	1.92
Birth Order	ns		ns		ns		1.0413	1.24	ns	
Child's Age	0.7066	0.51	ns		1.2348	1.83	ns		ns	
Male	ns		ns		1.4090	1.41	ns		ns	
Dead Siblings	ns		ns		ns		ns		ns	
Breast-fed	ns		ns		ns		ns		2.1930	2.19
Water	ns		0.4988	0.50	ns		ns		ns	
Bottle	ns		ns		ns		ns		ns	
Liquids	ns		ns		ns		1.2463	1.25	ns	
Solids	ns		1.8026	1.80	ns		0.8129	0.81	ns	
Full Vaccination	ns		ns		ns		ns		ns	
Diarrhea	ns		ns		1.2732	1.27	1.3910	1.39	1.3890	1.39
Fever	ns		ns		1.3611	1.36	1.5455	1.55	ns	
Mum's age	ns		ns		1.0344	1.59	ns		ns	
Mum's Years of Education	ns		0.9297	0.57	ns		ns		ns	

Explanatory Variable	All Children (excluding multiple births and pregnant mothers)									
	Less than 4 mos.		4-6 mos.		7-11 mos.		12-23 mos.		24+ mos.	
	B	Effect	B	Effect	B	Effect	B	Effect	B	Effect
Mum's BMI	**ns**		**ns**		**0.9480**	**0.70**	**0.9233**	0.58	**0.8935**	**0.44**
Child has minder	ns		ns		ns		ns		ns	
Dad's Years of education	ns		ns		ns		0.9573	0.71	0.9656	0.74
No. Under 5 in HH	ns		ns		ns		ns		ns	
No. of HH members	ns		ns		ns		ns		ns	
HH Assets	ns		ns		ns		ns		ns	
Model/Total χ^2	0.039		0.060		0.078		0.092		0.059	
N	2771		2435		3574		6918		13297	

B is OLS regression coefficient
Effect is regression coefficient for dichotomous variables and two standard deviation effect of continuous variables
ns Not significant

Other variables not shown in the table for brevity but which were tested and not found to be significant for any of the age groups were: prenatal care, having a dead sibling, being bottle fed, getting formula or other non-breast milk, being fully vaccinated, having had a cough or rapid breathing the preceding two weeks, having a working mother, being minded by someone else while the mother works, the number of household members both total and under five years, the asset index and urban residence. Child's age is a significant predictor of wasting but is not shown since it is structural variable entered for control.

Table II.18 summarizes the ranking of the effects on wasting of the significant explanatory variables.

Table II.18
Child's Wasting by Age Group:
Ranking of Effects of Explanatory Variables

Estimated Relative Odds Effects	<4 months	4-6 months	7-11 months	12-23 months	24+ months
< 0.60		Water 0.50 M Educ. 0.57		Mother's BMI 0.58	Mother's BMI 0.44
0.69 to 0.60					
0.79 to 0.70			Mother's BMI 0.70	F Educ. 0.71	F Educ. 0.74
0.89 to 0.80				Solids 0.81	
1.00 to 0.90					
1.01 to 1.10					
1.11 to 1.20					
1.21 to 1.30			Diarrhea 1.27	Birth Order 1.24 Liquids 1.25	
1.31 to 1.40			Fever 1.36	Diarrhea 1.39	Diarrhea 1.39
>1.40		Solids 1.80	Male 1.41 M age 1.59	Fever 1.55 Birth Size 1.84	Birth Size 1.92 Breast-fed 2.19
Model/Total χ^2	.039	.060	.078	.092	0.059
N	2771	2435	3574	6918	13297

5.4 Interaction between mother's and child's nutritional status

As seen above, the mother's nutritional status as measured by BMI is strongly related to both the child's acute and chronic nutritional status, measured either with the z-score distribution or with indicators of malnutrition, even after many other confounding factors have been controlled. It is likely that the maternal condition is reflecting a shortage of food that affects the child directly through the availability of foods to feed the child and indirectly through prenatal nutrition and ability

to give adequate child care. Why is it then that many well-nourished mothers have malnourished children and that malnourished mothers can have well-nourished children? In order to investigate these questions, regressions were run for each age group for well-nourished and malnourished mothers (using 18.5 BMI as the dividing line) for both z-scores and child's nutrition cut-offs. An additional regression was run including mother's wasting status as an interaction with each of the explanatory variables. Below are discussed the results of the logistic regressions for child's stunting and wasting, whose coefficients are presented in tables II.19 and II.20. Results of the linear regressions on height-for-age and weight-for-height z-scores are in appendix tables II.A4 and II.A5.

5.4.1 Stunting by Mother's Nutritional Status

Most of the characteristics associated with stunting for well-nourished mothers have the same effect for malnourished mothers. Only seven variables interact with mother's nutritional status so that they have different effects according to whether the mother is wasted or not. In table II.19, the odds ratios (exponentiated regression coefficients) are presented for explanatory factors that are significant for either well-nourished (BMI$\geq$ 18.5) or wasted (BMI < 18.5). Significant interactions are also shown by the exponentiated coefficients and represent the relative increase or decrease in the odds ratios between well-nourished and malnourished mothers. Explanatory factors that were not significant in any of the age groups are not shown in the table for simplicity. In addition, in order to conserve computing time and resources, factors which were not significant for both well and malnourished mothers in a particular age group did not have their interaction effects tested, since they were assumed to be non-significant as well.

Assistance at delivery has differential impacts between well- and malnourished mothers for children who are 12 months and above: it reduces the odds of being wasted by 13% for children 12-23 months of well-nourished mothers and by 48% of malnourished mothers, there being a significant interaction with maternal wasting. For children 24 months and older, there again is a significant interaction, even though the coefficient for the variable assistance at delivery is not significant for malnourished mothers, probably due to a relatively small sample size. The estimated odds ratio for malnourished mothers would be 0.81 multiplied by 0.69 or 0.56, approximately the same as for children 12-23 months of age.

Other significant interactions for factors that increase the odds of being stunted are a short birth interval (worse for children 24+ of malnourished mothers), bottle feeding (much worse for children 12-23 of malnourished mothers), recent illness with fever (worse for children 7-11 months of well-nourished mothers). Significant interactions for factors that lessen the odds of being stunted are father's education (better for children 24+ months of malnourished mothers), asset index (greater benefit for children under four months, and 12 months or more of well nourished mothers) and living in an urban area (greater benefit for children 12-23 months of malnourished mothers).

Explanatory factors without significant interaction effects can be assumed to have approximately the same effect whether the mother is well or malnourished.

Table II.19
Child's Stunting by Mother's Nutritional Status, according to Age Group:
Exponentiated Logistic Regression Coefficients (Odds Ratios)

Explanatory Variable	Less than 4 mos.			4-6 mos.			7-11 mos.			12-23 mos.			24+ mos.		
	Well Nourished	Mal Nourished	Interaction	Well Nourished	Mal Nourished	Interaction	Well Nourished	Mal Nourished	Interaction	Well Nourished	Mal Nourished	Interaction	Well Nourished	Mal Nourished	Interaction
Prenatal Care	ns	ns		0.58	ns		0.68	ns		0.84	ns		0.85	ns	
Assistance at Delivery	0.66	ns		ns	ns		0.77	ns		0.87	0.52	0.66	0.81	ns	0.69
Birth Size	2.88	ns		2.53	3.76		2.27	2.71		1.87	1.50		1.54	1.81	
Child's Age	1.91	ns		1.44	ns		1.14	1.21		1.12	1.13		ns	ns	
Birth Order	ns	ns		ns	ns		ns	ns		1.06	ns		1.05	ns	
Short Birth Interval	ns	ns		1.39	ns		1.22	ns		ns	ns		1.18	1.98	1.53
Male	1.47	ns		ns	ns		1.50	1.94		1.37	1.44		1.11	ns	
Dead Siblings	ns	ns		ns	ns		ns	ns		1.20	ns		ns	ns	
Breast-fed	ns	ns		ns	ns		ns	ns		1.60	1.72		1.56	2.16	
Bottle	ns	ns		ns	ns		1.53	ns		1.34	3.47	2.69	ns	ns	
Liquids	ns	ns		ns	ns		ns	ns		0.88	ns		ns	ns	

Explanatory Variable	Less than 4 mos.			4-6 mos.			7-11 mos.			12-23 mos.			24+ mos.		
	Well Nourished	Mal Nourished	Interaction	Well Nourished	Mal Nourished	Interaction	Well Nourished	Mal Nourished	Interaction	Well Nourished	Mal Nourished	Interaction	Well Nourished	Mal Nourished	Interaction
Solids	ns	ns		0.67	ns		0.68	ns		ns	ns		ns	ns	
Any Vaccination	ns	ns		0.60	ns		ns	ns		ns	ns		ns	ns	
Full Vaccination	ns	ns		ns	ns		ns	ns		ns	ns		ns	ns	
Diarrhea	ns	ns		ns	ns		ns	ns		1.20	ns		1.31	1.64	
Fever	ns	ns		ns	ns		1.26	ns	0.54	ns	ns		ns	ns	
Mum's age	ns	ns		Ns	ns		ns	ns		0.97	ns		0.96	ns	
Mum's Years of Education	ns	ns		0.91	ns		0.96	ns		ns	0.95		0.95	ns	
Mum works away	ns	ns		ns	ns		ns	ns		ns	ns		1.18	ns	
Dad's Years of education	ns	ns		ns	ns		ns	ns		0.97	ns		0.98	0.95	0.95
No. Under 5 in HH	ns	ns		ns	ns		1.07	ns		1.08	1.12		1.04	ns	
HH Assets	0.91	ns	1.29	ns	ns		0.93	0.85		0.93	ns	1.07	0.91	0.96	1.07
Urban	ns	ns		ns	ns		ns	ns		ns	0.60	0.61	ns	ns	

Explan-atory Variable	Less than 4 mos.			4-6 mos.			7-11 mos.			12-23 mos.			24+ mos.		
	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action
χ^2 Ratio	0.105	0.126	0.102	0.091	0.124	0.104	0.088	0.084	0.098	0.079	0.115	0.086	0.091	0.059	0.091
N	2532	278	2771	2209	272	2435	3216	424	3574	6096	968	6918	12051	1537	13297

Country Dummies included in all regressions (not shown).
ns Not significant
Non-significant interactions are shown by blank cells.

