Dietary pattern, socioeconomic status and child health outcomes in Ghana: application of multilevel analysis

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DIETARY PATTERN, SOCIOECONOMIC STATUS AND CHILD HEALTH OUTCOMES IN GHANA: APPLICATION OF MULTILEVEL ANALYSIS

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Abstract

Introduction – Child welfare, especially issues bordering on child health, continues to be one of the core issues of development. Over the years, appreciable progress has been made, but the levels are still not good enough.

Objective - This paper investigates the effects of mothers' socioeconomic characteristics and regional effect on the health of the child. Also, the paper employs a multilevel estimation technique, a methodology that distinguishes this study from previous studies to investigate in detail, the sources of variation in child health for appropriate policy recommendations

Design/methodology/approach - This study revisits the issue on the determinants of child health using the 2012 Ghana version of the Multiple Indicator Cluster Survey, with a sample size of 7364, to investigate how infant diet practices impact child health in Ghana. We estimate the impact of dietary pattern and other socioeconomic characteristics and regional effect on child anthropometric indicators using the multilevel estimation technique to control for clustering effect.

Results - We found a dietary pattern to have a positive impact on child health. In addition, we realised that both mother characteristics and regional effect play a role in the growth of the child, but mother characteristics seem the most driving force when mother effects and regional effect are set at play.

Conclusion - It is recommended that parents should adhere to the appropriate diet requirement for their children to better health outcome. Also, it is imperative for policies to be geared towards parents as a first step in ensuring a better child health. In addition, policies and programmes directed to the three Northern regions of Ghana are very crucial in supporting a positive child health development for children in Ghana.

Key Words: Child Health Outcome, Dietary Pattern, Socioeconomic Status, Multilevel Analysis, Ghana

Introduction

Child welfare, especially issues bordering on child health, continues to be one of the core issues of development and therefore has featured prominently in most global development agenda, especially the Millennium Development Goals (MDGs) and its successor, the Sustainable Development Goals (SDGs). Specifically, the fourth target of the MDG (under the broad goal of reducing child mortality) was to reduce by two-thirds, between 1990 and 2015, the under-five mortality rate. This issue again received a renewed interest in the SDGs under its targets 2 and 3 agenda. Specifically, by 2030 the SDGs targets 2.1, 2.2 and 3.2 seek to end hunger and ensure access by all people, in particular, the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round. Thus, end all forms of malnutrition, including achieving by 2025 the internationally agreed targets on stunting and wasting in children under-five years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons.

World Health Organisation (WHO) has denoted good nutrition to encapsulate adequate a well-balanced diet tailored to regular physical activity. Hence, taking a proper diet of essential nutrients (macro and micronutrients) is very important to prevent infectious cardiovascular diseases and contagious disease. Thus, the role played by nutrition in the prevention of sickness and the preservation of good health conditions is now on public attention more than ever (1). A healthy diet and nutrition with the appropriate food nutrients requirements are important factors in the promotion and maintenance of a good health outcome in one's life course (2). Studies on the global burden of disease show that 20% of deaths in Sub-Saharan Africa (SSA) were caused by non-communicable diseases (NCDs), with the top 10 condition regarding disability and mortality in low and low-middle income countries (3).

Poor nutrition among children manifests itself in underweight, stunting, and wasting leading to lifelong complications disease (4,5). Other studies have also suggested that malnutrition is the underlying cause of some diseases and child deaths: diarrhoea (61%); malaria (57%); measles (52%); pneumonia (45%) and infant death (53%) (6,7). Global estimate of malnutrition indicates that malnutrition is skewed towards Africa and South Asia. Sub-Saharan Africa (SSA) was seen to have the highest prevalence of malnutrition at about 40 percent of all children under five years to be stunted, another 9 percent wasted, 21 percent underweight and 7 percent were overweight (8). It is again on record that between 1990 and 2014, stunting prevalence globally declined from 39.6 per cent to 23.8 per cent, and the number of children affected fell from 255 million to 159 million. In 2014, just over half of all stunted children lived in Asia and over one-third in Africa (9). These rates raise concern about Africa's ability to devise resiliency in striving towards the achievement of the SDG goals 2 and 3.

The 2014 Ghana Demographic Health Survey (GDHS) report points out marked differences concerning child growth. This was especially seen in height-for-age (HAZ) (a measure of linear growth also known as stunting which is a condition reflecting the cumulative effect of chronic malnutrition) and weight-for-age (WAZ). The report shows that 19 percent of Ghanaian children are stunted (below -2 SD), and 5 percent are severely stunted (below -3 SD), a decrease from the figures of 28 percent and 10 percent, respectively, reported in the 2008 GDHS survey (10). Although the story shows that progress is being made, there is the need for concern. This is because the report indicates that stunting increases with age, peaking at 28 percent among children age 24-35 months which is very high on average compared to the world average of 26.3 percent as at 2010. By region, stunting ranges from 10 percent in the Greater Accra to 33 percent in the Northern region. These differences add to the assertion that there are disparities in children growth skewed negatively against three northern regions of Ghana. Not surprisingly, one-third of all children are stunted in the Northern Region, followed by Upper West with one in every five children being stunted.

A cursory glance at the World Bank statistics, from the year 2008 to 2014, on HAZ, WHZ and WAZ indicate that there is a significant drop in these child health indicators. However, more needs to be done especially with HAZ as shown in the trends and patterns in Figure 1.

