DO MOTHERS' EDUCATIONAL LEVELS MATTER IN CHILD MALNUTRITION AND HEALTH OUTCOMES IN GAMBIA AND NIGER?[1]

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Abstract

Despite past policy interventions and supports, malnutrition remains one of the major problems confronting children in Sub-Sahara Africa (SSA). This study analyzed the effect of mothers' educational levels on child malnutrition. Data from the 2000 End-Decade Multiple Indicator Cluster Survey by the United Nations International Children Emergency Funds (UNICEF) for Gambia and Niger were used. Data were analyzed with Foster-Greer-Thorbeck approach and Probit regression. Results show stunting, wasting and underweight head counts are higher in Niger rural and urban areas, while stunting, wasting and underweight head count, depth and severity are higher among children whose mothers had no secondary education for all the countries. The Probit analysis reveals that attainment of secondary education by the mothers, urbanization, presence of pipe water, presence of mother and father at home, polio vaccination, ever breast fed and access to radio and television significantly reduce the probability of stunting, wasting and underweight, while infection with diarrhea, fever and age at first polio vaccine significantly increase it. It was recommended that to reduce malnutrition and achieve the Millennium Development Goals (MDGs) in Gambia and Niger, institutional arrangements for catering for secondary education of girls and ensuring consistency in child health programs must be strengthened, among others.

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1. Introduction

Hunger and malnutrition remain among the most devastating problems currently facing the majority of the world's poor (WHO, 2000). Conventionally, the nutritional status of under-five children is one of the acceptable indicators of households' well-being (Thomas *et al,* 1990). However, child malnutrition has worsened significantly over the past few decades in many developing countries (ACC/SCN, 2000). Without appropriate policy interventions, the hope of achieving the Millennium Development Goals (MDGs) is bleak. This is because adequate nutrition is a fundamental requirement for children healthy living and development (WHO, 2000).

It should be noted that the African traditional role division has largely laid the responsibility of childcare on women. This begins at conception and continues until infancy, teenage and adulthood. Therefore, women are key players in the growth and development of children. However, it is not until recently that the role of mothers' education in enhancing the quality of care and nutritional status of children is being emphasized in empirical research (Smith *et al*, 2004).

The generally adopted conceptual framework for understanding the causes of malnutrition is that proposed by UNICEF (1990; 1998) and Engle *et al* (1999). This framework incorporates household food security, care for mother and children, and healthy environment and service as key factors influencing malnutrition. As distinct and important as these factors may be, the educational level of mothers can play a facilitating role of ensuring that they make maximum impacts. For instance, educated mothers may have better paid jobs thus be able to earn higher income and take better care of their children, be resident in urban areas where there are functioning social infrastructures, possess commendable culture of hygiene needed to protect children from diseases, be more likely to participate in child health enhancing programs like immunization and child care talks, and be able to benefit maximally from nutrition- and health-related radio and television programs.

The nutritional status of children can be studied using clinical signs of malnutrition, biochemical indicators and anthropometrics surveys. However, the use of anthropometrics measurement has some advantages over other approaches. This is because they are cheaper and relatively easier to obtain. Theoretically, the body of a child responds to malnutrition in two ways that can be measured by anthropometrics survey. First, a reduction in growth over the long-term results in low height-for-age or stunting. Second, a short-term response to inadequate food intakes is assessed by weight relative to height (wasting). The combination of short-term and long-term food shortage and growth disturbances produces low weight-for-age (underweight) (de Onis, 2000).

Underscoring the role of mothers' education, Ryan *et al* (1984) analyzed the determinants of individual diets and nutritional status in six semi-arid villages of Southern India using weight-for-age classification suggested by Gomez *et al* (1955). They found that educational level of mothers and non-involvement of the mothers in the rural labour market significantly reduced the nutritional status of children. Gunasekara (1999) found that the employment status of mothers, the number of living children, the level of education of the mother and non-involvement of the mothers in the rural labour market significantly reduced the incidence of stunting, wasting and underweight among children in Sri Lanka.

Christiansen and Alderman (2001) measured child malnutrition in Ethiopia using height-for-age z-score. It was found that gender of the child, household resources, food prices, maternal education and strengthening of nutritional knowledge of the community through child growth monitoring or nutritional education are the key determinants of chronic growth disturbances.

Department of Census and Statistics (DCS) (2003) found that in Sri Lanka, the key factor explaining stunting, wasting and under-weight in children were age of the child, sector of residence (urban or rural), work status of mother, access to media by the mother, mother's educational level, and type of toilet. Shah (2003) analyzed the prevalence and correlates of stunting among children in rural Pakistan. Using data from 1878 children that were less than 3 years of age, their results showed that 26 percent, 55 percent and 15 percent of the children were wasted, stunted and wasted/stunted respectively. It was further revealed that mothers who were illiterate and fathers that were earning less than $20 per month were more likely to have stunted children. Also, Silva (2005) analyzed the determinants of child malnutrition in Ethiopia. The result showed that child's age, mother's height, household wealth, educational levels of the mothers and access to good water explain to a large extent the nutritional status of children.

