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Assessing the Factors Affecting Malnutrition in Northern Ghana

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Abstract

Malnutrition is a matter of public concern worldwide, and remains the greatest challenge in Sub-Saharan Africa. The literature shows that, malnutrition is one of the major causes of childhood deaths and developmental problems around the globe. This study analyzed the factors affecting stunting and wasting in children 0-59 month's old in Northern Ghana using secondary data from Feed the Future Northern Ghana survey data. The study found that the prevalence rate of stunting was 37.14%, 35.79%, and 25.11% for the Northern, Upper East and Upper West regions respectively, while the prevalence of wasting was found to be 11.11%, 11.24%, and 7.31% for these regions. The study also found that the age of child, household total expenditure, region, age of the head of household and household access to safe drinking water were found to be significantly associated with both stunting and wasting. Furthermore, the gender of child, and household location in an urban area, were also found to be significantly associated with only stunting while household access to productive capital was also found to be significantly associated with only wasting. In conclusion, these factors identified should be taken into account when designing interventions on malnutrition in Northern Ghana.

Keywords: Malnutrition; Growth; Underweight; Food

Introduction

Malnutrition remains the greatest challenge in most developing countries particularly Sub-Saharan Africa (SSA) with children being the most vulnerable. This problem is the cause of about half of all childhood deaths worldwide [1]. Among the 6.9 million children who died by age five in 2011 due to malnutrition, almost half lived in SSA [2]. Malnutrition in children results in growth impairment and affects their life when they become adults [3,4]. Furthermore, children tend to suffer from intellectual impairment, and increased mortality and morbidity when they are malnourished [5,6].

Ghana, a country in SSA, has made remarkable malnutrition gains in the past few years. Furthermore, Ghana is among few other SSA countries that achieved their Millennium Development Goals (MDGs) targets on stunting, wasting, and underweight in 2015 [7]. However, the country is yet to achieve its goal of bridging the nutritional and socioeconomic gaps between the Northern and Southern parts of Ghana.

Specifically, malnutrition in children continues to be a major challenge in the Northern, Upper East, and Upper West regions of Ghana. It is estimated that children between the ages of 0-59 months in these three regions, had 18.4% of them being underweight, 11% suffered from wasting, and 36.1% were stunted, as of 2012 [8] compared to 11% underweight, 19% stunting, 5% wasting respectively at the National level [9]. Furthermore, the 2016 UN Global Nutrition report indicated that Ghana loses $2.6 billion annually due to poor nutrition in children.

Northern Ghana also lag behind the rest of the country in every aspect of development. For instance, 5% of Ghana's population is considered food insecure[10], yet the proportion of the households living in the three Northern regions who are food insecure is estimated to be 59% with 15% of this population located in the Upper East region, followed by 34% in the Upper West region and 10% in the Northern region [10]. Similarly, while poverty in Ghana declined substantially from 56.5% to 24.2% between 1992 and 2013, poverty continue to be highest in the three regions [4].

With persistent and chronic child malnutrition prevalence in the three Northern regions, there is a need to confirm whether or not the known factors of malnutrition and their interrelationship hold for northern Ghana. We further ascertain whether or not northern Ghana has peculiar dimension of factors affecting child malnutrition.

Methodology

Study population: We used the baseline data from the Feed the Future initiative which was collected in 2012. "The Feed the Future (FTF) initiative aims to help developing countries address root causes of hunger and poverty specific to their individual and unique circumstances through the transformation of agricultural production and improvement in health and nutrition"[8] . The FTF initiative is based in 20 focus countries including Ghana. And the USAID missions in these focus countries play a leading role in the implementation of the initiative. As a result of the stark differences observed over the years between the northern and southern regions of Ghana, the principal FTF intervention activities are being focused in the northern part of the country.

