Evolution and Determinants of Non-monetary Indicators of Poverty in Kenya: Children's Nutritional Status, 1998-2003*

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ABSTRACT

This paper uses Demographic and Health Survey (DHS) data to analyze the evolution and determinants of children's nutritional status in Kenya using descriptive and econometric methods. Results suggest that child characteristics are significant determinants of children's nutritional status. In addition, share of women in a household and mother's education are found to be important household characteristics. Household assets are also important determinants of children's nutrition status but nutrition improves at a decreasing rate with assets. The results also suggest that rural children are likely to suffer more malnutrition than urban children, while boys are more likely to be malnourished than girls. Our findings suggest that if Kenya is to reduce the current high rates of malnutrition as stipulated in the strategic health objectives and the millennium development goals, policies and strategies for poverty alleviation, promotion of post secondary education for women and provision of basic preventive health care are critical issues which need to be pursued because they have a big impact on children's nutritional status.

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1 INTRODUCTION

National governments and donors emphasize the progressive realization of access to food and good nutrition as a human right. For this reason, reducing food insecurity and improving nutrition have acquired increased importance within the context of poverty reduction strategies. There is need to address the immediate causes of malnutrition and also their underlying basic factors if developing nations are to achieve nutritional well-being and reach functional and productive capacity in the population.

In Kenya, child mortality rates and malnutrition remain high in spite of the government's commitment to create an enabling environment for the provision of quality health care and reduction of mortality and malnutrition levels. Under-five mortality rates remain above 100 per 1,000 live births while infant mortality rates are well above 60. In addition, about 30% of under five children suffer from chronic malnutrition (stunted), almost 6% are severely malnourished (wasted), while 20% are underweight. The prevalence of these problems is most critical in rural areas, drought stricken areas, and among poor households (CBS et al., 2004). Efforts to reduce child mortality rates and malnutrition continue to be challenged by the HIV/AIDS scourge that has led to increased number of orphaned children who are at increased risk of malnutrition. Nutritional deficiencies contribute to high rates of disability, illness and death. They also affect the long term physical growth and development of children, and may lead to high levels of chronic illness and disability in adult life. In addition, high rates of malnutrition jeopardize future economic growth by reducing the intellectual and physical potential of the entire population.

In its efforts to ensure health for all Kenyans, the Ministry of Health's strategic plan (1999-2004) aimed among other targets at: reducing malnutrition among under five year olds by 30%; reducing the proportion of under-five morbidity and mortality rates attributable to key childhood diseases and malnutrition from 70 to 40 percent and eliminate vitamin A deficiency in under five year olds. However, the achievement of these targets continues to be undermined by lack of progress in key determinants of children malnutrition, morbidity and mortality.

There are a wide range of factors that determine the nutritional status of children. These can broadly be classified into child characteristics including age and gender of the child, household characteristics, particularly parental characteristics, and community variables. However, dietary intake and health status are also important determinants of children's nutritional status. These are in turn influenced by underling determinants such as food security and community infrastructure such as sanitation, access to water and local market conditions (Strauss and Thomas, 1995). Other factors which have been investigated in the literature include prices of related health inputs, available household resources such as income, time and household public goods (Fedorov and Sahn, 2005).

Malnutrition may also be affected by the cultural and natural environment in which individuals live, national policies and international conditions (Marini and Gragnolati, 2003).

This paper contributes to the literature on child health and poverty by investigating the evolution and determinants of children's nutritional status between 1998 and 2003 using demographic and health survey (DHS) data from Kenya. We focus on nutritional status as a non money-metric measure of poverty, which is a recent innovation in the literature. This is based on the argument that nutritional status is a different dimension of welfare (capability deprivation) from income and expenditure[2]. In addition, there are a number of other advantages of using nutrition instead of income as a measure of poverty: one, individual well-being in the form of nutritional status can be directly observed as opposed to household well-being. Two, money-metric comparisons of welfare over time are hampered by the absence of reliable and verifiable deflators, and information collected in surveys is often inadequate to solve this problem. Three, budget surveys that differ in instrument design, recall periods and even the nature of interviewer training have large systematic differences in the accuracy of measuring household expenditures (Sahn and Stifel, 2002a). Measuring height and weight is easy and consistent and therefore overcomes this difficulty.

To explain the determinants of children's nutritional status in the two surveys, our study focuses on child, household and community characteristics. The impact of ethnicity and religion is also investigated. Environmental factors (sanitation, access to clean water and housing material) are also investigated but results are excluded because we do not uncover any impact of these variables on children's nutritional status. The final aspect of the paper is to simulate the impact of changes in policy variables on children's nutritional status, focusing on household assets, parental education and access to health care services. This exercise underscores the importance of policy in improving children's nutritional status in Kenya.

The rest of the paper is structured as follows: The next section presents the analytical framework. Section 3 provides a detailed descriptive analysis of the data; section 4 presents the regression results. Section 5 concludes.

2 ANALYTICAL FRAMEWORK

Studies of determinants of children's nutritional status follow the household production framework of Becker (1965) and Strauss and Thomas (1995). Starting with a simple household utility maximizing model, we assume that a household has preferences that can be characterized by the

[2] We carry out more analysis of non-monetary measures of poverty in Kabubo-Mariara and Kirii (2005), while analysis of monetary measures of poverty for the same period is covered in Kabubo-Mariara et al., 2005.

utility function, U which depends on consumption of a vector of commodities, X, leisure, L, and the quality of children represented by their nutritional status, N:

$$U = u(X, L, N) \quad \ldots\ldots(1)$$

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

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

$$N_i = n(C, W, H, Z, \varepsilon) \quad \ldots\ldots(2)$$

Where C is consumption, W is a vector of child-specific characteristics; H is a vector of household specific characteristics; Z is a vector of community-level characteristics and ε is the child-specific disturbance term. The reduced form model can enable us to capture the total impact of child, household and community characteristics rather than their impact conditional on a set of choice variables through a structural model (Strauss and Thomas, 1995, Thomas et al. 1996). The specified nutritional production function allows us to estimate the following equations:

haz_i = f(child characteristics, household characteristics, community characteristics, ε_{ha})
whz_i = f(child characteristics, household characteristics, community characteristics, ε_{wa})

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

Individual child characteristics include age and gender of the child. Household level characteristics can be divided into parental characteristics and other household characteristics. Parental characteristics include height of the mother and parents' age, education, and marital status. Height of the mother captures both the genetic effects and the effects resulting from family background characteristics not captured by maternal education. Maternal education is expected to improve nutrition through altering the household preference function and also through better child care practices. Other household characteristics include structure of the household (captured by the number of persons in a specific age and sex group), headship and assets. The structure of the household enable us to test whether presence of older siblings may improve a child's nutritional status, and also whether presence of more adult women, holding household size and age composition of the household constant improve the nutritional status of a child (Sahn 1994, Sahn and Stifel, 2002b). In the absence of expenditure or income data, we use the asset index to proxy household welfare (Sahn and Stifel, 2003). Previous studies have also included a vector of other household characteristics such as religion, ethnicity and even occupation of the household head, depending on availability of data. Community characteristics represent access to public facilities such as immunization and health care as well as environmental factors such as water and sanitation (Strauss and Thomas 1995).

3 THE DATA AND DESCRIPTIVE RESULTS

The Data

The data used to analyze the determinants of children nutritional status is taken from the 1998 and 2003 Demographic and Health Surveys (DHS) for Kenya. The DHS are nationally representative samples of women aged 15 to 49 and their children. The two surveys, while relatively comparable differ in a number of ways: The 1998 DHS collected information on 7,881 women aged 15-49, and 6,185 children aged less than 60 months from 8,380 households in the months of February to July 1998. The 2003 DHS covered 8,195 women aged 15-49 and 6,102 children aged less than 59 months from 8,561 households in the months of April to August, 2003. Both surveys covered both rural and urban populations. The surveys collected information relating to demographic and socio-economic characteristics for all respondents and more extensive information on pre-school children.

The Demographic and Health Surveys utilized a two-stage sample design. The first stage involved selecting sample points (clusters) from a national master sample maintained by Central Bureau of Statistics (CBS) the fourth National Sample survey and Evaluation Programme (NASSEP) IV. In 2003, a total of 400 clusters, 129 urban and 271 rural, were selected. From these clusters, the desired sample of households was selected using systematic sampling methods. The 1998 DHS selected 536 clusters, of which 444 were rural and 92 urban.

Descriptive Results

To make the data comparable, we base our analysis on children aged less than 36 months in the two survey periods. After making this adjustment and further cleaning the data to remove children with missing values for nutritional indicators, our sample narrowed down to 2914 and 2956 children aged less than 36 months in 1998 and 2003 respectively. The descriptive statistics for the key variables from the two datasets are presented in Table 1. The distribution of children across 1 year age groups is almost similar in the two surveys with 33% and 36% children aged less than 12 months and 35% and 34% aged between 12 and 24 months in 1998 and 2003 respectively. The rest (32% in 1998 and 30% in 2003) were aged between 24 and 36 months.

In general, Table 1 indicates robustness of the two datasets across all variables. While the mean current age of mothers in the two surveys is similar at 27 years, household heads recorded a difference of one year, with a mean of 39 and 38 years in 1998 and 2003 respectively. Minor differences are also observed for schooling except for mothers with primary education. This pattern for education is consistent with that of husbands. There is no clear pattern in the change in education attainment between the two surveys. However, the data suggest that the mean years of schooling fell marginally for both men and women with primary education but increased marginally for both groups with respect to post primary schooling. The mean asset index fell from –0.12 in 1998 to –0.17 in 2003, implying that on average Kenyan households were worse off in terms of asset poverty in 2003 compared to 1998.

The nutritional status of children aged 0-35 months in our samples is indicated in the last 3 rows of Table 1. The measure for chronic under nutrition; height for age scores (*haz*) ranged from –5.98 to 5.96 and -5.93 to 5.88 in 1998 and 2003 respectively. The corresponding mean scores for these two periods are estimated to be –1.18 and –1.19 respectively. This implies that there was little difference in the levels of chronic under nutrition in the 2 years. There are however more pronounced differences in the measures for acute under nutrition (*whz*) and underweight (*waz*) in the two surveys. For instance, in 1998, the *whz* scores ranged from -3.87 to 5.7 compared to a range of -3.99 to 5.07 in 2003. For underweight, the range for 1998 was -5.12 to 5.34 compared to -5.74 to 5.35 in 2003. Overall, the data suggest some improvement in children nutritional status between 1998 and 2003. This improvement could probably be attributable to increased access to health care in 2003 (see table 7). The mean scores for current malnutrition and underweight for the two surveys also show more variation than for chronic malnutrition (Table 1).

Table 1: Descriptive statistics

	1998			2003		
Variable Description	**Mean**	**Std. Dev.**	**N**	**Mean**	**Std. Dev.**	**N**
Current age of child in years	0.99	0.81	2914	0.95	0.81	2956
Age in months	17.39	10.02	2914	16.91	10.10	2956
Sex of child	1.49	0.50	2914	1.50	0.50	2956
Weight of child	9.29	2.55	2914	9.25	2.53	2956
Height of child	74.79	10.18	2914	74.32	9.97	2956
Age of household head	39.13	13.24	2909	38.02	12.49	2956
Mother's age	27.28	6.44	2914	27.45	6.54	2956
Partners age	35.41	9.78	2478	35.26	9.04	2529
Height of mothers	160.00	6.29	2898	159.78	6.46	2892
Number of household members	6.19	2.64	2914	6.05	2.43	2956
Number of children 5 and under	1.91	0.94	2914	1.91	0.91	2956
Number of women aged 15-49	1.42	0.75	2914	1.37	0.71	2956
Mother's years of primary education.	6.23	2.72	2914	5.98	2.95	2956
Mother's years of post-primary education	3.41	1.57	688	3.48	1.98	673
Mother has no education	0.11	0.31	2914	0.15	0.35	2956
Primary	0.64	0.48	2914	0.64	0.48	2956
Secondary	0.24	0.43	2914	0.17	0.38	2956
Higher	0.02	0.14	2914	0.03	0.18	2956
Father years of primary education	6.83	2.37	2633	6.57	2.69	2740
Father's years of post-primary education	3.44	1.76	1074	4.25	2.69	1047
Father has no education	0.07	0.26	2636	0.12	0.33	2956
Primary education dummy	0.50	0.50	2636	0.52	0.50	2956
Secondary education dummy	0.39	0.49	2636	0.28	0.45	2956
Higher education dummy	0.04	0.19	2636	0.08	0.27	2956
Household asset index	-0.12	0.78	2914	-0.17	0.80	2946
Christian dummy	0.91	0.28	2914	0.88	0.32	2956
Muslim dummy	0.06	0.23	2914	0.09	0.28	2956
Other religion dummy	0.03	0.17	2914	0.03	0.18	2956
Nairobi	0.06	0.23	2914	0.07	0.25	2956
Central	0.09	0.28	2914	0.11	0.31	2956
Coast	0.08	0.27	2914	0.09	0.28	2956
Eastern	0.17	0.38	2914	0.16	0.37	2956
Nyanza	0.21	0.41	2914	0.16	0.36	2956
Rift Valley	0.25	0.43	2914	0.27	0.44	2956
Western	0.14	0.35	2914	0.13	0.34	2956
Kalenjin community	0.16	0.36	2914	0.17	0.38	2956
Kikuyu, Embu, Meru and Kamba	0.33	0.47	2914	0.34	0.47	2956
Luo, Luhya and Kisii	0.40	0.49	2914	0.35	0.48	2956
Other tribes	0.10	0.29	2914	0.14	0.35	2956
Haz- Height for Age Z-Score	-1.18	1.65	2899	-1.19	1.55	2953
Waz- Weight for Age Z-Score	-0.93	1.41	2899	-0.86	1.40	2953
Whz- Weight for height Z-Score	-0.24	1.33	2914	-0.15	1.29	2956