5.4.2 Wasting by Mother's Nutritional Status

The results of the logistic regressions run to detect significant differences in explanatory variables for wasting between wasted and non-wasted mothers are shown in Table II.20. As in the preceding table, this table is simplified by not showing factors which were found to be nonsignificant in all age groups and interactions between nonsignificant factors were not tested.

Only one factor turns out to have a significantly different effect between well and malnourished mothers: the number of children under age five years in the household, which increases the odds of being wasted for children 24 months of age or over of malnourished mothers but not for children of well-nourished mothers. This differential effect may be due to the lessened capacity of malnourished mothers to cope with child care and a lessened ability to provide food.

Table II.20
Child's Wasting by Mother's Nutritional Status, according to Age Group:
Exponentiated Logistic Regression Coefficients (Odds Ratios)

Explan-atory Variable	Less than 4 mos.			4-6 mos.			7-11 mos.			12-23 mos.			24+ mos.		
	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action
Assistance at Delivery	ns	ns		ns	0.35		ns	ns		ns	ns		ns	0.69	
Birth Size	ns	ns		ns	ns		ns	ns		1.83	1.60		1.99	1.91	
Child's Age	0.71	ns		ns	ns		1.21	1.32		ns	ns		ns	ns	
Birth Order	ns	ns		ns	ns		ns	ns		1.04	Ns		ns	ns	
Male	0.61	ns		ns	ns		1.46	ns		ns	ns		ns	ns	
Dead Siblings	ns	ns		ns	ns		ns	ns		ns	1.42		ns	ns	
Breast-fed	ns	ns		ns	ns		ns	ns		ns	ns		2.17	2.30	
Water	ns	ns		0.44	ns		ns	ns		ns	ns		ns	ns	
Milk/ Formula	ns	ns		ns	ns		ns	ns		ns	ns		1.34	ns	
Bottle	ns	ns		ns	ns		ns	ns		ns	ns		1.96	ns	
Liquids	ns	ns		ns	ns		ns	ns		1.21	ns		ns	ns	
Solids	ns	ns		2.00	ns		ns	ns		0.75	ns		ns	ns	
Diarrhea	ns	ns		ns	ns		ns	ns		1.40	1.43		1.51	ns	
Fever	ns	ns		ns	ns		1.51	ns		1.48	1.54		ns	ns	

Explan-atory Variable	Less than 4 mos.			4-6 mos.			7-11 mos.			12-23 mos.			24+ mos.		
	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action
Mum's age	ns	ns		ns	ns		1.04	ns		ns	ns		ns	ns	
Mum's Years of Education	ns	ns		0.93	ns		ns	0.84		ns	ns		ns	ns	
Child has minder	ns	ns		ns	0.00		ns	ns		ns	ns		ns	ns	
Dad's Years of education	ns	ns		ns	ns		ns	ns		0.97	ns		0.97	Ns	
No. Under 5 in HH	ns	ns		ns	ns		ns	ns		ns	ns		ns	1.15	1.14
No. of HH members	ns	ns		ns	ns		ns	ns		1.01	ns		ns	ns	
HH Assets	ns	ns		ns	ns		ns	ns		0.95	ns		0.96	ns	
χ^2 Ratio	0.019	0.290	0.046	0.077	0.072	0.072	0.076	0.065	0.077	0.083	0.098	0.096	0.043	0.064	0.069
N	2532	278	2771	2209	272	2435	3216	424	3574	6096	968	6918	12051	1537	13297

Country Dummies included in all regressions (not shown).
ns Not significant
Non-significant interactions are shown by blank cells.

6. Discussion

Given the high levels of both child and maternal malnutrition found in Part I of this combined report, the purpose of the Part II is to examine maternal and child nutritional status in sub-Saharan Africa to answer the following: 1) Is maternal nutritional status related to child status? 2) What are the key factors associated with maternal and child nutritional status and malnutrition? 3) Are there key factors that are common between children and their mothers? 4) Are there any special factors that influence well-nourished mothers to have malnourished children and allow malnourished mothers to have well-nourished children? 5) To what extent can food insecurity be distinguished from feeding practices as factors in child malnutrition? Below are discussed the results of the analysis in the context of these questions.

The Demographic and Health Surveys, while they contain much data relevant to the study of factors affecting or associated with both child and maternal nutritional status, do not measure several important factors, especially those related to food security and availability such as prices, rainfall, family agricultural and livestock production and consumption. It is beyond the scope of this investigation to assess the availability and quality of non-DHS data that pertain to these areas. Several potentially important factors are included within the DHS data sets, and so it is the purpose of the analyses in this report to highlight them.

The factors provided by the DHS data can be grouped into the following categories: those concerned with prenatal and birth conditions, demographic characteristics of children and mothers, feeding practices, health and health service utilization, and socio-economic levels, employment, and household conditions. Many variables provide proxy information or are measured at one point in time but are assumed to act over a span. Screening procedures consisting of assessing the strength and significance of bivariate relationships were first applied to the relevant variables. Those found to have significant relationships with nutritional status in at the pooled data set were included in subsequent multivariate analyses.

To assess the importance of individual factors in the presence of other factors, it was necessary to utilize multivariate techniques. For nutritional status, with z-scores for children and BMIs for mothers as dependent variables, ordinary least squares linear regression was used. For malnutrition, with a dichotomous dependent variable, logistic regression analysis was employed and the coefficients represent the relative odds of being malnourished.

6.1 Is maternal nutritional status related to child status?

Children: Effect of Maternal Nutrition

Maternal nutritional status is found to be an very important factor for both the child's chronic and acute nutritional status, no matter whether children under five years of age are considered as one group or separated into smaller age groups. Better nutritional status of the mother lowers the

probability of the child being stunted at all ages under five years and the odds of being wasted of children over six months of age. Maternal status may be proxying for food availability, but may also indicate the mother's ability to provide child care. Moreover, the mother's nutritional status may influence the child's prenatal growth, which in turn affects birth size and stature at the youngest ages.

6.2 Key factors associated with maternal and child nutritional status and malnutrition

6.2.1 Mothers

With respect to maternal nutrition, the level of living assessed with the consumption index and the number of children ever born are the most important factors influencing both BMI score and the odds of being malnourished. Both the woman's and her husband's education are also important factors as are employment status and assistance at delivery. The combination of the consumption index, education, work status (cash income) and urban residence may be taken as indicative of the influence of food security on maternal nutrition. Assistance at the delivery of the last child may be indicative that access to health care is also important. However, a surprising finding is that mothers with fully vaccinated children are more likely to be wasted.

6.2.2. Children

Turning to children's nutritional status, almost all the variables tested in bivariate relationships were significant, and only the prevalence of cough and acute respiratory infection in the two weeks preceding the interview were found to be unrelated to the child's chronic nutritional status. Cough and ARI were found to be significantly related to the child's acute nutritional status. The bivariate tests of significance in the pooled data set is not a strong predictor of importance, however, given the large number of cases.

Children: Effect of Feeding Practices

The most puzzling and disturbing findings relate to infant feeding. The results of the analyses here seem to indicate that recommended feeding practices are perhaps not necessarily optimal[14]. In order to retain as much explicative power as possible, a composite variable was constructed that indicated whether the child was acceptably fed according to its age and children of all ages under five years were considered together. Indications of an unexpected relationship were first encountered in the bivariate analyses but the effect was small and not expected to remain once other factors were taken into account. However, once these other factors were regressed along with the appropriate feeding indicator, stronger inverse relationships emerged for both height for age and weight for height. It was therefore decided that a more detailed analysis, albeit sacrificing explicative power due to

[14]However, in a review article Grummer-Strawn (1993), describes findings suggesting that children in less developed countries who breast-feed for longer than one-year are more likely to be malnourished. Magnani et al. (1993) also found negative relationships between the duration of partial and full-breast-feeding and growth.

smaller number of cases, was required in which the individual elements of the feeding indicator were analyzed separately for age groups contained in the WHO/UNICEF Innocenti Declaration recommendations (1990). Again the results were unexpected for some of the feeding variables, in particular breast feeding, solids and liquids other than milk and plain water.

In the under four months of age group of children, exclusive breast feeding is recommended with receiving plain water only in addition to breast milk considered by many to be acceptable. However, children who were given solids and milk (other than breast) or formula were of greater stature, even after removing the effects of maternal nutritional status (perhaps related to interuterine growth). The effect of breast feeding was not significant, most likely due to the fact that practically all children at this age are breast-fed, and thus there is no variation. Receiving solids at 4 to 6 months of age, acceptable according to the WHO recommendations, also increases stature, although decreasing weight-for-height in this age group. For children four months of age and over being breast-fed is quite negatively related to stature, reducing the height-for-age z-score between one-half to over one standard deviation. Being breast-fed does not appear to affect weight-for-height for children under one year of age but has a small negative impact for children 12 to 23 months of age and a larger impact for children over one year.