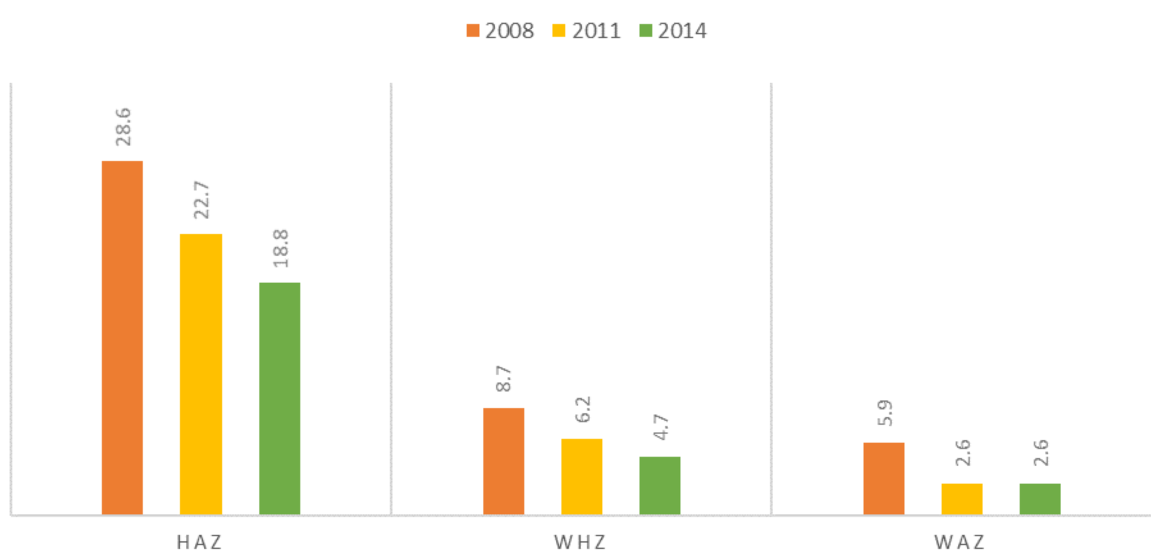

Figure 1: Trends and Patterns in Children under 5 Growth in Ghana

Source: Authors construct from World Bank Indicators 2016.

Figure 1 shows that all the three indicators for measuring child health have been decreasing, an indication that interventions are yielding some results. One such intervention is complementary feeding which has shown great potential for reducing the impact of stunting in many places (1,2). In addition, improvement is achieved with increased food diversity (11). The drop seems to be doubled in both the WHZ and WAZ except HAZ. Hence the need for further effort to be made in such areas as a mechanism for reducing poor growth in children, which has a direct effect on the health of the child, in Ghana.

The foregoing issues bring to light why investigating child health outcome in Ghana is an important concern that is deemed appropriate for investigation. Given of the burgeoning issues, the paper examines the effects of mothers' socioeconomic characteristics and regional effect on the health of the child. The mother is the first line of contact for every child, hence a look at their socioeconomic conditions and how it affects the child's health (12). Again, it has been documented that wealthy women mostly use their wealth to advance the course of the family's health and welfare (13). Additionally, the paper employs multilevel estimation technique, a methodology that distinguishes this study from previous studies to investigate in detail, the sources of variation in child health for appropriate policy recommendations. Existing literature in the area of child health employs different estimation techniques, namely, bivariate, OLS, multivariate analysis, and IV - aimed at examining the health outcome of the child (4,11,12,14–16). The outcome variable (child health) is nested within the characteristics of parents or the regional effects. The behaviour of the outcome variable sets the data into a hierarchical form. Whenever data is grouped (or nested) in more than one category, it becomes imperative to know whether the effect of the outcome variable vary by entity (different groups) or not. This has an advantage on generalisation which is a weakness in classical linear regression. This regression ignores the average variation between entities and this may have generalisation problems. Hence, to cater for the clustering effect in the data and heterogeneity problem, we employed multilevel estimation technique to take care of any biases that are likely to occur in the estimated results. Applying the multilevel methodology to the cross-section variation in the data, the paper argues that dietary pattern and mother's socioeconomic effect and region of residence could have a great deal on the health of the child. However, knowing the entity (the group) that has an overriding effect on the health of the child is of utmost interest for appropriate policy. The rest of the paper is organised as follows; the second section discusses the methodology followed by results and discussion, with conclusions being last part.

Methodology

Data

Data used for this study comes from Ghana Multiple Indicator Cluster Survey (MICS). The MICS was carried out in 2011 by the Ghana Statistical Service with support from UNICEF as part of the fourth global round of MICS surveys. The MICS thus provides current information on health, social and economic circumstances of households, mothers, and children. A total of 12,150 nationally representative sample of households were selected, 11,970 out of the selected households were identified in the interview. Of the identified household to be interviewed, 11,925 were interviewed. In all 10,627 women were interviewed while information was obtained on 7550 children under age five years (17). MICS provides up-to-date information on the situation of women and their children and measures key indicators that allow countries to monitor progress towards the MDGs and other internationally agreed commitments.

Measurement of child dietary variable

In this study, the dietary variable is captured in two ways. Firstly, it is measured as the food groups a child consumes (patterns in food groups) and second, as the number of times the child is given food in a day (frequency of food a child takes in a day). The diet pattern in measured as appropriate food pattern a child consumed in the previous day as specified by Infant and Young Children Feeding guidelines (IYCF) which are in consonance with various organizations measures such World Food Programme's Food Consumption Score (FCS), the World Health Organization's IYCF, and the FAO/USAID calculates Individual Dietary Diversity Score (IDDS). In the MICS, information is collected on food and liquids consumed by the child in the previous day. The foods given to the child are categorised under the seven groupings (18). The groupings are as follows: (i) grains, roots and tubers; (ii) legumes and nuts; (iii) flesh foods (meat, fish, poultry and liver/organ meats); (iv) eggs; (v) vitamin-A rich fruits and vegetables; (vi) dairy products (milk, yogurt, cheese); (vii)other fruits and vegetables. From the various groupings, each group is assigned a value of one (1). If a child consumed at least one food item from the food group, a value of one (1) is assigned to the child as consuming only one out of the seven of the food category. If a child consumes two, a value of two out of seven is allocated to the child food group in that order. The groups' score was summed to obtain the dietary pattern (food groups) score which ranges from zero to seven, where zero represents non-consumption of any of the food items, and seven represent the highest level of diet diversification or food groups consumed.

