Factors Contributing to Positive Deviance in the Growth of Children in Rural Northern Ghana

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Abstract: *Objective*: The main aim of the study was to identify factors contributing to positive deviance in growth of children in rural communities of Northern Ghana.

Methods: We assessed factors contributing to nutritional positive deviance among rural poor households by comparing household feeding care practices and health seeking behaviour in families with normal children (that is, neither stunted nor wasted) with children having at least one form of under nutrition.

Results: The prevalence of stunting and wasting was 28.0 % (CI: 25.3 - 30.9), and 10.5 % (CI: 9.0 - 12.3) respectively. Multivariable logistic regression adjusted for cluster sampling showed that positive deviant children (that is, neither wasted nor stunted) were 2.4 times more likely to have taller (≥160 cm) mothers [AOR 2.38; 95% CI (1.83 - 3.10)]. Female children were significantly more likely to be positive deviant [AOR 1.44; 95% CI (1.17 - 1.77)]. Households using salt of adequate iodine content were more likely to have positive deviant children [AOR 1.36; 95% CI (1.03 - 1.80)].

Conclusion and Recommendation: Positive deviance in child growth was characterized by taller mothers, being a female child, high maternal nutrition knowledge and being resident in the Upper West Region. The persistent high levels of child under nutrition in Northern Ghana can be mediated through a sustainable focused intervention strategy to improve maternal nutrition.

Keywords: IYCF practices, nutritional status, positive deviance, maternal height, Northern Ghana.

INTRODUCTION

Background

In spite of efforts at reducing malnutrition in Northern Ghana, it has remained unacceptably high in many communities. A number of interventions have been implemented by the government with assistance from international organizations including World Food Programme (WFP) but with little progress. The situation calls for better and improved ways of dealing with the problem.

It has been reported that children having similar living conditions such as disposable income and resource access grow adequately, while others fail to do so in the same households [1-3]. Though household income contributes positively to child nutrition outcomes, a large part of the variance can be attributed to differences in child care practices. There are therefore many instances where children in very poor households do grow best while others in even families with the best socioeconomic status struggle to grow. This suggests that there must be some hidden factors and/or practices that could be yielding these positive as well as negative results. Many experts believe that this phenomenon can be explained by what is being referred to as “nutritional positive deviance”. The term “positive deviance” in nutrition has been used to identify children who 'grow and develop well in impoverished environments where majority of children are victims of malnutrition and chronic illness, whereas, negative deviants grow at the lower end of the growth spectrum and median growers grow at or around the median of the growth spectrum [4].

A lot can be learnt from positive deviant children providing guidance to design nutrition sensitive programmes in communities to address the problem of malnutrition among children. For example, programmes can be designed to discourage behaviors that are associated with negative deviance, and to promote behaviors that are associated with positive deviance. To do this effectively, we need to have better understanding of the factors that predict positive deviance in child growth. However, there is little systematic investigation on the magnitude and determinants of positive deviance in the growth of children in Northern Ghana. There is therefore the need for more research to be done in this area and hence the need for this study.

Study Objective

The main aim of this analysis was to identify the child-care feeding practices and other factors

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contributing to nutritional positive deviance in deprived rural communities in Northern Ghana.

SUBJECTS AND METHODS

We assessed factors contributing to nutritional positive deviance among rural poor households by comparing household feeding care practices and health seeking behaviour in families with normal children (that is, neither stunted nor wasted) with children having at least one form of under nutrition.

Study Area

The study was conducted in Northern Ghana, where the prevalence of chronic malnutrition among children under five remains persistently high. According to the Ghana Demographic and Health Survey, there is substantial regional variation of malnutrition in Ghana, with some of the poorest indicators found in the Northern part of the country. The estimated prevalence of chronic malnutrition for example, in the Northern Region is 32.4 % compared with a national average of 28 % [5]. A recent UNICEF Multiple Indicator Cluster Survey (MICS) conducted in 2011 showed the prevalence of chronic under-nutrition in Northern Region of Ghana has increased from 32 % in 2008 to 37 % in 2011 [6]. According to the WHO (2000) classification of malnutrition, the malnutrition situation can be described as serious state in the Northern Region.