The objectives of the paper are to determine the malnutrition head count, depth and severity with respect to height-for-age (stunting), weight-for-height (wasting) and weight-for-age (underweight) and analyze the effect of mothers' education and other socio-economic factors on child's health outcomes of malnutrition (stunting, wasting and under-weight). The research hypotheses are that maternal education does not significantly reduce the problems of stunting, wasting and under-weight. In the remaining parts of the paper, section 2 highlights the method of data collection, section 3 presents the results of data analysis and section 4 presents the policy recommendations.

2. Materials and Method

Sources of data

The study used the data available for several African countries on child's anthropometrics information. The data were collected in the 2000 Multiple Indicator Cluster Survey by the United Nations International Children Emergency Funds (UNICEF). The requested information is robust in every respect comprising of child anthropometrics data, disease infection, mother's socio-economic characteristics, housing condition and participation in different forms of vaccination programs, among others. The samples in all the countries were selected in two stages. At the first stage, clusters were selected with probability proportional to size. After a household listing was obtained for the selected clusters, systematic samples were drawn. This study focuses on data from Gambia and Niger (see table 1). Data from Gambia were collected from Banjul, Kanifing, Brikama, Mansakonko, Kerewan, Kuntaur, Janjabureh and Basse. The survey in Niger was done in Agadez, Diffa, Dosso, Maradi, Tillaberi, Tahoua, Zinder_Diffa, and Niamey.

Table 1: Distribution of Samples and Household Members in the Gambia and Niger

Country	Gambia	Niger
Completed Samples	4190	4321
Household members	24213	26256
Women	5271	5664
Children	3509	5080

Analytical Models

Z-Score indices of prevalence of malnutrition

Following Cogill (2003), the z-score was used to carry out the analysis of child's malnutrition. This is represented as:

$$Z_{ij} = \frac{X_{ij} - \mu_j}{\sigma_j} \qquad 1$$

Where i refers to individuals (children) and j = 1….3 with Z_1 = z-score height-for-age nutrition index, Z_2 = z-score weight-for-height nutrition index, and Z_3 = z-score weight-for-age nutrition index, X_{ij} = observed value for the ith child, μ = mean value of the reference population, and σ = standard deviation of the reference population. A z-score of -2 standard deviation is the most commonly adopted cut off for all nutrition indicators. Consequently, children with z-scores below (-2σ) for stunting (HAZ), underweight (WAZ) and wasting (WHZ) are considered to be moderately or severely malnourished.

Following Sahn and Stifel (2002), the Foster *et al* (1984) method was applied to analysis of child nutritional status. This is specified as:

$$P_{ia} = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{z - y_{ij}}{z}\right]^{\alpha} \qquad \ldots\ldots\ldots\ldots\ldots \qquad 2$$

n = number of children in the population

q = number of malnourished children

z = nutrition poverty line (-2 standard deviation)

y_{ij} = z score of ith child for jth health outcome

α = degree of malnutrition aversion. Conventionally, it measures the incidence or head count ratio (α is 0), nutrition gap or depth (α is 1) and malnutrition severity (α is 2).

Probit Regression Model

The Probit regression was used to analyze the socio-economic determinants of child health outcomes. The dependent variables (Y_{ij}) were binary variables with value of 1 if malnourished in respect of stunting, wasting and underweight (z-score less than –2) and 0 otherwise. Following Zere and McIntyre (2003), some outliers were excluded based on the recommendation of WHO (1995). Therefore, weight-for-height z score less than –4 and greater than +5, height-for-age z-scores less than –5 and greater than +3, weight-for-age z-score less than –5 and greater than +5 were excluded. The estimated model is stated as:

$$Y_{ij} = \phi_j + \sum_{i=1}^{6}\beta_i M_i + \sum_{i=1}^{4}\varphi_i H_i + \sum_{i=1}^{4}\gamma_i D_i + \sum_{i=1}^{5}\theta_i V_i + \sum_{i=1}^{4}\mu_i P_i + \sum_{i=1}^{8}\vartheta_i A_i + v_j \qquad 3$$

Where:

M_1 = Sex (male 1, 0 otherwise)

M_2 = Urbanization (urban centers = 1, 0 otherwise)

M_3 = Age of child (months)

M_4 = Hour of early learning (minutes)

M_5 = Mother's secondary education (≥ secondary = 1, 0 otherwise)

M_6 = Mother's primary education (≥ primary = 1, 0 otherwise)

H_1 = ever received vitamin A (yes =1, 0 otherwise)

H_2 = Month since last dose of Vitamin A

H_3 = Ever breastfed (yes =1, 0 otherwise)

H_4 = Currently breast-feeding (yes =1, 0 otherwise)

D_1 = Diarrhea in last 2 weeks (yes =1, 0 otherwise)

D_2 = Cough in last 2 weeks (yes =1, 0 otherwise)

D_3 = Fever in last 2 weeks (yes =1, 0 otherwise)

D_4 = Sleep under bed net (yes =1, 0 otherwise)