Definition of Nutrition status (Anthropometric indicators)

The study measured outcome variable child health, which is measured as nutritional status of the child was based on the three conventional anthropometric indicators: weight-for-age (wasting), weight-for-height (stunting) and weight-for-height (underweight). Following Annim, Awusabo-Asare, Amo-Adjei and ICF International (19), we used stunting stunted, measured as a child's height-for-age z-scores less than two standard ($< -2SD$ of height-for-age z-scores) to measure chronic undernutrition due to prolonged food deprivation; wasting, which is measured as a child's weight-for-height z-scores less than two standard ($< -2SD$ of weight-for-height z-scores) to measure undernutrition caused by a more recent deprivation; and underweight which is measured as a child's weight-for-age z-scores less than two standard ($< -2SD$ of weight-for-age z-scores). In the descriptive statistics, we use binary outcomes of these indicators (wasting, stunting, and underweight) to group a child as stunted, wasted or underweight. Additionally, we employed the raw z-scores of the indicators regression section. We use the raw z-scores because it allows us to determine changes across observation instead of categories and also to solve the problem of clustering in the data. Also, we followed IYCF measurement on whether a child is being breastfed or not and the food groups a child is supposed to be given in a day.

Child health production

Following Thomas and Strauss (1992) theory of child anthropometric production function also in Annim's (20) study, we investigate the effect of mothers' socioeconomic characteristics and regional effect of child health outcomes in Ghana. This theory follows the work of Rosenzweig and Schultz (21) on household production function and the household health production function.

Based on the assumption of a static case and a strictly increasing, continuous and twice-continuously differentiable utility function (22,23), the observed household characteristics are given by *(X)*. Parents maximise their welfare function based on child health *(CH)*, leisure *(L)*, consumption of goods and services which is non-health related *(N)*.

$$U = U\,(CH_i, L_i, N_i, X_i) \qquad i = 1, 2, 3. \ldots, n \qquad [1]$$

where X_i is a vector of household characteristics including household wealth, ethnicity of household head and mother's education. The child's health production function is given by:

$$CH = F\,(Y_j, X_i, X_h, X_e, \mu) \qquad j = 1, 2, 3, \ldots, m; \qquad [2]$$

Equation (2) refers to the nutritional status of the child which are weight-for-age (wasting), weight-for-height (stunting) and weight-for-height (underweight). This depends on the (Y_j) which is our child characteristics such as age and gender and (X_h) being the dietary pattern and frequency. The regional effect variables are captured by (X_e), while (μ) is a vector of all unobservable characteristics of the child, parents, household, and the environment that can affect child health.

The household's utility is constraint by its income

$$HI = P_n N + WL + P_s S \qquad [3]$$

where P_n, W, P_s, are the vectors for prices of consumption goods, leisure and health inputs respectively with *HI* being household income derived from time use for work and leisure.

Optimizing the three equations leads to a reduced-form which is specified as:

$$CH = z\,(X_i, X_h, X_e, HI, P_n, W, P_s, \mu) \qquad [4]$$

From this reduced-form equation, we specified our econometric model.

Model specification and estimation technique

The empirical model estimated as well as the estimation technique employed in this study are discussed. Three models are run, one for each indicator. Centred on reviewed literature and the purpose of this study, factors contributing to child health are estimated as follows:

$$y_{ij} = \beta_0 + \beta_1 DPIYCF + \beta_7 medu_i + \beta_2 mage_i + \beta_3 wealth_i + \beta_4 cage + \beta_5 urb + \beta_6 ethnic_i + \beta_7 region_i + \epsilon_i \qquad [5]$$

where: DPIYCF=Diet pattern under IYCF groupings; medu=mother's education; mage=mother's age; wealth =wealth quintile; sex=sex of child; cage=age of child; urban=whether household is in an urban area; ethnic=ethnicity of household head; region=which administrative region is household located, $i = child\ and$ j = (WAZ, HAZ, WHZ).

To estimate model (5), mixed linear regression analysis was employed (Three Stage Multilevel Analysis).

Justifying the use of Multilevel Estimation for this Study

Over the years, reports have been that child health outcomes are skewed towards some regions and that there is the need for regional intervention (24). The need to resort to a methodology that establishes regional disparity in child health comes handy. The multilevel methodology aids to ascertain whether regional effect indeed plays a crucial role in child health development. Besides, the study aims to examine effects of diet pattern, mother's socioeconomic characteristics and regional effect on child health as an outcome variable. In this study, the variables of interest are measured at different levels as in equation 6. Equation 6 consists of different level measures: child variable (dietary pattern, age of child, child sex); mother effect (mothers' education, mothers' age, wealth of the household) and regional effect (region of residence).

We have child level variable, mother level variables and regional variable. It is therefore important to incorporate three-level structures into our models when levels arise in the data structure. The differences in levels in the data need to be catered for so that we can appropriately attribute variation in child health outcome to sources of levels in data (25–27). Resorting to a three-stage model to deal with the hierarchical data as in the case of our data is imperative. Extant literature points that when units are clustered classical regression analysis is not appropriate (28). Hence, we fit a three-stage multilevel estimation is appropriately chosen to model our data.

The study estimates three models for WAZ, HAZ, and WHZ respectively. In the estimation of the model, we conceptualized a three-stage system of equations in which variation in our outcome variable, child health, is explained by dependency in mother characteristics and regional characteristics.