In order to ascertain the impact of interventions targeted within the zone of intervention, the data was collected to establish a baseline of the principal indicators that will be used to measure progress towards the project results. The data were collected using a two-stage probability sampling approach. In the first stage, enumeration areas (EAs) were selected based on the 2010 Ghana Census using the probability proportional to size (PPS) method. In the second stage, a systematic sampling approach was used to select households in each

sampled EA. Then twenty households were drawn from each of the 230 EA within the ZOI by the Ghana Statistical Service (GSS). A comprehensive listings of households with location and name of household head in the selected EAs was prepared by METSS and GSS to overcome the absence of an existing list with location and household head name. A systematic sampling approach was applied on the comprehensive list of households and household head names to draw the household sample in the second stage.

The survey instrument consisted of eleven modules designed to capture the necessary information. The modules and their questionnaires were provided by the Bureau of Food Security of the government of Ghana. Questions were modified to reflect local contexts in a number of areas including, relevant crops and locally available foods, and the use of local examples to enhance clarity of the questions.

The FTF survey combines interviews and measurements of children and women. The respondents were interviewed for the information of age, race/ethnicity, education level, marital status, family expenditure, household food consumption, household hunger scale among others. A complete description of data-collection procedures and analytic guidelines has been provided in the baseline feed the future indicators for Ghana report [8].

Malnutrition assessments

In this study, two indicators of malnutrition among children developed by the World Health Organization (WHO) were used: stunting (age-for-height) and wasting (weight-for-height). These two were chosen because stunting gives an indication of long-term effects of malnutrition, and wasting is a short-term effect of malnutrition in children. As such, this analysis could provide a guide for designing short-term and long-term interventions to address malnutrition. These interventions can also address the underweight problem, since underweight is a reflection of a combination of both wasting and stunting over time.

Data quality control

To ensure data security and maintain continuous assessment of data quality, a number of data assembling protocols were developed. Data collected by enumerators were consolidated on a daily basis by their supervisors, who used the consolidation process to inspect the data for errors. The supervisors, then, transmitted the data to the database systems at ISSER, METSS and Kansas State University to ensure a continuous quality monitoring. This process also provided storage of the data at the end of each day in four places: the supervisor's computer; ISSER; METSS; and Kansas State University. Close contact was maintained between the field enumerators and the METSS office in Accra and its researchers in the US, which enabled enumerators and their supervisors to get real time feedback that also improved data quality and created the possibility of identifying and addressing emerging challenges quickly.

Empirical model and analysis

Data was analyzed using two software programs namely, Stata V14 and WHO Anthroplus V3.2.2. The Anthroplus V3.2.2 was used to calculate the Z-scores based on the internationally defined cut-off points for age-for-height (HAZ SD-6 to SD +6) and weight-for-height (WHZ SD-5 to SD+5). These Z-scores were recorded in Stata into three levels of malnutrition with children whose HAZ and WHZ are below >-3SD<-2SD and <-3SD respectively, from the median of WHO reference population [11-13] as moderate and severe stunting or wasting, respectively. Children with HAZ>-2SD and WHZ≤-2SD from the median WHO reference population were considered to be normal. A child with WHZ>2SD ≤ 3SD is overweight and WHZ >3SD is said to be obese.

The proportional odds model of the generalized logistic regression was used in the empirical analysis. An ordered logit was first specified to determine the effects of socioeconomic, demographic and environmental factors affecting children malnutrition in northern Ghana. The ordered logit however, failed the proportional odds assumption on the data. In order to address this problem, the partial proportional odds model of a generalized ordered logit was analyzed and estimated by a generalized ordered logit (GOL). GOL relaxes the proportional odds assumption and allows the effects of covariates to vary with the point at which the categories of the dependent variables are dichotomized [14].

Before the econometric estimations, data was assessed for basic statistical assumptions. First, the variance inflation factor (VIF) procedure was used to test the presence of multicollinearity. All variables used in the regression had a VIF less than 10 and were therefore considered not to suffer from severe multi-collinearity. Second, the standard errors of the model coefficients were also estimated using robust standard errors to minimize potential heteroscedasticity. Lastly, outliers were deleted using WHO [15] internationally defined cut-off points for height-for-age (HAZ SD-6 to SD +6) and weight-for-height (WHZ SD-5 to SD+5), 640 outliers that could distort the estimation were dropped from the anthropometry data set. For stunting, 246 outliers were identified and dropped while 394 were dropped for wasting. Based on the review of literature and the FTF data set, the variables outlined in Table 1 were used for the analysis.

