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Original Research Article

Evidences of Widespread Hunger in Gbeo Community, North East Region, Ghana; the Determinants of Malnutrition and Susceptibility to Extreme Hunger

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Abstract: ***Background:*** The global community aspires towards zero hunger and minimized prevalence of various metrics of malnutrition by 2030 and beyond. Despite mainstream routine nutrition/food surveillance interventions carried out by provincial, national and civil society bodies, the markers of global hunger are rife. This study sought to investigate with the aid of household food insecurity experience scale (HFIES) and nutrition indices, the evidence of hunger, child malnutrition and other forms of extreme household deprivation in Gbeo; a rural hard-to-reach community in the Mamprugu East Municipality, North East Region. ***Methods:*** This study was a case analysis of Gbeo community using cross-sectional modalities. Mother – child dyads from 235 systematically selected households were recruited for one-on-one interviews including anthropometric/dietary assessments. Data were obtained on household hunger (using HFIES as proxy), child (6 – 59 months) malnutrition and their potential predictors (SE characteristics, IYCF, WASH, etc.). Child anthropometric growth indices were computed in accordance with WHO (2017) revised standard protocols. ***Findings:*** Out of 235 children 34.4% were stunted, 18.8% underweight and 37.9% wasted; these are elevated above Ghana Demographic and Health Survey (GDHS) data for Northern Region, Ghana as a whole and WHO/UNICEF/World Bank (2021) latest global estimates. Four (1.8%) children had all growth failure and in 5.6% of cases, underweight co-occur with stunting and wasting. The proportion of HHs in the 3rd tertile [T3], 2nd tertile [T2] and 1st tertile [T1] of food insecurity were 33%, 29% and 38% respectively. Multiple logistic regression models showed that mean HFIES scores were higher among households that; has a female food-based decision maker [t (degrees of freedom=1, n=235) = 1.93, significance level p =.000], have not received any form of remittances within the past 12 months [t (1, 235) = 2.65, p = .016], source their food stuffs from predominantly purchasing [t (1, 235) = 2.65, p = .009] and has a caregiver or household head that is an alcoholic [t (1, 235) = 4.01, p = .000]. ***Conclusion:*** Food insecurity predicts acute child malnutrition. Social protection and economic empowerment interventions should be integrated with nutrition-based initiatives for holistic household improvement.

Keywords: Household hunger, child malnutrition, food insecurity, Ghana.

BACKGROUND

Extreme hunger, malnutrition and extreme poverty are resilient global challenges that has defied evidence-based interventions over the past decade. This is especially so in low to middle income countries. Household hunger (*measured with* level of food insecurity) is the chief of the underlying causes of malnutrition and most social protection programmes are aimed at ameliorating this cancer. The concept is an all-important factor internationally and for that matter it is at the

forefront of global agenda enshrined in the second of the Sustainable Development Goals (SDG 2 – zero hunger). In the 2020 global state of food security and nutrition, it was noted since 2014, an additional 60 million people have been plagued by hunger, according to a new estimate for 2019 (FAO, 2020). According to the world population report, about three-quarters of the world's food insecure, live in developing countries like Ghana and depend primarily on subsistence agriculture for their livelihoods and overall well-being (Birhane *et al*., 2014; Gelli *et al*., 2017).

Subsistence agriculture employs 55% of Ghana's workforce and accounts for over one-third of Ghana's GDP (Kafu, 2016). Household food insecurity has a negative effect on food consumption, including nutrient intake, dietary quality and subsequently, household members' nutritional status. The most proximate evidence of household hunger is child malnutrition. The metrics of early childhood development have been widely researched and linked to fluctuations in household hunger, socioeconomic status and upheavals associated with political insecurity (Bhandari & Chhetri, 2013; Cunha *et al*., 2018; Singh *et al*., 2016). Children who are food insecure are predisposed to poor nutritional status since they depend on inappropriate levels of food intake (Madiba *et al*., 2019).

Malnutrition manifest chiefly as growth faltering in diverse domains (i.e. wasting, stunting and underweight) as well as micronutrient deficiencies in developing countries. In 2019, over one-fifth of children under 5 years of age were stunted, 6.9 percent wasted and little under 40 million overweight, while at least 50% of children suffering from micronutrient deficiencies globally (UNICEF / WHO / World Bank Group, 2020). In Sub-Saharan Africa, an estimated 40% of children aged five (5) and below are estimated to be stunted (de Groot *et al*., 2017) with Western and Eastern Africa being worse affected. While global prevalence of malnutrition has seen some decline over the past one decade, progress is insufficient to reach the 2025 World Health Assembly targets and the SDGs timeline of 2030 (Global Nutrition Report, 2020). Target 2.1 of SDG 2 expects a 40% reduction in chronic malnutrition by 2030.

Emerging patterns reveal that worldwide progress on malnutrition is inequitable, with disparities across nations, within countries, and socio-demographic bounds. Poor to medium-resource households show a 25 to 9 malnutrition ratio relative to high wealth households. In like manner, children from rural households are 1.5 times probable to be stunted than children in urban households (GSS,UNICEF 2018). Succinct knowledge of what inform these disparities would inform precise targeting of appropriate nutrition-specific and nutrition-sensitive interventions. The greatest threat to child nutritional status is the looming, resilient and vicious cycle of resource deprivation in developing countries resulting in transient and perpetual prevalence of food insecurity in households.

Ghana's Northern Region has over one-third of all children being stunted, and this is a staggering high figure from the national stunting prevalence rate of 19 percent. The prevalence of wasting is also much higher in the northern Ghana, and at about 10% percent, the Upper East region is highest (GSS; GHS; ICF International, 2015). Experts opine that this is largely due to population growth and increasing food insecurity threats (WHO, UNICEF World Bank Group. 2017*)* as well as high rates of poverty and season delimited food security challenges (GSS, UNICEF, 2018). Also, economic nuances further highlight the geographical differences in child malnutrition in the country. The Northern region recorded a staggering 20% of underweight almost thrice that of the Greater Accra Region (GSS; GHS; ICF International, 2015).

Actions focused on prevention, such as ensuring that pregnant and lactating mothers are adequately nourished, that children receive exclusive breastfeeding during the first 6 months of life, and provision of adequate complementary feeding in addition to breastfeeding for children aged 6–23 months, can help address both stunting and wasting. Social protection programs have rapidly moved up the policy agenda both nationally and internationally to curb child nutrition through livelihood empowerment geared at guaranteeing household food security (Renzaho *et al*, 2017). Ghana introduced several social policy interventions since the 2000s which are intermittently evaluated through Ghana Poverty Reduction Strategy Reports (GPRS). Poor targeting of well-meaning strategies, based on lack of data is the bane of most hard-to-reach and rural communities. Food security concerns and malnutrition have being widely researched in the defunct Northern region of Ghana (Saaka *et al*., 2015; Saaka & Osman, 2013; Wemakor & Iddrisu, 2018). However, there is paucity of data on the food insecurity and malnutrition situation of communities in newly carved-out regions such as the North East Region.

Main Objective

This study sought to investigate with the aid of household food insecurity experience scale (HFIES) and nutrition indices, the evidence of hunger, child malnutrition and other forms of extreme household deprivation in Gbeo; a rural hard-to-reach community in the Mamprugu East Municipality, North East Region.