Survey Design

This paper on positive deviance in child growth is based on re-analysis of data from a community-based cross sectional 30 x 30 cluster follow-up survey carried out in World Food Programme (WFP) targeted Supplementary Feeding Programme (TSFP) communities of Northern Ghana. The TSFP is part of the WFP's country programme which started in 2012. The TSFP was initiated to help reduce chronic malnutrition in children under two years and acute malnutrition in children aged 6-59 months in Northern Ghana. The follow-up survey which was carried out in October 2013 was to provide information on progress made by the TSFP programme with regards nutritional status of children and infant and young child feeding practices of mothers.

Study Population and Sampling

The study population comprised young children (6-59 months) and women of child-bearing age (15-45 years). A minimum required sample size of 900 households per stratum (region) was applied. The sample size for the study was estimated using the two sample formula as follows:

$n = D\ [(Z\alpha+Z\beta)\ ^{2}*(P1\ (1-P1)\ +P2\ (1-P2)/\ (P2-P1)^{2}]$ where:

n= required minimum sample size per survey round or comparison group

D=design effect (assumed in the following equations to be the default value of 2)

P1=the estimated level of chronic malnutrition. (32.0 %) at the time of the baseline survey

P2= the expected level of chronic malnutrition (20.0%) at follow-up survey such that the quantity (P1- P2) is the size of the magnitude of change it is desired to be able to detect (12 % = 0.12).

Zα= the Z – score corresponding to the degree of confidence with which it is desired to be able to conclude that an observed change of size (P2- P1) would not have occurred by chance

Zβ=the Z-score corresponding to the degree of confidence with which it is desired to be certain of detecting a change of size (P2- P1) if one actually occurred(β- statistical power).

Zα and Zβ have "standard" values depending on the reliability desired. These are provided below;

Value of Zα: significance criteria "0.05" (95% confidence level) = 1.960

Value of Zβ: Statistical power 80%, Z power value = 0.842

The estimated sample size for each survey was 225 and so total sample size was thus 450. With a design effect of 2, the sample size worked out to 900.

The first stage of this survey consisted of the random selection of 30 clusters from each of the three geographical regions of Northern Ghana. Clusters were selected with a probability proportional to the size (PPS) of the communities. A total of 2,700 households were involved. Anthropometric assessment was however made on 3,485 children aged 6-59 months in sampled households.

Data Collection

Anthropometric assessment as well as household interviews, using structured questionnaires was undertaken concurrently. During the interview, mothers are asked questions about family demographics, child feeding practices, specific foods consumed by the child, child care practices, healthcare seeking behavior and home management of sick children.

Variables and Measurement Procedures

The independent variables for this study were infant and child feeding practices, parental and household characteristics, child's characteristics, other components of care practices, such as health/ sanitation knowledge and practices. The main outcome variable for this study was child's nutrition deviance status (that is, positive and negative deviants). A brief description of main independent and dependent variables is as follows:

Assessment of Infant and Young Child Feeding (IYCF) Practices

Infant and young child feeding indicators including minimum meal frequency, minimum dietary diversity and minimum acceptable diet were estimated by recall of food and liquid consumption during the previous day of the survey as per WHO/UNICEF guidelines [7].

An adapted version of infant and child-feeding index (ICFI) originally developed by Ruel and Menon [8, 9] included the following dimensions: Current breast-feeding status; dietary diversity in the past 24 hours; adequacy of meal frequency in the past 24 hours prior to the study, score for timely initiation of breast feeding, score for whether or not child was fed with prelacteal food, and score for timely introduction of complementary foods.