Variable	Frequency	Percent
Marital Status of Household head		
Not married/divorced/separated	163	6.65
Married	2,289	93.35
Gender of child		
Female	1,206	49.18
Male	1,246	50.82

Gender of head of household		
Female	275	275
Male	2,177	88.78
Education of head of household		
Cannot read and write in English/local language	2,086	85.07
Can read and write in English/local language	366	14.93
Never attended school	1,316	1,316
Have ever attended school	485	485
Urban–rural		
Lives in a rural area	1,990	81.16
Lives in an urban area	462	18.84
Access to productive capital		
Do not have access to farmlands and livestock	596	596
Have access to farmlands and livestock	1,856	1,856
Household access to a toilet facility		
Do not have access to toilet facility	2,032	82.97
Have access to toilet facility	417	17.03
Do not have access to safe water	778	31.73
Have access to safe water	1,674	68
Access to credit		
Do not have access to credit	1,570	64.24
Have access to credit	874	35.76
Region of residence		
Northern region	1,840	75.04
Upper East region	381	15.54
Upper West Region	231	9.42
Age of child in months categories		
<6	272	11.09
6-11	218	8.89
12-17	277	11.3
18-23	147	6
24-35	412	16.8
36-47	614	25.01
48-59	512	20.88
Age of head of household in years categories		
18-24	240	9.79

25-54	1,801	73.45
55-64	231	231
=>65	180	7.34
Household annual total expenditure in Ghana Cedis (Ghc)		
Household annual expenditure =< 792.05Ghc (classified as extreme poverty used as reference group)	709	28.92
Household annual expenditure > 792.05Ghc but <=1,314Ghc (classified as absolute poverty)	570	23.25
Household annual expenditure > 1,314Ghc (classified as not poor	1,173	47.84
Household food decision making		
Joint decision by husband and wife/other household members	996	40.62
Decision made by main male/husband	897	36.58
Decision made by main female/wife	452	18.43
Decision by someone living outside the household	39	1.59
Household does not engage in any form of decision making	49	2
I GHc=$0.52 as of December 31, 2012		

Table 1: Demographic and Socio-Economic Characteristics of Households with Children.

Results

Demographic and socio-economic characteristics

Demographic and socio-economic characteristics of respondents are summarized in Table 1.The majority of respondents resided in the Northern Region (75%). Based on age categories, 25% of the children fell in the 36-47 months age group and the 18-23 months age category recorded the lowest percentage of 6%. Also, 53% of the respondents were found to be in the extreme and or absolute poverty group.

The results of the econometric analysis for stunting and wasting are presented in Tables 2 and 3. Overall, the models were significant at 1% with stunting model recording a Chi-square of 153.97 (df=38) and p-value=0.000 and wasting recording a Chi-square value of 92.19 df=31 and p-value=0.000. The score test for the proportional test assumption (i.e. the assumption that the relationship between each pair of outcome groups is the same) was insignificant at 5% in both models with a Chi-square of 11.14 and with p-value of 0.89 for stunting and wasting recorded Chi-square of 17.37, df=25 and a p-value of 0.87. Thus, we concluded that the coefficients are more reliable.