V_1 = Ever given BCG vaccines (yes =1, 0 otherwise)

V_2 = Age at first polio vaccine

V_3 = Number of polio vaccine

V_4 = Number of DPT vaccine

V_5 = Ever given measles vaccine (yes =1, 0 otherwise)

P_1 = Mother alive (yes =1, 0 otherwise)

P_2 = Mother at home (yes =1, 0 otherwise)

P_3 = Father alive (yes =1, 0 otherwise)

P_4 = Father at home (yes =1, 0 otherwise)

A_1 = Pipe water (yes =1, 0 otherwise)

A_2 = Sanitary toilet (yes =1, 0 otherwise)

A_3 = Non-iodized salt (yes =1, 0 otherwise)

A_4 = Tile as floor material (yes =1, 0 otherwise)

A_5 = Electricity (yes =1, 0 otherwise)

A_6 = Radio (yes =1, 0 otherwise)

A_7 = Television (yes =1, 0 otherwise)

A_8 = Refrigerator (yes =1, 0 otherwise)

v_j = error term

3. Results and Discussions

Socio-Economic Characteristics of Under-Five Children

The descriptive statistics of some of the socio-economic characteristics of the under-five children are presented in table 2. It reveals that 50.48 percent and 51.55 percent of the children from Gambia and Niger respectively were males and 33.27 percent and 19.52 percent were from urban centers. The average ages are 26 months and 29 months for Gambia and Niger respectively. Only 11.76 percent and 79.53 percent of the children in Gambia and Niger respectively have ever taken food fortified with Vitamin A. while 98.98 percent and 97.62 percent were ever breast-fed. Percentages of children vaccinated are lower in Gambia with 8.40 percent, 8.97 percent, 9.95 percent, and 7.88 percent ever had BCG, polio, DPT and measles vaccination respectively. Furthermore, 99.98 percent and 92.27 percent of the mothers of the children in Gambia and Niger respectively had at least primary education. However, only 18.61 percent and 18.70 percent of the mothers in Gambia and Niger respectively had at least secondary education.

Table 2: Descriptive Statistics Some of the Variables Used for Probit Regression

Country/Variables	Gambia		Niger	
	Mean	Std deviation	Mean	Std deviation
Sex*	0.5048	0.5000	0.5155	0.4998
Urban/rural*	0.1430	0.3502	0.3771	0.4847
Age of child	26.2696	16.2429	29.2055	17.2371
Hour of early learning	0.6184	3.9580	0.3876	3.3505
Mother's secondary education*	0.1861	0.2114	0.1870	0.3899
Mother's primary education*	0.9988	0.3082	0.9227	0.2669
Vitamin A	0.1176	0.3222	0.7953	1.0921
Month since last dose of Vitamin A	0.6531	3.6511	1.8191	4.1040
Ever breast fed*	0.9898	0.1000	0.9762	0.1523
Currently breast feeding*	0.4357	0.4959	0.3779	0.4849
Diarrhea in last 2 weeks*	0.2493	0.4327	0.3632	0.4809
Cough in last 2 weeks*	0.1932	0.3948	0.2422	0.4284
Fever in last 2 weeks*	0.1394	0.3464	0.3755	0.4843
Sleep under bed net*	0.5084	0.5000	0.2209	0.4143
Ever given BCG vaccines*	0.0840	0.2775	0.1812	0.3853
Age at first polio vaccine	0.1592	0.5217	0.3927	0.7648
Number of polio vaccine	0.2174	0.8646	0.6578	1.3981
Number of DPT vaccine	0.1184	0.5717	0.3434	0.9073
Ever given measles vaccine*	0.0788	0.3265	0.2066	0.8094
Mother alive*	0.9454	0.2271	0.9861	0.1169
Mother at home*	0.9046	0.2938	0.9346	0.2471
Father alive*	0.9300	0.2550	0.9821	0.1323
Father at home*	0.8233	0.3814	0.8750	0.3307
Pipe water*	0.6789	0.4670	0.4006	0.4900
Modern toilet*	0.0226	0.1487	0.0347	0.1832
Non-iodized salt*	0.5513	0.4974	0.5471	0.4978
Tile as floor material*	0.0133	0.1147	0.7403	0.4384
Electricity*	0.2130	0.4095	0.1674	0.3734
Radio*	0.7041	0.4565	0.5271	0.4993
Television*	0.1305	0.3369	0.1372	0.3441
Refrigerator*	0.0941	0.2921	0.0105	0.1022

*0-1 dummy estimated variables implying percentage for those indicating 1 (yes).