Some researchers (see for example Victora et al., 1987) hold that there may be a differential impact of infant feeding according to the socio-economic status of the family, since low income families may not have adequate resources to provide for refrigeration, clean water supply, and cleanliness of milk, foods, bottles and utensils or to recognize their necessity. For these families, following the infant feeding recommendations would be most important. However, when the sample was split according to the level of the consumption index to view an interactive effect, regressions run for children of families with lower than the mean on the index had the same negative impacts of breast feeding and positive impacts of getting solid foods. A potential but unlikely explanation is that the relationship operates in reverse, that is, that small children, especially those who have suffered from illness, are more likely to keep breast feeding and have solid foods introduced later because their mothers think that it is good for them. The findings of these analyses clearly require more investigation, but which require data more in depth than that provided by the DHS surveys and so is beyond the scope of this report.

Children: Health Status and Health Care

Another surprising finding is that concerned with immunization. Since there would be too many variables to treat each vaccination separately, two indicators were created, whether the child had received any vaccinations and whether all recommended (i.e. BCG, DPT, Polio and Measles) were given. A separate report investigates on the specific relationship between measles vaccination and child nutritional status. In the bivariate analysis while malnourished mothers are less likely to have had their children fully vaccinated, malnourished children are more likely to have been fully vaccinated. However, this inverse relationship disappears when controlled for other factors but when separate age groups are considered being fully vaccinated has a positive on height for children through six months of age. This is surprising since most children receive measle vaccination after

this age. When children were separated into those with well- and malnourished mothers, it is seen that the positive effects of being fully vaccinated occur to the youngest children of the well-nourished mothers. Perhaps, the effect also may occur among the children with malnourished mothers, but the smaller number of cases does not allow for statistically significant results.

Also surprising is that fully vaccinated children of 7 to 11 months are more likely to be lower in weight-for-height than children who are not fully vaccinated. No explanation comes to mind for this result, especially since these children are more likely to have contact with the health care system than others, but this result parallels that for mothers.

Other factors indicative of health status and usage of health services have more expected relationships with nutritional status. It is expected that a recent bout of diarrhea is related to weight-for-height and to wasting, and such is the case in the data studied here. Perhaps new information is that a recent bout of fever also decreases weight-for-height and increases the odds of wasting in about the same amount as diarrhea. Also that may be new is that a recent bout of diarrhea is associated with decreased stature and greater odds of stunting for children over one year of age. The riddle is that an ostensibly acute condition is affecting one that is presumably chronic.

Beyond vaccination status, the two other variables indicative of health service usage are receiving prenatal care from a medically trained person and having a medically trained person to attend the childbirth. Both these variables are associated with improved stature and decreased likelihood of stunting including children over one year of age. It is likely that at the younger ages there may be a direct effect of each of these factors but at older ages they are proxying for the likelihood of using other health services. It is surprising that there are not a strong positive relationships of these health care use variables with acute nutritional status. Again no explanation of this lack comes to mind.

Children: Effect of Child Care

Factors related to the amount of time available for child care are whether the mother works at all, works away from home, has someone to care for the child while working away, the number of living siblings, the number of children under age five in the household, and perhaps, whether the child was wanted at conception or has a sibling who died. From both the bivariate (uncontrolled) and multivariate analyses, child care is not seen to have major effects on either height or weight. The odds of being stunted, however, increase with lessened child care evidenced through the mother working away from home and increased number of children under five in the household.

Children: Effect of Socio-economic Characteristics

Improved socio-economic conditions lead to better child nutrition. This is seen through the positive effects of education of both parents, the index of family consumption, and living in an urban area for stature. While better socio-economic conditions allow greater food security, they also promote

better child care, feeding behavior, health environment, and health care use through greater resources (consumption index), knowledge (education), and availability (urban residence)[15].

Children: Effect of Demographic Characteristics

Several demographic characteristics are also associated with the child's nutritional status but may be proxying for other types of factors. The child's age is a major factor in assessing nutritional status but, because time is needed to accumulate the effects of nutritional well- or malnourishment, much of its effect is structural. Demographic factors that have expected negative effects are higher birth order, shorter birth interval and small birth size. The latter relationship, which is quite strong, may be due to a reverse influence since mothers whose children are now small and thin may "recall" that they were small at birth as well. Eliminating birth size from the analysis did not change the results of the other variables.

Being a male also has a negative impact on nutritional status. The reasons for this are unknown but perhaps may relate to frailty. it is well known that, at least prenatally and neonatally, boys are frailer than girls (due to having only one X chromosome?), and so may suffer more in unhealthy environments. Another explanation may be preferences in feeding. The hypothesis works this way: Boys are preferred so they are given other foods earlier. However, this early feeding leads to increased diarrhea, which in turn causes a state of malnourishment. A variation to this idea would be that boys are kept on the breast longer than girls, which leads to malnourishment. In tabulations not shown, it was found that there was no difference in the duration of breast feeding by sex. However, boys are slightly more likely to get solids and liquids under age four and slightly less likely to use bottles during the first year of life. Given the direction of effects found for these variables, these relationships would therefore not explain the lower nutritional status of boys.

6.3 Key factors common between children and mothers

There are several factors that are related to both maternal and child nutritional status. Mothers with higher education and whose husbands have higher education are better off themselves and so are their children. Level of living (measured by the consumption index) and urban residence also benefits both mothers and their children. Work status affects children and mothers differentially. Mothers who work away from home are less wasted but their children are more likely to be stunted (in two age groups). However, having someone to mind the child is beneficial to weight-for-height for both the mother and the child (one age group). More persons in the household reduces both the mother's and child's weight for height scores (one age group). While the number of children under five years in the household affects children's stature and weight, it does not affect the mothers.

[15] Reed, Habicht and Niameogo (1996) found that the association between maternal education and child nutritional status varied according to the level of socio-economic status and, indeed, turned negative for mothers attaining higher levels of education.

Greater contact with the health care system, as indicated by having medical assistance at birth is beneficial to nutritional status of both child and mother. However, having a child who is fully vaccinated increases the mother's chances of being wasted and increases thinness in the child (one age group). This is surprising in two ways: first, this variable should be indicative of good health care, and second, fully vaccinated children are taller (two age groups). Given these anomalous results, it is hard to speculate on what is going on.

Another factor that affects mothers and children differentially is birth order. Children of higher birth order are usually of lower nutritional status (two age groups for height, one for stunting, one for wasting) but mothers are positively affected, increasing weight and decreasing wasting.
On the other hand, having a longer interval between births benefits the mother in weight and the child in height and lowers the chances of stunting(3 age groups).

While breast feeding beyond four months of age tends to affect children negatively, it does not affect either mothers' BMI or wasting.

6.4 Factors that influence well-nourished mothers to have malnourished children and allow malnourished mothers to have well-nourished children

The questions on special factors that distinguish the nutritional status of children differentially between well-nourished from malnourished mothers and on the roles of food security versus behavior are answered by investigating how nutritionally related variables interact with maternal nutritional status. If the mother is malnourished, the use of health care services as proxied by medical assistance at delivery, greater father's education and living in an urban area improves the chronic nutritional status of children of malnourished mothers more than those of well nourished mothers. However, the use of bottle feeding and having a short birth interval worsen their chances of being stunted. In addition, a larger number of children under age five in the household, decreases acute status more for malnourished mothers. On the other hand, having a fever or a lower level of living worsens the nutritional status of children of well-nourished mothers than those of malnourished mothers.

If the mother's nutritional status can be taken as a proxy for food availability, then some of the detrimental effects can be overcome by education and access to health care services and exacerbated by improper feeding and fertility behavior and having more children to care for. But even having food available (as evidenced by a well nourished mother) does not overcome living in an unhealthy environment.

7. Illustrative Impact of Nutrition Related Factors

The impact of nutrition factors analyzed here can be clearly seen by distinguishing two representative families, one high-status and the other low. A cluster of characteristics has been assigned to each and based on these characteristics and using the regression coefficients, the BMIs,

Z-scores and odds of malnutrition are calculated and compared. Only factors with significant relationships to nutritional status are used.

The high status family has the following characteristics: The family consists of two adults and two children, both under five years of age. It is urban resident with a consumption index score of 20 (highest level). The husband has 12 years of education and the wife 9 years. The wife who is 26 years works away from home and has someone to take care of the child while she is at work. She has two children with a birth interval of 27 months between them. She had both medical prenatal care and assistance at the delivery. Neither child was small at birth and both are alive. The children were breast-fed for six months although they got formula in a bottle starting at 2 months and began using a cup at 8 months. Other liquids (juice) were started at one month and mushy cereal was first given at 2 months of age. Vaccinations were given at birth (BCG) and soon after so that by 5 months they are fully vaccinated.

The low status family has the following characteristics: The family consists of two adults and four children but live with the husband's brother with his wife and two children so that there are 10 members of the household, four of whom are under five. It is rural resident and has the lowest consumption score of four. The husband has 3 years of education but the wife has none. She is 34 years of age and works away from home in the market but takes her under-five children with her. She has given birth 5 times with neither medical prenatal care nor delivery assistance. Although none of her children were considered small at birth, one child has died. The last birth interval was 36 months. She breast feeds her children 15 months, and introduces sweetened herb teas at four months and starts mushy food (mashed yams) at 10 months. The children do not use a bottle but were given extra milk at 10 months. Only two vaccinations have been received, the first doses of DPT and Polio when a health campaign came through the area.