	Non- stunted versus moderately stunted and severely stunted			**Non-stunted and moderately stunted versus severely stunted**		
Co-variate	COR 95% CI	AOR 95% CI	P-value	COR 95%CI	AOR 95% CI	P-value
Sex of child	0.233 (0.59-0.407)	1.263 (1.061-1.503)	0.008***	0.23 (0.06-0.41)	1.263 (1.061-1.503)	0.008***
Child age in months						
6-11	0.26 (-0.22-0.74)	1.30 (0.80-2.10)	0.29	0.26 (-0.22-0.74)	1.30 (0.80-2.10)	0.29
12-17	0.69 (0.25-1.13)	1.98 (1.28-3.08)	0.002***	0.37 (-0.15-0.88)	1.44 (0.86-2.41)	0.161
18-23	1.38 (0.90-1.86)	3.97 (2.45-6.42)	0.000***	0.84 (0.30-1.39)	2.33 (1.35-4.02)	0.002***
24-35	1.01 (0.62-1.41)	2.76 (1.85-4.10)	0.000***	0.72 (0.27-1.17)	2.06 (1.32-3.21)	0.002***
36-47	1.25 (0.87-1.63)	3.49 (2.39-5.09)	0.000***	0.76 (0.34-1.19)	2.15 (1.41-3.28)	0.000***
48-59	1.08 (0.70-1.47)	2.95(2.01-4.35)	0.000***	0.69 (0.25-1.13)	1.99 (1.29-3.08)	0.002***
<6	Reference group					
Household size	-0.01 (-0.03-0.02)	0.99 (0.97-1.02)	0.675	0.17 (-0.01-0.05)	1.02 (0.99-1.05)	0.26
Annual household expenditure in Ghana Cedis						

Expenditure >792.05-1314	-0.22 (-0.03-0.47)	1.25 (0.97-1.60)	0.081	-0.00 (-0.30-0.29)	0.99 (0.74-1.33)	0.979
Expenditure > 1,314	0.12 (-0.10-0.34)	1.13 (0.90-1.40)	0.298	-0.26 (-0.53- -0.01)	0.77 (0.59-1.01)	0.055*
Expenditure <792.05	Reference group					
Household food decision making						
Joint decision by husband and wife/other household members	-0.27 (-0.86-0.33)	0.77 (0.42-1.39)	0.377	-0.27 (-0.86-0.33)	0.77 (0.42-1.39)	0.377
Decision made by main male/husband	-0.27 (-0.87-0.33)	0.76 (0.42-1.39)	0.373	-0.27 (-0.87-0.33)	0.76 (0.42-1.39)	0.373
Decision made by someone outside the household	-0.31 (-0.92-0.33)	0.73 (0.40-1.34)	0.313	-0.31(-0.92-0.30)	0.73 (0.40-1.34)	0.313
Decision made by someone outside the household	-0.67(-1.55-0.21)	0.51 (0.21-1.23)	0.134	-0.67 (-1.55-0.21)	0.51(0.21-1.23)	0.134
Do not engage in any decision making	Reference group					
Age of head of household in years						
18-24	0.18 (-0.29-0.65)	1.20 (0.75-1.91)	0.453	0.18 (-0.29-0.65)	1.20 (0.75-1.91)	0.453
26-54	0.41 (0.04-0.78)	1.51 (1.04-2.18)	0.031**	0.20 (-0.20-0.59)	1.22 (0.82-1.81)	0.323
55-64	0.20 (-0.25-0.64)	1.22 (0.78-1.90)	0.389	0.20 (-0.25-0.64)	1.22 (0.78-1.90)	0.389
=>65	Reference group					
Resident in urban area	-0.31(-0.54--0.07)	0.74 (0.58-0.93)	0.010**	-0.31 (-0.54- -0.07)	0.77 (0.58-0.93)	0.010**
Marital status of head of household	-0.15 (-0.52-0.22)	0.86 (0.59-1.25)	0.424	-0.15(-0.52-0.22)	0.86 (0.59-1.25)	0.424
Head of household can write and write	-0.03 (-0.31-0.26)	0.97 (0.73-1.30)	0.852	-0.03 (-0.32- 0.26)	0.97 (0.73-1.30)	0.852
Head of household have ever attended school	-0.06 (-0.33-0.20)	0.94 (0.72-1.23)	0.641	-0.06 (-0.33-0.20)	0.94 (0.72-1.23)	0.641
Household have access to credit	0.09 (-0.10-0.27)	1.09 (0.91-1.31)	0.358	0.09 (-0.10-0.27)	1.09 (0.91-1.31)	0.358
Region of residence						
Household in Northern Region	0.71 (0.39-1.03)	2.04 (1.48-2.81)	0.000***	0.71 (0.39-1.04)	0.71 (0.39-1.04)	0.000***
Household in Upper East Region	0.61 (0.24-0.97)	1.83 (1.27-2.65)	0.001***	0.61 (0.24-0.97)	1.83 (1.27-2.65)	0.001***
Upper West Region	Reference group					
Household have access to safe water	-0.20 (-0.41-0.00)	0.82 (0.66-1.00)	0.052**	-0.20 (-0.41- 0.00)	0.82 (0.66-1.00)	0.052**
Household have access to a toilet facility	-0.21 (-0.47- 0.05)	0.81 (0.63-1.05)	0.111	0.06 (-0.24-0.37)	1.07 (0.79-1.45)	0.6679
Household head is male	0.05 (-0.25-0.35)	1.05 (0.78-1.42)	0.751	0.05 (-0.25-0.35)	1.05 (0.78-1.42)	0.751
Household have access to productive capital	-0.09 (-0.30-0.12)	0.91 (0.74-1.12)	0.385	0.385	0.91 (0.74-1.12)	0.385