Specific Objectives

1. To assess the nutritional status of children 6 -59 months in selected households in Gbeo.
2. To determine the food insecurity levels in selected households using HFIES data tool.
3. To surmise the determinants of both food insecurity and child nutritional status in selected households within Gbeo.

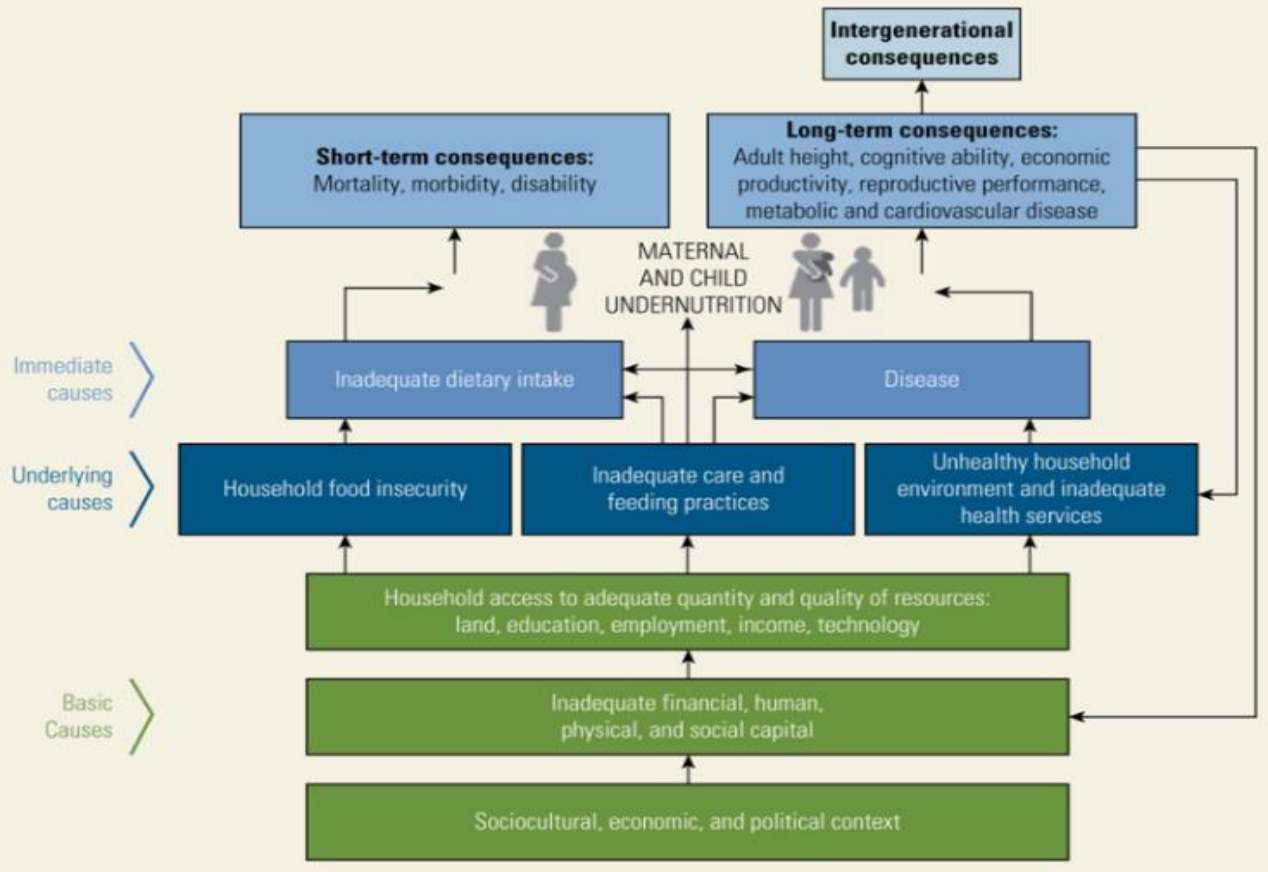

Figure 1: Conceptual illustration of the determinants of household hunger and malnutrition Adopted from (Black *et al.*, 2016)

MATERIALS & METHODS

Study design

The study was a case analysis of a single community (Gbeo) employing analytical cross-sectional study design. Two hundred and thirty-five (235) mother – child dyads were systematically recruited and engaged for one-on-one interviews to gather quantitative data. A mini census of the community was conducted on entry into the community. This involved household listing to obtain a composite sampling frame for all households. Households were the units of data collection.

Study participants and participant's selection

Nursing mothers and their children under five years were the primary study subjects and were recruited using multi-stage sampling process. Also, a peremptory sample size of 235 households was used and envisaged to provide valid data based on Krejcie and Morgan (1970) approximations.

In a mini census conducted as part of this survey, a listing of 940 households was garnered for the community. This was used as a sampling frame and subsequently every fourth house (sampling interval = 940 ÷ 235) was selected using the Chief's house as reference point. Household selection was carried out using systematic random sampling until the 235 HHs was exhausted. Eventually, mothers with children under five were purposively recruited from all selected households

Data collection methods and tools

The initial part of data collection will entail a mini census of all households taking note of mothers and their children 6 – 59 months. With the aid of a Structured Questionnaire following one-on-one interviews, data was gathered on household food insecurity and child nutritional status. These metrics were deemed the proxy measures/evidence on household hunger. In addition, the sociodemographic characteristics of participants, child food intake measures (IYCF), water, hygiene and sanitation features of HHs were tested with HFIES and child malnutrition to surmise areas of vulnerabilities that predispose to HH hunger.

Sociodemographic characteristics: Data were collected on socio-demographic characteristics of participants e.g. parity, religion, age, ethnicity, marital status, and household size as well as parental socioeconomic characteristics: educational level and occupation.

Child Food Intake assessments: Section B of the questionnaire assessed infant and young child feeding interventions (IYCF best practices) including early initiation of breastfeeding (within 1 hr postpartum *versus* after 1 hr), fate of colostrum (discarded *versus* fed to child), frequency of breastfeeding (on-demand *versus* premeditated), timely initiation of complementary feeding (at 6 months *versus* before *or* after 6^{th} month) and age-appropriate meal frequency among others. Postpartum vitamin A supplementation to children was also assessed as well as mother's receipt of IYCF training at some point in their lives.

Household Food Insecurity experience scale (HFIES): Section C involved household food insecurity measurement using household food insecurity experience scale [proxy for HH hunger]. HFIES contain nine constituent questions on household member's experiences in relation to availability and accessibility to adequate food. Each question begins with "*in the past 4 weeks*" denoting the recall period for the elements of the scale. The ending of each question "*due to lack of food or resources in the HH*" points to the shock that culminated in the problems. HFIES scale elements are (a) were you or any HH member not able to eat the kind of food you preferred (b) was a HH member forced to eat a smaller size of a meal than they needed (c) did you or any HH member have to eat fewer meals in a day [0.0.1 or 0.1.0 or 1.0.0] (d) did you or any HH member skip meals (e) did you or any HH member stay the whole day without food or drink (f) did a child in the HH skip meals (f) did a child in the HH go a whole day without food.

Each food insecurity experience question as shown in the preceding paragraph had a sub-question labelled 1a through to 6a according to the number of questions on the HFIES that was used. The sub-question is the same and proffer frequency of occurrence of participants' food insecurity experiences "how often did this happen? Always (3), sometimes (2), rarely (1) or never (0)".