The individual dietary diversity score (IDDS) of the children was determined based on 16 food groups over a period of 24 hours as recommended by the FAO [10]. The food groups are cereals, white roots & tubers, vitamin A rich vegetables and tubers, legumes and nuts, milk and milk products, dark green leafy vegetables, flesh meats, organ meat, fish, eggs, Vitamin A-rich fruits, other fruits, other vegetables, oils and fats, Sweets, and spices & condiments. This approach differs from the WHO recommendation of using 7- food groups. However, for the sake of easy comparison, we classified the 16 food items into seven food groups according to the WHO IYCF model.

The dietary diversity score ranges from 0-16 with minimum of 0 if none of the food group is consumed to 16 if all the food groups are consumed. From the dietary diversity score, the minimum dietary diversity indicator was constructed using the WHO recommended cut-off point with a value of "1" if the child had consumed four or more groups of foods and "0" if less.

Minimum meal frequency is the proportion of children who received complementary foods the minimum recommended number of times in 24-hours. For breastfed children, the frequency should be at least 2 times for 6–8 months, and at least 3 times for 9 –23 months of age. For non-breastfed children, it should be at least 4 times in last 24 hours.

Minimum dietary diversity is the proportion of children who ate at least 4 or more varieties of foods from the seven food groups in a 24 hour time period. Minimum acceptable diet is a composite indicator of minimum dietary diversity and minimum meal frequency. When a currently breastfed child meets both the minimum diversity and the minimum meal frequency, the child is considered to have met the WHO recommended minimum acceptable diet.

Assessment of Nutrition Knowledge of Mothers

The nutrition knowledge of mothers was assessed in some aspects of nutrition. The aspects of maternal nutrition knowledge studied included (1) right age for introducing semi-solid foods into a child's diet (2) mother's knowledge of timely initiation of breast feeding, (3) Giving fluids during diarrhoea, (4) Knowledge on how to produce more breast milk (5) Knowledge on duration of breast feeding (6) Knowledge on whether water should be given to a child less than 6 months (7) Knowledge on whether colostrum should be fed to the child (8) Knowledge on whether a child having diarrhoea should be given food. Based on the responses given, a score of 1 was given for each valid answer, with a maximum possible score of 8. For example, giving less fluids or withholding semi-solids food to a child having diarrhoea attracted a score of -1. Giving same amounts as before diarrhoea episode scored zero. Giving more fluids and semi-solids scored 1. A mother's overall nutritional knowledge of recommended child care practices was rated by calculating the total of all the valid responses she made. The overall composite knowledge index therefore ranged from a minimum of -2 to a maximum of 8 and terciles were created. Women who scored below the sample mean score were classified as having low nutritional knowledge and women with a score of at least the sample mean score were classified as having high score. This was necessitated because we needed to meet certain criteria for running some statistical analysis (e.g. chi-square). With more than two categories, we realized we could not satisfy the criteria for chi-square analysis (that is, each cell should contain at least five units).

Determination of Educational Level

Maternal educational level was based on the highest level attained according to the Ghanaian System where primary education consist of six years of formal education, the Junior High School (JHS) is nine years, Senior High School (SHS) is 13 years. This variable was categorized into three: no education, primary or junior secondary, senior secondary education or higher.

Data Analyses Plan

The Emergency Nutrition Assessment (ENA) for SMART software (2010 version) was used for the anthropometric data analysis and reported using WHO 2006 growth reference values with SMART cut-offs.

Data analyses were performed using procedures in SPSS complex samples module, version 18.0 for Windows. Design weights were added to each region (that is, total population divided by number of respondents) to perform weighted analysis. This module of SPSS takes into account the complex nature of the cluster sample design. This was done in order to make statistically valid population inferences and computed standard errors from sample data.

The positive deviance analysis sought to compare the characteristics of “positive deviant” young children with mildly, moderately, or severely malnourished children. In most studies, one growth indicator is often used to define positive or negative nutrition deviance. However, a child who is not stunted may still be wasted or vice versa. Consequently, we defined positive deviant children as having both height - for -age Z-score (HAZ) and height – for weight Z-score (WHZ) ≥-2 (better nutritional status) being compared with the remainder (HAZ) and WHZ <-2 (worse nutritional status).