Intercept	-2.02 (-2.91- -1.12)	0.13 (0.05-0.33)	0.000***	-2.398 (-3.318- -1.477)	0.09 (0.04-0.23)	0.000***
Score test for the proportional odds assumption: Chi-square= 11.14, df =18 , p-value = 0.888						
Goodness-of-fit test of overall model (Likelihood Ratio): Chi-square= 153.97 , df=38, p-value =0.000 , Pseudo R-square=0.037						
*, **, ***- significant at 10%, 5%, 1% respectively						

Table 2: Generalized logit results stunting.

	Not stunted versus moderately wasted and severely wasted			Not wasted and moderately wasted versus severely wasted		
Covariate	COR 95% CI	AOR 95% CI	P>z	COR 95% CI	AOR 95% CI	P>z
Sex of child	-0.013 (-0.292-0.2667)	0.987(0.747-1.306)	0.929	-0.01 (-0.29-0.27)	0.987 (0..747-1.306)	0.929
Child age in months						
6-11	0.13 (-0.40-0.67)	1.89 (1.13-3.18)	0.015**	0.64 (0.12-1.16)	1.89 (1.13-3.18)	0.015***
12-17	0.13 (-0.40-0.67)	1.14 (0.67-1.95)	0.62	0.13 (-0.40-0.67)	1.14 (0.67-1.95)	0.62
18-23	0.00 (-0.62-0.63)	1.00 (0.54-1.87)	0.995	-0.00 (-0.62-0.63)	1.00 (0.53-1.87)	0.995
24-35	-0.42 (-0.94-0.10)	0.66 (0.39-1.10)	0.113	-0.42 (-0.94- -0.10)	0.66 (0.39-1.10)	0.113
36-47	-0.63 (-1.14- -0.12)	0.53 (0.32-0.89)	0.016**	-0.63 (-1.14- -0.12)	0.53 (0.31-0.89)	0.016**
48-59	-0.87 (-1.42--0.33)	0.42 (0.24-0.72)	0.002***	-0.87 (-1.42- -0.33)	0.42 (0.24-0.72)	0.002***
<6	Reference group					
Household size	-0.01 (-0.05-0.03)	0.99 (0.95-1.03)	0.626	-0.01 (-0.05-0.03)	0.99 (0.95-1.03)	0.626
Annual household expenditure in Ghana Cedis						
Expenditure >792.05-1314	-0.22 (-0.64-0.20)	0.80 (0.53-1.22)	0.296	-0.22 (-0.64-0.20)	0.80 (0.53-1.22)	0.296
Expenditure >1,314	-0.29 (0.05-0.62)	1.33 (0.96-1.86)	0.090*	-0.29 (-0.05-0.62)	0.80 (0.96-1.86)	0.090*
Expenditure <792.05	Reference group					
Household food decision making						
Joint decision by husband and wife/ other household members	-0.19 (-1.04-0.67)	0.83 (0.35-1.95)	0.668	-0.19 (-1.04-0.67)	0.83 (0.35-1.95)	0.668
Decision made by main male/husband	-0.27 (-1.13-0.58)	0.76 (0.33-1.79)	0.534	-0.27 (-1.13-0.58)	0.76 (0.33-1.79)	0.534
Decision made by main female/wife	-0.12 (-1.00-0.76)	0.884 (0.37-2.13)	0.784	-0.12 (-1.00-0.76)	0.88 (0.37-2.13)	0.784
Decision made by someone outside the household	0.094 (-1.17-1.36)	1.10 (0.31-3.89)	0.884	0.09 (-1.17-1.36)	1.10 (0.31-3.89)	0.884
Do not engage in any decision making	Reference group					
Age of head of household in years						
18-24	0.73 (0.01-1.47)	2.07 (0.99-4.33)	0.053*	0.73 (-0.01-1.47)	2.07 (0.99-4.33)	0.053*
25-54	0.35 (-0.27-0.98)	1.43 (0.76-2.67)	0.269	0.35 (-0.27-0.98)	1.43 (0.76-2.67)	0.269
55-64	0.34 (-0.42-1.09)	1.40 (0.66-2.67)	0.381	0.96 (0.13-1.78)	2.61 (1.14-5.95)	0.023**
=>65	Reference group					