Given these characteristics and the relationships found, the following differences in nutritional status and chances of malnutrition result (shown in Table II.21 and Figures II.6 and II.7):

1) There is a 4.5 point difference in BMI score between the high-status and low-status mothers, and low-status mothers are over four times as likely to be wasted as high-status mothers. Since maternal nutritional status is associated with child's status, assume that high status mothers have a BMI score of about 24 and low status mothers about 19.

2) For children's stature, there is a difference in z-score that varies according to age from about one-half of a standard deviation for children under four to over two standard deviations for children 7 to 11 months of age. For the other age groups the high-status children have about a one and a half standard deviation advantage.

3) The odds of being stunted differ greatly between the high-status and low-status children. Low-status children have odds of being stunted that vary from almost 3 times to over 13 times those of high-status children, depending on age.

4) The differences by status in weight-for-height z-scores are smaller than those of height-for-age. At under four months of age there is no difference. However, by one year of age the advantage of high-status children is close to one standard deviation.

5) The ratio of the odds of being wasted follow a pattern similar to that of the weight-for-height z-score: there is no difference under four months of age, but by one year of age, the low-status children have about two and half times the odds of being stunted as the high-status children.

These comparisons clearly show the tremendous disadvantages that low status families have.

The results of this study show that there is no one "magic bullet" for malnutrition. They point to the need for improving mother's nutritional status for its effects on both mothers and their children. This can be done through improving socio-economic conditions, food security, health services including family planning, and the water and sanitation environment. Child feeding practices are also very related to nutritional status of children if not of mothers, but the results here bring into question the prevailing wisdom of exclusive breast-feeding during the first four months of life and continuing to breast-feed into the first year. From the current study, recommendations to extend exclusive breast-feeding beyond six months in order to extend the period of post-partum amenorrhea would appear to have detrimental effects on children's nutritional status. Clearly this is an area that needs more detailed study. The fact that many well-nourished women have malnourished children lessens the utility of screening procedures that just target the mother. That many malnourished mothers have well-nourished children is heartening in that it points out that actions can be taken by families to preserve the nutritional status of the most vulnerable group even if general conditions are inadequate.

Table II.21
Disadvantages in Nutritional Status of Low versus High Socio-Economic Status Families

Age Group	Height-for-Age Z-Score Difference	Percent Increase in Odds of Stunting	Weight-for-Height Z-score Difference	Relative Increase in Odds of Wasting
			BMI	
Mothers	NA	NA	-4.5	350%
	Z-Score		Z-Score	
Under 4 months	-0.53	285%	0.00	0%
4-6 months	-1.45	1001%	-0.29	7%
7-11 months	-2.13	780%	-0.48	71%
12-23 months	-1.55	1375%	-0.91	149%
24+ months	-1.44	775%	-0.31	141%

NA not applicable

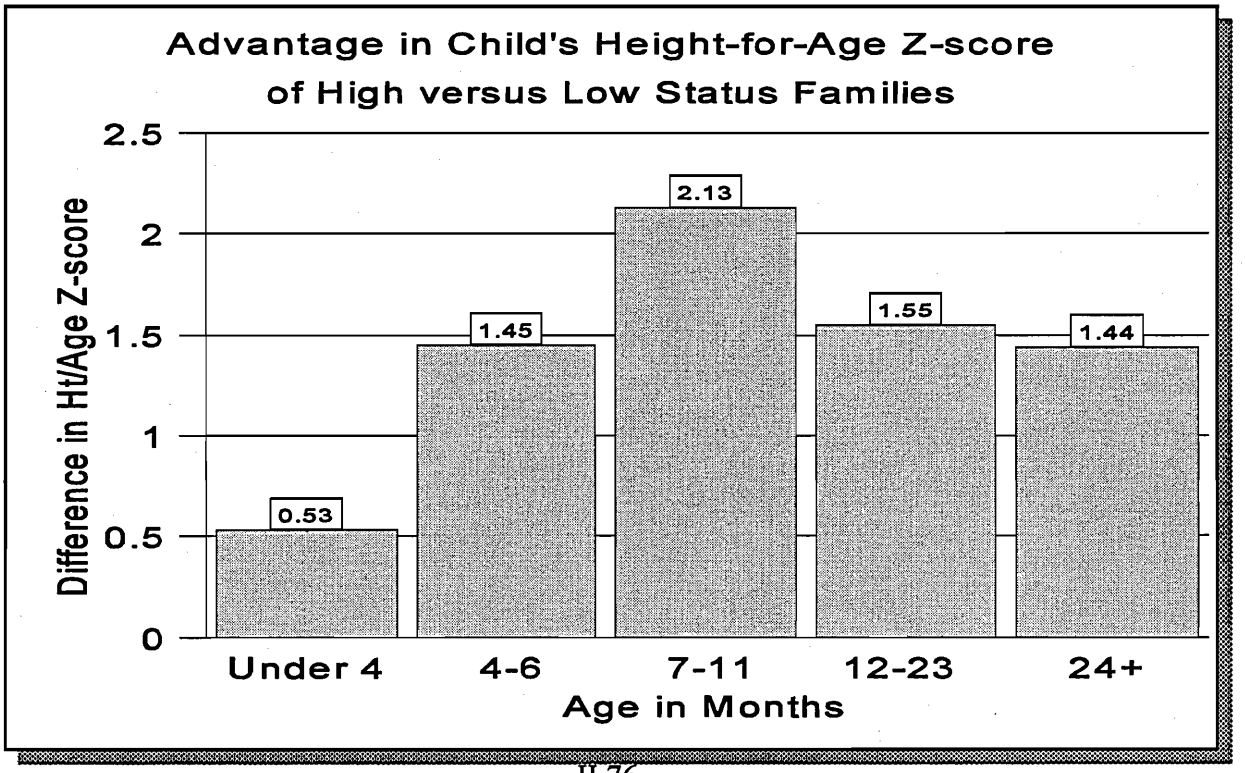

Figure II.6 Difference in Height for Age by Socio-Economic Status

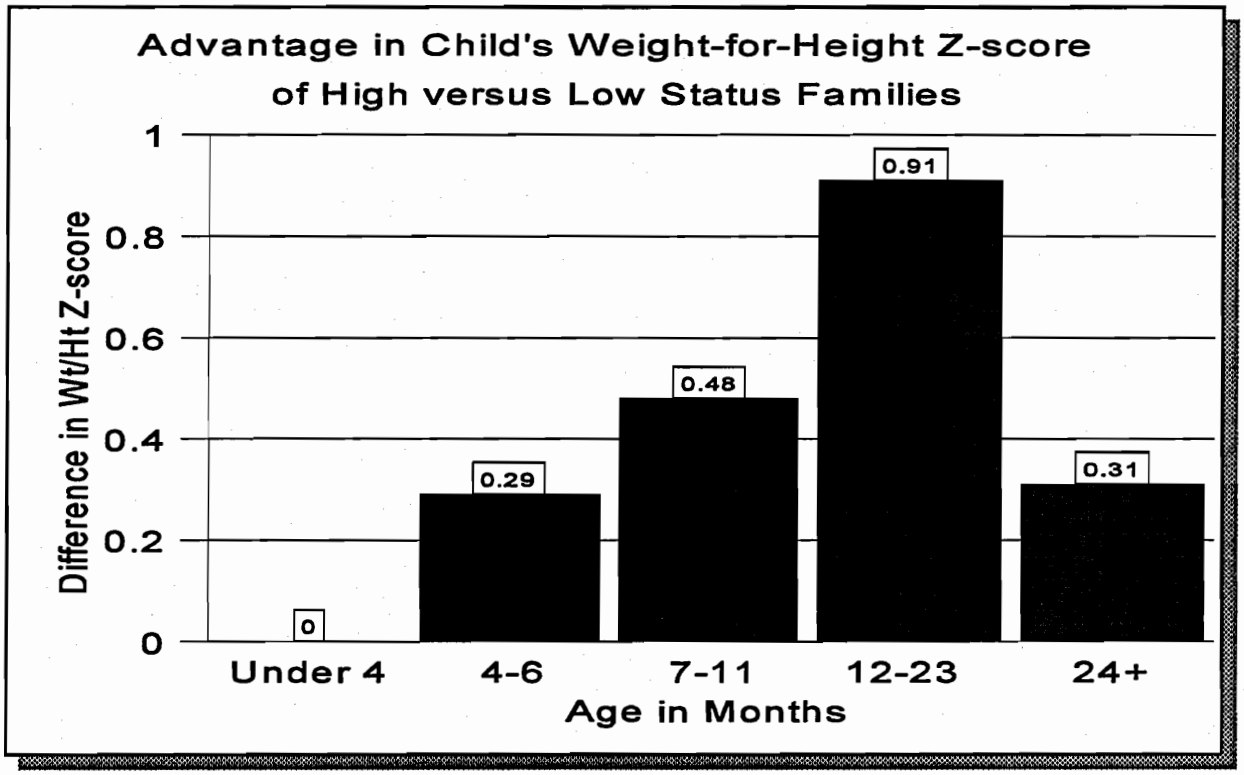

Figure II.7 Difference in Weight for Height by Socio-Economic Status

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APPENDIX

Table II.A1a
Percents and Means of Background Characteristics
for Full Combination Index of Mother's and Child's Nutritional Status