Malnutrition Head Count, Depth and Severity in Gambia and Niger

Table 3 shows the indices of malnutrition. The values were computed for the combination of rural and urban areas (all children), rural areas (rural children) and urban areas (urban children). The table shows that for all the children, rural children and urban children, stunting, wasting and underweight head counts are higher in Niger. Malnutrition depth indicates by how much the malnourished children would be lifted up the z-score in order to escape the

Table 3: Malnutrition Head Count, Depth and Severity Indices in Rural and Urban Areas in Gambia and Niger

Malnutrition Variable/ Country	Gambia (n = 2474)	Niger (n = 4545)
Rural and Urban (All Children)		
Malnutrition Head Count		
Stunting (HAZ)	0.2033	0.3529
Wasting (WHZ)	0.0860	0.1269
Under Weight (WAZ)	0.1847	0.3654
Malnutrition Depth		
Stunting (HAZ)	0.4314	0.4963
Wasting (WHZ)	0.2596	0.2715
Under Weight (WAZ)	0.3107	0.3790
Malnutrition Severity		
Stunting (HAZ)	0.3193	0.3836
Wasting (WHZ)	0.1152	0.1257
Under Weight (WAZ)	0.1641	0.2311
Rural Areas (Rural Children)		
Malnutrition Head Count		
Stunting (HAZ)	0.2089	0.4143
Wasting (WHZ)	0.0858	0.1419
Under Weight (WAZ)	0.1939	0.4118
Malnutrition Depth		
Stunting (HAZ)	0.4668	0.5204
Wasting (WHZ)	0.2524	0.2874
Under Weight (WAZ)	0.3149	0.4055
Malnutrition Severity		
Stunting (HAZ)	0.3580	0.4109
Wasting (WHZ)	0.1083	0.1393
Under Weight (WAZ)	0.1701	0.2578
Urban Areas (Urban Children)		
Malnutrition Head Count		
Stunting (HAZ)	0.1694	0.2520
Wasting (WHZ)	0.0875	0.1021
Under Weight (WAZ)	0.1299	0.2893
Malnutrition Depth		
Stunting (HAZ)	0.0302	0.4298
Wasting (WHZ)	0.3026	0.2351
Under Weight (WAZ)	0.2709	0.3159
Malnutrition Severity		
Stunting (HAZ)	0.0055	0.3085
Wasting (WHZ)	0.1558	0.0947
Under Weight (WAZ)	0.1132	0.1678

scourge of malnutrition. The analysis shows except for wasting among urban children, malnutrition is deeper among all categories of children in Niger. Malnutrition severity measures the severity intensity of malnutrition among the affected children. The results also show that except for wasting among urban children, Niger children are worst severely affected by malnutrition.

Table 4: Malnutrition Head Count, Depth and Severity Indices Among Mothers With Different Educational Levels in Gambia and Niger

Educational Level	Gambia		Niger	
	≥ Secondary	< Secondary	≥ Secondary	< Secondary
Malnutrition Head Count				
Stunting (HAZ)	0.0689	0.2099	0.2350	0.3799
Wasting (WAZ)	0.0948	0.1891	0.2796	0.3851
Underweight (WHZ)	0.1034	0.0852	0.1034	0.1323
Malnutrition Depth				
Stunting (HAZ)	0.2918	0.4343	0.4061	0.5091
Wasting (WAZ)	0.1877	0.3135	0.3440	0.3849
Underweight (WHZ)	0.2479	0.2604	0.2335	0.2784
Malnutrition Severity				
Stunting (HAZ)	0.1676	0.3216	0.2817	0.3981
Wasting (WAZ)	0.0725	0.1667	0.1990	0.2365
Underweight (WHZ)	0.1171	0.1144	0.0953	0.1312
	≥ Primary	< Primary	≥ Primary	< Primary
Stunting (HAZ)	0.0985	0.2157	0.3476	0.2749
Wasting (WAZ)	0.1174	0.1926	0.3624	0.2655
Underweight (WHZ)	0.1098	0.0832	0.1278	0.0772
Malnutrition Depth				
Stunting (HAZ)	0.3196	0.4385	0.4934	0.5256
Wasting (WAZ)	0.2794	0.3127	0.3801	0.0973
Underweight (WHZ)	0.2858	0.2556	0.2727	0.2558
Malnutrition Severity				
Stunting (HAZ)	0.2481	0.3230	0.3807	0.4121
Wasting (WAZ)	0.1422	0.1660	0.2319	0.0598
Underweight (WHZ)	0.1385	0.1115	0.1270	0.1087

Table 4 shows the malnutrition head count, depth and severity for mothers with different levels of education. The results show that stunting, wasting and underweight head count, depth and severity are higher among children whose mothers had no secondary education for all the countries. However, the indices for primary education do not follow a particular trend.

Determinant of Child Health Outcomes

Stunting (HAZ)

Table 5 shows the results of Probit analysis of the determinants of stunting among under five children in selected SSA countries. The statistical significance of the F- values ($p < 0.01$) shows that the model produced a good fit for the data. The discussions shall only focus on the variables that are statistically significant (at least $p < 0.10$).

The estimated parameters for child's sex are statistically insignificant ($p > 0.10$). This shows that there is no significant difference between male and female children in Gambia and Niger. Children from urban areas have significantly lower probability of stunting in all the countries. Smith *et al* (2004) also found that stunting is higher in rural areas than urban areas. The parameters of child's age show that as the children grow older, the probability of becoming stunted increases in all the countries. This is because the height of younger kids may not be seriously affected if the households have food problem due to their dependence on breast milk.