Resident in urban area	0.03 (-0.34-0.40)	1.03 (0.71-1.49)	0.865	0.03 (-0.34-0.40)	1.03 (0.72-1.49)	0.865
Marital status of head of household	0.16 (-0.46-0.79)	1. 177 (0.63-2.19)	0.608	0.163 (-0.46-0.78)	1.18 (0.63-2.19)	0.608
Head of household can read and write	-0.21 (-0.71-0.29)	0.74 (0.49-1.34)	0.41	-0.21 (-0.71-0.29)	0.81 (0.49-1.34)	0.41
Head of household have ever attended school	0.01 (-0.42-0.44)	1.01 (0.66-1.56)	0.966	0.01 (-0.42-0.44)	1.01 (0.66-1.56)	0.966
Household have access to credit	-0.17 (-0.46-0.13)	0.847 (0.63-1.13)	0.966	-0.17(-0.46- -0.13)	0.85 (0.63-1.13)	0.264
Region of residence						
Household in Northern region	0.71 (0.14-1.28)	2.03 (1.15-3.59)	0.015**	1.29 (0.63-1.95)	3.64 (1.89-7.03)	0.000***
Household in Upper East region	0.42 (-0.22-1.06)	1.52 (0.80-2.88)	0.015**	0.42 (-0.22-1.06)	1.52 (0.80-2.88)	0.000***
Upper West region	Reference group					
Household have access to safe water	-0.45 (-0.78- -0.13)	0.64 (0.46-0.88)	0.006**	-0.82 (-1.25- -0.40)	0.44 (0.29-0.67)	0.000***
Household have access to toilet facility	0.01 (-0.37-0.39)	1.01 (0.69-1.47)	0.975	-0.06 (-0.37-0.39)	0.44 (0.69-1.47)	0.975
Head of household is male	0.34 (-0.18-0.86)	1.40 (0.84-2.36)	0.201	0.34 (0.18-0.86)	1.40 (0.84-2.36)	0.201
Household have access to productive capital	-0.28 (-0.59- -0.04)	0.76 (0.55-1.04)	0.087*	-0.28 (-0.59- 0.04)	0.76 (0.55-1.04)	0.087*
Intercept	-2.54 (-3.86- -1.22)	0.08 (0.02-0.30)	0.000***	-3.71(-5.03- -2.38)	0.03 (0.01-0.09)	0.000***
Score test for the proportional odds assumption: Chi-square= 17.37, df =25 , p-value = 0.868						
Goodness-of-fit test of overall model (Likelihood Ratio): Chi-square= 92.19, df=31, p-value =0.000 , Pseudo R-square=0.052						
*,**,***-significant at 10%, 5% , and 1% respectively						

Table 3: Generalized logit results wasting.