Country	Percent Urban				Mean HH Asset Index				Mean Years of Mother's Education			
	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished
Burkina Faso	20.0	16.3	11.2	8.5	8.2	7.9	7.5	7.5	0.9	0.8	0.5	0.2
C.A. R.	45.7	42.6	36.1	30.1	8.0	8.0	7.1	8.4	2.6	2.3	1.9	1.7
Ghana	34.2	29.7	20.3	19.0	9.2	8.2	8.2	7.6	5.3	5.4	4.3	3.6
Kenya	14.3	5.7	8.6	7.4	7.7	6.7	6.8	6.7	6.4	4.8	5.5	3.9
Malawi	na	na	na	na	8.9	8.5	7.9	7.4	2.8	2.2	1.9	1.5
Niger	23.4	13.3	14.8	11.0	6.9	6.0	6.2	5.9	0.7	0.3	0.4	0.4
Namibia	35.9	21.3	26.3	18.4	10.1	8.0	8.3	8.0	6.0	4.5	4.7	4.0
Senegal	44.3	32.0	26.0	24.9	10.1	9.1	8.7	8.3	1.7	1.0	0.8	0.6
Zambia	54.0	41.4	41.7	30.9	9.8	8.4	8.3	7.4	5.6	4.8	4.7	4.3
Zimbabwe	27.4	14.4	23.4	7.8	9.2	7.7	8.1	7.3	6.8	6.1	5.9	5.3
All	30.0	22.8	19.4	15.6	8.8	7.8	7.6	7.2	3.8	2.7	2.8	2.0

Table II.A1b
Percents and Means of Background Characteristics by Full Combination Index of Mother's and Child's Nutritional Status

Country	Mother's Age in Years				Mean Number of Living Siblings				Percent of Children with Dead Siblings				Percent of Children Unwanted			
	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished
Burkina Faso	28.9	28.3	29.4	30.2	2.7	2.4	2.7	2.7	45.5	50.0	51.2	55.0	3.7	3.1	3.5	3.2
C.A. R.	26.9	27.8	27.4	27.3	2.4	2.6	2.5	2.3	30.1	31.1	34.7	33.0	6.9	8.2	6.3	10.2
Ghana	28.6	27.9	28.7	30.0	2.2	1.8	2.2	2.6	26.7	20.7	31.6	40.5	9.5	9.9	6.6	8.9
Kenya	28.7	28.4	28.5	29.7	3.0	3.0	3.1	3.7	22.5	23.0	28.3	35.3	18.9	15.3	16.6	13.9
Malawi	28.9	28.4	29.6	30.1	2.7	2.4	2.8	2.6	51.5	41.4	50.8	48.6	15.0	15.0	14.1	20.3
Niger	27.9	26.5	28.6	26.9	2.7	2.1	2.8	2.4	56.5	52.3	61.7	49.7	2.4	1.9	2.0	2.1
Namibia	29.7	30.0	29.6	29.1	2.6	2.6	2.8	2.1	17.4	23.4	21.8	21.8	12.9	10.6	13.9	11.2
Senegal	29.7	27.0	30.3	28.0	3.2	2.4	3.4	2.5	38.0	36.0	43.5	39.4	5.5	1.1	4.2	3.6
Zambia	28.4	27.1	28.4	27.7	3.0	2.3	3.0	2.4	35.5	28.3	40.6	36.5	7.5	4.7	7.3	4.3
Zimbabwe	27.6	26.0	28.4	27.9	2.3	2.0	2.6	2.4	17.2	11.9	30.1	18.6	8.5	4.7	9.1	9.7
All	28.6	27.7	28.9	28.6	2.8	2.4	2.8	2.6	34.6	34.6	42.4	41.2	9.2	6.6	8.3	7.4

Table II.A1c
Percents and Means of Background Characteristics by Full Combination Index of Mother's and Child's Nutritional Status

Country	Child's Age in Months				Percent of Children who are Male				Mean Birth Order				Percent with Preceding Birth Interval of Less than 24 Months			
	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished
Burkina Faso	23.8	22.2	28.8	29.2	48.8	52.2	53.7	46.1	4.2	4.0	4.3	4.3	10.4	10.6	14.1	10.2
C.A. R.	13.6	12.4	19.5	20.1	48.8	50.5	53.5	52.8	3.8	3.9	3.9	3.6	16.1	13.4	22.2	23.4
Ghana	14.0	15.3	19.8	20.2	49.6	39.6	55.1	53.2	3.4	3.0	3.6	4.2	8.8	10.7	12.0	4.6
Kenya	27.1	26.7	31.1	29.8	47.2	52.4	55.1	47.6	4.0	4.0	4.1	4.8	23.1	13.2	25.2	23.1
Malawi	20.2	23.5	31.3	29.4	48.1	47.3	51.1	51.5	4.4	3.8	4.4	4.3	18.8	10.0	21.8	19.2
Niger	20.6	22.2	26.7	27.3	53.3	46.0	55.0	57.6	4.6	3.8	4.8	4.1	19.6	18.8	25.0	26.8
Namibia	23.8	22.8	24.8	25.4	48.6	45.7	50.0	53.8	3.5	3.7	3.9	3.2	20.2	12.7	21.8	18.3
Senegal	24.1	21.6	29.3	28.1	45.7	51.3	53.5	54.9	4.4	3.6	4.7	3.9	16.4	16.3	15.2	21.0
Zambia	22.7	21.4	29.7	27.9	49.5	46.9	51.4	54.3	4.2	3.5	4.2	3.7	15.5	13.9	18.6	15.2
Zimbabwe	15.1	12.9	20.0	17.0	48.6	44.6	51.7	52.5	3.4	3.1	3.9	3.6	9.1	7.8	12.6	20.4
All	21.6	21.0	27.7	26.9	48.7	48.5	53.0	52.6	4.1	3.7	4.3	4.0	16.3	13.7	19.8	19.1

Table II.A1c
Percents and Means of Background Characteristics by Full Combination Index of Mother's and Child's Nutritional Status

Country	Percent with Medical Prenatal Care				Percent with Medical Delivery Assistance				Birth Weight in kg.				Percent Small or Very Small at Birth			
	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished
Burkina Faso	65.0	61.4	60.9	58.3	46.1	44.6	42.2	34.1	3.09	2.96	2.98	2.74	16.5	21.6	23.5	30.1
C.A. R.	70.6	72.1	59.5	63.1	50.0	49.6	39.3	39.4	3.16	3.19	3.01	2.89	12.9	16.2	20.5	28.6
Ghana	89.2	92.8	82.8	79.8	50.5	45.1	36.4	27.9	3.17	2.98	2.91	2.80	10.9	15.3	14.4	16.5
Kenya	96.7	91.3	95.7	95.7	51.0	33.3	41.3	38.3	3.33	3.26	3.22	3.30	13.1	13.5	18.5	24.2
Malawi	92.6	92.7	88.2	86.6	60.0	58.0	52.4	51.0	3.20	3.04	3.15	2.77	13.9	18.7	18.3	27.8
Niger	41.9	24.7	30.5	26.5	23.6	11.6	15.5	8.2	3.15	2.83	2.99	2.97	32.3	33.7	37.5	42.4
Namibia	90.3	88.6	86.1	77.7	75.2	71.9	60.0	47.6	3.17	3.19	2.83	2.94	13.0	20.1	26.8	23.4
Senegal	81.7	78.2	69.2	70.5	57.0	48.0	40.6	41.5	3.25	3.16	3.01	2.80	30.6	36.0	42.1	47.7
Zambia	91.8	90.3	86.7	82.0	57.5	43.8	45.2	34.9	3.23	3.03	3.05	2.94	7.6	10.3	13.1	13.2
Zimbabwe	94.0	96.6	92.4	89.1	72.3	66.7	62.5	55.0	3.17	3.05	2.87	2.90	14.7	15.9	28.0	35.1
All	81.6	74.0	73.8	66.8	53.6	43.1	41.6	33.8	3.21	3.11	3.04	2.95	16.9	21.7	23.7	30.2

Table II.A1d
Percents and Means of Background Characteristics by Full Combination Index of Mother's and Child's Nutritional Status

Country	Percent of Children with Diarrhea in Last 2 weeks				Percent of Children with Fever in Last 2 weeks				Percent of Children with ARI in Last 2 weeks				Percent Acceptably Fed			
	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished
Burkina Faso	19.0	17.9	25.4	21.2	34.0	31.0	39.4	41.5	12.4	8.9	13.3	14.6	48.1	53.3	52.0	49.5
C.A. R.	19.9	23.6	27.3	29.5	31.6	29.7	43.8	43.2	29.1	25.5	31.5	33.8	89.4	87.9	96.5	97.6
Ghana	18.3	20.7	24.0	27.9	24.9	29.7	32.4	24.1	9.7	10.8	10.7	10.1	45.4	46.0	48.8	62.0
Kenya	12.2	11.2	17.5	21.5	43.5	37.7	43.3	39.3	19.1	20.8	20.5	20.2	52.9	57.5	60.9	70.2
Malawi	22.7	26.2	23.4	30.0	41.7	43.8	42.0	41.1	15.1	17.7	14.3	11.4	67.6	59.2	72.4	68.2
Niger	25.6	27.4	31.7	36.6	42.0	51.0	50.7	50.4	11.0	11.6	11.3	12.3	63.0	63.8	70.4	65.2
Namibia	17.2	22.4	31.8	28.6	34.7	36.3	44.9	45.2	19.0	25.6	28.0	23.8	51.6	48.0	53.9	63.4
Senegal	21.3	22.9	25.5	20.7	37.7	44.7	42.1	40.9	15.5	14.6	14.3	18.1	60.1	61.1	55.1	47.2
Zambia	21.1	19.7	25.8	32.4	41.9	48.5	49.4	50.4	14.5	14.3	14.2	17.4	70.8	65.4	68.2	69.5
Zimbabwe	24.0	27.0	27.6	40.3	40.4	43.7	44.1	42.0	27.7	26.6	25.3	33.4	85.8	85.4	93.9	92.5
All	19.8	21.3	25.5	28.1	38.2	40.3	44.1	43.6	16.8	16.9	16.7	17.4	62.3	62.1	65.9	64.9