Before performing the anthropometric calculations for weight-for-height (WH), height-for-age (HA) and weight-for-age (WA), the data was cleaned and outliers removed. Z-scores which were outside the WHO flags: WHZ -5 to 5; HAZ -6 to 6; WAZ -6 to 5 were excluded from the data set. In all, 5 (0.4 %) of the WAZ scores, and 12 (1.0 %) each of WHZ and HAZ outliers were removed from the data set. The SMART methodology recommends that the percentage of outliers should not exceed 2 % of the sample.

Chi-square and t-tests were carried out to test for differences between positive and non-positive deviant children. Differences between the study groups were considered to be statistically significant if the p value was less than 0.05, or if the range for the 95% confidence interval for the odds ratio did not include 1.0. We then used logistic regression with adjustment for clustering in SPSS complex sample to identify independent predictors.

The risk factors that showed statistically significant or close to significant associations in the bivariate analyses were entered into the logistic regression. The logistic regression model incorporated gender of child, child’s age in months, nutrition knowledge of the mother, infant and child feeding index, mother’s height, diarrhoeal infection in the past two weeks prior to the study, and region of residence.

Ethics and Informed Consent

Informed verbal consent was sought through communication with community representatives and on individual household level, with accompanying clarification on purpose and nature of the study. There was also briefing of households selected for questionnaire administration, weight and height measurement. In each household, the survey team supervisor gave a brief orientation to the respondents as to the purpose and intended outcome of the study. He/she read and explained the informed consent statement to the mothers. All mothers approached opted to participate in the survey.

RESULTS

As shown in Table **1**, the mean (standard error) age of children included in the analysis was 25.8 (0.4) months and 50.0 % were male. The prevalence of stunting, wasting and underweight was 28.0 % (CI: 25.3 - 30.9), 10.5 % (CI: 9.0 - 12.3), and 21.6 % (CI: 19.3 - 24.2) respectively. The proportion of children suffering from both chronic and acute malnutrition was 4.2 %.

The mean (standard error) age of the mothers of under-fives was 29.9±0.3 years. Nearly 77.0 % (CI: 72.1 - 80.7) of the mothers had no formal education. The average height for women was 159.7±6.9 cm.

Table 1: Sample Characteristics

Child Characteristics	Sample size (N)	Mean ± s.e	Frequency (%)
% Male			
Mean Age (months)	2623	25.8 ± 0.4	
Age distribution			
6-11 months	2623		15.9 % (CI: 14.2 - 17.8)
12–23 months	2623		33.3 % (CI: 31.1 - 35.5)
24-59 months	2623		50.8 % (CI: 48.0 - 53.6)
HAZ	2572	-1.35±0.04	
WHZ	2561	-0.68±0.03	
Stunted (HAZ < -2)	2573		28.0 % (CI: 25.3 - 30.9)
Wasted (WHZ < -2)	2561		10.5 % (CI: 9.0 - 12.3)
Mid-upper arm circumference < 12.5cm	2616		7.5 % (CI: 6.1 - 9.2)
Had diarrhoea at least once in the past 14 days	2586		25.0 % (CI: 21.6 - 28.8)
Currently breastfeeding	2615		55.9 % (CI: 53.1 - 58.6)
Child fed prelacteals	2613		8.5 % (CI: 6.1 - 9.6)
Child fed colostrums	2621		85.6 % (CI: 79.4 - 90.1)
Maternal Characteristics			
Mean Age	2523	29.9±0.3	
Educational level	2616		
No schooling	2616		76.7 (CI: 72.1 - 80.7)
Low (Primary school and JHS/Middle)	2616		18.7 % (CI: 15.7 - 22.0)
High (at least Secondary school)	2616		4.7 % (CI: 3.2 - 6.8)
Maternal Height			
Height < 150 cm	2482		8 % (CI: 6.1 - 10.6)
Body mass index (BMI)			
Body mass index < 18.5kg/m^2	2465		8.9 % (CI: 7.7 - 10.3)
Normal (18-25) kg/m^2	2465		75.5 % (CI: 72.4 - 78.3)
Overweight >25$^+$ -30 kg/m^2	2465		12 % (CI: 10.3 - 14.0)
Obesity (> 30 kg/m^2	2465		3.6 % (CI: 2.2 - 6.0)