Anthropometric measurements: weight (Kg), height (cm or m) and ages of children 6 -59 months were measured and used to calculate child nutrition metrics such as weight per age z-scores (WAZ), weight per height z-scores (WHZ) and height per age z-scores (HAZ). The said indices were then employed to classify child nutritional status using WHO (2017) updated protocols as shown in Table 1 (World Health Organization, 2017).

Table 1: Definition of cut-offs for nutritional status indicators

Nutrition Indicator	Z-score cut-off	Nutritional status
Weight-for-Height	Z-score less than -3 of median reference population	Severely wasted
	$-3 \leq z-score < -2$	Moderately wasted
	$-2 \leq z-score < 2$	Normal weight per height
	WHZ-score > 2	Overweight
Weight-for-Age	Less than $-3\ SD$ of median reference population	Severely underweight
	$-3 \leq z-score < -2$	Moderately underweight
	$-2 \leq z-score < 2$	Normal weight per Age
Height-for-Age	Less than $-3\ SD$ of median reference population	Severely stunted
	$-3 \leq z-score < -2$	Moderately stunted
	$-2 \leq z-score < 2$	Normal Height per Age

Operation delineation of study variables

Potential Predictor variables

The independent variables assessed and tested for relationships with the outcome variable of interest were water - hygiene – sanitation (WASH) features of households, nutrition knowledge of mothers on IYCF practices, IYCF best practices, Vitamin A status of the child, prevalence of infections in the past month and socio-demographic characteristics of mother, child and household.

Mediator/moderator variable

Household food insecurity [HFIES] was a mediator between child nutritional status and background sociodemographic and socioeconomic underpinnings of households.

Outcome Variable(s)

Nutritional status of children from the ages of 6 – 59 months and household food insecurity (*measured using HFIES*) were the outcome variables. The two indices represented evidences of hunger and resource deprivation in households assessed. Child malnutrition was largely undernutrition and assumed three forms according to the classical

nutrition indicators namely; Weight-for-Height Malnutrition (WHM), Weight-for-Age Malnutrition (WAM) and Height-for-Age malnutrition (HAM). Also, multiple coexistence of the said undernutrition indicators was also assessed.

Validity & Reliability of Data

The data tool i.e., structured questionnaire was pretested prior to the actual data collection to remove ambiguities, reword leading questions, eliminate redundant concepts and add questions for relevant emerging issues. The split half technique was used to test two sets of responses from two different communities not connected to Gbeo. A correlation of the responses of the two groups using Spearmann ranked correlation coefficient (r) showed $r = 0.82$ which denoted positive linear relationship between the two sets data.

Data Synthesis and Analysis

WHO anthro software version 3.2 was used to compute child anthropometric z-scores using the 2006 WHO child growth standards as the reference population. Also, Statistical Product and Service Solutions (SPSS) version 24.0 software was used for data analysis. Descriptive analyses were carried out on indices of child anthropometric data, sociodemographic variables of mother-child pairs, WASH characteristics and child feeding metrics.

HFIES items were scored using responses from the sub-questions. Frequency of occurrence of a particular food insecurity experience was scored as follows; (Always) was scored 3, sometimes = 2, rarely = 1 and never = 0. These were compiled into composite HFIES scores for individual households with 0 representing food secure and 18 being extremely food insecure. The scores were also ranked into tertiles to decipher HHs in lowest rank [1st tertile], median rank [2nd tertile] and highest levels of food insecurity [3rd tertile].

The strength of associations of socio-economic variables and HFIES scores was carried out through independent sample t-test. Binary logistic regressions models were adopted to compare various potential predictors with odds of malnutrition indicators i.e. stunting, wasting and CIAF. In the unadjusted model, odds of malnutrition indicators were computed across the independent variables; sociodemographic variables, WASH features of HHs, IYCF best practices, maternal education, remittances to HHs, child Vitamin A status and child's birth weight were entered into the covariate box and one nutritional status indicator was entered into the dependent variable box. In both the unadjusted and the adjusted models, the reference categories were set to ''first'' using the contrast function. In these two models, the odds ratio (OR) and 95% confidence interval (95%CI) were calculated to determine the strength of association. All statistical tests of associations were considered statistically significant when P-value < 0.05.

Ethics Statement

The anonymity of participants was ensured through the use of pre-designated household codes and pseudonyms. A signed and thumb-printed (*for those who could not read & write*) consent was obtained from child-mother pairs prior to administration of data tools with mothers acting as legal guardians of their respective children 0 – 59 months. Ethical clearance was obtained from an affiliate University (Kwame Nkrumah University of Science and Technology, KNUST). The Committee on Human Research, Publications and Ethics (CHRPE) of the School of Medical sciences of the KNUST and Komfo Anokye Teaching Hospital provided ethical oversight to the elements of this study. In every household, the informed and signed consent of participants were sought before interviews with mothers.

RESULTS

Measuring Malnutrition

Out of 235 children assessed, 34.4% (80) were stunted [severe 21.9%, moderate 12.5%]; 18.8% (44) were underweight [severe 6.3%, moderate 12.5%] and 37.9% (89) were wasted [severe 20.7%, moderate 17.2%]. These highlights anthropometric growth faltering immensely higher than GDHS data for both the Northern Region and Ghana as a whole as well as WHO/UNICEF/World Bank (2021) estimates globally. Beside this, children exhibited multiple co-existence of different domains of undernutrition: four children (1.8%) experienced 'all growth failure' defined by poor WHZ (wasting), poor WAZ (underweight) and poor HAZ (stunting) combined. A fifth of children [13 (5.6%)] contracted a combination of 'wasting and underweight' and a similar proportion were both 'stunted and underweight'. Furthermore, majority of children constituting 47.1% (145) lived with mild forms of anemia relative to those that were normal.

Table 2: Distribution of child malnutrition in Gbeo Community

Indicator of Nutritional status	Responses	Count (n)	Percent (%)
Weight per Age (Underweight & overweight measures)	Normal (-2 < WAZ-score < + 2)	111	81.3
	Moderate (-3< WAZ-score <-2)	17	12.5
	Severe (WAZ-score <-3)	9	6.3
	Normal (-2 < WAZ-score < + 2)	111	81.3
	Total	**235**	**100.0**

Indicator of Nutritional status	Responses	Count (n)	Percent (%)
Height per Age (Stunting)	Normal (-2 < HAZ-score < + 2)	90	65.6
	Moderate (-3< HAZ-score <-2)	17	12.5
	Severe (HAZ-score <-3)	30	21.9
	Total	**235**	**100.0**
Weight per Height (Wasting)	Normal (-2 < WHZ-score < + 2)	77	62.1
	Moderate (-3< WHZ-score <-2)	21	17.2
	Severe (WHZ-score <-3)	26	20.7
	Total	**235**	**100.0**
CIAF (multiple burden)	No growth failure	141	61.0
	All growth failure	4	1.8
	Wasting & underweight	13	5.6
	Stunting & underweight	13	5.6
Single Burden	Only Stunting	30	13.0%
	Only Wasting	30	13.0%
	Total	**235**	**100.0**
Anemia Status	Moderate ($7 \leq Hb \leq 10.9$)	34	47.1
	Normal (≥ 11)	38	52.9

CIAF refer to cumulative index of anthropometric growth failure. Hb is hemoglobin. WAZ; weight per age z-score. HAZ; height per age z-score. WHZ; weight per height z-score.