Table 2 presents a tabulation of the mean `Z' scores by background characteristics of the children in the sample, focusing on child age groups, gender of the child, region and place of residence as well as parental characteristics. The analysis indicates that chronic under nutrition increased with age in the two surveys. However, acute under nutrition and underweight show no particular pattern. Further, the data shows lower z-scores for boys than for girls indicating that boys are more likely to suffer chronic and acute under nutrition as well as being underweight than girls. This finding is consistent with other studies on nutritional status of children in Africa (Alderman, 1990; Sahn, 1990; Ssewanyana, 2002). The distribution of mean 'Z'scores across regions is consistent in the two surveys. For instance, urban areas reported lower mean scores than rural areas for all measures of malnutrition, implying that rural children are likely to suffer more malnutrition than urban children. Except for acute under nutrition, the data suggests that children from female headed households are likely to be more malnourished than children from male headed households. This could be explained by the fact that most female-headed households may be more income constrained due to absence of a spouse and may therefore not be able to provide all required nutrients for their children. The differences are however quite minor.

Education attainment is expected to be inversely correlated with malnutrition. This expectation is supported by our data for the two surveys. Only mean weight for height scores show contradicting results. For chronic under nutrition and under weight, mean scores clearly decline with an increase in the level of mothers education, which is consistent with findings in the literature (see for instance Silva, 1995).

Table 3 shows the percentage of children falling below minus 2 z scores by social-economic characteristics. This table follows the U.S. National Centre for Health Statistics (NCHS) median reference where a cut-off of minus two standard deviations for *haz* is taken as measure of past or chronic malnutrition, and minus two *whz* taken as a measure of current or acute malnutrition. The results across child age groups for the two surveys are consistent with table 2. Malnutrition increases with age except for children aged 24-35 months. This is probably explained by the ceasing of breastfeeding and weaning especially for children aged 12-24 months. After the first 2 years, a child is likely to get more nutrients from a wider range of foodstuffs than at a more tender age. Except for children aged 6-12 months, there are larger proportions of malnourished children by age group in 2003 compared to 1998. This behaviour of malnutrition with age is consistent with findings in previous studies (Alderman, 1990; Ssewanyana, 2003).

Table 2: Mean Z-Scores by background characteristics 1998 - 2003

Variable	**1998**				**2003**			
Grouped child age (months)	**Height for Age**	**Weight for Height**	**Weight for Age**	**N**	**Height for Age**	**Weight for Height**	**Weight for Age**	**N**
0-6	-0.09	0.52	0.41	440	-0.110	0.540	0.420	484
6-12	-0.69	0.33	-0.84	520	-0.730	-0.110	-0.680	574
12-24	-1.67	-0.37	-1.29	1013	-1.110	-0.360	-1.310	1006
24-35	-1.44	-0.40	-1.24	941	-1.470	-0.310	-1.180	893
Sex of Child								
Male	-1.24	-0.26	-0.97	1490	-1.303	-0.204	-0.970	1487
Female	-1.12	-0.21	-0.89	1424	-1.063	-0.088	-0.749	1469
Region								
Nairobi	-0.85	0.05	-0.54	168	-0.652	0.329	-0.171	181
Central	-0.81	0.24	-0.38	258	-1.087	0.088	-0.607	303
Coast	-1.39	-0.37	-1.13	238	-1.368	-0.312	-1.094	249
Eastern	-1.42	-0.25	-1.09	496	-1.303	-0.233	-0.999	488
Nyanza	-1.15	-0.51	-1.13	615	-1.111	-0.005	-0.703	473
Rift Valley	-1.15	-0.19	-0.87	735	-1.295	-0.243	-1.019	796
Western	-1.24	-0.25	-0.95	404	-1.195	-0.207	-0.890	402
Type of place of residence								
Urban	-0.73	-0.03	-0.51	503	-0.974	0.193	-0.478	509
Rural	-1.28	-0.28	-1.02	2411	-1.230	-0.221	-0.944	2447
Sex of household								
Male	-1.17	-0.23	-0.92	2155	-1.171	-0.154	-0.856	2221
Female	-1.20	-0.27	-0.96	759	-1.226	-0.124	-0.872	735
Mother's highest educational level								
None	-1.57	-0.56	-1.41	313	-1.329	-0.512	-1.234	434
Primary	-1.29	-0.31	-1.06	1852	-1.274	-0.173	-0.939	1906
Secondary	-0.74	0.03	-0.45	690	-0.882	0.203	-0.393	513
Higher	-0.72	0.52	-0.08	59	-0.461	0.113	-0.198	102

Consistent with table 2, boys are more likely to suffer malnutrition than girls and the same scenario is observed for rural vs. urban areas. The results further suggest that in 2003, children from female headed households are more likely to be malnourished than those from male headed households, except for current (acute) malnutrition.

In Table 4 we present nutritional indicators by age group and gender. In the second part of the table (4.4b) we only present results for the percentage of children under different Z score groups for chronic and acute malnutrition. This is done to save on space and avoid too much detail; otherwise the results for wasting are robust in that they follow more or less the same pattern as the *haz* and *whz* scores for the two surveys.

Table 4a suggests that the levels of malnutrition in the two surveys are almost equal, though there seem to be considerable differences between the percentages of children with a *haz* score greater than 2 in the two surveys (4.4% and 2.7% in 1998 and 2003 respectively). The tabulation for acute malnutrition also suggests some considerable differences in the second and fourth most malnourished groups.

Table 3: Percentage of children below -2 Z-Scores

Variable	***1998***				***2003***			
	Height for Age	**Weight for Height**	**Weight for Age**	**N**	**Height for Age**	**Weight for Height**	**Weight for Age**	**N**
Child age group (months)								
0-6	6.96	5.17	2.26	440	7.28	3.93	2.43	484
6-12	17.53	7.77	14.86	520	15.63	6.07	15.22	574
12-24	41.51	9.44	26.77	1013	43.98	9.68	27.12	1006
24-35	32.59	4.89	28.18	941	36.17	5.32	25.1	893
Sex of child								
Male	33.5	7.25	22.76	1490	33.38	7.61	22.85	1487
Female	27.86	6.8	19.98	1424	26.8	5.83	17.45	1469
Type of place of residence								
Urban	22.42	5.17	11.38	503	23.88	4.77	13.48	509
Rural	32.49	7.42	23.49	2411	31.41	7.12	21.55	2447
Sex of household head								
Male	30.62	7.06	21.42	2155	29.38	7.23	19.7	2221
Female	30.92	6.94	21.36	759	32.32	5.02	21.55	735
Mother's highest educational level								
None	42.62	9.7	34.17	313	35.1	14.53	30.8	434
Primary	33.79	7.85	23.58	1852	31.97	5.76	20.71	1906
Secondary	18.8	3.95	11.08	690	22.44	3.75	11.68	513
Higher	21.12	3.12	6.16	59	12.95	6.37	7.46	102

Height for age Z-score less than -2.0 indicates chronic malnutrition
Weight for height Z-score less than -2.0 indicates acute malnutrition

Weight for age Z-score less than -2.0 indicates underweight children

From Table 4b, it is not clear what the pattern of malnutrition is when comparing boys and girls, though there are almost 6% more boys than girls in the lowest *haz* score group implying that boys are more likely to suffer chronic malnutrition than girls. Thought not as pronounced, the results for acute malnutrition also suggest that boys are more likely to be malnourished than girls. The results for 2003 confirm that boys appear to be at a relative disadvantage compared to girls in nutrition in Kenya. This conclusion is robust to findings from other studies for Africa cited above.

Table 4a: Nutritional Indicators by Age Group, 1998-2003 (%): Full Sample

	1998					**2003**				
Grouped Z-scores	**Grouped child age in months**									
	0-6	6-12	12-24	24-35	All	0-6	6-12	12-24	24-35	All
Height for Age[a]										
Z score <= -2	7.5	17.7	42.0	37.9	31.1	7.4	15.8	44.1	36.5	30.3
-2 < Z-score <=-1	17.2	25.1	28.6	27.3	25.8	19.7	27.3	27.5	29.4	26.7
-1 < Z-score <=0	33.3	30.7	15.9	17.6	21.7	24.7	29.5	17.4	20.7	22.0
0 < Z-score <=1	23.9	15.4	8.7	9.5	12.5	32.0	19.7	7.0	7.6	13.7
1 < Z-score <= 2	10.7	7.0	1.2	3.8	4.5	10.6	5.3	2.6	3.4	4.6
Z score > 2	7.4	4.1	3.6	4.0	4.4	5.7	2.5	1.5	2.5	2.7
Weight for Height[b]										
Z score <= -2	5.2	7.8	9.7	4.9	7.1	3.9	6.1	9.8	5.5	6.8
-2 < Z-score <=-1	8.5	23.9	22.7	23.5	21.0	7.2	16.7	20.9	19.3	17.4
-1 < Z-score <=0	21.1	29.5	31.2	38.3	31.7	20.1	33.9	31.6	37.6	32.0
0 < Z-score <=1	30.7	22.6	23.3	25.6	25.1	32.6	26.9	24.3	29.4	27.7
1 < Z-score <= 2	21.2	11.7	8.5	5.7	10.1	22.5	10.3	9.7	6.2	10.9
Z score > 2	13.3	4.5	4.7	2.0	5.1	13.8	6.1	3.7	2.0	5.3
Weight for Age[c]										
Z score <= -2	2.3	15.2	27.4	28.4	21.8	2.4	15.2	27.6	25.4	20.4
-2 < Z-score <=-1	9.2	32.5	35.5	31.8	29.8	7.6	26.0	35.1	34.4	28.6
-1 < Z-score <=0	26.7	29.7	23.0	24.8	25.3	24.6	32.2	23.7	23.4	25.4
0 < Z-score <=1	31.8	15.0	8.9	9.3	13.6	35.7	15.9	9.2	12.2	15.7
1 < Z-score <= 2	18.9	5.3	3.1	3.7	6.1	22.3	7.6	3.4	3.1	7.2
Z score > 2	11.1	2.4	2.1	2.0	3.5	7.4	3.1	1.0	1.6	2.7
N	440	520	1013	941	2914	484	574	1006	893	2956

[a] Low height for age Z-score indicates chronic under nutrition
[b] Low weight for height Z-score indicates acute under nutrition
[c] Low weight for age Z-score indicates underweight

From tables 4a and 4b, it is apparent that for z scores less than –2, the highest level of malnutrition is observed for children aged 12-24 months irrespective of whether they are boys or girls. Beyond age 24 months, malnutrition declines. In other words, for both years, the distribution of children below –2 z scores by age group follows an inverted `U' shape. This is again consistent with previous studies and our earlier conclusions from Table 3.