Maternal stature shorter than or equal to 150 cm was 8 % (CI: 6.1 - 10.6), and 8.9 % were underweight.

Of the 2,555 children studied, 65.7 % (CI: 62.9 – 68.4) were classified as positive deviant (PD).

A significantly higher proportion of PD children were younger (6–11 months), compared to children aged 36-47 months. Female children were significantly more likely to be positive deviant compared to boys. The mean maternal height was higher in positive deviant children than mothers of negative deviant children. Households having positive deviant children were more likely to be using iodated salt with adequate iodine content. Positive deviant children were more likely to come from the Upper West region. Mothers of positive deviant children had higher maternal nutritional knowledge. Positive deviant children had higher infant and child feeding index scores, compared to their counterparts who were negative deviants. The other factor that was marginally significant was a lower prevalence of diarrhoea in the past two weeks prior to the study (Table **2**).

Multivariate analysis was performed on the entire sample and on a separate subset composed of households where the mother had no formal education. The results showed that maternal nutrition knowledge was an important predictor of positive deviance in the whole sample but not in sub-group of mothers who had

Table 2a: Bivariate Analysis of Predictors of Positive Nutrition Deviance Among Children Aged 6-59 Months

Characteristic	N	Nutrition Deviance Classification (%)		
		Negative	Positive	Test statistic
Region of residence				
Northern	853	39.0 [CI: 34.7 – 43.5]	61.0 [CI: 56.5 – 65.3]	χ^2 = 36.9, p < 0.001
Upper East	847	29.4 [CI: 26.0 – 33.0]	70.6 [CI: 67.0 – 74.0]	
Upper West	855	25.8 [CI: 22.6 – 29.4]	74.2 [CI: 70.6 – 77.4]	
Age of child (months)				
6-11	359	25.8 [CI: 21.7– 30.5]	74.2 [CI: 69.5 – 78.3]	χ^2 = 21.3, p = 0.008
12-23	813	37.2 [CI: 33.1– 41.5]	62.8 [CI: 58.5 – 66.9]	
24-35	643	35.4 [CI: 30.8– 40.2]	64.6 [CI: 59.8 – 69.2]	
36-47	450	37.9 [CI: 30.8– 45.5]	62.1 [CI: 54.5 – 69.2]	
48-59 months	290	29.3 [CI: 24.0 – 35.3]	70.7 [CI: 64.7 – 76.0]	
Gender of child				
Male	1267	38.9 [CI: 35.7 – 42.2]	61.1 [CI: 57.8 – 64.3]	χ^2 = 24.2, p < 0.001
Female	1288	29.7 [CI: 26.5 – 33.0]	70.3 [CI: 67.0 – 73.5]	

*95 % confidence level (CI).

Table 2b: Bivariate Analysis of Predictors of Positive Nutrition Deviance Among Children Aged 6-59 Months