Socio-demographic characteristics of mother-child dyads

Most households were headed by males [124 (52.7%)] relative to those headed by females [111 (47.3%)]. The mean household size was found to be 7 persons [7.36 ± 5.17: 3 – 25]. The mean age of respondents was 34.8 (SD=6.38). Majority of respondents [68 (29.1%)] were in the age cohort 31-41 years. Respondents in the age categories 21-30 years and 41-50 years were 21.8% and 12.7% respectively. The age categories < 20 years had negligible representation (1.8%). On the socioeconomic front; 65.4% (154) of respondents were without any form of formal education. A tenth of respondents and 14.5% had basic level and Junior High education. Majority of respondents were residing in their own houses relative to being in a rented place (90.9% *vs.* 9.1%).

Table 3: Socio-demographic characteristics of Respondents & Households

Socio-demographic variable		Counts [n]	Percentage [%]
1. Gender of Respondents (n=235)			
	Male	124	52.7
	Female	111	47.3
2. Age of Respondents (n=235)			
	Less than 20 Years	4	1.8
	21-30	51	21.8
	31-40	68	29.1
	41-50	30	12.7
	51-60	56	23.6
	60+	26	10.9
3. Educational Level of Respondents (235)			
	No Education	154	65.4
	Primary	26	10.9
	JHS	34	14.5
	SHS	9	3.6
	Tertiary	13	5.5
4. Tenancy Status of Respondents (n=235)			
	Owner	214	90.9
	Tenant	21	9.1
5. Household Size (shown as mean ±SD: Min – Max)		7.36 ± 5.17 : 3 – 25	

WASH features of Households

In terms of improved water use, sanitation and hygiene assessment; majority of households obtained water from improved sources i.e. borehole [209 (89.1%)] relative to a tenth [26 (10.9%)] that obtained water from uncovered wells. Also, most households accounting for 73.6% (167) had improved sanitized environments (*defined by absence of fecal matter, houseflies and plugged drains around the household).* In addition, 85.4% (201) households had home built improved pit latrines, four (1.8%) use the community's public toilet and 12.7% (30) resort to open defecation. An assay of one of the items of the handwashing checklist showed that majority of respondents [192 (81.8%)] washed hands with soap and running water after using the toilet facility or after open defecation.

Table 4: Household Water, Sanitation & Hygiene [WASH] Conditions

WASH Feature		Counts [n]	Percentage [%]
1. Improved water sources			
	Borehole	209	89.1
	Others	26	10.9
2. Domestic Water Treatment (Boil before use)			
	Yes	103	46.9
	No	107	51.0
3. Sanitation			
	Improved	167	73.6
	unimproved	60	26.4
4. Hygiene (Toiletry)			
	Improved Home Toilet	201	85.4
	Public Toilet	4	1.8
	Bush/Open Defecation	30	12.7
5. Hand Washing after using the toilet			
	Yes	192	81.8
	No	43	18.2

Improved water sources: pipe borne, borehole, covered deep wells. Improved sanitized environment: absence of all forms of fecal matter, houseflies, stagnant drains. Improved toilets: deep covered man-hole, >=30 m from residence.

Household Food Insecurity Measurement with HFIES Scale

Household food insecurity was used as the proxy measure of household hunger with the aid of food insecurity experience scale (HFIES). On a continuum of HFIES scores from 0 through to 18 depicting increasing food insecurity; the average HFIES score for households was 12 out of an expected 18 [$\bar{x}(12.18) \pm SD(6.57)$: $\min(4) - \max(18)$]. Also, 33% (77) of households were in the 3rd and highest tertile [T3] of food insecurity relative to 38% (89) and 29% (68) of HHs in the 1st [T1] and 2nd [T2] tertiles respectively. Thus, a third of households suffered high levels of food insecurity. In addition, 29% of households were in median levels of food insecurity that had the potential to transition into severe food insecurity subject to shocks and economic instability.

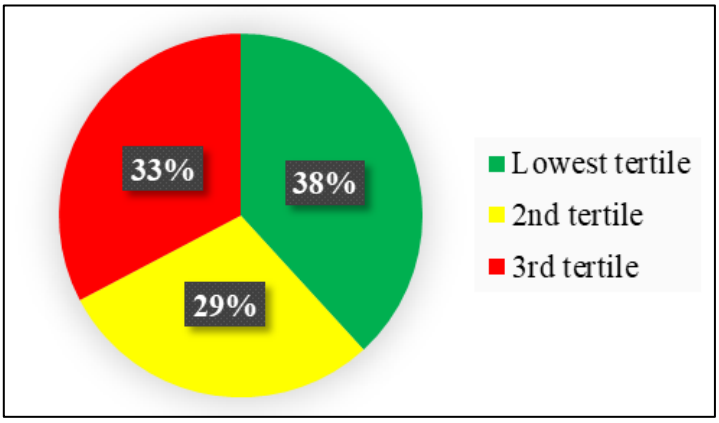

Figure 1: Distribution of households by food insecurity status

A component-by-component exposition of HFIES elements reveals that over 50% of child(ren) and members of selected HHs experience the following on a regular basis (always); 'go whole days without meals', 'skip meals', 'eat reduced portions of foods daily than expected', 'stay whole days with less food than sufficient' as well as 'ate meals that they do not prefer' as a consequence of insufficient resources in the household. Figure 2 illustrates that the instances

where children and household members never, rarely or sometimes experienced each of the HFIES scale elements was collectively less than their experience of the said elements on a regular basis.

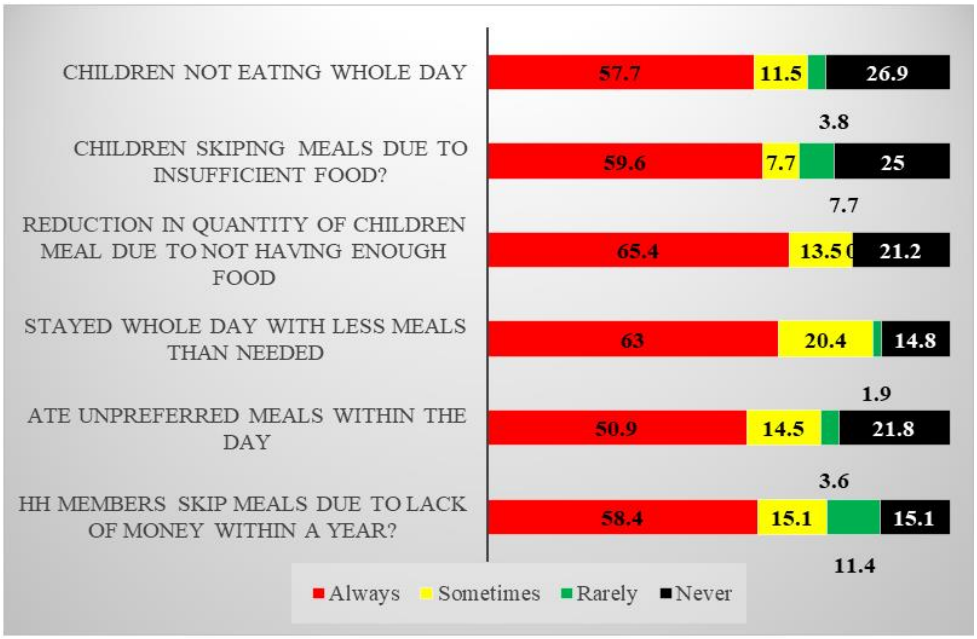

Figure 2: Component by component exposition of food insecurity in Gbeo

There were two main sources of food for households in Gbeo; majority of residents (90.9%) obtain food from subsistence farming and 9.1% from purchases. 49.1% of household reported benefitting from remittances in the last 12 months. The nature of this support was 50% of the time cash transfers and 50% of the time food items. Also, most respondents [47 (85.5%)] opined that their daily food intake was bad relative to the remaining 14.5% (8).