Table II.A1e
Percents and Means of Background Characteristics by Full Combination Index of Mother's and Child's Nutritional Status

Country	Percent of Children with Fully Vaccinated				Percent of Children with Any Vaccination				Percent of Children with Literate Mothers				Mean Number of Household Members			
	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nourish ed	Child Under-nourish ed	Both Under-nourish ed
All	43.4	39.4	51.1	45.4	84.4	78.7	84.2	80.1	48.6	36.1	38.3	27.4	8.7	8.9	8.6	8.9

Country	Mean Number of Children Under 5 Years of Age				Percent of Children with Mothers who are Currently Working				Percent of Children whose Mothers Work Away from Home				Percent of Children with a Child Minder Other than the Mother			
	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished
All	2.4	2.5	2.5	2.6	52.8	48.9	52.4	48.3	34.9	30.5	35.3	31.2	24.1	20.0	21.9	19.4

Country	Percent of Children from a Multiple Birth				Percent of Children with Prenatal Care and Delivery Assistance			
	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished	Both Normal or Above	Mother Under-nour-ished	Child Under-nour-ished	Both Under-nour-ished
All	2.0	1.8	3.7	3.4	52.1	41.8	39.9	32.3

Table II.A2a
Significance of Bivariate Relationships with Stunting Combination Indicator

Country	Percent Urban	Education	HH Assets	Water	Toilet	Vehicle	Flooring	Electricity	Radio	Television	Fridge
Burkina Faso	***	***	***	***	***	***	***	***	***	***	***
C.A. R.	***	***	--	--	***	***	**	***	**	***	**
Ghana	***	***	***	***	***	**	***	***	***	***	***
Kenya	***	***	***	***	***	**	***	***	***	***	***
Malawi	na	**	***	***	***	***	***	***	***	na	na
Niger	***	***	***	***	***	***	***	***	***	***	***
Namibia	***	***	***	***	***	***	***	***	***	***	***
Senegal	***	***	***	***	***	**	***	***	***	***	***
Zambia	***	***	***	***	***	***	***	***	***	***	***
Zimbabwe	***	***	***	--	***	*	***	***	*	***	***
All	***	***	***	***	***	***	***	***	***	***	***
All-Eta^2	.016	.020	.033	.016	.016	.004	.024	.022	.010	.016	.013

-- Not Significant
* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Table II.A2b
Significance of Bivariate Relationships with Stunting Combination Indicator

Country	Mother's Age	Living Siblings	Mortality Experien.	Unwanted	Child's Age	Percent Male	Birth Order	Birth Interval
Burkina Faso	***	**	***	--	***	--	*	***
C.A. R.	--	--	--	--	***	--	--	**
Ghana	--	--	**	--	***	*	--	--
Kenya	**	***	***	--	***	***	***	**
Malawi	**	--	--	--	***	--	--	**
Niger	***	***	***	--	***	--	***	***
Namibia	--	--	**	--	--	--	--	--
Senegal	***	***	**	***	***	**	***	--
Zambia	**	***	***	--	***	--	***	**
Zimbabwe	*	--	***	--	***	--	**	**
All	***	***	***	***	***	***	***	***
All-Eta^2	.002	.003	.006	.001	.048	.001	.003	.003

-- Not Significant
* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Table II.A2c
Significance of Bivariate Relationships with Stunting Combination Indicator

Country	Medical Prenatal Care	Medical Delivery Assistance	Birth Weight	Birth Size	Diarrhea	Fever	Cough	Feeding
Burkina Faso	***	***	***	***	--	--	--	*
C.A. R.	***	***	***	***	**	***	*	***
Ghana	***	***	***	**	--	*	--	--
Kenya	***	***	**	***	***	--	*	***
Malawi	***	***	***	***	--	--	--	*
Niger	***	***	***	***	**	***	--	--
Namibia	***	***	***	***	***	***	***	**
Senegal	***	***	***	***	--	*	--	***
Zambia	***	***	***	***	***	***	--	**
Zimbabwe	--	***	***	***	*	--	--	***
All	***	***	***	***	***	***	--	***
All-Eta^2	.010	.017	.015	.008	.002	.002	.000	.001

-- Not Significant
* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Table II.A2d
Significance of Bivariate Relationships with Stunting Combination Indicator

Country	BCG	DPT 1	DPT 2	DPT 3	Polio 1	Polio 2	Polio 3	Measles	Full Vaccination	Any Vaccination
All	***	***	***	***	***	***	***	***	***	***
All-Eta^2	.002	.005	.006	.005	.004	.006	.005	.017	.010	.002

Country	Mother's Literacy	No. Of HH Members	No. Of Children Under Five	Mother Working	Mother Works Away	Child has a Minder	Child of a Multiple Birth	Prenatal and Delivery Assistance
All	***	***	***	***	***	***	***	***
All-Eta^2	.014	.001	.001	.001	.001	.001	.003	.019

-- Not Significant
* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Table II.A3a
Significance of Bivariate Relationships with Wasting Combination Indicator

Country	Percent Urban	Education	HH Assets	Water	Toilet	Vehicle	Flooring	Electricity	Radio	Television	Fridge
Burkina Faso	***	***	***	***	**	--	--	*	**	--	**
C.A. R.	**	--	--	--	--	--	***	--	*	--	--
Ghana	*	***	***	***	***	**	**	**	--	--	*
Kenya	***	***	***	***	***	--	***	***	***	***	*
Malawi	na	**	***	**	***	--	**	--	***	na	na
Niger	***	**	***	***	***	***	***	***	**	***	***
Namibia	***	***	***	***	***	**	***	***	***	***	***
Senegal	***	***	***	***	***	--	***	***	--	***	***
Zambia	***	***	***	***	***	***	***	***	***	**	--
Zimbabwe	***	--	*	--	*	--	**	**	***	*	--
All	***	***	***	***	***	***	***	***	***	***	***
All-Eta^2	.004	.015	.011	.004	.012	.001	.005	.007	.002	.004	.004

-- Not Significant
* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Table II.A3b
Significance of Bivariate Relationships with Wasting Combination Indicator

Country	Mother's Age	Living Siblings	Mortality Experien.	Unwanted	Child's Age	Percent Male	Birth Order	Birth Interval
Burkina Faso	--	**	*	--	***	***	--	**
C.A. R.	--	--	--	*	--	--	--	*
Ghana	**	**	**	--	--	--	***	--
Kenya	--	**	***	--	--	--	***	**
Malawi	--	--	--	--	**	--	--	*
Niger	***	***	***	--	***	*	***	--
Namibia	--	***	--	--	***	--	***	--
Senegal	***	***	--	**	***	***	***	--
Zambia	**	***	--	--	*	--	***	--
Zimbabwe	--	--	--	--	*	--	--	--
All	***	***	***	***	***	***	***	*
All-Eta^2	.001	.002	.001	.001	.004	.000	.002	.000

-- Not Significant
* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Table II.A3c
Significance of Bivariate Relationships with Wasting Combination Indicator

Country	Medical Prenatal Care	Medical Delivery Assistance	Birth Weight	Birth Size	Diarrhea	Fever	Cough	Feeding
Burkina Faso	--	**	***	***	***	***	***	***
C.A. R.	--	--	--	***	**	***	--	--
Ghana	*	***	--	**	***	**	--	**
Kenya	**	***	--	***	***	*	--	***
Malawi	--	--	***	***	***	**	--	***
Niger	***	***	**	***	***	***	***	***
Namibia	***	***	--	**	***	--	--	--
Senegal	**	**	***	***	--	***	**	--
Zambia	*	***	***	--	***	**	--	*
Zimbabwe	--	--	**	***	*	--	--	--
All	***	***	***	***	***	***	*	***
All-Eta^2	.009	.008	.006	.008	.008	.005	.000	.001

-- Not Significant
* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Table II.A3d
Significance of Bivariate Relationships with Wasting Combination Indicator

Country	BCG	DPT 1	DPT 2	DPT 3	Polio 1	Polio 2	Polio 3	Measles	Full Vaccination	Any Vaccination
All	***	***	***	***	***	***	***	***	***	***
All-Eta^2	.005	.004	.004	.004	.004	.004	.003	.001	.002	.005

Country	Mother's Literacy	No. Of HH Members	No. Of Children Under Five	Mother Working	Mother Works Away	Child has a Minder	Child of a Multiple Birth	Prenatal and Delivery Assistance
All	***	***	***	***	***	***	***	***
All-Eta^2	.015	.001	.001	.001	.001	.001	.001	.010

-- Not Significant
* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Table II.A4
Child's Height-for-Age Z-score:
Linear Regression Coefficients By Mother's Nutritional Status According to Age of Child

Explan-atory Variable	Less than 4 mos.			4-6 mos.			7-11 mos.			12-23 mos.			24+ mos.		
	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action
Prenatal Care	ns	ns		ns	ns		ns	ns		0.10	ns		0.09	ns	
Assistance at Delivery	ns	ns		ns	ns		0.20	ns		0.10	0.40	0.24	0.12	ns	
Birth Size	-0.52	-0.45		-0.55	-0.36		-0.56	-0.61		-0.40	-0.31		-0.27	-0.33	
Child's Age	-0.13	ns		-0.15	ns		-0.12	-0.12		-0.09	-0.09		-0.01	ns	
Birth Order	0.03	ns		ns	ns		ns	ns		ns	ns		-0.04	ns	
Birth Interval	ns	ns		ns	ns		0.00	ns		0.00	ns		0.00	0.01	
Male	-0.17	ns		-0.15	ns		0.23	0.49		-0.16	-0.24		-0.09	ns	
Dead Siblings	ns	ns		ns	ns		ns	ns		ns	ns		-0.07	ns	
Breast-fed	ns	ns		-0.54	ns	3.27	-1.18	ns		-0.49	-0.70		-0.57	-0.75	
Water	ns	0.55		ns	ns		0.27	ns		ns	ns		ns	ns	
Milk/Formula	ns	ns		ns	ns		ns	ns		ns	ns		ns	ns	
Bottle	ns	ns		ns	ns		-0.40	ns		ns	-0.66	-0.56	ns	ns	
Liquids	ns	ns		ns	ns		ns	ns		ns	ns		0.06	ns	