The parameter for attendance at early learning centers for Gambia shows that those children attending early learning have significantly higher probability of stunting, while the opposite applies for Niger. Children on early learning are always given supplementary formula food if they have not been weaned. In most cases, weaned children attending these classes eat more than they would ordinarily do if they were with their parents because acceptance of child's attendance is strictly conditioned on provision of required food by the parents.

The parameters of primary education show that in Gambia and Niger, possession of at least primary education by the mothers significantly reduces the probability of the children becoming stunting. Also, possession of at least secondary education reduces stunting in the two countries. A similar finding had been reported by Smith and Haddad (2000). This observation goes in line with expectation because educated women are expected to be better than illiterate

Table 5: Probit Regression of the Determinants of Stunting (HAZ) Among Children in Sub-Saharan Africa

Country/Variables	Gambia		Niger	
	Parameter	t-value	Parameter	t-value
Constant	0.188803*	2.999	0.11361***	1.644
Sex	-0.002251	-0.205	0.006224	0.596
Urbanization	-0.121471*	-7.234	-0.036286**	-2.049
Age of child	0.000573**	2.022	0.002447*	4.602
Hour of early learning	0.003104**	2.170	-0.004290*	-2.667
Mother's primary education	-0.062898*	-2.665	-0.044178**	-2.239
Mother's secondary education	-0.086472*	-2.768	-0.069059**	-2.266
Vitamin A	-0.100349*	-5.088	0.002418	0.498
Month since last dose of Vitamin A	0.002051**	2.180	-0.000640	-0.482
Ever breast fed	-0.10021***	-1.809	0.034635***	1.990
Currently breast feeding	-0.011275	-0.622	-0.036463**	-1.969
Diarrhea in last 2 weeks	0.009545*	2.735	0.051180*	4.402
Cough in last 2 weeks	0.001667	0.116	-0.000413	-0.032
Fever in last 2 weeks	0.74849*	4.346	0.012775**	2.089
Sleep under bed net	-0.074849*	-6.764	-0.036386*	-2.772
Ever given BCG vaccines	0.044637	0.965	0.009954	0.388
Age at first polio vaccine	0.002732	0.080	-0.007539	-0.265
Number of polio vaccine	-0.01895***	-1.655	-0.019246**	-2.391
Number of DPT vaccine	-0.010922	-0.678	0.003044	0.323
Ever given measles vaccine	-0.000755**	-2.032	-0.021433*	-2.658
Mother alive	-0.07563***	-1.647	0.026300	0.472
Mother at home	-0.093340*	-2.950	-0.009054**	-2.310
Father alive	0.07465***	1.860	-0.034217*	-2.726
Father at home	-0.090142*	-4.584	0.000345	0.017
Pipe water	-0.070227*	-5.757	-0.020778***	-1.855
Sanitary toilet	-0.094301**	-2.518	-0.00989**	-2.319
Non-iodized salt	-0.02077***	-1.864	-0.002984	-0.284
Tile as floor material	-0.09276***	-1.928	-0.027845***	-1.642
Electricity	0.0676983*	4.030	-0.044275***	-1.845
Radio	-0.040869*	-3.217	-0.23967**	-2.120
Television	-0.102960*	-4.017	-0.011490	-0.458
Refrigerator	-0.032214	-1.013	-0.005821	-0.210
F- Value	9.35*		9.00*	

* - statistically significant at 1 percent level
** - statistically significant at 5 percent level
*** - statistically significant at 10 percent level

ones in all aspects of child care, food formulation and understanding of the needs of the child at every stage of growth and development.

Those children who were given vitamin A in Gambia have significantly lower probability of becoming stunting, while the opposite was observed for Swaziland. The longer the time that child last took vitamin A, the higher the probability of becoming stunting in Gambia. In many developing countries, institutional arrangements for campaigning for fortification of food with vitamin A are now in place. Educated mothers are likely to be better informed.

The parameters estimated for child ever breastfed show the expected negative relationship for Gambia. Child being currently breast-feeding significantly reduces the probability of stunting in Niger. Mothers' education may enhance their skills for breastfeeding, especially in the area of milk extraction for babies use.

The parameters estimated for children having diarrhea in the previous two weeks before the interview have the expected positive sign for all the countries. Therefore, illness with diarrhea increases the probability of child growing stunting. However, infection with cough has no significant effect on the probability of child becoming stunted. Infection with fever significantly increases the probability of stunting. In like manner, children that were sleeping under mosquito nets have significantly lower probability of stunting. The mother with high education will likely have a hygienic culture that will reduce child infection with diseases.

The probability of stunting also decreases with increase in the number of polio vaccines. Vaccination against measles leads to significant reduction in the probability of stunting. These vaccines are all expected to enhance the health of children as they guard the body against such sicknesses as diphtheria, polio and tuberculosis. Most times, educated mothers may be more aware about where these vaccines can be got.

Children whose mothers are alive have significantly lower probability of stunting in Gambia. Children whose fathers are alive have significantly lower probability of stunting in Niger, while the opposite applies for Gambia. However, presence of the fathers at home significantly reduces the probability of stunting only in Gambia. This implies that mothers play a stronger role in child health outcomes as the caretaker and decision makers in respect to the nutrition of the children.

