Predictors of undernutrition and anemia among children aged 6–24 months in a low-resourced setting of Ghana: a baseline survey

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Abstract

Purpose – The purpose of this study was to identify the predictors of child undernutrition and anemia among children 6–24 months old in the East Mamprusi district, Northern region, Ghana.

Design/methodology/approach – This cross-sectional study recruited 153 children and their mothers. Weight, height and hemoglobin levels of the children were measured. A structured questionnaire based on the World Health Organization's indicators for assessing infant and young child feeding practices was used to collect data on parents' socioeconomic status, household characteristics, hygiene and sanitation practices, mothers' knowledge on feeding practices such as child's meal frequency and dietary diversity and child

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morbidity within the past two weeks. Predictors of child nutritional status were determined using multinomial logistic regression analysis.

Findings – Underweight in the children was significantly predicted by maternal knowledge on protein foods (AOR = 0.045, p = 0.008), time of initiation of complementary feeding (AOR = 0.222, p = 0.032) and maternal age (AOR = 9.455, p = 0.017). Feeding child from separate bowls (AOR = 0.239, p = 0.005), minimum meal frequency per child's age (AOR = 0.189, p = 0.007) and time of initiation of complementary feeding (AOR = 0.144, p = 0.009) were significant determinants of stunting among the children. Exclusive breast feeding (AOR = 7.975, p = 0.012) and child's past morbidity (AOR = 0.014, p = 0.001) significantly contributed to anemia among the children.

Research limitations/implications – This is a cross-sectional study and cannot establish causality. The small sample size also limits the generalizability of study findings. However, findings of the study highlight factors which could potentially influence the high rate of child undernutrition in the study setting.

Practical implications – This study identifies determinants of undernutrition in the East Mamprusi district, an underresourced area in Ghana. This information could inform the development/reformulation of locally sensitive key messages and targeted intervention strategies to curb the high levels of child undernutrition in the East Mamprusi district of Ghana.

Originality/value – This study identifies maternal care practices as key potential drivers of undernutrition in a low-resource setting known for high prevalence of child undernutrition. It suggests insight for large-scale studies on the predictors of child undernutrition in Northern Ghana and other resource-poor settings.

Keywords Child undernutrition, Anemia, Nutritional status, Infant and young child feeding practices, Children aged 6–24 months

Paper type Research paper

Introduction

Malnutrition is a major global public health problem associated with morbidity and mortality among children, especially in low- and middle-income countries [1]. The 2019 WHO-UNICEF-World Bank Group joint child malnutrition estimates in 2018 showed alarming numbers of undernourished children under five years globally with 49 million and 149 million children wasted and stunted, respectively [1]. Undernutrition is mainly driven by poor diet and infection while household food security, nutrition knowledge, caregiver's practices, institutional support, sociocultural factors and health services accessibility constitute the underlying factors [2–4]. Child undernutrition is still a public health challenge in Ghana The Northern region of Ghana had the highest rates of child undernutrition (33.1%) and anemia (82%), higher than the national average of 19% and 66%, respectively [5]. The East Mamprusi district of the Northern region reported prevalence rate of moderate to severe underweight (50%) higher than both the regional and national averages [6].

It is well documented that colostrum, the first breast milk fed to newborn infants, is essential for immune system development and prevention of disease-related undernutrition [7, 8]. Breastfeeding provides protection against infections and disease in the first six months up to the second year of life [9, 10]. The risk of undernutrition in infants increases during the complementary feeding phase [11]. Maternal/caregiver infant feeding practices are crucial during the complementary feeding phase for optimal nutrition of the infant [12]. Victor *et al.* [13] identified low parental educational level and poor economic status as significant determinants of appropriate complementary feeding practices such as meeting requirements for minimum dietary diversity and minimum meal frequency.

Undernutrition and infection are related such that infection could increase nutrient requirements and also contribute to reduced appetite and low food intake. Studies such as the WASH study [4] have revealed that children living in environments with poor water, sanitation and hygienic conditions are prone to infections and undernutrition. Multiple pathogenic parasitic infections have been shown to be associated with anemia among children in Burkina Faso [14].