A Three-stage Formulation of the Child Health Model

In the model formulation, we first state lower level equation capturing child level measurement, a higher (second) level measurement capturing mother effect, and third (higher) equation capturing regional effect level variable. Our final three stage level modelling is estimated as follows:

$$CH_{ijk} = \beta_0 + \sum_{n}^{3} \beta_n CX_{ijk} + \sum_{m=1}^{5} \beta_m Z_{jk} + \beta_3 Reg_k + v_k + \mu_{jk} + e_{ijk} \qquad [6]$$

$$v_k \sim N(0\,, \sigma^2)$$

$$u_{jk} \sim N(0, \sigma^2)$$

$$e_{ijk} \sim N(0, \sigma^2)$$

$CH_{ijk} = Child\ health, our\ outcome\ variable$; $CX_{ijk}, our\ child\ characteristics\ variable$; $Reg_k = region$

Traditionally, $i = child\ level, j = mother\ effect\ characteristics\ and\ k = regional\ effect$

Where $\beta_0 + \sum_{n}^{3} \beta_n CX_{ijk} + \sum_{m=1}^{5} \beta_m Z_{jk} + \beta_3 Reg_k$ is termed the "fixed part effect" of the model, and $v_k + \mu_{jk} + e_{ijk}$ are termed the "random part effect" of the model. The fixed part of the model specifies the overall mean relationship between the response and the predictor variables; that is, the relationship that applies in the average region. The "random part effect part" of the model specifies how the region and mother specific characteristic relationships differ from the overall mean relationship for the reason that their coefficient are based on changes in the mothers and regions a child is identified. In the random part of the model, the random effects and residual errors are assumed independent of the three predictor variables.

Table 1. Definition and Measurement of Variables

Variable	Definition	Measurement
Male	Gender/sex of child	0=Female; 1=Male
Diet Frequency	The number of times a child is given the required food in a day	Measured as continuous variable

Urban	Residence status of the household	1=Urban; 0=Rural
Mother's Age	Age of the child's mother	Measured in years. Ranges from 15-45 years
Child’s age	Age of child in categories	Measured as: 0=0-5; 1=6-11; 2=12-23; 3=24-35; 4=36-47;5= 48-59
Mother’s education	Mothers highest educational attainment	0=None;1= Primary; 2=Middle/JSS; 3=Secondary and Above
Wealth quintile	An index of the wealth status of the household	0=Poorest; 1=Second; 2= Middle; 3=Fourth; 4=Richest
Ethnicity	Ethnic group to which the household head belongs	It is measured in categorical variable
Region	Region of Household	Set of dummy variables to capture the administrative regions in Ghana
Food pattern	Food diversity score	Measured as count of food items

Descriptive Statistics of the variables

The descriptive statistics of the relevant variables employed in this study are presented in Table 2. The mean measures the average values of a group of values. The standard deviation measures how the values are spread around the mean. The minimum and maximum values capture the range of variables. From table 2, it can be concluded that there is less variability among the relevant variables used in this study. With the exception of our outcome variable, all the relevant explanatory variables indicate a lower standard deviation as compared to the means.

Table 2: Descriptive statistics of the variables employed in the study

Variable	Observations	Mean	Standard Deviation.	Minimum	Maximum
HAZ	7364	-1.09846	1.312807	-5.98	5.85
WAZ	7364	-1.13494	1.146331	-5.96	5.75

HAZ	7364	-1.09846	1.312807	-5.98	5.85
Food diversity	7364	3.113428	1.695622	0	7
Diet frequency	7364	3.2628	1.169781	1	8
Mothers education level	7364	1.812615	1.000801	1	4
Mothers Age	7364	30.2441	9.922212	15	49
Wealth	7364	2.147682	1.338781	1	5
Sex of the Child	7364	0.510884	0.499914	0	1
Childs age	7364	3.903576	1.580942	0	5
Urban	7364	0.281275	0.449651	0	1

Source: Computed from MICS, 2011

Results and discussion

This section presents the test of associations (descriptive) and the conditional effect of each of the three main variables of interest (Least Squares) on nutritional status of children. For both the descriptive and inferential analyses, three outcomes of nutritional status, namely, height-for-age (stunting), weight-for-height (wasting) and weight-for-age (underweight) are used.

Maternal education and food diet Pattern

Figure 2 shows that children born to parent with higher education levels had more food groups consumed during the survey period. With no formal education, having the least, we found that as education level increases the differences in food groups consumed also increases. Thus, as far as child diet pattern is concerned, children who are born to parents with at least basic education are likely to consume better food groups compared to children born to parents with no education. This pattern presents a herald of the need to intensify nutrition awareness at the basic school levels since it can lead to improvement in child nutritional intake which has a longer positive health implication on the child health outcome.