Pipe (safe) water significantly reduces the probability of stunting. This is expected because with clean water, some diseases that can distort growth and development in children can be controlled. Presence of sanitary toilet also significantly reduces the probability of stunting.

Children from homes where the floor materials are made of tiles have lower probability of stunting. This could possibly associate with better sanitation and expected high income of the users. However, electricity significantly reduces the probability of stunting in Niger. However, it significantly increases it in Gambia. Presence of radio significantly reduces the probability of stunting. Also, presence of television significantly reduces the probability of stunting in Gambia. This can be traced to the fact that they are media for educating the parents on issues that affect their children's health and information dissemination of information. The presence of refrigerator does not show statistical significance in any of the results.

Wasting

The analysis of the determinant of wasting in under-five children in table 6 shows that the male children in Niger have significantly higher probability of wasting. As children grow older, their probability of wasting significantly reduces in Niger. The more the hours of early learning, the less the probability of wasting in Gambia. Possession of at least a primary education significantly reduces the probability of wasting incidence in Gambia. Also, possession of at

Table 6: Probit Regression of the Determinants of Wasting (WHZ) Among Children in Sub-Saharan Africa

Country/Variables	Gambia		Niger	
	Parameter	t-value	Parameter	t-value
Constant	0.110953**	2.196	0.043876	0.742
Sex	0.001632	0.186	0.030855*	3.455
Urbanization	0.011081	0.823	-0.005992	-0.396
Age of child	-0.000052	-0.118	-0.001065**	-2.344
Hour of early learning	-0.00167***	-1.860	0.000993	0.723
Mother's primary education	-0.03366***	-1.778	0.016108	0.955
Mother's secondary education	-0.022526*	-2.815	-0.021965*	-2.706
Vitamin A	0.003470	0.219	-0.000912	-0.220
Month since last dose of Vitamin A	-0.001585	-1.136	0.001855*	2.634
Ever breast fed	-0.032786	-0.738	-0.000901	-0.030
Currently breast feeding	-0.007795	-0.536	0.062385*	3.941
Diarrhea in last 2 weeks	0.01022**	1.981	0.038717*	3.895
Cough in last 2 weeks	0.01537***	1.828	0.012495**	2.129
Fever in last 2 weeks	0.001223**	2.094	0.037970*	3.786
Sleep under bed net	-0.005832*	-2.657	-0.022007**	-1.961
Ever given BCG vaccines	-0.003830**	-2.103	-0.005607**	-2.255
Age at first polio vaccine	0.018551*	2.677	0.042681*	2.753
Number of polio vaccine	-0.005158**	-2.561	0.003444	0.500
Number of DPT vaccine	0.008593	0.665	0.012900	1.602
Ever given measles vaccine	-0.005476**	-2.290	-0.001716**	-2.249
Mother alive	-0.012249**	-2.326	0.024832	0.521
Mother at home	0.003065	0.121	0.007674	0.307
Father alive	0.028419	0.882	-0.025026	-0.621
Father at home	-0.021821**	-2.383	-0.014846	-0.842
Pipe water	-0.022683**	-2.318	0.000271	0.024
Sanitary toilet	-0.000071	-0.696	-0.048304***	-1.819
Non-iodized salt	0.027217*	2.906	0.018943**	2.109
Tile as floor material	-0.004470**	-2.500	0.019914	1.349
Electricity	0.000556	0.041	0.032687***	1.893
Radio	0.004710	0.462	-0.006674	-0.691
Television	0.01494***	1.727	-0.021179*	-2.987
Refrigerator	-0.04402***	-1.727	0.026119	1.104
F- value	9.03*		8.93*	

* - statistically significant at 1 percent level
** - statistically significant at 5 percent level
*** - statistically significant at 10 percent level

least a secondary education significantly reduces the probability of wasting in all the countries.

The longer the time that the child took vitamin A, the higher the probability of wasting in Niger. Those children who were currently breast-feeding have significantly higher probability of wasting in Niger. Infection with diarrhea significantly increases the probability of wasting in the two countries. Also, infection with cough significantly increases wasting in all the countries. Fever infection significantly increases wasting in all the countries. Children that were sleeping under bed nets have significantly lower probability of wasting in all the countries.

Children who ever took BCG vaccination have significantly lower probability of wasting in all the countries. The older the children are at the first time of taking polio vaccination, the higher the probability of wasting in all the countries. The higher the number of polio vaccines that children took, the lower the probability of wasting in Gambia. Children who ever took vaccination against measles have significantly lower probability of wasting.

Children whose mothers are alive have significantly lower probability of wasting only in Gambia. Children whose fathers were at home have significantly lower probability of wasting in Gambia. Presence of father is expected to guarantee food provision and this may make children non-vulnerable to acute growth disturbances.