In Brazil, stunting in children was found to be associated with introduction of cow's milk before the first 30 days of life, low maternal height, low socioeconomic status and poor housing [15]. Care-giving practices have also been reported to influence the nutritional status of children [16]. Al-Sobaihi *et al.* [16] found that, in Yemen, appropriate caregiving was linked to low stunting levels and underweight in children aged 59 months or less [16]. Similarly, in Northern Ghana, Glover-Amengor *et al.* [17] reported that caregivers' occupation, household size and maternal age were associated with child malnutrition. The East Mamprusi district of the Northern region is known to have a very high rate of child undernutrition in Ghana [6]. There is, however, little information on the determinants of child undernutrition in the East Mamprusi District. Identifying the predictors of undernutrition in the district could inform the formulation of specific and tailored intervention strategies to reduce the high rate of undernutrition in the district, and other low-resource settings with a high burden of child undernutrition. It is against this backdrop that this study aimed to fill the knowledge gap on predictors of undernutrition and anemia among children in East Mamprusi District, Ghana.

Methods

Study population, study design and sampling procedure

The study area and population have been described in detail in a published article by the authors [18]. In this cross-sectional study, 153 children aged 6–24 months and their mothers were randomly selected from five communities in East Mamprusi District of the Northern region of Ghana, namely, Nagboo, Langbinsi, Gbangu, Gbintiri and Sakogu. Children between 6–24 months old who were without any medical complications were included in the study. Children who had malaria, fever or any infection at the time of recruitment were excluded from the study.

Sample size

Using the formula for sample size calculation by Charan and Biswas [19], the sample size of 153 was obtained for this study [18].

Data collection

A structured questionnaire based on the World Health Organization's (WHO) indicators for assessing infants and young child feeding (IYCF) practices [20] was used to collect data on parents' sociodemographic characteristics, household characteristics, mothers' knowledge on IYCF and practice of meal frequency, hygiene and sanitation, child nutritional status, child morbidity within the past two weeks prior to the study including malaria and the child's dietary diversity.

Procedures for collection of anthropometric data on nutrition status, determination of hemoglobin levels and quality control have been described in a previously published study by the authors [18].

Anthropometric data

The UNICEF-designed infantometer was used to measure the recumbent length to the nearest millimeters. Recumbent length was measured with the child lying on the UNICEF-designed infantometer with arms by the sides and feet flat and held together with feet and head touching the foot- and head boards, respectively. A Salter scale (UK) was used to measure weight to the nearest 0.1 kg. The children were weighed without shoes and clothing. A mid-upper arm circumference (MUAC) tape was used to measure the MUAC of the children to the nearest centimeter using the nondominant arm. Classifications of undernutrition were based on WHO classifications [21]; well-nourished, moderately malnourished and severely malnourished in terms of weight-for-age (WAZ), length-for-age (LAZ) and body mass index-for-age (BMIAZ). A child was classified as well-nourished, moderately malnourished and severely malnourished if the MUAC was >12.5 cm, 11.5–12.5 cm and <11.5 cm, respectively.

Biochemical data

Venous blood samples were collected from a finger by venepuncture using sterile butterfly lancets. Care was taken in pricking children to minimize pain. A portable battery-operated electronic hemoglobin meter (URIT-12, URIT Medical Electronic Co., Ltd) was used to determine the hemoglobin levels of the children by a trained phlebotomist. The reference ranges of hemoglobin values reported were as follows; 11 g/dl or higher = normal, 10–10.9 g/dl = mild, 7–9.9 g/dl = moderate and less than 7 g/dl = severe [22].

Data quality control

The questionnaire was pretested using 10 volunteers to assess and address inaccuracies. Trained field assistants assisted with the data collection procedure. Data collection instruments were well-calibrated to minimize errors.

Data analysis

The WHO AnthroPlus vs 1.0.4 was used to compute Z-scores from anthropometric measures following which the *Z*-scores were exported into SPSS for all statistical analyses. Socio-demographic characteristics of study participants were described using frequencies and percentages. multinomial logistic regression analysis was used to determine predictors of undernutrition from independent variables including IYCF knowledge and practices. Statistical significance was set at $p < 0.05$.

Study approval

Ethical approval for this study was obtained from The Committee on Human Research, Publications and Ethics of the School of Medical Sciences, Kwame Nkrumah University of Science and Technology & the Komfo Anokye Teaching Hospital, Ghana (Ethics identification number: CHRPE/AP/436/16). Care was taken to ensure minimum discomfort to the children and their mothers at every stage of the study. Participation in the study was absolutely voluntary.

Results

Results on participants' socio-demographic characteristics were presented in a previous publication by the authors [18]. The mean age of the children was 13.26 ± 4.3 months. The majority of the households earned below US$20 (~GH¢100) per month [18].