Table 4b: Nutritional Indicators by Age and Gender, 1998-2003 (%)

	1998					2003				
Grouped Z-scores	***Grouped child age in months***									
	0-6	6-12	12-24	24-35	All	0-6	6-12	12-24	24-35	All
Male Sub-sample										
Height for Age[a]										
Z score <= -2	6.9	21.5	47.1	39.3	33.8	9.2	19.5	49.1	38.2	33.6
-2 < Z-score <=-1	20.6	21.9	26.1	26.6	24.7	19.1	27.4	28.3	28.7	26.8
-1 < Z-score <=0	32.5	32.3	15.3	16.8	21.5	27.7	27.2	14.6	20.9	21.1
0 < Z-score <=1	21.5	13.9	6.8	10.2	11.5	28.3	19.0	4.9	6.1	11.8
1 < Z-score <= 2	10.5	4.8	1.4	3.3	4.1	9.5	4.8	2.1	4.2	4.4
Z score > 2	7.9	5.7	3.2	3.7	4.5	6.2	2.1	1.0	1.9	2.4
Weight for Height[b]										
Z score <= -2	5.9	8.7	9.5	5.0	7.3	3.7	7.6	10.8	6.5	7.7
-2 < Z-score <=-1	8.1	24.8	23.0	24.9	21.6	8.2	20.8	19.8	18.9	17.9
-1 < Z-score <=0	16.5	29.8	33.5	37.4	31.4	18.5	29.4	32.7	36.5	30.9
0 < Z-score <=1	31.8	22.2	24.2	24.5	25.1	33.2	28.7	23.7	31.5	28.6
1 < Z-score <= 2	20.9	11.0	5.9	6.5	9.3	24.0	9.1	10.0	4.3	10.4
Z score > 2	16.8	3.6	4.0	1.8	5.2	12.3	4.4	3.1	2.3	4.6
N	228	257	502	472	1460	240	283	504	451	1478
Female Sub-sample[a]										
Height for Age										
Z score <= -2	8.1	13.9	36.8	36.4	28.3	5.5	12.2	39.0	34.8	26.9
-2 < Z-score <=-1	13.3	28.4	31.1	28.1	27.0	20.3	27.1	26.7	30.1	26.7
-1 < Z-score <=0	34.2	29.0	16.5	18.4	22.0	21.7	31.8	20.3	20.5	22.9
0 < Z-score <=1	26.6	16.9	10.7	8.7	13.5	35.7	20.4	9.0	9.1	15.7
1 < Z-score <= 2	11.0	9.3	0.9	4.2	5.0	11.7	5.7	3.0	2.5	4.8
Z score > 2	6.9	2.5	3.9	4.3	4.2	5.1	2.8	2.0	3.0	3.0
Weight for Height[b]										
Z score <= -2	4.4	6.9	9.9	4.8	6.9	4.2	4.5	8.8	4.5	5.9
-2 < Z-score <=-1	8.8	23.0	22.4	22.0	20.4	6.1	12.7	22.0	19.7	16.8
-1 < Z-score <=0	26.3	29.3	28.8	39.3	31.9	21.6	38.2	30.5	38.7	33.0
0 < Z-score <=1	29.5	23.1	22.5	26.8	25.0	31.9	25.1	25.0	27.3	26.8
1 < Z-score <= 2	21.6	12.4	11.2	5.0	10.9	21.0	11.5	9.4	8.2	11.4
Z score > 2	9.4	5.4	5.3	2.2	4.9	15.2	7.9	4.3	1.7	6.0
N	211	263	511	468	1454	244	291	501	441	1478

[a] Low height for age Z-score indicates chronic under nutrition
[b] Low weight for height Z-score indicates acute under nutrition
[c] Low weight for age Z-score indicates underweight

Table 5 confirms our earlier results (in table 2) that malnutrition is higher in rural than in urban areas for both years, with 33% of all rural children suffering from chronic under nutrition in 1998, compared to 31% in 2003. Though the percentage of rural children with chronic malnutrition fell by 2% between the two surveys, the percentage of urban children with chronic malnutrition increased by 2%. Coast province has the largest percentage of malnourished children in the two surveys, though the percentage fell by 3% in 2003. Nairobi reported the lowest percentage. That urban children are less likely to be stunted or wasted than rural children may reflect differences in sanitation and access to health care, as well as possible self-selection of parents into urban areas (Alderman, 1990). The results in this table are consistent with sample characteristics presented in table 1. Another highlight from Table 5 is that male children are more likely to suffer chronic malnutrition than girls, which supports our earlier findings on the gender distribution of the indicators of children's nutritional status.

Levels of malnutrition by asset index quintiles were ranked using the household data for all interviewed women. The results are presented in Table 6. The results show that under nutrition declined linearly with assets. This is however not observed for the urban sample for 1998, probably due to a relatively small sample. Though the lack of linearity of the nutritional indicators by asset index quintiles for urban areas is surprising, this finding is not uncommon in the literature (see for instance Alderman 1990 and Sahn, 1990). The data shows that there was a notable improvement in the percentage of children with chronic and acute malnutrition in 2003 for the poorest 40% of the population (i.e. the lowest two quintiles). The general implication of the results of this table is the need for targeting poor households in order to reduce malnutrition.

Table 5: Nutritional Indicators by Region and Gender

	1998			2003		
Province	**Percentage with chronic malnutrition**	**Percentage with acute malnutrition**	**N**	**Percentage with chronic malnutrition**	**Percentage with acute malnutrition**	**N**
Male Sub-sample						
Nairobi	31.61	7.02	57	22.13	5.21	131
Central	27.44	5.74	113	32.30	4.59	181
Coast	37.13	4.65	224	35.70	6.10	197
Eastern	34.72	6.81	196	35.22	5.56	190
Nyanza	27.91	11.20	240	31.51	4.17	194
Rift Valley	35.40	6.67	432	34.88	12.11	313
Western	39.92	5.49	198	34.98	7.98	191
Urban	23.88	4.72	215	27.06	4.67	375
Rural	35.58	7.80	1245	34.74	8.24	1103
Female Sub-sample						
Nairobi	16.67	5.56	36	13.84	4.12	137
Central	25.78	5.93	121	26.70	4.56	192
Coast	36.17	6.75	222	32.95	7.05	168
Eastern	31.67	4.86	209	28.24	4.37	177
Nyanza	27.33	9.17	251	28.96	2.48	192
Rift Valley	26.79	7.05	390	27.69	7.53	290
Western	26.15	6.27	225	24.09	6.50	231
Urban	20.79	5.67	205	20.25	4.87	364
Rural	29.28	7.03	1249	28.10	6.02	1114
Full Sample						
Nairobi	25.81	6.45	93	17.99	4.66	268
Central	26.83	5.84	234	29.51	4.57	373
Coast	37.93	5.62	446	34.42	6.54	365
Eastern	32.99	5.80	405	31.87	4.98	367
Nyanza	26.91	10.19	491	30.25	3.34	386
Rift Valley	31.58	6.84	822	31.42	9.90	422
Western	32.63	5.89	423	28.91	7.15	172
Urban	22.42	5.17	420	23.80	4.76	739
Rural	32.49	7.42	2494	31.42	7.13	2217

Table 6: Nutritional Indicators by Asset Index Quintile

Quintiles	1998			2003		
	Rural Areas					
	Percentage with chronic malnutrition	Percentage with acute malnutrition	N	Percentage with chronic malnutrition	Percentage with acute malnutrition	N
Rural Sample						
Quintile 1	43.37	6.98	564	35.42	10.47	610
Quintile 2	36.38	8.60	533	34.08	7.06	591
Quintile 3	29.55	8.72	664	30.53	6.33	497
Quintile 4	25.98	6.18	507	28.04	4.72	373
Quintile 5	16.34	5.04	207	16.16	3.72	140
Urban Sample						
Quintile 1	43.06	5.06	13	52.17	13.43	48
Quintile 2	17.24	14.18	27	34.53	9.93	33
Quintile 3	21.49	7.24	42	29.76	4.05	78
Quintile 4	31.32	4.86	94	22.24	3.68	182
Quintile 5	19.11	4.13	242	19.92	4.11	394
Full Sample						
Quintile 1	42.488	6.76	577	36.12	10.59	658
Quintile 2	35.378	8.89	560	34.10	7.17	624
Quintile 3	28.977	8.62	706	30.46	6.13	575
Quintile 4	27.047	5.92	601	26.75	4.49	555
Quintile 5	17.978	4.50	449	18.66	3.98	534

To assess the impact of availability of health care on children's nutritional status, we generate a vector of community level variables as proxies[3]. We focus on six variables, namely: the share of children who were fully immunized; the share of children who had at least one immunization vaccine; the share of women who used modern contraceptive methods; the share of women who received professional pre-natal and birth care(doctor, midwife or nurse) and the share of pregnant women who received tetanus toxoid.

The sample characteristics for all community variables for the two surveys are presented in Table 7. The results indicate that except for use of modern contraception which recorded a minor decline, use of other health care services improved in 2003. Only about 40% of all the children had been fully immunized in both urban and rural areas in the two surveys, which depicts very low immunization coverage. The share of women receiving professional birth care and using modern contraception in urban areas is much higher than in rural areas. The rural urban differential in birth care is extremely high. For other health care services, there is no major difference in usage in rural and urban areas.

We also estimated non-self cluster shares for households with access to piped water, with toilet facilities, with traditional floor (earth, mud, dung or sand) and roof. These variables can be seen as measures of the environmental/sanitation quality of the residence of the child and are therefore expected to affect child nutritional status (Strauss and Thomas 1995). Once again, the results are robust across regions for the two surveys. As expected, only a small proportion of households have access to piped water in rural areas compare to urban areas. Somehow, there seem to be marked differences in the proportions between 1998 and 2003, more so for the urban sample. The rural urban differences across the years conform to expectations. For instance, 94% of all urban households have corrugated iron roofs compared to only 60% in rural areas. The same case applies to toilet facilities while as expected only a small proportion (20%) of urban dwellers have a traditional floor, compared to over 80% in rural areas.

The descriptive analyses presented above suggest some relationship between nutritional indicators and a vector of groups of variables, namely: child characteristics, household characteristics and community level characteristics. However, descriptive analysis alone cannot be relied on to establish the existence or otherwise of causation between variables. To establish the nature and strength of the impact of these variables on child nutritional status, we resort to econometric analysis. The results are presented and discussed in the next section.

3 Individual level variables such as whether a child is fully immunized or not or whether a woman used modern contraception are arguably endogenous because they depend on among other factors household characteristics. To make these variables exogenous, we use the non-self cluster shares or local community shares of each of these variables.

Table 7: Community and Environmental Variables: Non-Self Cluster Shares by Characteristic

	1998			2003		
Variable/characteristic	**Mean**	**Std. Dev.**	**N**	**Mean**	**Std. Dev.**	**N**
Rural Sample						
Any vaccination received	0.71	0.20	2490	0.84	0.17	2217
All vaccinations received	0.40	0.23	2490	0.45	0.24	2217
Any professional pre-natal care	0.75	0.19	2490	0.87	0.17	2217
Tetanus toxoid received	0.74	0.19	2490	0.85	0.17	2217
Any professional birth care	0.31	0.25	2490	0.35	0.27	2217
Use of modern contraception	0.24	0.19	2494	0.23	0.19	2217
Listens to radio	0.58	0.22	2494	0.72	0.22	2217
Piped water	0.11	0.32	2476	0.08	0.27	2214
Toilet facility	0.77	0.32	2476	0.72	0.36	2214
Traditional floor	0.81	0.26	2476	0.81	0.25	2214
Corrugated roof	0.57	0.34	2476	0.63	0.33	2214
Urban Sample						
Any vaccination received	0.72	0.21	419	0.91	0.12	738
All vaccinations received	0.40	0.24	419	0.47	0.24	738
Any professional pre-natal care	0.74	0.21	419	0.93	0.11	738
Tetanus toxoid received	0.71	0.22	419	0.90	0.12	738
Any professional birth care	0.55	0.25	419	0.74	0.24	738
Use of modern contraception	0.36	0.17	420	0.33	0.16	739
Listens to radio	0.74	0.18	420	0.84	0.15	739
Piped water	0.44	0.50	411	0.45	0.450	735
Toilet facility	0.95	0.17	411	0.92	0.21	735
Traditional floor	0.23	0.31	411	0.22	0.32	735
Corrugated roof	0.94	0.16	411	0.94	0.18	735
Full Sample						
Any vaccination received	0.71	0.20	2909	0.85	0.17	2955
All vaccinations received	0.40	0.23	2909	0.45	0.24	2955
Any professional pre-natal care	0.75	0.19	2909	0.88	0.16	2955
Tetanus toxoid received	0.73	0.20	2909	0.86	0.16	2955
Any professional birth care	0.35	0.26	2909	0.42	0.30	2955
Use of modern contraception	0.26	0.19	2914	0.25	0.19	2956
Listens to radio	0.61	0.22	2914	0.74	0.22	2956
Piped water	0.16	0.36	2887	0.17	0.37	2949
Toilet facility	0.80	0.31	2887	0.76	0.35	2949
Traditional floor	0.71	0.34	2887	0.70	0.35	2949
Corrugated roof	0.63	0.35	2887	0.69	0.33	2949

4 REGRESSION RESULTS

4.1 Introduction

We concentrate our regression analysis on explaining chronic and acute malnutrition as measured by height for age and weight for height scores respectively. To derive the empirical results, we use survey regressions rather than ordinary least squares methods in order to control for sample design used in the data collection procedure. Survey regression takes care of three important sample characteristics: sampling weights, clustering and stratification (Stata Corp, 1999). Failure to include sampling weights gives estimators that are biased and affect standard error of the estimates. Further, because of the sampling design, observations in a cluster are not independent and using OLS will give very small standard errors. Accounting for clustering is therefore necessary to adjust the standard errors for design effects. DHS data collection procedures do not use purely random sampling methods. Instead different groups of clusters are sampled separately. Since sampling is done independently across strata, the resulting standard errors will be smaller than normal. Applying survey regression techniques to the DHS therefore produces the correct standard errors.

