European Journal of Nutrition & Food Safety

Volume 17, Issue 1, Page 96-108, 2025; Article no.EJNFS.129522
ISSN: 2347-5641

Household Dietary Diversity and Its Influence on Preschoolers' Nutritional Status in Tamale Metropolis, Ghana

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Authors' contributions

This work was carried out in collaboration between both authors. Authors WMN and MA designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author WMN managed the analyses of the study and literature searches. Both authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/ejnfs/2025/v17i11622

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/129522

Original Research Article

Received: 02/11/2024
Accepted: 08/01/2025
Published: 11/01/2025

ABSTRACT

Introduction: Household dietary diversity serves as a simple indicator of various parameters that affect the nutrition of people. Food security has three important aspects (availability, access, and utilization). Household accessibility to food has also been shown to be affected by demographic and socioeconomic factors, accounting for variations in diet quality. This study aimed to determine

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Cite as: *Nyango, Wahabatu Mohammed, and Mustapha Alhassan. 2025. "Household Dietary Diversity and Its Influence on Preschoolers' Nutritional Status in Tamale Metropolis, Ghana". European Journal of Nutrition & Food Safety 17 (1):96-108. https://doi.org/10.9734/ejnfs/2025/v17i11622.*

the relationship between preschoolers' household dietary diversity and their nutritional status in the Tamale Metropolis.

Methods: A cross-sectional survey was used to obtain data from 357 caregiver-preschooler pairs from three randomly selected communities in Tamale Metropolis. Structured questionnaires were used to collect data on the demographic and nutritional status of the preschoolers. Dietary data for preschoolers and households were obtained using a single 24-hour recall method. Height and weight measurements of preschoolers were collected on anthropometric indices (weight-for-height, weight-for-age, and height-for-age). The relationships between the independent variables (household dietary diversity) and dependent variables (weight-for-age, weight-for-height, and height-for-age) were examined using the statistical analysis test to assess the strength of the relationship. The data were collected between December 2022 and January 2023.

Results: The results indicated that preschoolers consumed more starchy staples than other food groups. Dairy, egg, and meat products were the least consumed. Households had a mean household dietary diversity of 6.7059 ± 1.23 out of 12 food groups, and about 84.3% of the households had minimum dietary diversity. The finding from this study showed 22.1% stunting, 7.8% wasting and 14.3% underweight. No significant relationship was found between dietary diversity and height-for-age and weight-for-height nutritional status. However, there was a significant relationship between the age of the child and being stunted (P = .00) and underweight (P = .00).

Conclusion: These results show no significant relationship between household dietary diversity and preschoolers' nutritional status. Therefore, there should be improvements in household food security, maternal knowledge of balance, and hygienic food practices.

Keywords: Preschoolers; diet; household; dietary diversity; food; nutritional status; relationship; Tamale Metropolis.

ABBREVIATIONS

BMI : Body Mass Index
CDDS : Child Dietary Diversity Score
DDS : Dietary Diversity Score
DHS : Demographic and Health Survey
FAO : Food and Agricultural Organization
FCS : Food Consumption Score
FV : Food Variety
GDHS : Ghana Demographic and Health Survey
GSS : Ghana Statistical Service
HAZ : Height-for-Age Z-score
HDDS : Household Dietary Diversity Score
LDD : Low Dietary Diversity
MDD : Minimum Dietary Diversity
MDG : Millennium Development Goal
MICS : Multiple Indicator Cluster Survey
NGO : Non-Governmental Organization
SD : Standard deviation
SDG : Sustainable Development Goal
SPSS : Statistical Package for the Social Sciences
WAZ : Weight-for-Age-Z-score
WHO : World Health Organization
WHZ : Weight-for-Height-Z-score

1. INTRODUCTION

"Household dietary diversity serves as a simple indicator of various parameters that affect people's nutrition" (Bezerra & Sichieri, 2011). "Food security has three important aspects (availability, access, and utilization)" (Leyna et al., 2010). "Dietary diversity has been positively linked to three pillars of food security" (Hillbruner & Egan, 2008).

Seasonality, location, climate, and agricultural practices are among the factors affecting food availability in any locality (Swindale & Bilinsky, 2006). Household accessibility to food has also been shown to be affected by demographic and socioeconomic factors, accounting for variations in dietary quality (Bernal & Lorenzana, 2003).