Seasonal analysis of food availability in households revealed that most (63.6%) become food sufficient in the fourth quarter of the year; with that proportion decreasing to 23.6% in the first quarter of the succeeding year and five percent (5.5%) in the 2nd quarter. In a reverse fashion, 46.3% of households are insufficient in the first quarter of a given year and subsequently reduces to 40.7% of HHs in the 2nd quarter. However, both food sufficiency and food sufficiency were poorly reported in the 3rd quarter owing to expected harvest and actual food insufficiency in that quarter.

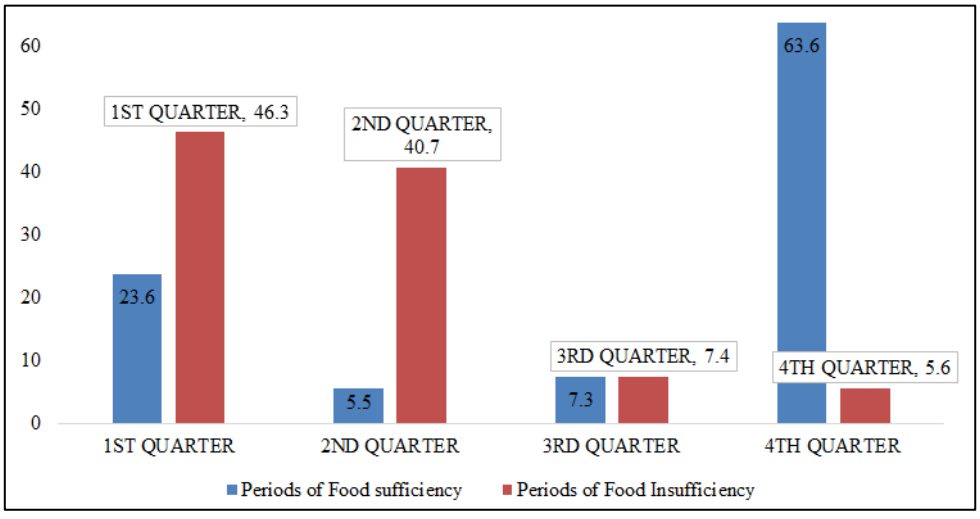

Figure 3: Distribution of at-risk periods of food insecurity per annum

Food Intake Measurements: Infant & Young Child Feeding

An assay of optimum child feeding indices showed that; most children 93.2% were breastfed, 30.8% (vs 79.2%) were put to breast within an hour of birth and 80.5% (vs 18.5%) fed colostrum to the child instead of the bad practice of expressing it away. Also, 61.6% (vs.388.4%) gave prelacteal feeds especially water and as such compromised exclusive breastfeeding. 35.3% initiated complementary feeding on the sixth month of the child's life relative to 35.2% and 29.3%

of respondents that did the said practice before and after six months respectively. Most children (60.0% vs. 40%) ate with others from the same bowl.

Table 5: Infant & Young Child Feeding indices in Gbeo

IYCF Indicators		Counts [N]	Percentage [%]
• **Ever Breastfed**			
	Yes	175	93.2
	No	60	6.8
• **Time Of Initiation Of Breastfeeding**			
	0-1 Hour	12	30.8
	1-24 Hours	17	43.6
	24+ Hours	10	25.6
• **Fate Of Colostrum**			
	Discarded It	8	18.5
	Gave It To Baby	33	80.5
• **Frequency Of Breastfeeding (Night & Day)**			
	Less Than 6 Times	2	5.0
	6-9 Times	21	52.5
	10-12 Times	13	32.5
	On Demand	4	10.0
• **Prelacteal Feeds**			
	Yes	192	61.6.
	No	43	38.4
• **Time Of Initiation Of Cf**			
	Less Than 6 Months	12	35.2
	6 Months	12	35.3
	Above 6 Months	10	29.3
• **Source Of Complementary Feeds**			
	Purchases	4	12.1
	Home Meal	29	87.9
• **Child Eats With Others From The Same Bowl**			
	Yes	21	60.0
	No	14	40.0
• **Currently Breastfeeding**			
	Yes	25	62.5
	No	15	37.5

Determinants of Household Hunger (using HFIES scores as proxy)

Household food insecurity (HFIES scores) was juxtaposed with various categorical factors using independent sample t-test to surmise potential predictors. Out of seven variables entered into the model, five were significantly associated with changes in food insecurity within households. These were (a) household decision-maker food access/purchase, (b) receipt of remittance within the past 12 months, (c) source of HH foodstuff, (d) Respondents opinion of how sufficient their meals are daily, (e) alcohol abuse among HH heads. Table 6 illustrates that mean HFIES scores were higher among households that; has a female food-based decision maker [t (degrees of freedom=1, n=235) = 1.93, significance level p =.000], have not received any form of remittances within the past 12 months [t (1, 235) = 2.65, p = .016], source their food stuffs from predominantly purchasing [t (1, 235) = 2.65, p = .009] and has a caregiver or HH head that is an alcoholic [t (1, 235) = 4.01, p = .000]. Inclusive in this list is households opine that their daily food requirements are always sufficient [t (1, 235) = 2.70, p = .007]. Households that reported that their daily food requirements were sufficient had higher food insecurity scores relative to those who reported contrary.

Table 6: HH determinants of food insecurity [HFIES]

		Food Insecurity Experience scores (HFIES)	***Inferential Statistics***	
	N	**Mean ± SD**	**t (df, n)**	**p**
Decision maker regarding HH food access				
Male/father	143	11.4 ± 6.95	1.93 (1, 235)	.000
Female/mother	92	14.5 ± 5.68		
Tenancy status of HH				

		Food Insecurity Experience scores (HFIES)	***Inferential Statistics***	
House owner	214	12.0 ± 6.51	0.22 (1, 235)	.828
Tenant	12	11.6 ± 5.38		
Receipt of Remittances to HH				
Yes	114	11.2 ± 6.73	2.44 (1, 235)	.016
No	112	13.35 ± 6.32		
Source of HH food stuff				
Farm	215	11.8 ± 6.31	2.65 (1, 235)	.009
Purchasing	17	16.17 ± 8.29		
Reported Daily HH Food Sufficiency				
Sufficient	34	14.8 ± 7.41	2.70 (1, 235)	.007
Insufficient	201	11.65 ± 6.26		
HH head or caregiver (s) takes alcohol				
Yes	56	14.9 ± 6.23	4.01 (1, 235)	.000
No	167	11.1 ± 6.22		
Educational status of caregiver				
No formal education	152	11.8 ± 6.17	1.03(1, 235)	.306
Some formal education	83	12.7 ± 7.12		

Predictors of acute, chronic malnutrition and cumulative anthropometric growth failure

Using binary logistic regression analysis, occurrence of chronic, acute and multi-indicator child malnutrition was compared to 18 key factors as shown in Table 7 for significant predictors. The results showed that breastfeeding, child's receipt of postpartum Vitamin A, timely initiation of complementary feeding and birth weight were concurrently associated with chronic and acute child malnutrition as well as multi-indicator malnutrition. Breastfed children had significantly less susceptibility to child malnutrition [i.e. stunting (RR=0.3, 95% CI, 0.2 – 0.4, p= .000); wasting (RR=0.4, 95% CI, 0.2 – 0.8, p= .025) and CIAF (RR=0.4, 95% CI, 0.3 – 0.7, p= .041)].