In addition we control for unobservable community level characteristics that may be correlated with observable determinants of/and or child nutritional status by introducing dummy variables for each of the sample clusters into the model. This controls for the community fixed effects, eliminating any bias from unobserved community level heterogeneity, provided such heterogeneity enters the nutritional function linearly.

Another estimation issue worth of mention is that the nutritional status of a child is a function of two main inputs, food and health status. The common practice in the literature is to proxy food/nutrient intake by per capita household expenditure due to paucity of information on actual food/nutrient intakes. Likewise health inputs are generally difficult to measure and may be proxied by days of illness per child or whether a child caught a particular illness or not. Where such information is available, both per capita expenditure and illness have to be instrumented because they are jointly determined.. If this is not feasible, simple reduced forms of nutritional status models are estimated. We follow the latter approach due to difficulties of obtaining the relevant data for nutrient intake and health inputs. On addition, we use the asset index (which is exogenous) rather than income or per capita expenditure (Sahn and Stifel, 2003).

4.2 Chronic Malnutrition

The estimated individual reduced form models explaining the determinants of child nutritional status for the two surveys are presented in table 8. The table presents the results with and without controls for cluster fixed effects for the full sample. For all models, controlling for the community fixed effects has some marginal impact on the betas and levels of significance of some variables. The explanatory powers of the models are however slightly different, which is expected because of the cluster share variables in the non-fixed effects model. The results imply that there may be some important unobserved community level characteristics that are correlated with the determinants of and/or child nutritional status omitted from the model. We base the discussion on the non-fixed effects results.

For all regressions, the explanatory power of the model is consistent with other studies on nutritional status, That is, the R-squared values are quite low. The Chow (F) tests as well as the test for joint significance of all variables for all models (results not presented) however confirm that the variables are jointly significant in explaining chronic malnutrition.

Child Characteristics
The results suggest that all variables for child characteristics are important determinants of chronic nutrition, which is consistent with results of descriptive analysis. Chronic malnutrition is inversely related to the age of the child but improves at a later age, which is consistent with results of our descriptive analysis and with previous studies. This result is also supported by dummies for child age (not presented) which indicated that all child age groups relative to age 12-24 months have significant coefficients, but which clearly decline with age in terms of magnitudes and levels of significance.

Table 8: Determinants of Chronic Malnutrition: 1998-2003; Full Sample

	1998		2003	
Variable by Category	No fixed effects	Cluster fixed effects	No fixed effects	Cluster fixed effects
Child characteristics				
Age of child in months	-0.1716	-0.1738	-0.1793	-0.1764
	[12.54]***	[14.57]***	[13.99]***	[16.07]***
Age of child in months squared	0.0036	0.0036	0.0037	0.0036
	[9.64]***	[11.13]***	[10.97]***	[12.01]***
Male child dummy	-0.155	-0.1007	-0.2262	-0.2077
	[2.37]**	[1.66]*	[4.07]***	[3.77]***
Household characteristics				
Share of women aged 15-49 yrs	-0.8094	-0.535	0.5904	0.6234
	[2.18]**	[1.39]	[1.53]	[1.81]*
Household size	-0.058	-0.0481	0.0106	-0.0057
	[3.46]***	[3.36]***	[0.53]	[0.38]
Mothers age	-0.0433	-0.016	0.031	0.0041
	[0.96]	[0.40]	[0.79]	[0.11]
Mothers age squared	0.0009	0.0005	-0.0003	0.0001
	[1.13]	[0.71]	[0.51]	[0.21]
Mothers height	0.0373	0.0355	0.0433	0.0386
	[6.39]***	[7.01]***	[8.57]***	[8.33]***
Mothers years of primary education	0.016	0.0181	0.0145	0.0244
	[1.08]	[1.22]	[0.93]	[1.58]
Mothers years of post primary educ.	0.0482	0.0185	0.0475	0.04
	[2.08]**	[0.70]	[2.07]**	[1.89]*
Heads years of primary educ.	0.0205	0.0195	-0.0157	-0.0123
	[1.62]	[1.54]	[1.07]	[0.79]
Heads years of post primary educ.	0.025	0.0351	0.0146	0.0162
	[1.10]	[1.52]	[1.18]	[1.40]
Age of house hold head	0.0138	0.0232	-0.0244	-0.0166
	[0.80]	[1.47]	[1.46]	[1.06]
Age of house hold head squared	-0.0001	-0.0001	0.0002	0.0002
	[0.31]	[0.84]	[1.48]	[1.14]
Mother is head dummy	0.1242	0.2031	-0.0332	0.0728
	[1.22]	[1.98]**	[0.40]	[0.81]
Asset index	0.4516	0.4109	0.2209	0.191
	[4.68]***	[3.94]***	[2.51]**	[1.85]*
Asset index squared	-0.1141	-0.0669	-0.0268	-0.0598
	[2.95]***	[1.52]	[0.71]	[1.35]
Religion relative to Christian				
Muslim	0.3006		0.1146	
	[1.56]		[0.83]	
Other religion	-0.0033		-0.1822	
	[0.01]		[1.11]	
Fertility preferences				
Ideal number of kids	-0.0267	-0.0461	0.04	0.0165
	[1.47]	[2.21]**	[1.75]*	[0.99]
Ideal number of kids missing dummy	-0.0583	-0.0499	0.305	0.2568

	[0.32]	[0.27]	[1.54]	[1.52]
Intends to use modern contraception	0.0247	0.0701	0.0231	-0.0783
	[0.21]	[0.66]	[0.21]	[0.80]
Partner approves us family planning	-0.2653	0.0351	0.0676	0.0104
	[1.65]*	[0.28]	[0.71]	[0.10]
Community/health care variables				
Any vaccination received	-0.2099		-0.5786	
	[0.79]		[2.42]**	
All vaccinations received	0.2015		-0.0324	
	[1.01]		[0.18]	
Any professional pre-natal care	-0.2105		0.7403	
	[0.62]		[2.27]**	
Tetanus toxoid received	0.0786		-0.6176	
	[0.25]		[2.19]**	
Any professional birth care	0.1771		0.1681	
	[1.13]		[1.14]	
Use of modern contraception	0.4578		0.7642	
	[1.95]*		[3.05]***	
Listens to radio	-0.0683		-0.161	
	[0.36]		[0.85]	
Occupation of Household head				
Professional	-0.1837	-0.147	0.2395	0.0879
	[1.42]	[1.13]	[1.66]*	[0.72]
Clerical	-0.2158	-0.1415	0.1017	0.1006
	[2.51]**	[1.67]*	[1.30]	[1.25]
Household and domestic	-0.1424	-0.1114	0.0373	-0.0042
	[1.67]*	[1.23]	[0.50]	[0.05]
Rural area dummy	-0.056		0.1854	
	[0.47]		[1.85]*	
Constant	-4.5903	-5.4778	-6.8704	-5.7726
	[3.61]***	[5.27]***	[6.45]***	[6.08]***
Observations	2851	2855	2753	2879
R-squared	0.21	0.18	0.23	0.19

Absolute value of t statistics in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

Male children are clearly more likely to be malnourished than female children which is also consistent with some studies in the literature (see for instance Sahn and Alderman, 1997). Other studies however suggest that though the coefficients for male dummies are negative, they may be insignificant implying absence of gender bias in nutritional status (Webb and Block, 2004, Ssewanyana, 2003, Strauss, 1990, Sahn, 1990). This also implies the absence of physiological impact on gender specific nutrition status.

Household Characteristics

Household characteristic variables include share of adult women, household size, mothers' characteristics, household head characteristics and the household asset index variable. Since about 20% of mothers are also household heads, we include a dummy variable for mother being household head in model one. The results suggest that share of adult women in a household and household size were associated with lower z-scores in 1998, but not in 2003. Mother's age is not an important determinant of chronic malnutrition, though mother's age is positive and significant when the quadratic term is not included. Household head age variables also turn out to be insignificant in all models. Results for mother's height are consistent with findings in the literature. Most literature suggests a U-shaped relationship with chronic malnutrition, implying that genetics and phenotype play an important role in affecting the stature of children (Sahn, 1994). We dropped the quadratic term for mother's height because of very low betas inspite of significant impacts[4]. Maternal education is positively related to nutritional outcomes. Mothers' primary education dummy turn out to be insignificant in all models, but the post primary education dummy is significant implying the importance of human capital investments in improving children's nutritional status. Education of the household head is insignificant implying that father's education may not be an important determinant of a child's nutritional status. This result is consistent with some of the studies cited above (Webb, 2004; Sahn and Alderman, 1997; Alderman, 1990; Sahn and Stifel, 2002b).

Household assets have a strong significant correlation with children's heights and portray a U-shaped relationship with nutritional status. The results imply that nutrition improves at a decreasing rate with assets. This finding supports Sahn and Stifel (2003), who show that the asset index is a valid predictor of child nutrition. Assets have a large impact on children's nutritional status, especially in 1998. An increase in the asset index by one point would increase children's height by between 0.19 and 0.45 z-scores in the two surveys respectively. These results therefore do not concur with studies that find a weak correlation between wealth and children's health (see for instance Haddad et al., 2003).

Ethnicity and Religion

Ethnicity and religion do not seem to be important determinants of chronic malnutrition. We drop ethnicity dummies because in addition to being insignificant, they are expected to be highly correlated with location (clusters) especially in rural areas. Religion dummies are retained in the non-fixed effects model but are insignificant.

Fertility Preferences

[4] Significance of mother's height is also confirmed by retaining the quadratic term and carrying out an F test for joint significance of the linear and quadratic term. The test shows that the variables are jointly significant at all conventional levels of testing for both surveys. The same case applies to the linear and quadratic term of mother's age.

Fertility has been shown to have a large negative impact on children's nutritional status. In particular, empirical studies have shown that there is a significant correlation between the number of children and their nutrition (Glick et al., 2005). In this paper, we test the impact of fertility preferences rather than actual fertility on children's nutritional status. This is because actual fertility is endogenous and cannot be used directly in the child nutrition model without instrumentation. Fertility is determined by among other factors infant mortality rates and children's nutritional status. The traditional argument is that women who have had children die will want to have more children. Fertility may also cause infant mortality rates as women who have endured more pregnancies may have less healthy children. The correlation between fertility and children's nutritional status is that women whose children are unhealthy may be inclined to have more kids, who end up receiving less nutritional intake.

The fertility preference variables are based on answers to attitudinal questions asked to women. We test for the impact of three variables, the ideal number of children that a women would want to have, the intention to use modern contraception in the future and whether the woman's partner approves of family planning or not. The ideal number of kids has the expected impact in 1998 but not in 2003[5]. The intention to use modern contraception in the future has the unexpected positive impact in both years for the non-fixed effects model. All fertility preference variables fail the joint significance test for the two surveys implying that unobserved heterogeneity in fertility preferences may not be important determinants of children's nutritional status in Kenya.

Health Care Variables

The variables that proxy availability of health care are cluster level shares of individual responses on the use of vaccination, prenatal jab of tetanus toxoid, prenatal and delivery care by a professional (doctor, mid-wife or nurse), use of modern contraception methods. Cluster level shares are used instead of the individual responses to control for endogeneity of individual level data on service use. The results show that for both years, most of the healthcare variables are insignificant while some have the wrong signs. In 1998, all vaccination and pre-natal care by a professional have the unexpected signs. In 2003 the vaccination and birth care by a professional variables have the unexpected sign but turn out to be significant. Access to modern contraception methods in both periods and pre-natal care by a professional in 2003 are highly correlated with children's height. The impact of contraception is expected to be through the impact on fertility (increased birth interval) that allows a mother more time for breast feeding (Ssewanyana, 2003). Modern contraception could also be a proxy for the general availability of health services. Though some of the results are counter-intuitive, we cannot conclude that health care is unimportant for children's nutritional status. We suspect that high correlation between cluster level variables could account for the insignificance and unexpected signs of some of the variables. It happens that clusters where one service is available may have all other services. For instance, a cluster with a modern health care facility will have

[5] We include a dummy to capture households with missing values for ideal number of kids

facilities for vaccination, prenatal and birthing care as well as family planning services. This is confirmed by looking at a correlation matrix for the health care variables which show high levels of correlation, more-so between prenatal and birth care. That health care is indeed important for children's health is confirmed by a test for joint significance of the variables, which show that the health care variables are jointly significant at the 5% level of significance in 1998 and at all conventional levels in 2003. In addition, summing the coefficients of the variables for health care services show that modern health care would increase children's height by 0.49 z-scores in 1998 and by 0.44 z-scores in 2003.