Table 1 shows the demographic characteristics associated with anemia status among the children. Results in Table 1 indicates a significant association between household size ($p = 0.027$), type of community ($p = 0.001$), mother's occupation ($p = 0.007$) and anemia status in the children.

Results in Table 2 suggest that children fed complementary meals separately were less likely to be moderately underweight (AOR = 0.229, $p = 0.001$) compared to children who were fed from the same bowl with other family members. Mothers who had adequate knowledge of protein foods had children who were less likely to become moderately (AOR = 0.372, $p = 0.04$) or severely (AOR = 0.045, $p = 0.008$) underweight compared to children of mothers with inadequate knowledge of protein food. Children who were less than six months old before the introduction of complementary foods (AOR = 0.222, $p = 0.032$) and those who were six months old (AOR = 0.346, $p = 0.044$) were less likely to be moderately underweight than those fed complementary foods after six months. Children of mothers who were below 20 years were also found to be about nine times more likely to be moderately underweight (AOR = 9.455, $p = 0.017$) compared to the mothers who were aged above 40 years.

	Variable anemia status			
	Moderate *n* (%)	Mild *n* (%)	Normal *n* (%)	*p*-value
Child's age (months)				
6–8	2(18.2)	2(18.2)	7(63.6)	0.491
9–11	7(30.4)	6(26.1)	10(43.5)	
12–24	48(40.3)	23(19.3)	48(40.3)	
Gender				
Male	28(37.3)	12(16.0)	35(46.7)	0.382
Female	29(37.2)	19(24.4)	30(38.5)	
Mother's age at pregnancy (years)				
<20	15(46.9)	7(21.9)	10(31.3)	
20–30	28(34.1)	17(20.7)	37(45.1)	
31–40	12(46.2)	3(11.5)	11(42.3)	
Above 40	2(15.4)	4(30.8)	7(53.8)	
Mother's occupation				
Artisan	4(28.6)	3(21.4)	7(50.0)	
Professional	1(100)	0(0.0)	0(0.0)	
Trading	23(37.7)	12(19.7)	26(42.6)	0.007*
Farming	18(33.3)	12(22.2)	24(44.4)	
Others	11(47.8)	4(17.4)	8(34.8)	
Mother's educational level				
Primary/JHS	6(28.6)	2(9.5)	13(61.9)	
Secondary	4(36.4)	4(36.4)	3(27.3)	0.223
None	47(38.8)	25(20.7)	49(40.5)	
Type of community				
Rural (hamlet)	14(20.9)	17(25.4)	36(53.7)	0.001*
Peri-urban (main town)	43(50.0)	14(16.3)	29(33.7)	
Household size				
Less than 5	3(11.1)	11(40.7)	13(48.1)	
5–10	32(41.0)	13(16.7)	33(42.3)	0.027*
10–20	19(45.2)	7(16.7)	16(38.1)	
>20	3(50.0)	0(0.0)	3(50.0)	
Monthly household income (US$)				
<20	30(35.3)	14(16.5)	41(48.2)	
20–30	19(47.5)	8(20.0)	13(32.5)	
80–120	4(22.2)	6(33.3)	8(44.4)	0.501
140–180	4(40.0)	3(30.0)	3(30.0)	

Note(s): Normal, mild and moderate anemia were defined as hemoglobin values $\geq$ 11 g/dLl, 10.0–10.9 g/dL and 7.0–9.9 g/dL, respectively. *p*-values are significant at $p < 0.05$

Table 1. Anemia status among the children

Children who were fed separately from other members of the family were more likely to be moderately stunted (AOR = 0.239, p = 0.005) than those who were not fed separately. Children who were introduced to complementary foods under six months old (AOR = 0.144, p = 0.009) were less likely to be moderately stunted than those that started complementary feeding at above six months old. Timely introduction of complementary feeding at six months old (AOR = 0.224, p = 0.006) was less likely to result in severe stunting than those introduced at age over six months. Children fed fortified foods were less likely to be severely stunted (AOR = 0.286, p = 0.040). Meeting daily minimum recommended meal frequency per age of child reduced the likelihood of severe stunting (AOR = 0.189, p = 0.007) among the children (Table 3).