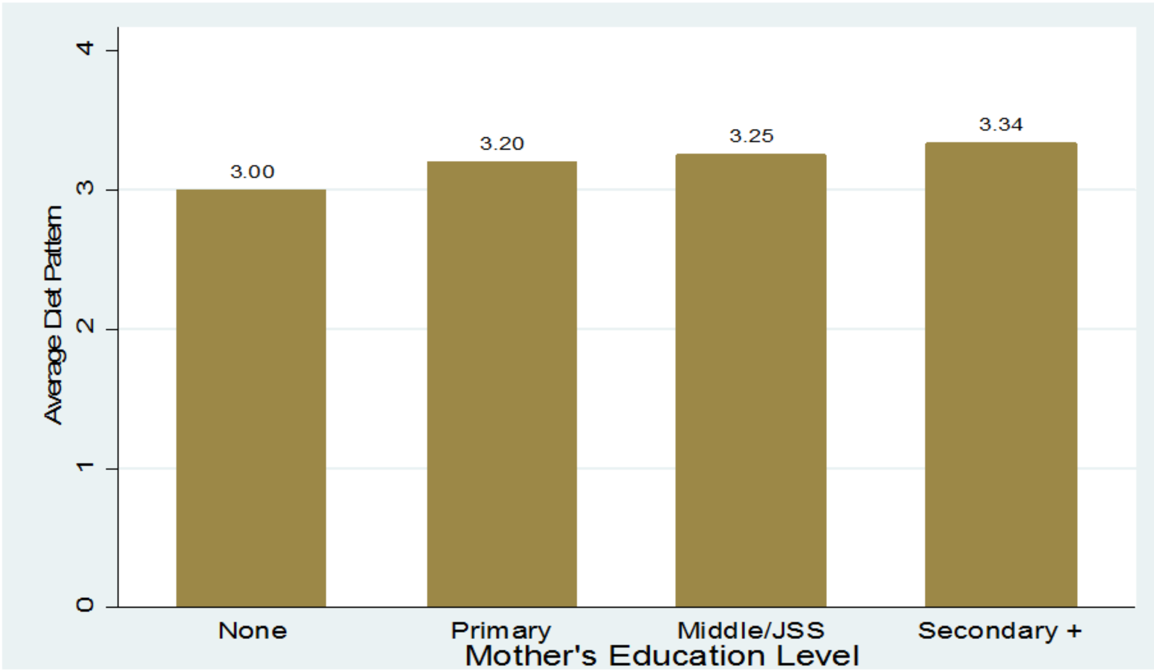

Figure 2: Distribution of Food Patter by Mother's Education Level

Source: Author's Computation from MICS, 2011

Regional distribution of food diversity among children less than 5 years

In terms of dietary diversity, Figure 3 shows that children in Greater Accra Region, which is the national capital had the most diversified diet pattern. This is followed by Brong Ahafo Region. As one would expect, the Northern Region had the least diverse dietary pattern for children. The pattern in Figure 2 could be attributed to the distribution of poverty levels in the ten regions of Ghana and with this accounting for the poor food group pattern in the region with high poverty level.

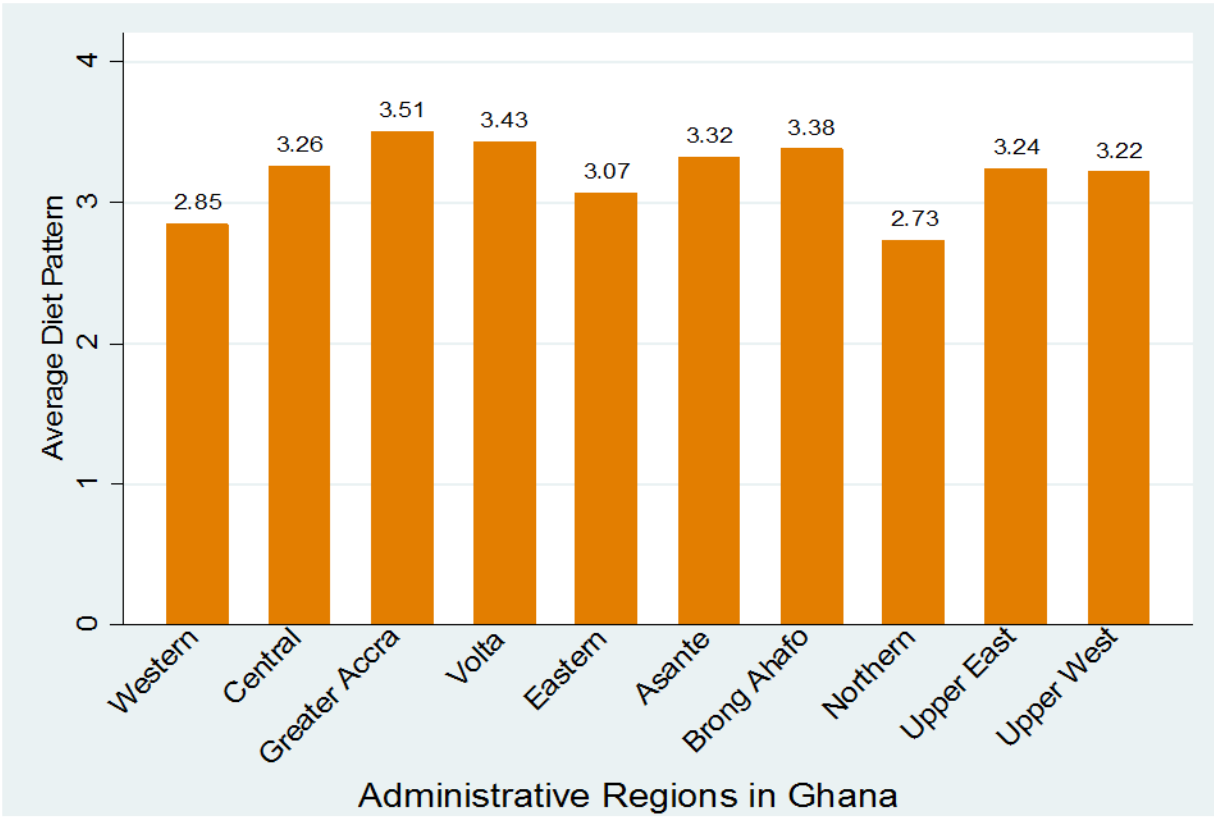

Figure 3: Distribution of Food Diversity by Administrative Regions in Ghana

Source: Author's Computation from MICS, 2011

Patterns in minimum diet a child is given across Mothers' Education Level, Wealth, and Childs Age if child is not under breastfeeding