Environmental factors

The environmental/sanitation determinants: cluster shares of households with piped water, proportion with toilet facilities, proportion with traditional floor and proportion with corrugated iron roof turn out to be insignificant[6]. Though some studies have found environmental factors to matter (Silva, 2005), our findings are not uncommon in the literature (see for instance Christiaensen and Alderman, 2004). Strauss and Thomas (1995) also review evidence that the environmental factors may be uncorrelated with children's health states. The argument is that while these variables are environmental indicators, they may not measure well the quality of the environment that children grow up in.

Occupation of household head

Next we test for the impact of the employment status of the head of the household. We categorize current occupation of the head into four main categories: professional (also includes technical and managerial), clerical (also includes sales, services and skilled manual), agricultural self employment and a category for household and domestic workers (including a few who did not work or did not know). In 1998, all occupational categories are inversely correlated with children's height. Employment in clerical jobs and household and domestic occupations relative to agricultural self employment have a significant impact. Though the results may seem surprising, the interpretation is that children of agricultural self employed parents are likely to be taller than for kids whose parents are employed as clerical or household and domestic workers. This result implies that self employment in agriculture may give households more access to dietary requirements for better nutrition than non-agricultural employment. For 2003, the results imply that employment in all categories other than agriculture self employment is associated with better nutrition. Of importance is that professional occupation is a much more important determinant of the nutritional status than all other categories. A child is likely to be 0.24 z-scores higher if the father is employed as a professional than if he is in agricultural self employment. Nevertheless, though the lack of robustness of the results for the two surveys may be counter-intuitive, we expect that this is because assets, education of the household head and location pick up the effects of occupation on children's nutritional status.

[6] To save on space, we drop the environmental factors from the regression analysis, but regressions with these variables would be available from the authors upon request

Regional effects and interaction terms
Surprisingly, the rural dummy is positive and significant for 2003 implying that rural children are likely to have better nutrition status than urban children. This is inconsistent with our descriptive analysis. However, the rural dummies for 1998 are negative and insignificant. Furthermore, the test for significance confirms the insignificance of the rural dummy in 1998, but significance of the same at the 1% level of significance in 2003.

In addition to the above variables, we also tested the impact of a number of interaction terms namely: parental education and gender of the child, assets and gender of the child, parental age and region of residence and asset index interacted with rural area dummy. None of the interaction terms are significant either individually or jointly and so we drop them from the model to save on space.

Analysis by regional of residence
The results for chronic malnutrition for rural and urban areas are presented in appendix table A. As expected the rural models for the two surveys are almost identical to the results of the full sample given that about 82% of the sample is rural. Except for level of significance of some variables, the results for rural and urban areas are generally consistent in terms of direction of the impact of different variables on nutritional status. A few highlights from the regional models are in order. The non-fixed effects and fixed effects model results are very close, except in some instances for the significance of some variables. In 1998, parental characteristics are much more important determinants of children's nutritional status in urban than in rural areas, though the differences are quite modest. Child characteristics however seem to matter more for rural than for urban areas. Agricultural self employment is positively correlated with children's nutritional status. The impact is significant for heads with clerical jobs whose children's height is 0.23 z-scores lower than for heads in agricultural self employment. In 2003, share of adult women in a household, assets and access to modern contraception are much more important in rural than in urban areas. On the other hand, gender of the child, household heads years of post primary education, religion, fertility preferences and access to professional birth care are more important in urban than in rural areas. The result that assets in urban areas are not significant determinants of children's height could be attributed to omitted variables such as prevalence of communicable diseases (e.g. HIV/AIDS) which are not accounted for in our model.

Analysis by gender of the child
The regression results for chronic malnutrition by gender of child are presented in appendix Table A3. The overall results suggest that there are no major differences in determinants of child malnutrition by gender of child judging from the value of the R-squared. All child characteristics are important determinants of malnutrition across gender. Generally, the results are robust across gender for the two surveys except for some cases with reversed signs and differences in significance as was the case in our descriptive results. In 1998, education and age of the household head are positively correlated with boys' heights but are either insignificant or negatively correlated with girls' heights. Relative to agricultural self employment, other occupations are also strongly correlated with boys' heights but not with girls' heights. This finding is interesting as it reflects a father to son gender bias.

The finding also confirms our earlier finding of the importance of human capital variables on children's nutritional status. There are less notable gender differences in 2003, except for assets which seem to matter a lot for girls but not for boys. The results for acute malnutrition give a less defined picture (appendix Table A4).

4.3 Current/Acute Malnutrition

The econometric results for the model of current or acute malnutrition as measured by *whz* scores are presented in Table 9. Like for chronic malnutrition, the regional (rural and urban) models are presented in appendix table A2 and the gender of child models in table A4. The results differ with those of long term malnutrition in several aspects. In the first place the models portray much poorer fits with the 1998 models explaining only between 7% and 13% of the total variation in current malnutrition in the two surveys. The low explanatory power of the model is however consistent with findings in the literature. Nevertheless, chow tests results (not presented) indicate that all variables are jointly significant in explaining acute malnutrition.

In both years, assets are not important determinants of current nutrition, though important for long term nutritional status. The impact of the share of adult females turns out to be positive but only significant for 2003. Though most of the variables are insignificant they are reversed compared to the results for chronic malnutrition in table 8. This is not uncommon in the literature and is the reason why most studies concentrate on long term malnutrition alone because the acute malnutrition results are often hard to interpret. The results for religion are consistent in the two surveys and show that compared to Christian, children from all other religions have lower z-scores. The dummy for Muslim is significant in both years, but the religion dummies are only jointly significant in 1998. Except for prenatal care by a professional, all other health care variables have a positive impact on children's current nutritional status. However, only the share of mothers that used modern contraception has a significant impact in 1998. The health care variables are jointly significant at the 5% level for the 1998 model but insignificant in 2003. Unlike in the model for long term malnutrition, fertility preferences are jointly significant at the 5% level in the 1998 model. Children whose parents are employed in all other jobs other than agricultural self employment are likely to have higher z-scores that children from agricultural self employment households. The impacts for professional and clerical workers are significant in 1998. Like for most other groups of variables, the occupational dummies are jointly significant in 1998 but not in 2003.

Table 9: Determinants of Acute Malnutrition: 1998-2003; Full Sample

	1998		2003	
Variable by category	No fixed effects	Cluster fixed effects	No fixed effects	Cluster fixed effects
Child characteristics				
Age of child in months	-0.0883	-0.0975	-0.1132	-0.1079
	[7.49]***	[9.59]***	[10.68]***	[11.38]***
Age of child in months squared	0.0019	0.0021	0.0026	0.0024
	[6.33]***	[7.66]***	[9.34]***	[9.19]***
Male child dummy	-0.0489	0.0026	-0.1198	-0.0833
	[0.92]	[0.05]	[2.37]**	[1.75]*
Household characteristics				
Share of women aged 15-49 yrs	0.1635	0.1114	0.7875	0.7618
	[0.50]	[0.34]	[2.57]**	[2.55]**
Household size	0.0065	0.0037	0.0013	0.009
	[0.54]	[0.30]	[0.10]	[0.69]
Mothers age	0.0042	0.0055	-0.0241	0.0263
	[0.12]	[0.16]	[0.66]	[0.84]
Mothers age squared	-0.0001	-0.0001	0.0007	-0.0002
	[0.09]	[0.20]	[1.15]	[0.39]
Mothers height	0.0006	0.0002	0.0003	0.0066
	[0.13]	[0.06]	[0.07]	[1.65]
Mothers years of primary education	0.0236	0.0139	0.0058	-0.0042
	[1.75]*	[1.11]	[0.38]	[0.32]
Mothers years of post primary educ.	0.0339	0.0131	0.0268	0.0075
	[1.38]	[0.59]	[1.53]	[0.41]
Heads years of primary educ.	-0.0232	-0.0194	0.0183	0.0246
	[2.01]**	[1.79]*	[1.15]	[1.85]*
Heads years of post primary educ.	0.0096	0.033	0.0025	0.0025
	[0.48]	[1.68]*	[0.25]	[0.25]
Age of house hold head	0.0074	0.0101	-0.0178	-0.025
	[0.53]	[0.75]	[1.37]	[1.95]*
Age of head squared	-0.0001	-0.0001	0.0002	0.0002
	[0.59]	[0.90]	[1.31]	[1.79]*
Mother is head dummy	-0.1028	-0.0934	-0.0553	-0.1258
	[1.22]	[1.07]	[0.72]	[1.62]
Asset index	0.1501	0.0866	0.0532	0.1355
	[2.87]***	[1.25]	[1.10]	[2.15]**
Religion relative to Christian				
Muslim	-0.2651		-0.2049	
	[2.10]**		[1.81]*	
Other religion	-0.1184		-0.1576	
	[0.94]		[0.98]	
Fertility preferences				
Ideal number of kids	-0.0233	-0.0054	-0.0176	0.0103
	[1.52]	[0.30]	[0.93]	[0.72]
Ideal number of kids missing dummy	-0.1457	-0.1135	0.096	0.205
	[0.89]	[0.72]	[0.60]	[1.40]
Intends to use modern contraception	0.2243	0.1406	0.0898	0.0983

	[2.54]**	[1.55]	[1.10]	[1.17]
Partner approves us family planning	0.1249	0.0889	0.1776	0.0371
	[1.27]	[0.84]	[1.91]*	[0.42]
Community/health care variables				
Any vaccination received	0.3088		-0.0794	
	[1.39]		[0.28]	
All vaccinations received	0.0932		0.0084	
	[0.65]		[0.05]	
Any professional pre-natal care	-0.364		-0.3848	
	[1.16]		[0.99]	
Tetanus toxoid received	0.0315		0.0848	
	[0.11]		[0.26]	
Any professional birth care	0.1139		0.1566	
	[0.91]		[1.16]	
Use of modern contraception	0.3039		0.2336	
	[1.87]*		[1.13]	
Any vaccination received	0.1026		0.3417	
	[0.76]		[1.64]	
Occupation of Household head				
Professional	0.2272	0.1325	0.0933	0.1097
	[2.00]**	[1.20]	[0.78]	[1.04]
Clerical	0.1841	0.1559	0.0343	0.026
	[2.48]**	[2.16]**	[0.51]	[0.37]
Household and domestic	0.1124	0.1025	0.0348	0.0755
	[1.39]	[1.33]	[0.50]	[1.07]
Rural area dummy	0.126	0	-0.127	0
	[1.34]	[.]	[1.44]	[.]
Constant	-0.2685	0.1483	0.8822	-0.7645
	[0.33]	[0.17]	[0.97]	[0.94]
Observations	2866	2870	2756	2882
R-squared	0.09	0.07	0.13	0.09

Absolute value of t statistics in brackets
* Significant at 10%; ** significant at 5%; *** significant at 1%

Pooled Regressions

To test the robustness of the results, we pooled the two datasets together and estimated pooled regressions for chronic and acute malnutrition. The results were robust with individual year results in terms of the signs of coefficients, though a few differed in levels of significance. For almost all variables, a test of the significance of the difference between pairs of variables in the pooled models failed the significant test. The few variables that show significant differences are presented in appendix table A5. The results for the pooled model confirm that there are no significant differences in the determinants of children's nutritional status in the two surveys.

4.4 Impact on Policy

We use the results in table 8 to simulate the impact of various policy changes on children's nutritional status. While the regression results show the impact of the regressors on the mean z-scores, of relevance to policy is to improve nutritional status for the severely malnourished children. Raising the living standards for children at the lowest end of the distribution, improving education of their parents and access to health care are the major policy concerns that could be expected to have an impact on children's health. We therefore simulate policies based on these options.

In the sample, the mean asset index for both years is negative. Looking at the distribution of households by asset quintiles, our interest is to move the average poor person from the lowest quintile to the highest quintile and estimate the impact on children's nutritional status of such a policy change. In 1998, if all households had the median assets of the lowest quintile (-0.665), the predicted z-score is -1.27. However, shifting everyone to the median of the highest quintile (1.524) would increase children's height by 0.41 z-scores. In 2003, a similar policy would increase the height by 0.45 z-scores (Table 10). This means that on average, heights would improve by 0.41 and 0.45 standard deviations of the NCHS distribution of healthy children's heights in 1998 and 2003 respectively. The implication of these findings is that higher assets (income) will lead to a big reduction in stunting in Kenya.

The second policy simulation compares three education scenarios: where parents have no education at all, parents have full primary and parents have post primary education. Given that Kenya has recently introduced free primary education, it is expected that in the future, the average Kenyan will have at least primary education and so these policy changes are achievable in the long run. In 1998, children born of mothers with no education are likely to be 0.32 scores lower than kids born to mothers with post primary education. In 2003, the impact of mother's education is almost identical to that of 1998. Mother's post primary education has an approximate 3 fold impact on heights compared to primary education. The policy impact of father's post primary education is much lower than for mothers in 1998, but is counter-intuitive in 2003. These results affirm the importance of maternal education in improving children's health.