Characteristic	N	Nutrition Deviance Classification (%)		
		Negative	Positive	Test statistic
Iodine content of household salt				
Inadequate	1946	35.0 [CI: 31.9 – 38.2]	65.0 [CI: 61.8 – 68.1]	χ^2 = 5.7, p = 0.047
Adequate	576	29.3 [CI: 24.8 – 34.2]	70.7 [CI: 65.8 – 75.2]	
Timely initiation of breast feeding				
More than one hour	704	40.2 [CI: 35.6 – 45.0]	59.8 [CI: 55.0 – 64.4]	χ^2 = 19.0, p = 0.006
Within one hour	1847	31.4 [CI: 27.9 – 35.1]	68.6 [CI: 64.9 – 72.1]	
Infant and young child feeding (IYCF) index				
Low	1169	37.1[CI: 33.6 – 40.7]	62.9 [CI: 59.3 – 66.4]	χ^2 = 8.5, p = 0.024
High	1397	31.6 [CI: 28.1 – 35.3]	68.4 [CI: 64.7 – 71.9]	
Maternal Height Classification				
Up to 154 cm	470	47.4 [CI: 42.4 – 52.4]	52.6 [CI: 47.6 – 57.6]	χ^2 = 62.0, p < 0.001
155-159 cm	723	35.9 [CI: 31.1 – 40.9]	64.1 [CI: 59.1 – 68.9]	
At least 160 cm	1225	27.7 [CI: 24.7 – 30.8]	72.3 [CI: 69.2 – 75.3]	
Maternal Educational level				
None	1871	35.7 [CI: 32.6 – 38.9]	64.3 [CI: 61.1 – 67.4]	χ^2 = 9.3, p = 0.013
Low	548	28.3 [CI: 24.6 – 32.4]	71.7 [CI: 67.6 – 75.4]	
High	129	36.3 [CI: 27.9 – 45.6]	63.7 [CI: 54.4 – 72.1]	
Child had diarrhoea in the past two weeks?				
Yes	616	38.2 [CI: 33.6 – 43.0]	61.8 [CI: 57.0 – 66.4]	χ^2 = 5.5, p = 0.058
No	1915	33.1 [CI: 30.0 – 36.3]	66.9 [CI: 63.7 – 70.0]	
Maternal nutritional knowledge level				
Low	1324	36.8 [CI: 33.1 – 40.6]	63.2 [CI: 59.4 – 66.9]	χ^2 = 9.9, p = 0.023
High	1242	30.8 [CI: 27.3 – 34.6]	69.2 [CI: 65.4 – 72.7]	

*95 % confidence level (CI).

not been to school. Whereas, households using salt of adequate iodine content was a strong predictor of positive deviance in the sub-group of illiterate mothers, it was not an important determinant in the whole sample.

The results showed that being a female child, residence in the Upper West Region, tall mothers and younger children were factors contributing significantly related to positive deviance (PD (Table **3**). Compared to the Northern Region, children in the Upper West region were 1.7 times more likely of becoming positive deviant (OR= 1.68, CI= 1.30 - 2.16). The data showed that children whose mothers' height was ≥160 cm were 2.4 times more likely of being positive deviant [AOR 2.38; 95% CI (1.83 - 3.10)] compared to children whose mothers were ≤150 cm tall. Female children were significantly more likely to be positive deviant [AOR 1.44; 95% CI (1.17 - 1.77)]. Households using salt of adequate iodine content were more likely to have positive deviant children [AOR 1.36; 95% CI (1.03 - 1.80)].

Table 3a: Multivariate Analysis of the Determinants of Positive Nutrition Deviance (Whole Sample)

	Wald	Sig.	Exp(B)	95% C.I.for EXP(B)	
				Lower	Upper
Gender (female child)	16.925	.000	1.453	1.216	1.735
Nutritional knowledge score (NKS)	3.841	.050	1.082	1.000	1.171
Maternal Height (reference : ≤ 150 cm)	67.117	.000			
Height (155 - 159 cm)	17.161	.000	1.667	1.309	2.123
Height (At least 160 cm)	65.874	.000	2.574	2.049	3.235
Region of residence (reference: Northern)	22.053	.000			
Upper East Region	9.873	.002	1.419	1.141	1.766
Upper West Region	20.858	.000	1.681	1.345	2.100
Age of child (reference: 24-59 months)	13.491	.001			
6-11	11.291	.001	1.611	1.220	2.127
12-23	.216	.642	.955	.786	1.160
Constant	18.521	.000	.325		