Table 3 examines patterns in minimum dietary requirements a child is supposed to take when the child is not under breastfeeding. This is examined with mother's education level, wealth quintile and age of child under 5. From Table 3, it can be observed that mothers' education increases with minimum food requirement a child is given. Mothers with no education level do not follow the required food supplement for children who are not under breastfeeding. Thus, 52.1 % do not give the minimum required diet supplement a child is supposed to take when the child is not under breastfeeding while 47.9 % ensures that the minimum diet their child is expected to take in a day is met. Mothers with primary, middle/JSS and secondary education and above (52.4 57.4 and 57.4 respectively) feed their child with the required food supplement. These observations reveal that parent with at least some form of education tends to provide their wards with the appropriate food requirement. A similar result is also recorded in the wealth category. The majority of families who fall within the poorest wealth group fail to provide the appropriate food group requirement for their wards. But the case seems to turn around as family wealth increases. This implies that parents who are poor find it difficult to provide or access the appropriate food supplement with the required food nutrients for their children. The result shows that poor parents are at disadvantaged in providing their child with the appropriate food supplement. Feeding a child under age five food supplement with inadequate food nutrients can have an adverse implication on the growth of the child's development (16,29). As a child ages, it is evident from Table 3 that food supplement or the minimum food group the child is supposed to take also increases. This observation shows that at tender age, the child is likely to bypass the appropriate food supplement, but as the child ages, the required food consumption is given to them. Implying that mothers are likely to continue the adequate food supplement the child requires as the child ages and this is true when the child is not under breastfeeding.

Table 3: Patterns in minimum diet a child is given across Mothers Education Level, Wealth, and Childs Age if child is not under breastfeeding

	No		**Yes**		**Total**	
	Frequency	row %	Frequency	row %	Frequency	row %
Mother's education						
None	1240	52.1	1139	47.9	2379	100
Primary	383	47.6	421	52.4	804	100
Middle/JSS	422	42.6	569	57.4	991	100
Secondary +	138	42.6	186	57.4	324	100
Total	**2183**	**48.5**	**2315**	**51.5**	**4498**	**100**
Wealth						
Poorest	1039	52.8	930	47.2	1969	100
Poor	414	46	486	54	900	100
Middle	285	42.9	380	57.1	665	100
Rich	243	45.5	291	54.5	534	100
Richest	202	47	228	53	430	100
Total	**2183**	**48.5**	**2315**	**51.5**	**4498**	**100**

Age						
0-5	5	100	0	0	5	100
6-11	6	60	4	40	10	100
12-23	151	52.2	138	47.8	289	100
24-35	593	48.3	636	51.7	1229	100
36-47	754	49.2	780	50.8	1534	100
48-59	674	47.1	757	52.9	1431	100
Total	**2183**	**48.5**	**2315**	**51.5**	**4498**	**100**

Source: Computed from MICS 2011

Patterns in minimum diet a child is given across Mothers Education Level, Wealth, and Childs Age if child is under Breastfeeding

We examine patterns in minimum diet a child is supposed to be given when the child is under breastfeeding. We do this on the various indicators: mother education level, wealth quintile and age of child under 5 (see Table 4). From Table 4, it is evident that as mothers' education level increases, the required food group a child who is still under breastfeeding declines. Considering mothers' education level, mothers with no, primary, middle/JSS and secondary plus education are 57.5%, 54.1%, 61.6% and 63 % respectively as against those who feed their child the appropriate food supplement (42.3%, 45.9%, 38.4% and 37 %) in that order. Wealth status indicates similar result. As wealth level increases, it is evident that families who do not feed their children with the required food supplement also increase as against those who do feed their children the required food supplement. However, a reversal result is found with regard to a child's age. One can also observe that as the child ages, the required food supplement a child is supposed to take also increases. This trend suggests that if the child is under breastfeeding, mothers may consider feeding their child with breast milk than resorting to other food supplements.

Table 4: Patterns in minimum diet a child is given across Mothers Education Level, Wealth, and Childs Age if child is under breastfeeding

	No		**Yes**		**Total**	
	Frequency	row %	Frequency	row %	Frequency	row %
Mother's education						

None	962	57.7	704	42.3	1666	100
Primary	297	54.1	252	45.9	549	100
Middle/JSS	344	61.6	214	38.4	558	100
Secondary +	131	63	77	37	208	100
Total	**1734**	**58.2**	**1247**	**41.8**	**2981**	**100**
Wealth						
Poorest	856	55.9	674	44.1	1530	100
Poor	329	55.7	262	44.3	591	100
Middle	231	63.1	135	36.9	366	100
Rich	187	64.5	103	35.5	290	100
Richest	131	64.2	73	35.8	204	100
Total	**1734**	**58.2**	**1247**	**41.8**	**2981**	**100**
Age						
0-5	780	99.2	6	0.8	786	100
6-11	487	68.8	221	31.2	708	100
12-23	407	35.1	751	64.9	1158	100
24-35	54	20.3	212	79.7	266	100
36-47	4	9.8	37	90.2	41	100
48-59	2	9.1	20	90.9	22	100
Total	**1734**	**58.2**	**1247**	**41.8**	**2981**	**100**

Source: Computed from MICS 2011

Estimation results on the effects of dietary pattern on child health outcomes in Ghana

The study used the three anthropometric indictors of child health measures and regressed it on dietary diversity, indicators of maternal education and ethnicity and other covariates of child health (see Table 5).

Before reporting the results, we present post estimation on the results in Table 5. In summary, there is significant evidence that the choice of the model is appropriate per the post estimation results as indicated in the Log likelihood test (lr test) and intra-class correlation test (ICC). To confirm that the three-model hierarchical model fits our data, we first specify and fit an empty random intercept model as against the full model. The empty model includes the intercept, the dietary variable and regional random effect and the residual error. This is followed by a likelihood test between the three level and a simple linear model. The likelihood ratio test in Table 5 shows that our three-level model for estimating the child health as our outcome variable is preferred to the single linear regression model. This confirms that there is a statistically significant difference between a simple linear regression and the use of multilevel estimation technique for this study. The results confirm that the choice of the model (multilevel models) for this study is appropriate and the random coefficient models provide a better fit. Thus, the log likelihood test for the choice of model shows that we are justified in employing the multilevel methodology than using a single linear model.