The fourth policy simulation focuses on improvements in health care. We take a scenario that compares zero access to vaccination, professional prenatal and birth care, prenatal tetanus toxoid injections and modern contraception and compare this to a 100% access to these facilities. In 1998, a scenario of no access predicts the mean z-score at -1.19, which is very close to the actual predicted z-score given the mean usage of these services. However, these scores increase to by 0.49 points in the scenario with universal access. In 2003, the mean scores increase by 0.41 points. These results show that though it may not be possible to ensure a 100% access to modern health care for all

Kenyans, improving health care services would be expected to have a large impact on children's nutritional status.

Combining all these simulations, the results show that moving from the worst scenario for all policies (lowest asset index, zero education for both parents and zero access to health care facilities) to the best scenario (highest asset index, 100% education for both parents and 100% access to health care facilities) would increase height by 1.48 in 1998. A similar change for 2003 would increase heights by 1.14. These results imply that if Kenya was to adopt the high scenario simulation, she would totally solve the current high levels of long term malnutrition.

Table 10: Simulating Impact of Policy on Mean Long term Malnutrition.

	1998			**2003**		
	Scenario			Scenario		
Variable	Low[a]	Mid[b]	High[c]	Low[a]	Mid[b]	High[c]
Asset index	-1.27		-0.86	-1.27		-0.82
Mother's education	-1.32	-1.20	-1	-1.32	-1.20	-1.01
House hold head's education	-1.31	-1.18	-1.09	-1.12	-1.24	-1.19
All health care variables	-1.19		-0.7	-1.08		-0.62
All above variables	-1.62		0.14	-1.21		-0.067
Predicted mean haz from sample		-1.18			-1.08	

a Low scenario simulates assigning all households the median asset for the lowest quintile, no education at all for mothers and heads of households, and no access to health care services at all.

b Mid scenario: simulates a situation where mothers and fathers have full primary education.

c High scenario simulates assigning all households the median asset for the highest quintile, post primary education for all mothers and heads of households, and a 100% access to health care services.

5 CONCLUSION

This paper investigates the evolution and determinants of child nutritional status in Kenya for the period 1998-2003, using demographic health survey data. Our study makes an important contribution to the emerging literature on non-monetary measures of poverty. We investigate the impact of child, household and community characteristics on both chronic and acute malnutrition. We employ both descriptive statistics and econometric techniques to explain the determinants of children's nutritional status. We estimate both individual and pooled regressions for chronic and acute malnutrition. In estimation, we control for sample design and possible heterogeneity arising from unobserved community characteristics correlated with children's nutritional status and its determinants.

Descriptive results show that the 1998 and 2003 datasets are robust across all variables in spite of differences in sample sizes, and therefore, child nutritional status and its determinants can be compared across the two periods. The descriptive results further imply that there was evidence of regional disparities in child nutritional status in the two surveys. Rural children were likely to suffer more malnutrition than urban children. The descriptive results also suggest that children from female headed households are likely to be more malnourished than children from male headed households. Maternal education is positively correlated with child nutritional status.

The regression results support the descriptive analysis. In particular, we find child characteristics to be significant determinants of nutritional status, while male children are more likely to be malnourished than female children. We find that household size was a significant determinant of children's nutritional status in 1998 but not in 2003. Share of adult women in a household and mother's post primary education are important, but paternal education does not seem to matter. . Results by gender of the child however show that that paternal education and occupation are more correlated with children's nutritional status for boys than for girls, implying a father to son gender bias. Mother's height display a U shaped relationship with malnutrition and the linear term has a positive and significant impact on long term malnutrition, but the impact on current malnutrition is insignificant. The marginal impacts are however quite modest. Without the quadratic term, a one centimeter increase in mother's height would increase a child's height by about 0.042 z-scores in the two surveys. Another finding is that nutrition improves at a decreasing rate with assets, which is also consistent with descriptive statistics. Health care variables are jointly significant in explaining child nutritional status, though only use of modern contraceptives and pre-natal professional care are individually significant. Even after accounting for sample design and unobserved heterogeneity across clusters, we do not uncover any important effect of environmental factors on children's nutritional status. Also religion and fertility preferences do not seem to matter, though ideal number of kids was an important factor in 1998.

Policy simulation results confirm the importance of key policy variables in improving children's nutritional status. The regression results show that households with mean assets were 0.45 haz-scores higher than households with zero assets in 1998, but only 0.22 in 2003. The impact is much smaller for whz scores with sampled households being only 0.15 and 0.05 z-scores higher than households with zero assets in 1998 and 2003 respectively. Taking a policy that would see a poor person move from the median of the poorest quartile to the median of the highest quartile would have the impact of rising heights by 0.41 and 0.45 z-scores in 1998 and 2003 respectively. Children born of mothers with no education are likely to be 0.12 haz scores lower than children born to mothers with primary education and 0.31 scores lower than children born to mothers with post primary education. Fathers' education is less important than mother's education in 1998, and is even counter-intuitive in 2003.

We also find provision of health care to be an important policy for reducing malnutrition in children. A package of improved health care i.e. immunization coverage, professional prenatal and birth care, prenatal tetanus toxoid injections and modern contraception would have a big impact on children's nutritional status. If all households had full access to these services, the mean haz scores would have increased by 41% and 43% in 1998 and 2003 respectively. A combination of all the above policy changes would be enough to alleviate poverty (measured by children's nutritional status) as heights would have increased by 1.48 and by 1.14 standard deviations of the NCHS distribution of healthy kid's heights in 1998 and 2003 respectively. If Kenya is to achieve her strategic objective of reducing malnutrition by 30%, and also her millennium development goal target of reducing the prevalence of underweight children less than 5 years from 28% in 2003 to 16.2% in 2015, policies and strategies for poverty alleviation, promotion of post secondary education for women and provision of basic preventive health care are critical. This is more so the case given that the proportion of underweight children only declined from 32.5% in 1990 to 28% in 2003.

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Appendix

Table A1: Determinants of Chronic Malnutrition by Region of Residence: 1998-2003

	1998				2003			
	Rural		Urban		Rural		Urban	
Variable by category	No fixed effects	Fixed effects	No fixed effects	Fixed effects	No fixed effects	Fixed effects	No fixed effects	Fixed effects
Child characteristics								
Age of child in months	-0.1752	-0.1734	-0.1615	-0.1902	-0.1862	-0.1844	-0.1454	-0.1558
	[12.58]***	[13.81]***	[3.92]***	[4.95]***	[13.00]***	[14.77]***	[5.46]***	[6.63]***
Age of child in months squared	0.0036	0.0036	0.0032	0.0039	0.0039	0.0037	0.0032	0.0033
	[9.57]***	[10.57]***	[2.99]***	[3.70]***	[10.22]***	[10.96]***	[4.42]***	[5.11]***
Male child dummy	-0.1337	-0.0937	-0.1569	-0.0972	-0.1959	-0.1766	-0.2967	-0.248
	[2.03]**	[1.46]	[0.81]	[0.51]	[3.21]***	[2.81]***	[2.56]**	[2.11]**
Household characteristics								
Share of women aged 15-49 yrs	-0.5165	-0.3958	-1.5764	-1.1769	0.8646	0.9378	-0.029	0.1048
	[1.18]	[0.93]	[2.02]**	[1.17]	[2.02]**	[2.28]**	[0.04]	[0.16]
Household size	-0.0448	-0.0325	-0.1263	-0.1281	0.0121	0.0002	-0.0157	-0.0171
	[2.45]**	[2.12]**	[3.30]***	[2.89]***	[0.53]	[0.01]	[0.52]	[0.54]
Mothers age	-0.0312	0.0031	0.017	-0.1958	0.0217	-0.0053	0.1442	0.1339
	[0.65]	[0.07]	[0.16]	[1.19]	[0.53]	[0.13]	[1.21]	[1.57]
Mothers age squared	0.0008	0.0002	-0.0006	0.0032	-0.0001	0.0003	-0.0025	-0.0022
	[0.92]	[0.31]	[0.32]	[1.07]	[0.21]	[0.45]	[1.19]	[1.49]
Mothers height	0.0375	0.0354	0.0364	0.0411	0.0444	0.0424	0.0265	0.0191
	[6.12]***	[6.72]***	[2.55]**	[2.38]**	[7.90]***	[8.04]***	[2.74]***	[1.90]*
Mothers years of primary education	0.0122	0.0217	0.078	0.0063	0.0167	0.0326	-0.0233	0.0025
	[0.78]	[1.41]	[1.68]*	[0.12]	[0.98]	[1.87]*	[0.72]	[0.07]
Mothers years of post primary educ.	0.0658	0.0415	-0.0132	-0.0533	0.0405	0.0503	0.0576	0.0093
	[2.45]**	[1.44]	[0.30]	[0.75]	[1.32]	[1.82]*	[1.75]*	[0.26]
Heads years of primary educ.	0.0174	0.0195	0.0114	0.0312	-0.0227	-0.0098	0.0779	-0.0265
	[1.35]	[1.48]	[0.28]	[0.67]	[1.46]	[0.58]	[1.63]	[0.65]
Heads years of post primary educ.	0.0494	0.0395	-0.0303	-0.0176	0.0017	0.0054	0.0791	0.0575
	[2.04]**	[1.57]	[0.55]	[0.28]	[0.13]	[0.40]	[3.32]***	[2.36]**
Age of house hold head	0.0078	0.0113	0.0302	0.1051	-0.0199	-0.0133	-0.0371	-0.0357
	[0.46]	[0.68]	[0.52]	[1.65]	[1.14]	[0.75]	[0.96]	[1.05]
Age of head squared	0.0001	0.0003	-0.0002	-0.0009	0.0002	0.0002	0.0004	0.0004
	[0.06]	[0.18]	[0.26]	[1.23]	[1.19]	[0.84]	[0.96]	[1.08]
Mother is head dummy	0.0733	0.1517	0.3432	0.7269	-0.0333	0.1005	0.1296	0.087
	[0.69]	[1.43]	[1.13]	[1.84]*	[0.39]	[1.00]	[0.61]	[0.42]
Asset index	0.404	0.3039	0.4881	0.6218	0.238	0.2437	0.1341	0.0825
	[3.57]***	[2.58]***	[2.62]**	[2.38]**	[2.41]**	[1.94]*	[0.88]	[0.44]
Asset index squared	-0.0514	0.0298	-0.0577	-0.0811	-0.0458	-0.076	0.003	-0.0226

	[0.62]	[0.38]	[1.00]	[0.96]	[0.62]	[0.76]	[0.05]	[0.33]
Religion relative to Christian								
Muslim	0.0042		0.4803		-0.093		0.4822	
	[0.02]		[1.70]*		[0.52]		[2.21]**	
Other religion	0.1295		-1.2355		-0.1815		-0.1241	
	[0.47]		[3.61]***		[0.97]		[0.36]	
Fertility preferences								
Ideal number of kids	-0.0315	-0.0445	0.0246	-0.0639	0.0204	0.0093	0.1246	0.0486
	[1.62]	[2.07]**	[0.44]	[0.84]	[0.81]	[0.50]	[2.84]***	[1.31]
Ideal number of kids missing dummy	-0.1227	-0.0616	0.2767	0.0344	0.234	0.3357	0.414	-0.0674
	[0.63]	[0.33]	[0.46]	[0.04]	[1.08]	[1.76]*	[0.85]	[0.18]
Intends to use modern contraception	-0.0414	0.0417	0.4213	0.2782	0.1316	0.0886	-0.4227	-0.6273
	[0.35]	[0.38]	[1.20]	[0.70]	[1.10]	[0.80]	[1.92]*	[3.04]***
Partner approves us family planning	-0.2295	0.0366	-0.3673	0.1416	0.134	0.122	-0.3236	-0.427
	[1.29]	[0.27]	[1.16]	[0.38]	[1.33]	[1.07]	[1.41]	[1.74]*
Community/health care variables								
Any vaccination received	0.0025		-1.9918		-0.4362		-1.2002	
	[0.01]		[2.92]***		[1.73]*		[1.81]*	
All vaccinations received	0.1617		0.1915		-0.0277		-0.3231	
	[0.83]		[0.33]		[0.13]		[1.13]	
Any professional pre-natal care	-0.3987		1.5447		0.6373		1.0528	
	[1.15]		[1.45]		[1.53]		[1.72]*	
Tetanus toxoid	-0.1335		1.1267		-0.5462		-0.4699	
	[0.42]		[1.09]		[1.44]		[1.02]	
Any professional birth care	0.1843		-0.3681		0.1631		0.1878	
	[1.20]		[0.75]		[1.06]		[0.57]	
Use of modern contraception	0.3248		0.8765		0.8337		0.0928	
	[1.37]		[1.28]		[2.92]***		[0.20]	
Listens to radio	-0.0702		0.1593		-0.2275		0.3335	
	[0.35]		[0.28]		[1.11]		[0.69]	
Occupation of Household head								
Professional	-0.1277	-0.099	-0.6693	-0.1936	0.3382	0.0617	-0.0614	0.1699
	[0.98]	[0.72]	[1.42]	[0.40]	[2.02]**	[0.42]	[0.20]	[0.68]
Clerical	-0.2285	-0.1564	-0.1159	0.0058	0.1113	0.08	0.0915	0.1946
	[2.67]***	[1.78]*	[0.39]	[0.02]	[1.28]	[0.89]	[0.52]	[0.93]
Household and domestic	-0.1261	-0.1159	-0.2163	-0.0054	-0.0231	-0.0852	0.3183	0.3049
	[1.44]	[1.24]	[0.69]	[0.01]	[0.29]	[0.93]	[1.63]	[1.40]
Constant	-4.7058	-5.7592	-6.0511	-4.643	-6.84	-6.49	-5.8944	-3.5385
	[3.43]***	[5.27]***	[2.20]**	[1.28]	[5.84]***	[5.95]***	[2.45]**	[1.77]*
Observations	2441	2444	410	411	2042	2167	711	712
R-squared	0.21	0.18	0.22	0.2	0.24	0.22	0.26	0.17