Variable	Moderately underweight Coef	AOR	95% CI	p-value	Severely underweight Coef	AOR	95% CI	p-value
Child fed from separate bowl								
Yes	−1.473	0.229	0.096–0.547	0.001*	−1.054	0.348	0.057–2.129	0.254
No	Reference							
Mothers' knowledge of protein foods								
Yes	−0.99	0.372	0.145–0.956	0.040*	−3.091	0.045	0.005–452	0.008*
No	Reference							
Initiation of complementary feeding								
<6 months old	−1.505	0.222	0.056–0.879	0.032*	−2.286	0.106	0.006–1.622	0.106
At 6 months old	−1.061	0.346	0.123–0.971	0.044*	−1.351	0.238	0.028–2.437	0.238
>6 months old	Reference							
Age of mother (years)								
<20	2.247	9.455	1.499–59.620	0.017*	1.095	2.989	0.275–32.53	0.369
20–30	0.054	1.056	0.214–5.204	0.947	−21.728	0.036	0.036–0.066	
31–40	0.966	2.626	0.440–15.674	0.289	−0.309	0.734	0.064–8.354	0.803
>40	Reference							

Note(s): Reference category is normal weight (−2<Score <+2), final model sig = 0.000, Goodness of fit sig = 1.000, pseudo R-square = 650, CI = confidence interval, AOR = Adjusted odds ratio, Coef = coefficient. p-values are significant at $p < 0.05$

Table 2.
Predictors of underweight in the children

Variable	Moderate stunting Coef	AOR	95% CI	p-value	Severe stunting Coef	AOR	95% CI	p-value
Child fed from separate bowls								
Yes	–1.431	0.239	0.087–0.655	0.005*	–1.065	0.345	0.107–1.107	0.074
No	Reference							
Initiation of complementary feeding								
<6 months old	–1.935	0.144	0.033–0.623	0.009*	–3.743	0.024	0.002–0.24	0.002*
At 6 months old	–0.701	0.496	0.185–1.331	0.164	–1.494	0.224	0.078–0.645	0.006*
>6 months old	Reference							
Fortification of child's food								
Yes	–0.052	0.949	0.344–2.622	0.92	–1.253	0.286	0.086–0.946	0.040*
No	Reference							
Minimum meal frequency per child's age								
Yes	–0.863	0.422	0.155–1.149	0.091	–1.668	0.189	0.056–0.63	0.007*
No	Reference							

Note(s): The reference category is: normal/no stunting. Final model = 0.000, Goodness-of-fit = 0.680, pseudo R-square = 0.230, CI = confidence interval, AOR = Adjusted odds ratio, Coef = coefficient. p-values are significant at $p < 0.05$

Table 3.
Predictors of stunting in the children

Shown in Table 4 are the predictors of anemia among the children. The children who lived with their mothers in rural communities (hamlets) had about seven times more likelihood of having mild anemia (AOR = 7.554, p = 0.001) or no anemia (AOR = 7.932, p = 0.001), respectively, compared to those living in the main towns (peri-urban). Results in Table 4 also indicate that children who were breastfed exclusively for less than six months had a higher likelihood of normal hemoglobin levels (AOR = 7.975, p = 0.012) than those exclusively breastfed for more than six months. Children with a history of morbidity in the past two weeks prior to the study were less likely to have no anemia (AOR = 0.014, p = 0.001) or mild

Variable	Mild anemia Coef	AOR	95% CI	p-value	No anemia (normal hb level)** Coef	AOR	95% CI	p-value
Type of community								
Rural (hamlet)	2.022	7.554	2.228–25.614	0.001*	2.071	7.932	2.712–23.198	0.001*
Peri-urban (main town)	Reference							
Duration of exclusive breastfeeding								
<6 months	0.928	2.530	0.295–21.726	0.397	2.076	7.975	1.572–40.445	0.012*
6 months	1.116	3.054	0.775–12.04	0.111	1.098	2.998	0.906–9.917	0.072
>6 months	Reference							
‡*Child's morbidity in the past two weeks*								
Yes	−4.503	0.011	0.002–0.054	0.001*	−4.281	0.014	0.003–0.06	0.001*
No	Reference							

Note(s): **Hb- Hemoglobin. The reference category is: Moderate anemia (Hb:7–9.9 g/dl). Final model = 0.000, Goodness-of-fit = 0.590, pseudo R-square = 0.534, CI = confidence interval, AOR = Adjusted odds ratio, Coef = coefficient. ‡Morbidity in the past two weeks including malaria episodes. *p-values are significant at $p < 0.05$

Table 4. Determinants of anemia in the children

anemia (AOR = 0.011, p = 0.001), respectively, than children who had a history of morbidity prior to the study.