Also, children who had prior evidence of intrauterine malnutrition i.e. low birth weight were concurrently at increased risk of chronic, acute and multi-indicator malnutrition [i.e. stunting (RR=3.1, 95% CI, 2.3 – 4.2, p= .000); wasting (RR=2.6, 95% CI, 1.9 – 3.4, p= .026) and CIAF (RR=2.31, 95% CI, 1.8 – 2.9, p= .002)]. In addition, timely initiation of complementary feeding at six months (*versus initiation at <6months and > 6 months*) was another factor that significantly correlated with child malnutrition in all its forms {i.e. stunting [χ^2 (degrees of freedom 2, estimated sample 235) =13.5, p= .001]; wasting [χ^2 (2, 233) =7.5, p= .026] and CIAF [χ^2 (1, 107) =17.5, p= .000]. children that received postpartum vitamin A supplementation were at decreased risk of chronic malnutrition (RR=0.6, 95% CI, 0.4 – 0.8, p= .012), acute malnutrition (RR=0.3, 95% CI, 0.2 – 1.7, p= .000) and CIAF (RR=0.45, 95% CI, 0.37 – 0.55, p= .001).

Other factors pose a risk of child wasting exclusively, these were; children from households headed by a female, staying in rented homes, bad environmental sanitation and poor educational status of mother (*no formal education*). Also, the practice of open defecation (*relative to use of toilets)* increases risk of multi-indicator child malnutrition (RR=1.33, 95% CI, 0.11 – 0.94, p= .038).

Table 7: Covariates of chronic, acute malnutrition and cumulative anthropometric growth failure

		Chronic malnutrition (stunting) status			**Acute Malnutrition (Wasting) Status**			**Cumulative Anthropometric Failure**		
	Responses	**Stunted**	**Normal**	**OR (95% ci) p**	**Wasted**	**Normal**	**OR (95% CI) p**	**Multiple burden**	**Normal**	**OR (95% CI) p**
Gender	Male	23	42	1.2 (0.6 – 2.54) .588	13	44	0.3 (.1 - 0.6) .001	27	42	0.8 (0.4 – 1.6) .609
		35.4%	64.6%		22.8%	77.2%		39.1%	60.9%	
	Female	22	50		36	32		32	40	
		30.6%	69.4%		52.9%	47.1%		44.4%	55.6%	
Food expenditure decision maker	Father	25	56	0.8(0.4 – 1.7) .583	32	41	1.6 (0.7 – 3.4) .265	39	46	1.5 (0.7 – 3.05) .295
		30.9%	69.1%		43.8%	56.2%		45.9%	54.1%	
	Mother	20	36		17	35		20	36	

	Responses	Chronic malnutrition (stunting) status			Acute Malnutrition (Wasting) Status			Cumulative Anthropometric Failure		
		Stunted	Normal	OR (95% ci) p	Wasted	Normal	OR (95% CI) p	Multiple burden	Normal	OR (95% CI) p
		35.7%	64.3%		32.7%	67.3%		35.7%	64.3%	
Tenancy	House Owner	37	84	0.4 (0.15 – 1.3) .157	40	73	0.2 (0.05 – 0.7) .011	51	74	0.7 (0.2 – 1.9) .592
		30.6%	69.4%		35.4%	64.6%		40.8%	59.2%	
	Tenant	8	8		4	3		8	8	
		50.0%	50.0%		57.1%	42.9%		50.0%	50.0%	
Received remittance from others	Yes	16	45	0.7 (0.3 – 1.5) .440	14	43	0.4 (0.1 – 0.8) .013	21	44	06 (0.2 – 1.1) .115
		26.2%	73.8%		24.6%	75.4%		32.3%	67.7%	
	No	24	47		30	33		33	38	
		33.8%	66.2%		47.6%	52.4%		46.5%	53.5%	
Cleanliness of HH environment	Good	13	19	1.7 (0.8 – 4.1) .191	30	63	0.4 (0.2 – 0.9) .047	37	64	0.6 (0.2 – 1.25) .171
		40.6%	59.4%		32.3%	67.7%		36.6%	63.4%	
	Bad	28	73		15	13		18	18	
		27.7%	72.3%		53.6%	46.4%		50.0%	50.0%	
Child is Breastfed	Yes	41	84	0.3 (0.2 – 0.4) .014	45	72	0.4 (0.2 – 0.5) .025	55	70	0.4 (0.3 – 0.54) .041
		32.8%	67.2%		38.5%	61.5%		44.0%	56.0%	
	No	4	0		4	0		4	0	
		100.0%	0.0%		100%	0.0%		100.0%	0.0%	
Fate of Colostrum	Discarded	4	18	0.4 (0.1 – 1.1) .088	9	13	1.0 (0.4 – 2.6) .574	13	9	1.9 (0.7 – 4.9) .240
		18.2%	81.8%		40.9%	59.1%		59.1%	40.9%	
	Fed to the child	41	66		36	59		46	61	
		38.3%	61.7%		37.9%	62.1%		43.0%	57.0%	
Eat with others from the same bowl	Yes	19	44	1.2 (0.5 – 2.8) .830	26	29	1.9 (0.8 – 4.5) .151	24	39	0.7 (0.3 – 1.5) .431
		30.2%	69.8%		47.3%	52.7%		38.1%	61.9%	
	No	12	33		14	31		21	24	
		26.7%	73.3%		31.1%	68.9%		46.7%	53.3%	
Child introduced to family foods	Yes	27	59	0.7 (0.3 – 1.7) .451	32	50	0.6 (0.5 – 0.7) .001	41	45	1.3 (0.5 – 3.4) .637
		31.4%	68.6%		39.0%	61.0%		47.7%	52.3%	
	No	9	13		0	18		9	13	
		40.9%	59.1%		0.0%	100%		40.9%	59.1%	
Child received postpartum vitamin A	Yes	45	63	0.6(0.4 – 0.7) .012	32	72	0.3 (0.2 – 1.7) .000	59	49	0.4 (0.3 – 0.5) .001
		41.7%	58.3%		30.8%	69.2%		54.6%	45.4%	
	No	0	9		9	0		0	9	
		0.0%	100.0%		100.0%	0.0%		0.0%	100.0 %	
Mother received IYCF education	Yes	25	68	0.49 (0.2 – 1.2).159	37	52	0.7 (0.3 – 1.8) .493	39	54	0.9 (0.4 – 2.2) .550
		26.9%	73.1%		41.6%	58.4%		41.9%	58.1%	
	No	12	16		12	12		12	16	
		42.9%	57.1%		50.0%	50.0%		42.9%	57.1%	
Educational status	No formal education	32	52	1.9(0.8 – 4.1) .135	17	63	9.1 (0.05-0.3) .000	36	52	0.9 (0.4 – 1.8) .860
		38.1%	61.9%		21.3%	78.8%		40.9%	59.1%	
	Formally educated	13	40		32	13		23	30	
		24.5%	75.5%		71.1%	28.9%		43.4%	56.6%	
Water source	Unimproved	4	4	2.2 (0.5 – 9.0) .438	4	4	1.6 (0.4 – 6.7) .711	4	4	1.4 (0.3 – 5.92) .720
		50.0%	50.0%		50.0%	50.0%		50.0%	50.0%	
	Improved	41	88		45	72		55	78	
		31.8%	68.2%		38.5%	61.5%		41.4%	58.6%	
Toilet	Open Defecation	5	18	0.5 (0.2 – 1.5) .330	13	10	2.38 (0.9 – 5.9) .09	5	18	1.3 (0.11 – 0.9)