Absolute value of t statistics in brackets, * significant at 10%; ** significant at 5%; *** significant at 1%

Table A2: Determinants of Acute Malnutrition by Region of Residence: 1998-2003

	1998				2003			
	Rural		Urban		Rural		Urban	
Variable by category	No fixed effects	Fixed effects	No fixed effects	Fixed effects	No fixed effects	Fixed effects	No fixed effects	Fixed effects
Child characteristics								
Age of child in months	-0.0969	-0.1061	-0.0455	-0.0392	-0.1199	-0.1146	-0.0761	-0.077
	[7.41]***	[9.88]***	[1.74]*	[1.25]	[9.85]***	[10.72]***	[4.20]***	[3.70]***
Age of child in months squared	0.0021	0.0023	0.001	0.0009	0.0028	0.0026	0.0015	0.0014
	[6.34]***	[7.87]***	[1.32]	[1.01]	[8.80]***	[9.00]***	[3.10]***	[2.41]**
Male child dummy	-0.0747	-0.0593	0.0308	0.3515	-0.1377	-0.115	-0.0332	0.0564
	[1.31]	[1.08]	[0.22]	[2.25]**	[2.40]**	[2.14]**	[0.32]	[0.54]
Household characteristics								
Share of women aged 15-49 yrs	-0.035	0.0996	1.0331	0.5971	0.8671	0.6207	0.5176	1.224
	[0.09]	[0.27]	[1.63]	[0.73]	[2.45]**	[1.77]*	[0.95]	[2.10]**
Household size	0.0038	0.0025	0.0209	0.0019	0.002	0.0026	0.0098	0.0216
	[0.28]	[0.19]	[0.76]	[0.06]	[0.14]	[0.17]	[0.35]	[0.78]
Mothers age	0.004	0.0014	-0.089	-0.0284	-0.011	0.0326	-0.0401	-0.0127
	[0.11]	[0.04]	[0.77]	[0.21]	[0.27]	[0.93]	[0.62]	[0.17]
Mothers age squared	-0.0001	-0.0001	0.0018	0.0007	0.0005	-0.0002	0.0007	0.0002
	[0.14]	[0.13]	[0.83]	[0.29]	[0.79]	[0.43]	[0.64]	[0.18]
Mothers height	0.0002	-0.0029	-0.0007	0.0239	-0.0011	0.0028	0.0083	0.014
	[0.04]	[0.64]	[0.06]	[1.68]*	[0.26]	[0.62]	[0.90]	[1.57]
Mothers years of primary education	0.0224	0.0145	0.0109	0.0094	-0.0018	-0.0139	0.0755	0.0491
	[1.54]	[1.10]	[0.32]	[0.22]	[0.11]	[0.94]	[2.67]***	[1.62]
Mothers years of post primary educ.	0.0231	0.0135	0.0797	0.0268	0.0446	0.0437	-0.0147	-0.032
	[0.85]	[0.55]	[1.57]	[0.46]	[1.95]*	[1.85]*	[0.52]	[1.03]
Heads years of primary educ.	-0.0266	-0.0177	-0.0085	-0.0458	0.0291	0.0391	-0.0947	-0.0573
	[2.15]**	[1.56]	[0.27]	[1.21]	[1.78]*	[2.72]***	[2.49]**	[1.60]
Heads years of post primary educ.	0.0237	0.0407	-0.0581	-0.0176	0.0007	0.0016	0.0111	0.0044
	[1.03]	[1.89]*	[1.35]	[0.34]	[0.07]	[0.14]	[0.49]	[0.21]
Age of house hold head	0.008	0.0167	0.0065	-0.0456	-0.027	-0.0263	0.0135	-0.0159
	[0.51]	[1.19]	[0.25]	[0.88]	[1.77]*	[1.73]*	[0.67]	[0.62]
Age of head squared	-0.0001	-0.0002	-0.0002	0.0004	0.0003	0.0003	-0.0001	0.0001
	[0.54]	[1.28]	[0.53]	[0.69]	[1.72]*	[1.66]*	[0.71]	[0.39]
Mother is head dummy	-0.0719	-0.0442	-0.2629	-0.407	-0.0855	-0.1306	0.0753	-0.1412
	[0.80]	[0.49]	[1.12]	[1.26]	[0.98]	[1.52]	[0.45]	[0.77]
Asset index	0.165	0.1213	0.088	0.0661	0.0574	-0.0394	0.1428	0.2637
	[2.06]**	[1.40]	[1.10]	[0.51]	[0.78]	[0.39]	[2.16]**	[2.99]***
Religion relative to Christian								
Muslim	-0.296		-0.1296		-0.1017		-0.3518	
	[1.63]		[0.69]		[0.75]		[1.61]	

Other religion	-0.1826		0.3433		-0.2144		0.0137	
	[1.36]		[0.95]		[1.16]		[0.05]	
Fertility preferences								
Ideal number of kids	-0.0291	-0.0083	0.0308	0.0596	0.0047	0.0106	-0.0977	0.0138
	[1.81]*	[0.45]	[0.60]	[0.96]	[0.23]	[0.66]	[2.40]**	[0.42]
Ideal number of kids missing dummy	-0.1189	-0.083	-0.5562	-0.5952	0.2149	0.1912	-0.2448	0.2906
	[0.71]	[0.51]	[1.01]	[0.86]	[1.22]	[1.17]	[0.72]	[0.88]
Intends to use modern contraception	0.2156	0.0827	0.4214	0.6638	0.0749	0.024	0.0437	0.2312
	[2.38]**	[0.88]	[1.32]	[2.06]**	[0.82]	[0.25]	[0.23]	[1.27]
Partner approves us family planning	0.0796	0.0312	0.5768	0.7551	0.1626	0.0186	0.1851	0.098
	[0.82]	[0.27]	[2.10]**	[2.47]**	[1.56]	[0.19]	[0.89]	[0.45]
Community/health care variables								
Any vaccination received	0.2821		0.7253		-0.3027		0.7517	
	[1.21]		[0.92]		[0.97]		[1.37]	
All vaccinations received	0.1103		-0.0195		0.1014		-0.2077	
	[0.70]		[0.05]		[0.56]		[0.66]	
Any professional pre-natal care	-0.4136		0.0213		-0.1927		-0.4791	
	[1.28]		[0.02]		[0.49]		[0.54]	
Tetanus toxoid	0.1548		-1.0592		-0.141		0.5102	
	[0.49]		[1.67]*		[0.39]		[0.93]	
Any professional birth care	-0.0044		0.7223		0.1821		-0.214	
	[0.03]		[2.01]**		[1.23]		[0.76]	
Use of modern contraception	0.4248		-0.1692		0.3395		-0.1554	
	[2.37]**		[0.42]		[1.50]		[0.33]	
Listens to radio	0.0473		0.3762		0.3525		0.0327	
	[0.34]		[0.73]		[1.55]		[0.07]	
Occupation of Household head								
Professional	0.1258	0.051	0.9434	0.6263	0.1433	0.2286	-0.1773	-0.1855
	[1.01]	[0.43]	[2.85]***	[1.58]	[1.08]	[1.83]*	[0.60]	[0.84]
Clerical	0.1816	0.1215	0.4222	0.4257	0.0652	0.0625	-0.1622	-0.1241
	[2.38]**	[1.61]	[1.57]	[1.42]	[0.85]	[0.81]	[0.79]	[0.67]
Household and domestic	0.1149	0.1103	0.3205	0.1551	0.0322	0.0548	-0.0774	0.0334
	[1.33]	[1.38]	[1.16]	[0.47]	[0.42]	[0.70]	[0.34]	[0.17]
Constant	0.1599	0.7563	-0.3946	-3.6437	0.9758	-0.2918	-0.4272	-1.5259
	[0.17]	[0.81]	[0.19]	[1.22]	[0.96]	[0.31]	[0.22]	[0.87]
Observations	2452	2455	414	415	2043	2168	713	714
R-squared	0.09	0.08	0.13	0.09	0.13	0.09	0.14	0.12

Absolute value of t statistics in brackets

* Significant at 10%; ** significant at 5%; *** significant at 1%

Table A3: Determinants of Chronic Malnutrition by gender of Child: 1998-2003

	1998				2003			
	Male		Female		Male		Female	
Variable by category	No fixed effects	Fixed effects	No fixed effects	Fixed effects	No fixed effects	Fixed effects	No fixed effects	Fixed effects
Child characteristics								
Age of child in months	-0.1687	-0.1577	-0.1744	-0.1856	-0.1973	-0.1954	-0.1613	-0.1669
	[9.41]***	[8.41]***	[9.35]***	[9.85]***	[12.22]***	[11.41]***	[9.11]***	[10.05]***
Age of child in months squared	0.0035	0.0033	0.0036	0.0039	0.0043	0.0041	0.0032	0.0034
	[7.12]***	[6.28]***	[7.11]***	[7.69]***	[10.19]***	[8.67]***	[6.74]***	[7.58]***
Household characteristics								
Share of women aged 15-49 yrs	-0.6288	-0.5223	-1.0748	-0.6547	1.1111	1.0543	0.1173	0.6937
	[1.26]	[0.84]	[2.11]**	[1.13]	[2.21]**	[2.03]**	[0.22]	[1.25]
Household size	-0.0621	-0.058	-0.0583	-0.0449	0.0322	0.0096	-0.0093	-0.0173
	[2.76]***	[2.60]***	[2.77]***	[2.06]**	[1.47]	[0.41]	[0.35]	[0.74]
Mothers age	-0.0012	0.0035	-0.0882	-0.0485	0.0466	0.0047	0.023	0.0445
	[0.02]	[0.05]	[1.47]	[0.78]	[0.88]	[0.08]	[0.46]	[0.80]
Mothers age squared	0.0001	0.0002	0.0017	0.001	-0.0005	0.0001	-0.0003	-0.0006
	[0.12]	[0.18]	[1.65]*	[0.93]	[0.62]	[0.15]	[0.36]	[0.65]
Mothers height	0.0337	0.0276	0.0407	0.0383	0.0427	0.0449	0.045	0.0334
	[4.17]***	[3.27]***	[5.75]***	[5.09]***	[6.08]***	[6.31]***	[6.84]***	[4.73]***
Mothers years of primary education	-0.0002	0.0318	0.0343	0.034	0.0049	0.0064	0.0189	0.0104
	[0.01]	[1.32]	[1.49]	[1.47]	[0.23]	[0.28]	[0.89]	[0.43]
Mothers years of post primary educ.	0.0342	0.0338	0.0619	-0.0091	0.0487	0.0182	0.0477	0.0546
	[0.96]	[0.76]	[2.14]**	[0.23]	[1.73]*	[0.56]	[1.38]	[1.63]
Heads years of primary educ.	0.0506	0.0311	-0.0139	-0.0052	-0.025	0.0191	-0.0115	-0.0039
	[2.70]***	[1.58]	[0.75]	[0.26]	[1.16]	[0.81]	[0.52]	[0.16]
Heads years of post primary educ.	0.0356	0.0344	0.0133	0.0469	0.0162	0.0053	0.0124	0.0222
	[1.05]	[0.93]	[0.48]	[1.31]	[1.07]	[0.30]	[0.63]	[1.24]
Age of house hold head	0.0386	0.0426	-0.0115	0.0024	-0.0378	-0.0296	-0.0047	-0.0073
	[1.66]*	[1.71]*	[0.49]	[0.10]	[1.72]*	[1.25]	[0.20]	[0.30]
Age of head squared	-0.0003	-0.0002	0.0002	0	0.0003	0.0003	0.0001	0.0001
	[1.13]	[0.96]	[0.70]	[0.08]	[1.57]	[1.30]	[0.38]	[0.51]
Mother is head dummy	0.2401	0.3242	0.0212	0.0426	0.0329	0.1397	-0.0567	0.0606
	[1.59]	[1.95]*	[0.16]	[0.27]	[0.24]	[1.02]	[0.46]	[0.44]
Asset index	0.4877	0.3526	0.4216	0.3496	-0.0507	-0.1028	0.5004	0.4285
	[3.60]***	[2.07]**	[3.14]***	[2.20]**	[0.42]	[0.65]	[4.36]***	[2.60]***
Asset index squared	-0.1492	-0.0383	-0.0729	-0.0505	0.0696	0.0413	-0.1292	-0.1406
	[3.12]***	[0.53]	[1.01]	[0.76]	[1.23]	[0.54]	[2.90]***	[2.22]**
Religion relative to Christian								
Muslim	0.2825		0.276		0.2559		-0.0726	
	[1.11]		[1.21]		[1.59]		[0.35]	