Among all the covariates considered to examine the effects of each covariate in the models the age of child, household annual total expenditure in Ghc., age head of household, region of residence, and household access to safe water were found to be significant determinants of stunting and wasting among children at the 1%, 5% and 10% significant levels respectively. In addition to these covariates, gender of child and resident in an urban area were found to be significant determinants of stunting while household access to productive capital were found to be significantly associated with wasting in children.

The results showed that boys had a higher probability of being stunted than girls (p-value<0.005). The probability of a children being moderately and severely stunted among children in all the age categories except the 6-11 age group whilst the probability of a child being moderately and severely wasted among children within the age group of 36-47 and 48-59 months significantly (p-value=0.05) decreases. On the other hand, moderate and severe wasting among children within the 6-11 months age group were found to increase (p-value=0.05) when compared to the reference group (<6months).

The probability of moderate and severe stunting and wasting among children were also found to decrease with increasing household expenditures (p-value=0.1). Furthermore, the probability of moderate stunting significantly (p-value=0.05) increased among children in households headed by heads aged within the 26-54 age category, and the probability of moderate and severe wasting increases among children living in households headed by heads within the 18-24 age group compared to the reference group (=>65). Region of residence was also found to be significantly (p-value=0.05) associated with stunting and wasting. Children living in households located in the Northern and Upper East regions were found to be at higher risk of being moderately and severely stunted and wasted compared to the reference group (Upper West Region). Household access to safe water was also found to significantly (p-value=0.05) reduce the risks of being severely and moderately stunted and wasted among children.

Discussion

This study evaluated the factors that influenced stunting and wasting in Northern Ghana. The results obtained indicated that child malnutrition is affected by child characteristics (e.g. age of child, gender of child), household socioeconomic factors (e.g. household access to productive capita, household expenditure) and environmental factors (e.g. household access to toilet facilities and potable water). Directions of the correlation of most of the significant co-variates agreed with a priori expectations and findings from other studies in the literature.

Consistent with a priori expectations and findings of previous research [17-19], this study found that boys were more prone to stunting than girls. The possible justification of this evidence for stunting could be because girls are considered to be genetically more robust than boys [20]. Also, the difference may be linked to the fact that girls have more access to food because of the food preparation roles society ascribed to them. As such, at that early age they may be with their mothers in the kitchen and hence may get some food to eat before the family gathers to eat. It may also be due to the different energy requirements for boys and girls [21]. These results shows that

boys are more vulnerable to stunting than their female counterparts in the same age group. This disparity should be taken into account when formulating nutritional policies. Alternatively, the gender of the child was not significantly associated with wasting. These results were inconsistent with the findings in other studies [22-24] but consistent with the FTF baseline survey report findings [8] and, Ghana Demographic Health Survey [25]. Children who were in the <6 months and 6-11 months age groups were more at risk to wasting compared to older children. This age group coincides with the introduction of complementary feeding to children and is usually linked to increased incidence of diarrheal diseases from food contamination [23]. The higher odds of severe and moderate wasting among children 0-11 months old implies that interventions designed to tackle the problem of wasting would most effectively be targeted at children in this age group.

Higher levels of stunting were found in the Northern region, followed by the Upper East region when compared to the Upper West region. Wasting was also a more common phenomenon in the Northern regions compared to the other two regions. These results conformed to the findings of national data from the Demographic and Health survey [25] and [17] as well as the baseline report of FTF [8]. These differences could be attributed to cultural differences in these regions regarding practices towards child feeding. In addition, stunting was found to be higher among children in rural communities when compared to their urban counterparts. These results were also consistent with a priori expectations as well as findings from previous research [26]. Urban households have easier access to different kinds of food, nutrition, and health information, which may affect their decisions on nutrition and may be the explanation for these differences. The implication of these results is that since children in northern region were more likely to be stunted than children from other regions, cultural differences in these regions as well as the location of households (rural/urban) should be considered when designing interventions to address stunting in Northern Ghana.