In Ghana, almost one in five preschoolers is underweight (11%) and severely underweight (3%). Nearly a quarter of preschoolers (19%) are stunted or too short for their age, and 5 percent are wasted or too thin for their age (Ewusie et al., 2014). This information poses a severe challenge to Ghana's public health and to the development of high-quality human resources for national development. The results of the 2014 Ghana Demographic and Health Survey clearly demonstrated that Ghana failed to achieve the Millennium Development Goal 1 (MDG 1) target, attaining a prevalence rate of 1.8% (Ewusie et al., 2014). The prevalence rate of malnutrition among preschoolers in northern Ghana has

been found to be the highest, apparently because of the high rate of poverty and illiteracy.

"Research has shown that the northern region of Ghana is still far from achieving the MDG 1 target of attaining a 1.8% malnutrition prevalence rate, as stunting, underweight, and wasting prevalence rates among children are 27%, 25%, and 13% respectively" (Mutiso, 2017).

Among other factors that have been found to influence preschoolers' nutritional status are the mothers' characteristics, ranging from health and feeding habits to socioeconomic background. Children born to thin mothers (BMI < 18.5) are more than four times as likely to be underweight (22%) as children born to obese mothers (5%) (Hotz & Brown, 2004). "Children living in rural areas are more likely to be underweight than those living in urban areas (13% and 9%, respectively). Children whose mothers have secondary or higher education are the least likely to be underweight (8%) and stunted (9%) compared with children whose mothers have no education" (Hotz & Brown, 2004).

In view of these complexities, the current study sought to test the relationship between household dietary diversity and the nutritional status of preschoolers in Tamale Metropolis.

2. MATERIALS AND METHODS

2.1 Study Design

"This study used a cross-sectional design, which allowed data collection at a single point in time. This design was chosen because it is economical to conduct in a situation where resource constraints such as money, labor, and time exist" (Lumole, 2013). The study had a cross-sectional design.

2.2 Study Area

This study was conducted in the Tamale Metropolis, one of the 26 districts in the northern region of Ghana. There are 115 metropolitan communities. The population of the metropolis is youthful, with 36.4% under the age of 15 years (Malapit & Quisumbing, 2015). Children constituted the largest proportion of households, accounting for 40.4%, and heads of households constituted 16.1%.

2.3 Study Population

The sample consisted of preschoolers and their respective mothers in Tamale metropolitan area. This particular group was selected because it is the most vulnerable in terms of nutrition and food insecurity (Burke & Shields, 2005). It also reflects the overall nutritional status and poverty level of a given population (Nestle, 2001).

2.4 Sampling

2.4.1 Sample size

The sample consisted of 357 mother-preschooler pairs. This was determined using the formula of Khalili et al., (2014), and a random sampling technique was used to obtain respondents.

2.4.2 Sampling procedures

Different sampling techniques were used. Three communities participated. Dungu was far from Tamale Township, Nyohini was nearest, and Moshi Zongo was at the center. Simple random sampling was employed to obtain a proportionate number of households with the desired characteristics. A total of 122, 120, and 115 households were selected from Dungu, Nyohini, and Moshi Zongo, respectively. A list of households with women bearing children under five years of age from each community was used to select households, resulting in 357 households.

2.5 Data Collection

Data was collected using structured questionnaires with open-ended and closed-ended questions. Data was collected during the household visits. Interviews and anthropometric measurements were conducted with preschoolers. All the data were collected between December 2022 and January 2023.
The components of the questionnaire included the following:

2.5.1 Socio-demographic characteristics

These included background information on the respondents' age, sex, occupation, and marital status, among others.

2.5.2 Household dietary diversity

"Household dietary diversity data were collected using a 24-hour dietary intake recall" (Oldewage-Theron et al., 2005). "The information collected on dietary consumption allowed for the calculation of dietary diversity score (DDS), defined as the number of different food groups

consumed by family members over 24 hours. Dietary data were collected using a validated 24-hour recall which was not quantified. Research assistants visited their homes during the survey. As most women cook household meals at home, it was assumed that they had a good ability to remember food eaten" (Steyn et al., 2006).