Other religion	-0.1756		0.082		-0.4068		0.1936	
	[0.61]		[0.29]		[2.21]**		[0.75]	
Fertility preferences								
Ideal number of kids	-0.0393	-0.0482	-0.0093	-0.0413	0.0287	0.0195	0.0391	0.0148
	[1.80]*	[1.52]	[0.33]	[1.22]	[0.92]	[0.78]	[1.38]	[0.56]
Ideal number of kids missing dummy	-0.2757	-0.2281	0.1626	0.1306	0.4584	0.4079	0.0545	0.0737
	[1.00]	[0.73]	[0.69]	[0.46]	[1.53]	[1.58]	[0.23]	[0.29]
Intends to use modern contraception	-0.1071	-0.0062	0.2061	0.1005	0.209	-0.1137	-0.1034	-0.0286
	[0.56]	[0.04]	[1.50]	[0.64]	[1.56]	[0.76]	[0.67]	[0.19]
Partner approves us family planning	-0.2592	0.0838	-0.2488	-0.2083	0.2688	0.076	-0.1346	-0.0859
	[1.16]	[0.41]	[1.21]	[1.09]	[1.87]*	[0.48]	[1.03]	[0.54]
Community/health care variables								
Any vaccination received	-0.4324		-0.0735		-0.8358		-0.3715	
	[0.98]		[0.21]		[2.48]**		[1.12]	
All vaccinations received	0.2075		0.2657		0.0425		-0.1136	
	[0.73]		[1.05]		[0.19]		[0.49]	
Any professional pre-natal care	-0.0567		-0.2512		1.1102		0.599	
	[0.10]		[0.53]		[2.35]**		[1.36]	
Tetanus toxoid	0.1666		-0.019		-0.5102		-0.9009	
	[0.32]		[0.04]		[1.26]		[2.45]**	
Any professional birth care	0.2572		0.126		0.3718		-0.1153	
	[1.12]		[0.59]		[1.93]*		[0.59]	
Use of modern contraception	0.2824		0.5993		0.6791		0.8728	
	[0.85]		[2.03]**		[2.09]**		[2.71]***	
Listens to radio	-0.0719		-0.0409		0.0348		-0.2465	
	[0.28]		[0.18]		[0.14]		[1.00]	
Occupation of Household head								
Professional	-0.3039	-0.2226	-0.0287	0.1462	0.1713	0.047	0.3196	0.1638
	[1.71]*	[1.03]	[0.17]	[0.75]	[0.97]	[0.25]	[1.66]*	[0.88]
Clerical	-0.3942	-0.322	-0.0189	0.0647	0.1532	0.1831	0.0608	0.0325
	[3.32]***	[2.43]**	[0.17]	[0.49]	[1.53]	[1.51]	[0.55]	[0.26]
Household and domestic	-0.2018	0.0035	-0.0801	-0.0379	0.1108	0.0785	-0.0301	-0.0891
	[1.72]*	[0.02]	[0.63]	[0.26]	[1.08]	[0.63]	[0.29]	[0.72]
Rural area dummy	-0.0829		-0.0305		0.2272		0.101	
	[0.49]		[0.17]		[1.64]		[0.77]	
Constant	-5.312	-5.4933	-4.0017	-4.5259	-7.7537	-7.0652	-6.5391	-5.5638
	[2.90]***	[3.26]***	[2.62]***	[2.86]***	[5.51]***	[4.84]***	[4.79]***	[3.87]***
Observations	1430	1432	1421	1423	1382	1441	1371	1438
R-squared	0.21	0.17	0.22	0.18	0.24	0.22	0.24	0.19

Absolute value of t statistics in brackets
* Significant at 10%; ** significant at 5%; *** significant at 1%

Table A4: Determinants of Acute Malnutrition by Gender of Child: 1998-2003

	1998				**2003**			
	Male			**Female**	**Male**			**Female**
Variable by category	No fixed effects	Fixed effects	No fixed effects	Fixed effects	No fixed effects	Fixed effects	No fixed effects	Fixed effects
Child characteristics								
Age of child in months	-0.1105	-0.1216	-0.0673	-0.0702	-0.1113	-0.1135	-0.111	-0.1116
	[6.32]***	[7.79]***	[4.45]***	[4.24]***	[7.62]***	[7.84]***	[7.53]***	[7.60]***
Age of child in months squared	0.0025	0.0028	0.0014	0.0013	0.0026	0.0027	0.0024	0.0024
	[5.68]***	[6.49]***	[3.40]***	[3.00]***	[6.85]***	[6.81]***	[6.23]***	[5.88]***
Household characteristics								
Share of women aged 15-49 yrs	0.3602	0.0854	-0.029	0.1286	0.8427	0.551	0.6966	0.6489
	[0.78]	[0.17]	[0.07]	[0.25]	[1.93]*	[1.25]	[1.61]	[1.32]
Household size	0.0246	0.0254	-0.0055	-0.0149	0.0094	0.025	-0.01	-0.0059
	[1.28]	[1.36]	[0.40]	[0.78]	[0.52]	[1.27]	[0.56]	[0.29]
Mothers age	0.0357	0.0183	-0.0358	-0.0571	-0.0569	-0.0058	0.0038	0.0309
	[0.70]	[0.34]	[0.76]	[1.04]	[1.28]	[0.12]	[0.07]	[0.63]
Mothers age squared	-0.0005	-0.0004	0.0006	0.001	0.0014	0.0005	0.0001	-0.0004
	[0.63]	[0.45]	[0.75]	[1.11]	[1.85]*	[0.61]	[0.08]	[0.51]
Mothers height	-0.0026	0.0013	0.0033	0.0043	0.0002	0.0074	0.0006	0.0043
	[0.41]	[0.18]	[0.60]	[0.66]	[0.03]	[1.23]	[0.11]	[0.69]
Mothers years of primary education	0.0193	-0.0145	0.0332	0.0343	0.0267	0.0167	-0.0108	-0.0207
	[1.02]	[0.73]	[1.84]*	[1.68]*	[1.36]	[0.86]	[0.55]	[0.96]
Mothers years of post primary educ.	0.017	0.0132	0.0468	0.0451	0.0451	0.0177	0.0135	0.0173
	[0.53]	[0.36]	[1.44]	[1.32]	[1.86]*	[0.64]	[0.54]	[0.58]
Heads years of primary educ.	-0.0193	0.0002	-0.029	-0.0258	0.0189	0.0165	0.0198	0.0251
	[1.31]	[0.01]	[1.77]*	[1.45]	[0.91]	[0.84]	[0.94]	[1.21]
Heads years of post primary educ.	0.0254	0.039	-0.0098	0.0194	0.008	0.0135	-0.0048	0.0065
	[0.96]	[1.26]	[0.34]	[0.62]	[0.55]	[0.92]	[0.37]	[0.41]
Age of house hold head	0.0073	0.022	0.0003	0.0175	-0.0311	-0.0545	0.0009	-0.002
	[0.42]	[1.06]	[0.02]	[0.79]	[1.90]*	[2.95]***	[0.04]	[0.09]
Age of head squared	-0.0001	-0.0003	0	-0.0002	0.0003	0.0005	0	0
	[0.31]	[1.22]	[0.21]	[1.04]	[1.71]*	[2.66]***	[0.09]	[0.07]
Mother is head dummy	-0.0348	-0.0142	-0.2098	-0.2434	-0.1717	-0.2702	0.0422	-0.0204
	[0.30]	[0.10]	[1.73]*	[1.73]*	[1.72]*	[2.33]**	[0.37]	[0.17]
Asset index	0.1837	0.1343	0.1119	0.0852	0.0321	0.1465	0.0619	0.0797
	[2.40]**	[1.20]	[1.57]	[0.80]	[0.48]	[1.51]	[1.00]	[0.79]
Religion relative to Christian								
Muslim	-0.2129		-0.3263		-0.1795		-0.1892	
	[1.32]		[1.71]*		[1.28]		[1.33]	
Other religion	-0.0845		-0.1356		-0.1092		-0.1463	
	[0.49]		[0.65]		[0.45]		[0.91]	

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fertility preferences								
Ideal number of kids	-0.0223	-0.0098	-0.0202	-0.0155	0.0173	0.0293	-0.0547	0.0032
	[1.20]	[0.37]	[0.80]	[0.52]	[0.70]	[1.39]	[2.18]**	[0.14]
Ideal number of kids missing dummy	-0.0341	0.032	-0.2691	-0.1576	0.1722	0.359	0.0327	0.1193
	[0.14]	[0.12]	[1.20]	[0.63]	[0.72]	[1.65]*	[0.17]	[0.52]
Intends to use modern contraception	0.1625	0.1234	0.2453	0.0799	0.0491	0.0828	0.1141	0.0946
	[1.27]	[0.84]	[1.97]**	[0.58]	[0.42]	[0.66]	[1.02]	[0.71]
Partner approves us family planning	0.0369	0.0844	0.1904	0.1497	0.2235	0.0898	0.1232	0.0413
	[0.27]	[0.49]	[1.21]	[0.89]	[1.64]	[0.68]	[1.12]	[0.29]
Community/health care variables								
Any vaccination received	0.365		0.2806		-0.1802		-0.0296	
	[1.33]		[0.89]		[0.59]		[0.08]	
All vaccinations received	0.2504		-0.0685		0.1737		-0.158	
	[1.24]		[0.35]		[0.90]		[0.69]	
Any professional pre-natal care	-0.1884		-0.438		-0.3281		-0.4544	
	[0.44]		[0.96]		[0.70]		[0.96]	
Tetanus toxoid	-0.1812		0.1388		-0.0951		0.2118	
	[0.43]		[0.34]		[0.22]		[0.50]	
Any professional birth care	-0.1027		0.2747		0.1102		0.2292	
	[0.52]		[1.62]		[0.66]		[1.19]	
Use of modern contraception	0.5301		0.1445		0.4638		-0.0146	
	[2.21]**		[0.65]		[1.74]*		[0.05]	
Listens to radio	0.1712		0.1057		0.3014		0.416	
	[0.92]		[0.54]		[1.18]		[1.67]*	
Occupation of Household head								
Professional	0.3507	0.4607	0.1001	-0.088	-0.1067	-0.012	0.3013	0.1945
	[2.08]**	[2.59]***	[0.64]	[0.52]	[0.71]	[0.08]	[1.72]*	[1.18]
Clerical	0.174	0.2396	0.1996	0.1216	-0.0315	0.0225	0.1122	0.1607
	[1.57]	[2.18]**	[2.13]**	[1.05]	[0.34]	[0.22]	[1.11]	[1.47]
Household and domestic	0.0192	0.0094	0.2182	0.2401	0.0604	0.1048	0.0142	0.1294
	[0.17]	[0.08]	[1.77]*	[1.91]*	[0.63]	[1.00]	[0.15]	[1.17]
Rural area dummy	0.0673	0	0.1935		-0.197		-0.0545	
	[0.48]		[1.37]		[1.90]*		[0.43]	
Constant	-0.3402	-0.3507	-0.042	0.0944	1.2316	-0.2138	0.3713	-0.6507
	[0.30]	[0.25]	[0.03]	[0.07]	[1.05]	[0.17]	[0.29]	[0.51]
Observations	1439	1441	1427	1429	1384	1443	1372	1439
R-squared	0.13	0.11	0.08	0.06	0.15	0.1	0.12	0.09

Absolute value of t statistics in brackets

* Significant at 10%; ** significant at 5%; *** significant at 1%

Table A5: Testing for Joint Significance from Pooled Regression Model

Variable	**F- statistic***
Share of women aged 15-49 yrs	6.17 [0.013]
Heads years of primary education	4.97 [0.026]
Age of house hold head	4.47 [0.035]
Any professional pre-natal care	3.26 [0.013]
Tetanus toxoid	3.34 [0.068]
Professional occupation	5.14 [0.024]
Clerical occupation	7.65 [0.006]

* Probability level in parenthesis.