	Responses	Chronic malnutrition (stunting) status			Acute Malnutrition (Wasting) Status			Cumulative Anthropometric Failure		
		Stunted	Normal	OR (95% ci) p	Wasted	Normal	OR (95% CI) p	Multiple burden	Normal	OR (95% CI) p
										.038
		21.7%	78.3%		56.5%	43.5%		21.7%	78.3%	
	Improved KVIP	40	74		36	66		54	64	
		35.1%	64.9%		35.3%	64.7%		45.8%	54.2%	
Household food source	Purchasing	4	4	2.2 (0.5 – 9.0) .431	4	4	1.6 (0.4 – 6.7) .711	4	4	1.4 (0.3 – 5.9) .720
		50.0%	50.0%		50.0%	50.0%		50.0%	50.0%	
	The farm	41	88		45	72		55	78	
		31.8%	68.2%		38.5%	61.5%		41.4%	58.6%	
Early initiation of breastfeeding	Within 1 Hr of birth	25	64	0.5 (0.2 – 1.1) .094	36	53	1.43 (0.6 – 3.5) .508	39	50	0.9 (0.4 – 2.1) .552
		28.1%	71.9%		40.4%	59.6%		43.8%	56.2%	
	After 1 Hr of birth	16	20		9	19		16	20	
		44.4%	55.6%		32.1%	67.9%		44.4%	55.6%	
Timely initiation of complementary feeding*	< 6 months	16	21	*13.5(1, 107) .001	13	20	*7.5 (2, 99) .024	25	12	*17.5 (1, 107) .000
		43.2%	56.8%		39.4%	60.6%		67.6%	32.4%	
	At 6 months	16	49		23	38		21	44	
		24.6%	75.4%		37.7%	62.3%		32.3%	67.7%	
	> 6 months	5	0		5	0		5	0	
		100.0%	0.0%		100.0%	0.0%		100.0%	0.0%	
Birth weight	< 2.5 Kg	8	0	3.1 (2.3 – 4.19) .000	4	0	2.6 (1.9 – 3.4) .026	8	0	2.3 (1.8 – 2.9) .002
		100.0%	0.0%		100.0%	0.0%		100.0%	0.0%	
	2.5 + Kg	29	61		33	53		39	51	
		32.2%	67.8%		38.4%	61.6%		43.3%	56.7%	

DISCUSSION OF FINDINGS

Food insecurity and attendant household hunger are globally recognized as immense population nutrition and public health challenges. In this current study food insecurity and its immediate consequence of household hunger was rife in Gbeo community (*rural*). The proportion of HHs in the 3rd tertile [T3], 2nd tertile [T2] and 1st tertile [T1] of food insecurity were 33%, 29% and 38% respectively. Deductively, a third of HHs were in T3; and the 28% in the median tertile [T2] holds the potential to be severely food insecure with the least shock. Relatively, the situation seem better in the Northern Region (54%) (Saaka & Osman, 2013), a closer province to the study district. Also, similarly dire food insecurity situations are observed in other low income countries [82% in Cambodia (McDonald *et al*., 2015), 69% in West Oromia Ethiopia (Berra, 2020) 75.8% in Semi-arid Kenya (Bukania *et al*., 2014)]. However, these figures are subject to time and study deisgn differences as well as sample size. In most developing countries including the Ghanaian context food insecurity is rife (Birhane *et al*., 2014; Gelli *et al*., 2017). The chief driver is subsistence production coupled with transient unemployment as a result of dry season. In Ghana alone, 55% of food insecurity is attributed to low volume production connected to subsistence farming (Kafu, 2016). In support of this, this current study's result show that 90.1% of household food was from subsistent production.

This present study showed that household hunger (HFIES scores) varied significantly with receipt of remittances (none), HH food decision-maker (*being* female), source of HH food stuff (purchasing [relative to production]) and alcoholism among HH heads. These factors underscore a socioeconomic nuance in relation to food insecurity in tandem with (Mutisya *et al*., 2015). Socioculturally, there are hardly any female-headed households in Gbeo unless the male-figure is deceased forcing impoverish mothers to assume bread winner roles. Also, the odds of food insecurity were highly affiliated with HHs that procured food stuffs through purchasing relative to those that produce their foods. Essentially, the occurrence of an extended period of dry season creates transient food shortages spanning six months that affects buyers of foods than producers (Quaye, 2008; Saaka & Osman, 2013). Buyers are at the mercy of the economic realms of supply and demand.

Evidence shows that the three indices of child growth faltering i.e. stunting, wasting and underweight are functions of household food insecurity (Mutisya *et al*., 2015; Saaka & Osman, 2013; Berra, 2020; Suara *et al*., 2022). In

this present study, food insecurity was found to be positively correlated with acute malnutrition in children. Similar studies corroborated this finding (Suara *et al*., 2022; Motbainor *et al*., 2015). In other studies, food insecurity rather predicts maternal thinness and anemia status (McDonald *et al*., 2015) portraying that children might be shielded via household changes in HH food distribution modalities in favor of children. Food insecure households have limited access to foods (*ceteris paribus*) which could necessitate deleterious coping measures and meal frequency alterations that compromises food/nutrient intakes and subsequent nutritional status.

Malnutrition indices are distal but no less representative metrics of household hunger. Out of 235 children 34.4% were stunted, 18.8% underweight and 37.9% wasted; these are elevated above GDHS data for Northern Region, Ghana as a whole and WHO/UNICEF/World bank (2021) latest global estimates. According to De Onis and his colleagues on prevalence thresholds; stunting, wasting and underweight levels measured in this study exceeds 15% benchmark that requires urgent public health intervention (De Onis *et al*., 2019). Also, this current study revealed instances of cumulative anthropometric growth failures in children i.e. four (1.8%) children had all growth failure and in 5.6% of cases, underweight co-occur with either stunting or wasting. Log regression analysis linked the practice of breastfeeding, child's receipt of postpartum Vitamin A, timely initiation of complementary feeding and birth weight to both single-indicator (chronic and acute) and multi-indicator child malnutrition.