"A list of meals, dishes, and all food items and beverages consumed in the last 24 hours was recorded. Although using 24-hour recall period does not provide an indication of an individual's habitual diet, it does provide an assessment of the diet at the population level and can be useful for monitoring progress or target interventions" (Savy et al., 2005). "A recall period of 24-hour was chosen for this study because it is less subject to recall errors, less cumbersome for the respondent, and conforms to the recall time period used in many dietary diversity studies" (Ruel, 2003). Participants were asked to provide a full description of the ingredients in the mixed dishes.

2.5.3 Anthropometric measurements of preschoolers

Anthropometric measurements of height/length and weight were used in the computation of nutritional status indices, namely, weight-for-age, weight-for-height, and height-for-age.

2.5.4 Height/length

Anthropometric measurements of length and height were performed. All measurements were recorded at one decimal place. Length measurements were taken with a preschooler lying correctly on an infantometer. Length measurements were taken for preschoolers aged 2 years who could not stand properly for a correct height measurement or preschoolers aged slightly above 2 years who were sick, could not stand properly, or were too frightened to stand on an infantometer. Where length was measured for preschoolers above two years, 0.7 cm was subtracted from the measurement to convert it to height. Height measurements were taken for preschoolers over two years using an infantometer. Height was measured when the children were standing straight with their feet together, buttocks, and lower back touching the wall (infantometer); preschoolers looking straight ahead without footwear, and with long hair well positioned. Length and height were measured as the distance from the lowest point on the floor (or the head/foot piece of an infantometer) to the highest point on the head.

2.5.5 Weight

The weight of each preschooler was measured and recorded to the nearest 0.1 kg. Measurements were taken for preschoolers older than two years who could stand erect on the scale in the standing position. A preschooler 2 years' who could not stand erect weight was taken by tare weighing. This was done by weighing the mother alone, and the 2 in 1 button was pressed to tare the preschooler with minimal clothing was given to the mother while on the scale, and the new weight was read and recorded. All weights were recorded with minimal movements of the subjects on a scale and minimal clothing acceptable for the situation.

2.5.6 The nutritional status indices

"The most common nutritional indices used to assess the nutritional status of preschoolers in this study were the weight-for-age z-score (WAZ), height-for-age z-score (HAZ) and weight-for-height z-score (WHZ). Preschoolers whose WHZ, WAZ or HAZ less than < -3SD were classified as being severely wasting, underweight or stunting while those whose WHZ, WAZ or HAZ laid between -3SD and -2SD of the standard were regarded as moderately wasting, underweight or stunting respectively" (WHO, 2004). "Preschoolers with WHZ, WAZ, or HAZ between -2SD and -1SD were considered mildly wasted, underweight, or stunted, respectively. Preschoolers whose WHZ, WAZ, or HAZ laid between -1SD and +2SD were classified as normal, whereas those lying between +2SD and +3SD were considered overweight" (WHO, 2004).

2.6 Data Processing and Analysis

The data were entered into the IBM Statistical Package for Social Sciences (SPSS) version 21. Anthropometric indices (WAZ, WHZ, and HAZ) were computed using WHO Anthro software version 3.2.2. Data were analyzed using descriptive statistics (mean, frequency, percentage, and cross tabulation). The means of the measured variables were compared between the two study locations. Relationships between categorical variables such as household and preschooler dietary diversity and stunting, wasting, and underweight categories were

assessed using the chi-square (χ^2) test. The level of significance was set at P = 0.05.

3. RESULTS

3.1 Descriptive Data

In this study, 122 households from Dungu (122), Nyohini (120), and Moshi Zongo (115) participated, resulting in a total of 357.

3.2 Household Food Consumption and Dietary Diversity

Household food consumption and dietary diversity were defined as food groups consumed by households within the past 24-hour period. All households (100%) consumed foods made from cereals (maize, millet, rice, wheat), and 99.7% consumed vegetables including vitamin "A" rich vegetables and tubers, dark green leafy vegetables (mostly *bra* and *ayoyo* leaves), and other vegetables (carrot, sweet potato, tomatoes, onion, pepper, okro, and garden eggs). Almost all (99.7%) households consumed food made from fish and seafood, 99.7% and 99.2% consumed sweet and spices (condiments, beverages), and 52.1% consumed oil and fats (mostly palm kernel oil and palm oil). More than half (55.7%) of households consumed legume nuts and seeds. However, fruits (vitamin "A" rich fruit and other fruits), roots and tubers, eggs, meat (including organ meat), and dairy products were less frequently consumed food groups (Table 1).