Table 3b: Multivariate Analysis of the Determinants of Positive Nutrition Deviance (Illiterate Mothers Only)

	Wald	Sig.	Exp(B)	95% C.I.for EXP(B)	
				Lower	Upper
Gender (female child)	12.00	0.001	1.44	1.17	1.77
Maternal Height (reference : ≤ 150 cm)	42.44	<0.001			
Height (155 - 159 cm)	11.55	0.001	1.62	1.23	2.14
Height (At least 160 cm)	41.97	<0.001	2.38	1.83	3.10
Region of residence (reference: Northern)	16.43	<0.001			
Upper East Region	5.03	0.025	1.34	1.04	1.72
Upper West Region	16.04	<0.001	1.68	1.30	2.16
Age of child (reference: 24-59 months)	13.93	0.001			
6-11	12.42	<0.001	1.84	1.31	2.58
12-23	0.06	0.808	0.97	0.78	1.22
Adequate iodine content of household salt (≥ 15 ppm)	4.72	0.030	1.36	1.03	1.80
Constant	12.39	<0.001	0.48		

Of all the predictors of positive deviance, high maternal height contributed most (Wald = 42.44, $p < 0.001$) to the variation of positive deviance of growth.

DISCUSSION

In this cross-sectional analysis of data, we assessed the determinants of positive deviance with respect to child growth. The analysis was conducted on the entire sample and on a separate subset composed of households where the mother had no formal education. Maternal education could serve as a proxy measure of socioeconomic standing and many other socio-cultural environmental conditions. By using households of similar conditions, it was possible to provide possible answers to the fundamental question of: "What is it that certain households have been able to do, despite low educational standing but that has resulted in normal nutritional status?

A major strength of this paper lies in the fact that it is about the first to identify the main determinants of positive deviance in Northern Ghana. Most studies tend to focus on the prevalence and determinants of malnutrition. However, the determinants of 'positive deviance' are not necessarily the converse of poor growth. It has been hypothesized that the mechanisms operating to produce 'positive deviance' and 'negative deviance' are different [11]. A factor that may be associated with 'negative deviance' need not be inversely associated with 'positive deviance'. One other uniqueness of the present study is that it defined positive deviance taking into consideration the absence of both chronic and acute malnutrition.

The prevalence of acute under-nutrition has remained over 10 %, a level considered to be serious according to WHO. The overall prevalence of chronic malnutrition was as high as 28.0 %, which indicates a serious malnutrition situation as judged by the World Health Organization criteria [12, 13].

In the present study, factors contributing to positive deviance in rural environment of Northern Ghana were high maternal nutritional knowledge, being a female child, taller women, and younger children (6-11 months), region of residence and whether or not the child was from a household where the iodine content of salt being used was adequate. One other factor that was associated with positive deviance in bivariate analysis but failed to reach significance level in multivariable regression analyses was frequency of diarrhoeal infection.

Evidence from this study supports the view that nutrition improvements in women have great potential of ameliorating stunting and wasting in early infancy. Children born to taller mothers (at least 150 cm) exhibited more positive deviance with respect to child growth. Similar findings have been reported from Dhaka slum population, Bangladesh [14, 15]. It is well established that poor maternal nutrition impairs foetal growth and subsequent stunting. Poor maternal nutrition as manifest in short maternal stature was an independent major contributor to positive deviance of child growth in Northern Ghana. Malnourished women tend to deliver premature or small babies who are more likely to die or suffer from suboptimal growth and development [16].

Since growth failure occurs almost exclusively during the intrauterine period and in the first two years of life, programmes targeting the in utero environment in order to break intergenerational transfer of malnutrition are to be vigorously implemented. In this way, the persistent high levels of child under nutrition in Northern Ghana can be mediated through a sustainable focused intervention strategy to improve maternal nutrition. For children under two years low HAZ reflects a continuous failure to growth but for older children, it reflects a state of having failed to grow.