On the issue of intra-class correlation coefficient (ICC), we report the results in Table 5. The ICC for the three models (HAZ, WAZ and HAZ) for the different levels, mother and regional effects, are 12.8% and 11.17%, 15.6% and 19.6%, and 12.6% and 15.4% for Height-for-age (HAZ), Weight-for-age (WAZ) and Weight-for-height (HAZ) respectively. These results indicate that correlation of measurement within the same individual and the proportions of variance explained by the individual random effect. Thus, the ICC shows that there is a significantly high degree of clustering in the data. Finally, we examined the data on normality test on the various models. The results in Table 5 show that the errors are normally distributed.

The results indicate that dietary pattern has a positive relationship with all 3 health indicators (child health outcome). This relationship is significant in HAZ and WAZ but not significant in the WHZ model. At 5 and 10 percent significance levels, a unit increase in the number of food groups a child consumes causes HAZ and WAZ to increase by 0.030 and 0.037 units respectively. This finding agrees with the works of Frempong and Annim (11) and Arimond and Ruel (30). There is a positive relationship between the diet frequency and WAZ, WHZ indicators but a negative relationship with HAZ. Thus, an additional increase in the number of times a child is fed in a day is associated with 0.034 decrease in HAZ, but 0.009 increase in WAZ and 0.025 in WHZ. This is significant at 10 percent for HAZ and WHZ but this is not significant in the case of WAZ.

Mother's education plays less important role in the child health outcome based on the three indicators (HAZ, WAZ, WHZ) used. From the HAZ model results, it is evident that there is a positive association between mother's education and child health but only significant for mothers with education above primary (that is those with secondary and above) education level. Mothers with secondary education and above have 0.126 units of HAZ higher than mothers with no education level. However, mothers with primary education have 0.064 units of WHZ higher than their counterparts with no education. The weak effect of education identified here could be as a result of the narrow scope of educational measure used (formal education) accounting for only a partial effect (16). Furthermore, mother's age is found to correlate negatively with WAZ. Increasing mother's age by an additional year is associated with 0.003 units reduction in WAZ at 10 percent significance level. The result in mother's age and WAZ could be due to the fact that older women tend to have experience in raising children.

It was realized that household wealth had a positive relationship with all of our outcome variable as expected. This relationship tends to increase as one move to higher wealth brackets. Children within higher wealth quintiles tend to have better nutritional status (HAZ, WAZ and WHZ) than children within the poorest wealth quintile(4,15,16,29)

Across the various categories, a negative association is observed with the health measure. This indicates that as the child ages, there is an increased likelihood for the child's health to worsen. This can be attributed to the lack of attention some parents tend to give to their children as they grow up. The result also shows that male children have negative correlation on all the child health measures. Concerning the sex-specific issues, at 5 and 10 percent significance levels, male children had 0.062, 0.058 and 0.054 of WAZ, HAZ and WHZ scores lesser than their female counterparts. The result failed to confirm Amugsi et al., (31) who found that between 1993 and 2008, declining trends in stunting and wasting were noteworthy among males than females. The relationship between sex and nutritional status could be explained regarding of differences in biological makeup as well as socio-cultural characteristics. This view is supported by Fuse who showed that daughters are preferred to sons in Ghana especially among tribes that are matrilineal (32).

On the relationship between ethnicity and child health, we found that Ewes have better HAZ and WAZ scores than Akans. Similarly, children who are Grusi tend to have better weight-for-height than their Akans. In Ghana, different ethnic groups have different feeding and postpartum practices, with some tribe prohibiting the giving of certain foods to children with the belief that it can make them thieves as they grow. The result confirms the finding of Annim and Imai (33) which indicates that child health outcomes differ among children of different ethnic groups. In addition, Pastor et al., (34) saw that Hispanic–Spanish children, compared with

Hispanic–English children, non-Hispanic black children, and non-Hispanic white children tend to self-report worse status in the United States of America.

Results from Table 5 show that regional fixed effects play significant role in explaining child nutrition as a higher-level variable. Using Western region as the base outcome, it is observed that there is a negative association between Northern and Upper East region for all the child health outcomes. At 1 and 10 percent significance levels, children in Northern and Upper East region have 0.336 and 0.176 HAZ scores respectively lower than children in Western region. A similar result is observed for WAZ and WHZ. Compared to the Western region, the case of the three northern regions is worse with regard to child health outcome. This could be attributable to the high poverty and deprivation rates in these regions. According to the Ghana Statistical Service 2015 report, concentration of poor persons in Ghana is mainly observed in the northern than the southern districts of the country. The district with the poorest persons is found in the in the Northern Region - East Gonja (35). Furthermore, the highest depth of poverty is also markedly seen in the northern half of the country.

Insert Table 5

Conclusion

This paper investigated different approach to the interplay between clustering and variable regression effects ('contextuality') on health outcomes of children under five health status and dietary habit. The child health outcome was a continuous variable measured with three conventional anthropometric indicators; weight-for-age (wasting), weight-for-height (stunting) and weight-for-height (underweight). Multilevel model is used to help in making appropriate attribution.

The study found that dietary pattern (required food groups per day) significantly affects height-for-age and weight-for-age but does not significantly affect weight-for-height. Hence, it can be concluded that taken the period before the survey; it is expected that dietary diversity will have less effect on weight-for-height (underweight) which arises as a result of prolonged periods of food deprivation or malnutrition. This could be attributed to the many interventions rolled out at education both pregnant and nursing mothers at antenatal and postnatal clinics across the country. Again, our analysis of the frequency or number of times a child is fed in a day indicated that it is likely for a child to have a poor HAZ if stricter measures are not imposed on increasing the number of times the child is fed in a day. Mothers are therefore advised to take keen interest in the feeding of their children in the required number of times the child is supposed to be fed per the IYCF standards to prevent the child from being underweight.