CONCLUSION

In a nutshell, a third of households are in severe realms of food insecurity with 29% in median levels holding the potential to for future food insecurity with the least shock. Very high prevalence of chronic (34.4%) and acute malnutrition (37.9%) were found among children. Higher scores of HFIES were associated with higher odds of acute malnutrition. To reduce household hunger and malnutrition, nutrition professionals and other duty bearers ought to juxtapose optimum IYCF practices, with social protection, women empowerment and community-based dry season livelihood improvement ventures.

Competing interests

I together with the team of co-authors declare that there were (are) no competing interests associated with this study.

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Author's Contributions to the Study

Authors VA, VAA and NDA conceived the study and pooled resources and institutional human man-power to bring it to fruition. HBS drafted and added suggested inputs to the report. EKD, VAA, NDA and JA reviewed the report. EA and HBS corroborated statistical and context-specific data analysis. MA managed community engagement sessions and data collection exercise.

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REFERENCES

- Ghana Statistical Service [GSS] & UNICEF (2018). Multiple Indicator Cluster Survey (MICS2017/18). *Survey Findings Report.[Google Scholar]*.
- Berra, W. G. (2020). Household Food Insecurity Predicts Childhood Undernutrition: A Cross-Sectional Study in West Oromia (Ethiopia). *Journal of Environmental and Public Health*, *2020*. https://doi.org/10.1155/2020/5871980
- Bhandari, T. R., & Chhetri, M. (2013). Nutritional status of under five year children and factors associated in Kapilvastu District, Nepal. *J Nutr Health Food Sci*, *1*(1), 1–6.
- Birhane, T., Shiferaw, S., Hagos, S., & Mohindra, K. S. (2014). Urban food insecurity in the context of high food prices: a community based cross sectional study in Addis Ababa, Ethiopia. *BMC Public Health*, *14*(1), 1–8.
- Black, R., Laxminarayan, R., Temmerman, M., & Walker, N. (2016). *Disease Control Priorities, Third Edition (Volume 2): Reproductive, Maternal, Newborn, and Child Health*. Washington, DC: World Bank.

https://doi.org/10.1596/978-1-4648-0348-2

- Bukania, Z. N., Mwangi, M., Karanja, R. M., Mutisya, R., Kombe, Y., Kaduka, L. U., & Johns, T. (2014). Food insecurity and not dietary diversity is a predictor of nutrition status in children within semiarid agro-ecological zones in Eastern Kenya. *Journal of Nutrition and Metabolism*. https://doi.org/10.1155/2014/907153
- Cunha, M. P. L., Marques, R. C., & Dórea, J. G. (2018). Child nutritional status in the changing socioeconomic region of the northern Amazon, Brazil. *International Journal of Environmental Research and Public Health*, *15*(1), 15.
- De Onis, M., Borghi, E., Arimond, M., Webb, P., Croft, T., Saha, K., De-Regil, L. M., Thuita, F., Heidkamp, R., Krasevec, J., Hayashi, C., & Flores-Ayala, R. (2019). Prevalence thresholds for wasting, overweight and stunting in children under 5 years. *Public Health Nutrition*, *22*(1), 175–179. https://doi.org/10.1017/S1368980018002434
- FAO. (2020). Food Security and Nutrition in the World. In *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*.
- Gelli, A., Becquey, E., Ganaba, R., Headey, D., Hidrobo, M., Huybregts, L., Verhoef, H., Kenfack, R., Zongouri, S., & Guedenet, H. (2017). Improving diets and nutrition through an integrated poultry value chain and nutrition intervention (SELEVER) in Burkina Faso: study protocol for a randomized trial. *Trials*, *18*(1), 1–16.
- Groot, R., Palermo, T., Handa, S., Ragno, L. P., & Peterman, A. (2017). Cash Transfers and Child Nutrition: Pathways and Impacts. *Development Policy Review*, *35*(5), 621–643. https://doi.org/10.1111/dpr.12255
- GSS; GHS; ICF International. (2015). Ghana demographic health survey. *Demographic and Health Survey 2014*, 530.
- Kafu, G. Y. (2016). *Micro-Finance And Poverty Alleviation Of Rural Agricultural Households In The Hohoe Municipality*. University of Ghana.
- McDonald, C. M., McLean, J., Kroeun, H., Talukder, A., Lynd, L. D., & Green, T. J. (2015). Household food insecurity and dietary diversity as correlates of maternal and child undernutrition in rural Cambodia. *European Journal of Clinical Nutrition*. https://doi.org/10.1038/ejcn.2014.161
- Motbainor, A., Worku, A., & Kumie, A. (2015). Stunting is associated with food diversity while wasting with food insecurity among underfive children in East and West Gojjam Zones of Amhara Region, Ethiopia. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0133542
- Mutisya, M., Kandala, N. B., Ngware, M. W., & Kabiru, C. W. (2015). Household food (in)security and nutritional status of urban poor children aged 6 to 23 months in Kenya Global health. *BMC Public Health*, *15*(1). https://doi.org/10.1186/s12889-015-2403-0
- Quaye, W. (2008). Food security situation in northern Ghana, coping strategies and related constraints. *African Journal of Agricultural Research*, *3*(5), 334–342.
- Report, G. N. (2020). 2020 Global Nutrition Report: Action on equity to end malnutrition. Bristol, UK: Development Initiatives. *The Global Nutrition Report's Independent Expert Group*, 168.
- Saaka, M., Larbi, A., Hoeschle-Zeledon, I., & Appiah, B. (2015). *Child malnutrition in northern Ghana: evidence, factors and recommendations from a new study*.
- Saaka, M., & Osman, S. M. (2013). Does Household Food Insecurity Affect the Nutritional Status of Preschool Children Aged 6–36 Months? *International Journal of Population Research*. https://doi.org/10.1155/2013/304169
- Singh, H., Chaudhary, V., Joshi, H. S., Upadhyay, D., Singh, A., & Katyal, R. (2016). Sociodemographic correlates of nutritional status of under-five children. *Muller J Med Sci Res*, *7*, 44–49.
- Suara, S. B., Ziblim, S., Abukari, S., & Sarpong, N. N. (2022). *Household Food Insecurity is a Predictor of Acute Malnutrition but Not Chronic Malnutrition among Children (6-59 Months Old): A Cross- Sectional in Tamale South Constituency*. *3987*(2), 31–36. https://doi.org/10.36346/sarjms.2022.v04i02.002
- UNICEF / WHO / World Bank Group. (2020). *Joint Child Malnutrition Estimates Key Findings*. 16.
- Wemakor, A., & Iddrisu, H. (2018). Maternal depression does not affect complementary feeding indicators or stunting status of young children (6–23 months) in Northern Ghana. *BMC Research Notes*, *11*(1). https://doi.org/10.1186/s13104-018-3528-x
- *World Health Organisation WHO, United Nations Children's Fund UNICEF World Bank Group. 2017. Joint Child Malnutrition Estimates. WHO Library Cataloguing-in Publicati - Bing*. (n.d.).
- World Health Organization. (2017). Guideline: assessing and managing children at primary health-care facilities to prevent overweight and obesity in the context of the double burden of malnutrition Updates for the Integrated Management of Childhood Illness (IMCI). In *Who*.