Positive deviant children were more likely to reside in households using salt with adequate iodine salt content. It is not clear what accounted for this but our data showed that households in which women had attained high educational level (at least Senior High School) were more likely to use iodated salt with adequate iodine content, compared to households where the mother had no formal education (52.6 % versus 19.3 %), chi-squared = 92, $p < 0.001$. Use of iodated salt may have mediated the effect of maternal educational level on the presence of positive deviant children in a particular household. It is also well established that iodine is necessary for the thyroid hormones that regulate growth, development, and metabolism [17]. Inadequate intake of iodine deficiency during infancy and early childhood can substantially impair physical growth

Our finding reinforces the need for all households in Ghana must be using salt and that the salt must have an iodine content of 15 parts per million (ppm) or more. To be fully effective in correcting iodine deficiency, salt must necessarily reach the entire affected population, especially pregnant women and young children and be iodized to the right levels.

In this study we found female children more likely to be positive deviants, contrary to what was reported in other countries including Bangladesh, where male children were three times more likely to be positive deviants as compared to girl children.

Poor complementary feeding practices contribute to inadequate energy and protein intake [18]. Therefore, complementary feeding indicators were also assessed as predictors of nutritional adequacy. Families of positive deviant children reported desirable IYCF behaviors, especially timely initiation of breast feeding. The analysis of data collected on feeding practices showed that only 58.9 % of the children aged 6-23 months met the minimum acceptable diet suggesting over 40 % were on poor diet quality. Surprisingly, none of the World Health Organization (WHO) recommended complementary feeding indicators (Minimum meal frequency, minimum dietary diversity, and minimum acceptable diet) was associated with positive deviance in growth among children aged 6-23 months. The apparent lack of association may be due to the fact there was very little variation in the study population with respect to these indicators.

However, in bivariate analyses, a composite index of infant and child feeding practices was significantly higher among positive deviant children but was not a strong determinant in the multiple regression analyses. The index comprised the elements: current breast feeding status, timely initiation of breast feeding, whether or not the child was given prelacteal food, age at which complementary foods were introduced, adequacy of meal frequency in the past 24 hours and 24 hour dietary diversity score.

Findings about the relationship between feeding practices and child growth have been mixed. A survey conducted in Mexico found that measures of recommended breastfeeding and complementary feeding practices were not associated with growth when family economics and other factors were included in logistic regression models [19]. In seven Latin American countries, it was reported that recommended child feeding practices were positively associated with height-for-age with a stronger effect for children of lower socio-economic status [8]. Dietary diversity among 6–23-month-old children was found to be positively associated with height-for-age in seven of 11 countries when other variables were included in the models [20].

Under-nutrition and childhood morbidity have a synergistic relationship. The two conditions act in such a way that illness can suppress appetite precipitating under nutrition of a child while, on the other hand, nutritional deficiencies increase the susceptibility of the child to infectious diseases [21]. Children who suffer less from frequent bouts of diarrhoeal disease were more likely to be positive deviant, though this relationship was not significant in the regression model. Generally, improving dietary intake to recommended levels together with the elimination of diarrhoea and febrile illness at the same time would be necessary to achieve optimal child growth.

CONCLUSION

In this paper, we have analyzed some characteristics and caring practices that enable children in Northern Ghana to perform better in terms of growth under conditions which their counterparts failed. The major amenable factors contributing to positive deviance appear to be increased maternal height and utilization of iodated salt.

Our study contributes to the literature on positive deviance in child growth by identifying factors that are most relevant for child growth and nutrition in Northern Ghana. Our findings strengthen the argument that it is always possible to resolve problems of malnutrition if we promote factors that enhance positive deviance. These findings may therefore help identify areas for intervention.

Limitation of the Study

A major limitation of our work relates to the use of cross-sectional data. Although informative for determining the factors associated with positive deviance, the cross-sectional nature of the study precludes any attribution or causation to any particular risk factor.

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