Explan-atory Variable	Less than 4 mos.			4-6 mos.			7-11 mos.			12-23 mos.			24+ mos.		
	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action
Solids	0.22	ns		0.21	0.34		0.20	ns		ns	0.25		ns	ns	
Any Vaccination	0.14	ns		ns	ns		ns	ns		ns	ns		ns	ns	
Full Vaccination	0.71	ns		1.01	ns		ns	ns		ns	ns		ns	ns	
Diarrhea	ns	0.82	0.81	ns	ns		ns	ns		-0.19	ns		-0.23	-0.52	-0.32
Fever	ns	ns		ns	-0.31		ns	ns		ns	ns		ns	ns	
Mum's age	ns	ns		0.02	ns		ns	ns		ns	ns		0.03	ns	
Mum's Years of Education	0.02	ns		0.02	ns		ns	ns		ns	ns		0.03	0.03	
Mum works	ns	ns		ns	ns		ns	ns		ns	ns		ns	ns	
Mum works away	ns	ns		ns	ns		ns	ns		ns	ns		-0.07	ns	
Child has minder	ns	ns		ns	ns		ns	ns		ns	ns		ns	ns	
Dad's Years of education	ns	ns		ns	ns		ns	ns		0.01	ns		0.02	ns	
No. Under 5 in HH	ns	ns		ns	ns		ns	ns		-0.03	-0.07		ns	ns	
No. of HH members	ns	ns		ns	ns		ns	ns		ns	ns		ns	ns	

Explan-atory Variable	Less than 4 mos.			4-6 mos.			7-11 mos.			12-23 mos.			24+ mos.		
	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action
HH Assets	0.02	ns	-0.06	0.02	ns		0.04	0.05		0.04	ns		0.06	0.04	-0.04
Urban	ns	ns		ns	ns		0.22	0.42		ns	0.31		ns	ns	
R^2	0.100	0.127	0.113	0.138	0.143	0.144	0.144	0.141	0.143	0.137	0.188	0.152	0.156	0.100	0.16
N	2493	278	2771	2163	272	2435	3150	424	3574	5950	968	6918	11760	1537	13297

B is OLS regression coefficient
Effect is regression coefficient for dichotomous variables and two standard deviation effect of continuous variables
ns Not significant
Blank cells indicate non-significant interaction effects with mother's wasting.

Table II.A5
Child's Weight-for-Height Z-score:
Linear Regression Coefficients by Mother's Nutritional Status According to Child's Age

Explan-atory Variable	Less than 4 mos.			4-6 mos.			7-11 mos.			12-23 mos.			24+ mos.		
	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action
Prenatal Care	ns	ns		ns	ns		ns	ns		ns	ns		ns	ns	
Assistance at Delivery	ns	ns		ns	ns		ns	ns		ns	ns		0.06	ns	
Birth Size	-0.16	ns		-0.22	-0.41		-0.16	ns		-0.33	-0.25		-0.26	-0.30	
Child's Age	0.12	Ns		-0.14	Ns		-0.09	-0.11		ns	ns		ns	ns	
Birth Order	ns	ns		ns	ns		ns	ns		ns	ns		ns	ns	
Birth Interval	ns	ns		ns	ns		ns	ns		ns	ns		ns	ns	
Male	ns	ns		-0.11	ns		-0.15	ns		-0.10	ns		ns	ns	
Dead Siblings	ns	ns		ns	ns		ns	ns		ns	-0.16		ns	ns	
Breast-fed	ns	ns		ns	ns		ns	ns		ns	ns		-0.36	-0.39	
Water	ns	ns		ns	ns		ns	ns		ns	ns		ns	ns	
Milk/Formula	ns	ns		ns	ns		ns	ns		ns	ns		ns	ns	
Bottle	ns	ns		ns	0.67		ns	ns		0.16	ns		ns	ns	
Liquids	0.17	ns		ns	ns		ns	ns		ns	-0.23		ns	ns	

Explan-atory Variable	Less than 4 mos.			4-6 mos.			7-11 mos.			12-23 mos.			24+ mos.		
	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action
Solids	ns	ns		-0.19	ns		ns	ns		ns	ns		ns	ns	
Any Vaccination	ns	ns		ns	ns		ns	ns		ns	ns		ns	ns	
Full Vaccination	ns	ns		1.01	ns		-0.14	ns		ns	ns		ns	ns	
Diarrhea	ns	ns		-0.17	ns		-0.11	ns		-0.12	ns		-0.07	ns	
Fever	ns	ns		-0.14	ns		-0.15	-0.25		-0.22	ns		-0.13	-0.13	
Mum's age	ns	ns		-0.02	ns		-0.01	ns		ns	ns		ns	ns	
Mum's Years of Education	ns	ns		0.02	0.07		0.02	0.08	0.05	ns	ns		ns	ns	
Mum works	ns	ns		ns	ns		ns	ns		ns	ns		ns	ns	
Mum works away	ns	ns		ns	ns		ns	ns		ns	ns		ns	ns	
Child has minder	ns	-0.40		ns	ns		ns	ns		ns	ns		0.07	0.15	
Dad's Years of education	0.01	ns		ns	ns		0.02	ns		0.02	0.03		ns	ns	
No. Under 5 in HH	ns	ns		ns	ns		ns	ns		ns	ns		-0.02	-0.04	
No. of HH members	ns	ns		ns	ns		ns	ns		-0.01	ns		ns	ns	

Explan-atory Variable	Less than 4 mos.			4-6 mos.			7-11 mos.			12-23 mos.			24+ mos.		
	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action	Well Nour-ished	Mal Nour-ished	Inter-action
HH Assets	ns	ns		ns	ns		ns	ns		0.03	ns	-0.04	ns	ns	
Urban	ns	ns		ns	ns		0.11	ns		ns	0.23	0.24	ns	ns	
R^2	0.076	0.060	0.083	0.113	0.143	0.127	0.121	0.080	0.127	0.119	0.077	0.132	0.082	0.074	0.10
N	2493	278	2771	2163	272	2435	3150	424	3574	5950	968	6918	11760	1537	13297

B is OLS regression coefficient
Effect is regression coefficient for dichotomous variables and two standard deviation effect of continuous variables
ns Not significant
Blank cells indicate non-significant interaction effects with mother's wasting.

Table II.A6
Mother's BMI and Odds of Maternal Wasting Predicted for High and Low Status Families

Characteristic	Value		BMI		Maternal Wasting	
	High Status	Low Status	High Status	Low Status	High Status	Low Status
Prenatal Care	yes	no	0	0	1	1
Assistance at Delivery	yes	no	0.35	0	0.82	1
Small Birth Size	no	no	0	0	1	1
Birth Order	2	5	0.38	0.96	0.88	0.73
Birth Interval	27 months	36 months	0.15	0.19	1	1
Dead Sibling	no	yes	0	0	1	1
Breast-fed	until 6 months	until 15 months	0	0	1	1
Milk/Formula	at 2 months	at 10 months	0	0	1	1
Bottle	at 2 months	not used	0	0	1	1
Other liquids	at 1 month	at 4 months	0	0	1	1
Solid Foods	at 2 months	at 10 months	0	0	1	1
Any vaccination	BCG at birth	at 4 months	0	0	1	1
Full Vaccination	at 6 months	no	0	0	1.18	1
Mother's Age	26	34	0.37	0.49	1	1
Mother's Education	9 years	none	0.55	0	0.75	1
Mother's BMI	24	19			1	1
Mother Works Away	yes	yes	0.21	0.21	0.78	0.78

Characteristic	Value		BMI		Maternal Wasting	
	High Status	Low Status	High Status	Low Status	High Status	Low Status
Child has minder	yes	no	0.15	0	1	1
Dad's Education	12 years	3 years	0.45	0.11	0.65	0.9
No. Under 5 in HH	2	4	0	0	1	1
No of HH members	4	10	0	-0.1	1	1
HH Asset Index	20	4	4.4	0.88	0.3	0.79
Urban Resident	yes	no	0.41	0	1	1
Sum or Product			5.56	1.06	0.1	0.4
Difference or Ratio			4.5		4.1	

Table II.A7
Child's Height-for-Age Z-Score Predicted for High and Low Status Families