Children from homes where there is safe (pipe) water have significantly lower probability of wasting in Gambia. The presence of sanitary toilet significantly reduces the probability of wasting in Niger. Consumption of non-iodized salt leads to significant increase in the probability of child wasting in all the countries. Children from households where floors are covered with tiles have significantly lower probability of wasting only in Gambia. However, households with television have significantly lower probability of wasting in Niger. Children whose households have refrigerator also have lower probability of wasting in Gambia.

Underweight

The Probit analysis for determinants of underweight in table 7 shows that urban children have significantly lower probability of underweight in the two countries. Also, possession of at least a secondary education by the mothers significantly reduces the probability of under-five underweight.

Consumption of food fortified with vitamin A significantly reduces the probability of underweight in Gambia. Also, children that were ever breastfed have significantly lower probability of underweight in Gambia. Children who are currently breast-feeding in Niger have significantly lower probability of underweight.

Infection with diarrhea significantly increases the probability of underweight in all the countries. This is expected because diarrhea causes a lot of discomfort and leads to quick weight losses. However, the parameter of cough infection shows no statistical significance ($p > 0.10$). Fever infection leads to significant increase in the probability of underweight in Niger. Sleeping under bed net significantly reduces the probability of underweight.

Ever received BCG vaccination leads to significant reduction in the probability of underweight. The older the children are at the first polio vaccine, the higher the probability of underweight. Increase in the number of polio vaccines significantly reduces the incidence of underweight. The number of DPT vaccination significantly reduces the probability of underweight. Also, measles vaccination leads to significant reduction in probability of underweight in Niger.

The probability of under-five children underweight significantly reduces when the mothers of the children are alive in Gambia. Also, when the mothers of the children are at home, the probability of underweight significantly reduces in

Table 7: Probit Regression of the Determinants of Underweight (WAZ) Among Children in Sub-Saharan Africa

Country/Variables	Gambia		Niger	
	Parameter	t-value	Parameter	t-value
Constant	0.301076*	4.293	0.177462**	2.227
Sex	0.002636	0.216	-0.000583	-0.048
Urbanization	-0.035544***	-1.901	-0.044414**	-2.176
Age of child	0.000126	0.202	0.000462	0.755
Hour of early learning	-0.001171	-0.735	-0.003107***	-1.876
Mother's primary education	-0.007167	-0.273	-0.020750	-0.912
Mother's secondary education	-0.041661**	-2.085	-0.015022***	-1.865
Vitamin A	-0.064549*	-2.939	0.007240	1.295
Month since last dose of Vitamin A	-0.000188	-0.097	-0.000455	-0.298
Ever breast fed	-0.100265***	-1.825	0.040383	1.001
Currently breast feeding	0.000082	0.004	-0.011163***	-2.523
Diarrhea in last 2 weeks	0.014193**	1.981	0.076651*	5.720
Cough in last 2 weeks	-0.002139	-0.133	0.008177	0.548
Fever in last 2 weeks	-0.062672*	-3.465	0.057647*	4.263
Sleep under bed net	-0.061165*	-4.963	-0.041083*	-2.716
Ever given BCG vaccines	-0.045319***	-1.879	-0.043743**	-2.478
Age at first polio vaccine	0.049352**	2.298	0.031129**	1.948
Number of polio vaccine	-0.009074*	-2.711	-0.18798**	-2.026
Number of DPT vaccine	-0.023973**	-2.336	-0.000469**	-2.046
Ever given measles vaccine	-0.012587	-0.481	0.023277**	2.505
Mother alive	-0.012634**	-2.242	0.040361	0.629
Mother at home	-0.039912**	-2.133	-0.000666	-0.020
Father alive	-0.024982	-0.559	-0.048800	-0.898
Father at home	-0.040539***	-1.851	-0.023424**	-1.985
Pipe water	-0.011813**	-1.969	-0.027452***	-1.782
Sanitary toilet	-0.047930	1.149	-0.054350	-1.518
Non-iodized salt	-0.11935	-0.961	0.0084689***	1.699
Tile as floor material	-0.0074865**	-2.140	-0.033993***	-1.707
Electricity	-0.004847**	-2.259	-0.021274***	-1.769
Radio	-0.010301	-0.728	-0.024386***	-1.872
Television	-0.063910**	-2.239	-0.022884*	-2.791
Refrigerator	0.0062582	0.177	-0.003983	-0.125-

* - statistically significant at 1 percent level
** - statistically significant at 5 percent level
*** - statistically significant at 10 percent level

Gambia. Children whose fathers were at home have significantly lower probability of underweight.

Children from homes where there is access to pipe (safe) water have significantly lower probability of underweight. Also, children from homes where there is access to sanitary toilet have significantly lower probability of underweight. Consumption of non-iodized salt significantly increases the probability of underweight in Niger. The parameters of flooring material show that those children from houses where tiles are the floor material have significantly lower probability of underweight. Presence of electricity at home significantly reduces the probability of underweight. Presence of radio significantly reduces the probability of underweight. Children from households where television is present also have significantly lower probability of underweight. This could result from benefits derived from nutrition related programs and expected affluence/high income of those using the asset. The parameters of presence of refrigerators have no significant effect on the probability of underweight.