We found that there is a positive association between child age and dietary pattern. An indication that as a child ages, diet pattern also improves. This gives a promising hope in term of child health outcome as mothers are likely to consider the need to meet nutritional requirement of their children in their growth process. Dietary pattern differed across mother's education levels and was consistent with our apriori expectation even though not all the categories were significant. We conjecture that the insignificance in some of the levels of education may be because of these feed practices are handed down to mothers informally. Therefore, continuous education on nutrition and awareness of mothers through traditional news media and social media will help improve the situation.

It is recommended that improvements in mothers' financial standings should be the focus for social protection and poverty reduction programmes because of its rippling effect to better child health job creation. Also, the three northern regions should be given special dispensation through the Savanah Accelerated Development Authority's programs. This tends to impact positively on the health outcome of the child in the regions.

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Table 5: Effects of Dietary Pattern, Mother's Socioeconomic Status of child health outcomes in Ghana.

Explanatory Variable	Dependent Variable		
Fixed Parameters	**Height-for-Age**	**Weight-for-Age**	**Weight-for Height**
Dietary pattern (IYCF Score)	0.0300**	0.0374***	0.0158
	(2.44)	(3.47)	(1.51)
Diet frequency	-.03387*	. 0085	0. 0250*.
	(-1.68)	(0.71)	(2.14)
Mother's education	**(None=0)**		
Primary	0.015	0.0359	0.0636*
	(0.35)	(0.98)	(1.75)
Middle/JSS	0.0343	-0.0114	-0.026
	(0.73)	(-0.28)	(-0.65)
Secondary and above	0.126*	-0.0127	-0.0581
	(1.78)	(-0.21)	(-0.96)
Mothers Age	-0.00276*	-0.00161	-0.0009
	(-1.87)	(-1.28)	(-0.72)
Wealth quintile	**(Poorest=0)**		
Second	0.115** *	0.0764**	0.0115
	(2.72)	(2.10)	(0.32)
Middle	0.157** *	0.111**	0.0113
	(3.05)	(2.52)	(0.26)
Fourth	0.468***	0.294***	0.00347
	(8.27)	(6.08)	(0.07)
Richest	0.637***	0.511***	0.148**
	(8.63)	(8.80)	(2.36)
Male	-0.0617* *	-0.0580**	-0.0536*
	(-2.15)	(-2.36)	(-2.19)
Child Age (0-5=0)			
6-11	-0.511***	-1.171***	-0.823***
	(-7.55)	(-20.21)	(-14.20)
12-23	-1.221***	-1.572***	-0.985***
	(-18.23)	(-27.45)	(-17.18)
24-35	-1.062***	-1.403***	-0.694***
	(-15.16)	(-23.41)	(-11.58)
36-47	-1.197***	-1.269***	-0.498***
	(-17.09)	(-21.18)	(-8.31)
48-59	-1.264***	-1.275***	-0.510***
	(-17.86)	(-21.03)	(-8.41)
Urban	0.001	0.006	0.036
	(0.02)	(0.18)	(0.98)
Ethnicity (Akan=0)			

Ga/Dangme	0.132	0.0713	-0.0172
	(1.51)	(0.96)	(-0.23)
Ewe	0.281***	0.106*	-0.0663
	(3.99)	(1.76)	(-1.11)
Guan	0.0978	0.062	0.0422
	(1.12)	(0.83)	(0.57)
Gruma	-0.0441	0.0285	0.107
	(-0.58)	(0.44)	(1.66)
Mole Dagbani	0.0847	0.0302	0.00269
	-1.33	(0.55)	(0.05)
Grusi	-0.0866	0.104	0.281***
	(-1.04)	(1.46)	(3.95)
Mande	0.152	0.0345	-0.0556
	-1.35	(0.36)	(-0.58)
Region (Western=0)			
Central	-0.0392	-0.0923	-0.0811
	(-0.52)	(-1.43)	(-1.27)
Greater Accra	0.0133	-0.00419	0.00491
	(0.14)	(-0.05)	(0.06)
Volta	0.104	-0.0552	-0.159
	(1.04)	(-0.65)	(-1.88)
Eastern	-0.0495	0.00902	0.0445
	(-0.52)	-0.11	(0.55)
Ashanti	0.0105	0.0324	0.0403
	(0.12)	-0.44	(0.55)
Brong Ahafo	0.101	0.082	0.0653
	(1.13)	-1.06	(0.85)
Northern	-0.336***	-0.336***	-0.213**
	(-4.08)	(-4.75)	(-3.04)
Upper East	-0.176*	-0.340***	-0.277***
	(-1.94)	(-4.39)	(-3.59)
Upper West	0.127	-0.0687	-0.207**
	-1.44	(-0.91)	(-2.75)
Constant	-0.228*	0.0485	0.152
	(-2.29)	-0.57	(1.79)
Random Parameters			
Region (v_k)	0.0411**	0.0723*	0.051
	(0.017)	(0.039)	(0.065)
Mother effect(u_{jk})	0.038***	0.091	0.062**
	(0.002)	(0.061)	(0.021)
Constant (e_{ijk})	0.241***	0.301***	0.291*
	(0.006)	(0.009)	(0.159)
Observation	**7364**	**7364**	**7364**
ICC for region	12.8%	15.6%	12.6%
ICC for mother	11.7%	19.6%	15.4%

lr Test	80.75=0.000	65.05=0.000	12.41=0.000

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ [Standard errors in parenthesis]

Source: Computed from MICS 2011