Discussion

The majority of households involved in the study earned below US$20 (~GH¢100) [18] which put the majority of the mothers in the low-income category. This finding has many implications for optimal nutrition and overall wellbeing of the children. Poor households have been associated with low literacy, food insecurity, and low dietary diversity, which are linked to child undernutrition [17, 23]. Families in the lower socioeconomic brackets are less likely to frequently acquire and provide diverse foods to feed their children. Saaka *et al.* [12] found that the ability to practice appropriate IYCF and provide adequate diet is determined by household income levels. Even though the poverty rate in Ghana has fallen by more than half over the past three decades, rural poverty remains high, especially in Northern Ghana [24, 25]. Poverty levels in the study area range between 40-50% [25]. The Ghana government and her development partners have implemented some poverty eradication programs, such as the Livelihood Empowerment against Poverty program [26], however, the impact of these programs have been limited [27]. In addition, these areas have a single farming season and many households become food insecure during nonfarming periods. This could affect food availability and negatively impact on the provision of appropriate complementary foods and dietary diversity.

This study shows that the main predictors of underweight, stunting and anemia among the children were mothers' IYCF practices (such as appropriate exclusive breastfeeding, timely introduction of complementary foods, meeting minimum feeding frequency, feeding children from separate bowls, fortifying child's food). Children whose mothers practiced IYCF were less likely to be underweight, stunted or anemic compared to their cohort whose mothers did not adhere to these recommendations. Previous studies in rural communities in Ecuador indicated that appropriate breastfeeding and adequate complementary foods have protective effects on stunting in children [28]. Similarly, in rural parts of China, studies identified IYCF practices as a predictor of anemia [29, 30] in young children. Adequate knowledge of IYCF predicts correct IYCF practices [31–34]. In this study, mothers with adequate knowledge of protein-rich foods were less likely to have undernourished children. Yang *et al.* [29] also found that maternal educational status influenced child nutritional status. In our previous paper [18], we reported on how nutrition education intervention improved nutrition indicators of undernourished children among the study participants. However, this was a small-scale research study and the long-term impacts of the intervention had not been determined.

Maternal knowledge in IYCF would not necessarily translate into behavior change and practice. Other factors such as food availability, nutrient content of food, cultural norms and supporting environment have roles to play in achieving desired behavior change and sustaining the change in the long term [35]. This is consistent with findings by Saaka [36] who indicated that an improvement in the socioeconomic conditions of women is necessary to significantly improve child care knowledge and child nutritional status.

The Ghana government, with support from development partners, has implemented various nutrition interventions to curb the incidence of malnutrition, especially among children under two years, adolescent girls, pregnant women and women of reproductive age, in the study area. Some of the interventions include the growth monitoring and promotion sessions at all health facilities, micronutrient supplementation, portable water supply, sanitation and food fortification [37]. The World Food Programme also offers food-based assistance in the form of a supplementary feeding program targeting children under two years and their mothers. These strategies have resulted in a slight reduction in child wasting and underweight rates while stunting continues to increase [38]. The mixed results of the intervention efforts could be attributed to gaps in the planning and implementation of strategies such as poor coordination and harmonization of nutrition intervention programs by different agencies and limited cross-sectoral cooperation [39]. Morris *et al.* [39] identified several implementation problems such as a lack of high-level interest and weak coordination that reduced the effectiveness of the nutrition systems. This calls for more robust and targeted intervention strategies to curb the high prevalence of undernutrition in the East Mamprusi District of the Northern region of Ghana.

This is a cross-sectional study and cannot establish causality. The small sample size also limits the generalizability of study findings. However, findings of the study highlight factors which could potentially influence the high rate of child undernutrition in the study setting.

Conclusion

This study demonstrates that the key predictors of child undernutrition among the study participants were factors concerning mothers' infant and young child feeding practices. This study provides evidence on maternal care practices as key potential drivers of undernutrition in a low-resource setting known for high prevalence of child undernutrition. It provides insight for large scale studies on the predictors of child undernutrition in Northern Ghana and other resource-limited settings.

Authors' contributions: All authors contributed closely to plan and execute the study. CAA, FOM and VAA were involved in the design, data collection, data analysis and write-up; FEAH and DEK were involved in data analysis and write-up.

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