4. Policy Recommendations

This study presents an analysis of the state of malnutrition and mortality among children in Gambia and Niger. The policy issues emanating from the study are hereby discussed:

First, the study shows that stunting is a major problem among the children. Therefore, efforts to address malnutrition must be consistently pursued until substantial results are achieved. A situation where there is no continuity in child welfare programs will not be to the advantage of the intended beneficiaries. This implies that institutional arrangement must be put in place for ensuring sustainability of child health programs so that chronic growth disturbances that ultimately manifest in stunting will be addressed. However, special attention must be channeled towards assisting children in Niger (where wasting and underweight are higher) given their present food crises.

Second, the analyses reveal that malnutrition health outcomes worst affect rural areas. The divides in infrastructure and institutional services between urban and rural areas must have accounted for this. Therefore, improvement in rural health services will foster prompt clinic attendance and reduce child mortality. In addition, efforts must be channeled towards empowering rural people for increased income generation so malnutrition can be reduced. Assisting African rural people presumes that the understanding of their risk and vulnerability is well noted. Setting up a kind of conditional cash transfer programs to cater for their health and children education can help.

Third, stunting becomes more prominent as children grow older. The need to implement school feeding program to complement the food provided by the parents can therefore be justified. The needed institution for proper implementation of this program must be set up.

Fourth, education of mothers reduces the health problems of malnutrition. However, this study reveals that attainment of primary education by women may not lead to significant reduction in wasting and underweight, but secondary education will. There is therefore the need to strengthen educational institutions in these countries in order to be able to cater for secondary education of girls, especially those in rural areas. The alternative of adult education can be explored in order to cater for grown up women who might be interested in education.

Fifth, although mixed results were obtained on the effect of food fortification with vitamin A on child health outcomes, a general consensus is that children given vitamin A fortified foods fare better. The need to create awareness about the benefits of vitamin A fortified food cannot be over-emphasized, especially in the rural areas. Companies that are producing some food meant for children must also compulsorily fortify them with vitamin A. This effort will lead to reduction in the incidence of diseases caused by vitamin A deficiency, and chronic and acute growth disturbances will be reduced.

Sixth, the analysis show that breast fed children generally have lower incidence of malnutrition health problems. The need to strengthen health related institutions in order to create awareness and educate women on breast-feeding should be emphasized. This will help some women to discard some cultural views that a lazy woman's baby is the one that sucks breast to satisfaction.

Seventh, this study finds that malnutrition health outcomes are more prominent among children that had suffered from one form of sickness or the other. Specifically, diarrhea presents the most serious threat, by significantly increasing stunting, wasting and underweight among the children. This is followed by fever. There is need to ensure that health institutions strengthen their in-house education of mothers on the causes of these diseases. A major step is to educate them to threat all food items meant for little babies with utmost and strict hygiene. Available water (especially in the rural areas) may not always be clean, but women must cultivate the habit of boiling the water meant for children under-five. Also, ensuring that children are prevented from fever/malaria is a necessary step. This study finds that children that were sleeping under bed nets have lower problems of stunting, wasting and underweight in some countries. This somehow strengthens the fact that private, corporate and public organizations should assist by providing mosquito nets to children, especially those in the rural areas where housing quality may not be too good.

Eight, it was found that children who obtained some vaccination (BCG, polio, DPT and measles) have significantly lower incidence of malnutrition health outcomes. This results from the concomitant prevention of diseases like polio, diphtheria and tuberculosis. The need therefore arises to strengthen the health institutions in SSA, in order to be able to cope with the financial needs of vaccinating children and pregnant women free of charge. Appropriate institutional arrangements for taking these services to the rural areas must also be considered. SSA countries must allocate sufficient funds for organizing "national immunization days". When international supports are given, financial propriety must be ensured in order to achieve good results and ensure continuity.

Ninth, the analysis for some countries revealed that children whose parents were alive and at home are nutritionally better that those who might have lost their parents or staying with guardians. This finding presupposes that setting up appropriate institutions to address issues like HIV/AIDS, malaria, tuberculosis, accidents etc. that often lead to untimely death of parents is a way of addressing malnutrition among the children.

Tenth, the findings show that access to potable water is a *sine qua non* for enhancing the nutritional status of under-five children in SSA. There is therefore need to resuscitate water management schemes and their institutions to be able to cope with the water needs of the rural and urban people. These will lead to drastic reduction in the incidence of such diseases as guinea worm, schitosomiasis, cholera and diarrhea.

Eleventh, proper sanitary condition is a prerequisite for healthy living. This study captures this with inclusion of sanitary toilet and floor variables, which significantly reduce malnutrition health outcomes in some SSA countries. The onus therefore rests on sanitary officers to ensure that every household has a sanitary toilet for appropriate disposal of children and adult stools.

Twelfth and finally, improved living condition with access to electricity, radio and television was found to significantly reduce malnutrition. This vividly underscores the important role of media institutions in improving the nutrition conditions of children in SSA. Radio and television programs on child care and nutrition requirements of children should be sponsored and promoted.

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