Characteristic	Value		Under 4 months		4 to 6 months		7-11 months		12-23 months		24+ months	
	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status
Prenatal Care	yes	no	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.08	0.00
Assistance at Delivery	yes	no	0.00	0.00	0.00	0.00	0.14	0.00	0.11	0.00	0.11	0.00
Small Birth Size	no	no	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Birth Order	2	5	0.05	0.12	-0.09	-0.21	0.00	0.00	0.00	0.00	-0.10	-0.26
Birth Interval	27 months	36 months	0.00	0.00	0.00	0.00	0.08	0.10	0.10	0.13	0.11	0.15
Dead Sibling	no	yes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Breast-fed	until 6 months	until 15 months	0.00	0.00	-0.51	-0.51	0.00	-1.09	0.00	-0.55	0.00	0.00
Milk/Formula	at 2 months	at 10 months	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bottle	2 to 8 months	not used	0.00	0.00	-0.23	0.00	-0.37	0.00	0.00	0.00	0.00	0.00
Other liquids	at 1 month	at 4 months	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Solid Foods	at 2 months	at 10 months	0.22	0.00	0.24	0.00	0.18	0.00	0.10	0.10	0.00	0.00
Any vaccination	BCG at birth	DPT at 4 months	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Characteristic	Value		Under 4 months		4 to 6 months		7-11 months		12-23 months		24+ months	
	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status
Full Vaccination	at 5 months	no	0.00	0.00	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mother's Age	26	34	0.00	0.00	0.72	0.94	0.00	0.00	0.00	0.00	0.71	0.93
Mother's Education	9 years	none	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.27	0.00
Mother's BMI	24	19	1.09	0.86	0.65	0.51	0.72	0.57	0.73	0.58	0.73	0.58
Mother Works Away	yes	yes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.06	-0.06
Child has minder	yes	no	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dad's Education	12 years	3 years	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.03	0.19	0.05
No. Under 5 in HH	2	4	0.00	0.00	0.00	0.00	0.00	0.00	-0.07	-0.14	0.00	0.00
No of HH members	4	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HH Asset Index	20	4	0.00	0.00	0.41	0.08	0.79	0.16	0.61	0.12	0.99	0.20
Urban Resident	yes	no	0.00	0.00	0.00	0.00	0.21	0.00	0.11	0.00	0.00	0.00
Sum of Effects			1.52	0.99	2.26	0.81	1.87	-0.26	1.83	0.28	3.02	1.58
Difference			0.53		1.45		2.13		1.55		1.44	

Table II.A8
Odds of Being Stunted Predicted for Children of High and Low Status Families

Characteristic	Value		Under 4 months		4 to 6 months		7-11 months		12-23 months		24+ months	
	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status
Prenatal Care	yes	no	0.58	1	0.61	1	0.64	1	0.82	1	0.86	1
Assistance at Delivery	yes	no	0.65	1	1	1	1	1	0.8	1	0.85	1
Small Birth Size	no	no	1	1	1	1	1	1	1	1	1	1
Birth Order	2	5	1	1	1	1	1	1	1	1	1.01	1.03
Birth Interval	27 months	36 months	1	1								
Dead Sibling	no	yes	1	1	1	1	1	1	1	1.19	1	1
Breast-fed	until 6 months	until 15 months	1	1	1	1	1	1	1	1.54	1	1
Milk/Formula	at 2 months	at 10 months	1	1	1	1	1	1	1	1	1	1
Bottle	2 to 8 months	not used	1	1	1	1	1.5	1	1	1	1	1
Other liquids	at 1 month	at 4 months	1	1	1	1	1	1	1	1	1	1
Solid Foods	at 2 months	at 10 months	1	1	0.68	1	0.76	0.74	1	1	1	1
Any vaccination	BCG at birth	DPT at 4 months	1	1	0.62	1	1	1	1	1	1	1

Characteristic	Value		Under 4 months		4 to 6 months		7-11 months		12-23 months		24+ months	
	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status
Full Vaccination	at 6 months	no	1	1	1	1	1	1	1	1	1	1
Mother's Age	26	34	1	1	1	1	1	1	0.73	0.67	0.32	0.22
Mother's Education	9 years	none	1	1	0.47	1	0.68	1	0.82	1	0.67	1
Mother's BMI	24	19	0.17	0.24	0.27	0.36	0.26	0.35	0.4	0.48	0.36	0.44
Mother Works Away	yes	yes	1	1	1	1	1	1	1.13	1.13	1.18	1.18
Child has minder	yes	no	1	1	1	1	1	1	1	1	1	1
Dad's Education	12 years	3 years	1	1	1	1	1	1	0.7	0.91	0.75	0.93
No. Under 5 in HH	2	4	1	1	1	1	1	1	1.17	1.49	1.08	1.22
No of HH members	4	10	1	1	1	1	1	1	1	1	1	1
HH Asset Index	20	4	1	1	1	1	0.15	0.69	0.37	0.82	0.21	0.73
Urban Resident	yes	no	1	1	1	1	1	1	1	1	1	1
Product			0.06	0.24	0.03	0.36	0.02	0.17	0.05	0.75	0.01	0.10
Ratio			3.85		11.01		8.80		13.75		8.75	

Table II.A9
Child's Weight-for-Height Z-Score Predicted for High and Low Status Families

Characteristic	Value		Under 4 months		4 to 6 months		7-11 months		12-23 months		24+ months	
	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status
Prenatal Care	yes	no	-0.1	0	0	0	0	0	0	0	0	0
Assistance at Delivery	yes	no	0	0	0	0	0	0	0	0	0	0
Small Birth Size	no	no	0	0	0	0	0	0	0	0	0	0
Birth Order	2	5	0	0	0	0	0	0	0	0	0	0
Birth Interval	27 months	36 months	0	0	0	0	0	0	0	0	0	0
Dead Sibling	no	yes	0	0	0	0	0	0	0	0	0	0
Breast-fed	until 6 months	until 15 months	0	0	0	0	0	0	0	-0.1	0	0
Milk/Formula	at 2 months	at 10 months	0	0	0	0	0	0	0	0	0	0
Bottle	2 to 10 months	not used	0	0	0	0	0	0	0	0	0	0
Other liquids	at 1 month	at 4 months	-0.1	0	0	0	0	0	0	0	0	0
Solid Foods	at 2 months	at 10 months	0	0	-0.2	0	0	0	0.11	0.11	0	0
Any vaccination	BCG at birth	DPT at 4 months	0	0	0	0	0	0	0	0	0	0

Characteristic	Value		Under 4 months		4 to 6 months		7-11 months		12-23 months		24+ months	
	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status
Full Vaccination	at 6 months	no	0	0	0	0	-0.1	0	0	0	0	0
Mother's Age	26	34	0	0	-0.5	-0.6	0	0	0	0	0	0
Mother's Education	9 years	none	0	0	0.17	0	0.2	0	0	0	0	0
Mother's BMI	24	19	0.62	0.49	0.8	0.63	0.9	0.71	1.14	0.9	1.12	0.89
Mother Works Away	yes	yes	0	0	0	0	0	0	0	0	0	0
Child has minder	yes	no	0	0	0	0	0	0	0	0	0.1	0
Dad's Education	12 years	3 years	0.2	0	0	0	0.17	0	0.27	0.1	0	0
No. Under 5 in HH	2	4	0	0	0	0	0	-0.2	0	0	0	0
No of HH members	4	10	0	0	0	0	0	0	0	0	0	0
HH Asset Index	20	4	0	0	0	0	0	0	0.37	0.1	0	0
Urban Resident	yes	no	0	0	0	0	0	0	0	0	0	0
Sum			0.53	0.54	0.33	0.04	1.08	0.60	1.86	0.94	1.10	0.79
Difference			0.00		0.29		0.48		0.91		0.31	

Table II.A10
Odds of Being Wasted Predicted for Children of High and Low Status Families

Characteristic	Value		Under 4 months		4 to 6 months		7-11 months		12-23 months		24+ months	
	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status
Prenatal Care	yes	no	1	1	1	1	1	1	1	1	1	1
Assistance at Delivery	yes	no	1	1	1	1	1	1	1	1	1	1
Small Birth Size	no	no	1	1	1	1	1	1	1	1	1	1
Birth Order	2	5	1	1	1	1	1	1	1.08	1.22	1	1
Birth Interval	27 months	36 months	1	1	1	1	1	1	1	1	1	1
Dead Sibling	no	yes	1	1	1	1	1	1	1	1	1	1
Breast-fed	until 6 months	until 15 months	1	1	1	1	1	1	1	1	1	1
Milk/Formula	at 2 months	at 10 months	1	1	1	1	1	1	1	1	1	1
Bottle	at 2 months	not used	1	1	1	1	1	1	1	1	1	1
Other liquids	at 1 month	at 4 months	1	1	1	1	1	1	1	1	1	1
Solid Foods	at 2 months	at 10 months	1	1	1.8	1	1	1	1	1	1	1
Any vaccination	BCG at birth	DPT at 4 months	1	1	1	1	1	1	1	1	1	1
Full Vaccination	at 6 months	no	1	1	1	1	1	1	1	1	1	1

Characteristic	Value		Under 4 months		4 to 6 months		7-11 months		12-23 months		24+ months	
	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status	High Status	Low Status
Mother's Age	26	34	1	1	1	1	2.41	3.16	1	1	1	1
Mother's Education	9 years	none	1	1	0.52	1	1	1	1	1	1	1
Mother's BMI	24	19	1	1	1	1	0.28	0.36	0.15	0.22	0.1	0.12
Mother Works Away	yes	yes	1	1	1	1	1	1	1	1	1	1
Child has minder	yes	no	1	1	1	1	1	1	1	1	1	1
Dad's Education	12 years	3 years	1	1	1	1	1	1	0.59	0.88	0.66	0.9
No. Under 5 in HH	2	4	1	1	1	1	1	1	1	1	1	1
No of HH members	4	10	1	1	1	1	1	1	1	1	1	1
HH Asset Index	20	4	1	1	1	1	1	1	1	1	1	1
Urban Resident	yes	no	1	1	1	1	1	1	1	1	1	1
Product			1.00	1.00	0.94	1.00	0.67	1.14	0.09	0.24	0.04	0.11
Ratio of Odds			1.00		1.07		1.71		2.49		2.50	