Head of household age was shown to have significant association with stunting and wasting. Children living particularly in households with household head aged in the 25-54 years were more likely to be stunted while children living in households headed by heads of household in the 18-24 years category were more likely to be wasted. However, stunting and wasting decreased among children living in households within the 55-64. A possible explanation for this could be that, within this age group (18-24 and 25-54 years), heads of household are mostly engaged in external activities in order to generate income. This implies that for households headed by women who spent most part of their time on other activities, time for child care and feeding may be left in the hands of other caregivers who may not take good care of the kids. In addition, Household heads within 55-64 years may have had experience in taking care of.

Family annual total expenditure were significantly associated with child stunting and wasting of under-fives. Children in the poorest households with expenditure <=792.05 were at a greater risk of stunting. These results were consistent with the findings of [27-30]. Low household expenditure may affect household access to food. Poor access to food together may exacerbate the poor nutritional status of children. Therefore, designing policies with alternative livelihoods to increase household income will be in the right direction to addressing stunting.

The coefficients associated with access to safe water were also found to be significantly associated with stunting and wasting. These results are in agreement with a priori expectations and findings from other researchers in Ethiopia and Lao respectively [20,31]. Households with access to safe water may have health and hygiene benefits (e.g. clean drinking water and clean water for cooking) that are associated with having access to clean, safe water. By implication, policies designed to address nutritional problems should be geared at improving household's access to safe water.

Lastly, household access to productive capita was found to significantly decrease the chance of child wasting. Access to productive capital provides a greater opportunity to access food, which could be an explanation for this association. This results are similar to those obtained by [32-35].

Strengths and limitations of the study

Household expenditure was used as a measure of income which is a comparative improvement compared to earlier research which used proxies (e.g. principal component indexes) as a measure of income [6], which may not be a true representation of household income. By comparison, expenditure measures are more reliable and easier to collect than income, especially in rural settings [36].

Compared to other studies, this study used an ordinal logistic model to identify and analyze determinants of stunting and wasting in Ghana, instead of the traditional logistic regression model.

The study is, however, limited by the following: the covariates considered for this analysis do not represent an exhaustive list of the factors affecting malnutrition such as: birth interval weight at birth, breastfeeding, and mother's characteristics.

Summary, Conclusions and Recommendations

This study sought to confirm whether or not the known factors of malnutrition and their interrelationship hold for northern Ghana as well as ascertain if northern Ghana has a peculiar dimension of factors affecting stunting and wasting among children in 0-59 month's age group in Northern Ghana using data from FTF. The main findings from the study were that the age of child, household total expenditure, region in which household was located, age of the head of household and household access to safe drinking water were found to be significantly associated with both stunting and wasting. In addition to these, the gender of a child, and whether household was located in an urban area, were also found to be significantly associated with only stunting while household access to productive capital was also found to be significantly associated with only wasting.

Based on the findings of this research, the following recommendations are made:

- Attention should be given to male child feeding, particularly meeting their energy requirements as outlined in WHO guidelines.
- Policy makers must pay attention to improving environmental health through the provision of safe water and toilet facilities particularly for rural communities. In the short-term, households should be educated and provided with necessary skills and chemicals to treat unsafe water before usage.
- Policies and programs aimed at improving household income should be promoted (eg. "The Ghana Poverty Reduction Strategy").
- Policies geared at solving nutritional problems should be focused in the Northern region since this region records the highest

number of wasted and stunted children. The current efforts by the government of Ghana and other donor partners to reduce malnutrition in Northern Ghana and particularly the Northern region is in the right direction and should be continued and maintained.

- This study did not evaluate all the factors affecting child malnutrition due to lack of data. Therefore, further research needs to be conducted to explore the influence of other factors on wasting and stunting, which were not considered in this study.

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