The mean dietary diversity for the household was 6.71 (±1.2) food groups out of the 12 food groups. Approximately 84% of households were classified as meeting the minimum dietary diversity based on consuming foods from at least six or more food groups within a 24-hour recall (Table 2).

3.3 Food Groups Consumed and Dietary Diversity of Children

Starchy staples, flesh, meat, and fish were the most consumed food groups, with all children consuming them at least once within the past 24-hour period. Other commonly consumed food groups were fruits and vegetables (61.3%), legumes, nuts and seeds (54.9%), vitamin "A" rich fruits and vegetables (8.4%). Less than half (31.7%) of the children consumed dairy products, with eggs being the least consumed (3.4%) (Table 3).

The mean dietary diversity of the children was 3.57 (±0.85) out of 7 food groups. Nearly 50% of the children were classified as meeting the minimum dietary diversity based on consuming at least four or more food groups out of the seven food groups within the past 24-hour period (Table 4).

Table 1. Consumption of food groups among households

Food groups	Frequency (n)	Percentage (%)
Cereals		
Yes	357	100
No	0	0.0
Vegetables		
Yes	356	99.7
No	1	0.3
White root and tubers		
Yes	61	17.1
No	296	82.9
Fruits		
Yes	17	4.8
No	340	95.2
Meat		
Yes	41	11.5
No	316	88.5
Legumes, nut and seeds		
Yes	199	55.7
No	158	44.3
Milk and milk product		
Yes	99	22.7
No	258	72.3
Oil and fats		
Yes	186	52.1
No	171	47.9
Fish		
Yes	356	99.7
No	1	0.3
Egg		
Yes	12	3.4
No	345	96.6
Spices and condiments		
Yes	354	99.2
No	3	0.8
Sweets		
Yes	356	99.7
No	1	0.3

Table 2. Household dietary diversity

Dietary diversity score (HDDS)	Frequency (n)	Percentage (%)	Mean (±SD)
≤ 5 food groups (low diversity)	56	15.7	6.71 (±1.2)
≥ 6 food groups (minimum diversity)	301	84.3	

Table 3. Food groups consumption among children

Food groups	Frequency(n)	Percentage (%)
Starchy and staples		
Yes	357	100
No	0	0.0
Milk and milk products		
Yes	113	31.7
No	244	68.3
Organ meat, flesh and fish		
Yes	348	97.5
No	9	2.5
Eggs		
Yes	12	3.4
No	345	96.6
Legumes, nuts and seeds		
Yes	196	54.9
No	161	45.1
Vitamin A rich fruits, vegetable fats and oil		
Yes	30	8.4
No	327	91.6
Dried fruits and other vegetable		
Yes	219	61.3
No	138	38.7

Table 4. Child dietary diversity

Dietary diversity score (CDDS)	Frequency (n)	Percentage (%)	Mean (±SD)
≤3 food groups (low diversity)	178	49.9	3.5714 (±0.84705)
≥4 food groups (minimum diversity)	179	50.1	

Table 5. Nutritional z-scores of children

Index	Mean	SD
HAZ	-0.3885	±1.91805
WHZ	-0.5743	±1.00276
WAZ	-0.5995	±1.15798

Table 6. Prevalence of malnutrition among children

Indicator	Frequency(n)	Percentage (%)
Stunting	79	22.1
Wasting	28	7.8
Underweight	51	14.3

3.4 Nutritional Status of Children

Approximately 22% of the children were stunted (0.39±1.9), 14.3% were underweight (0.57 ±1.0), and few (7.8%) wasted (0.6 ±1.2) as per FAO cut-off values for nutritional status of children (FAO, 2011). Cumulatively, almost 44% of the children in this study had at least one nutritional deficit (stunting, underweight, and wasting**)** (Tables 4 and 5).

Table 7. Dietary diversity and stunting status of children

Factors	Stunting (%)		P = value
	Stunted	Normal	
DDS (child)			
LDD	38(21.3)	140(78.7)	.723
MDD	41(22.9)	138(77.1	
DDS (household)			
LDD	13(23.2)	43(76.8)	.831
MDD	66(21.9)	235(78.1)	
Child age			
Low	42(45.2)	51(54.8)	.000
Middle	24(18.5)	106(81.5)	
High	13(9.7)	121(90.3)	
Child sex			
Male	41(21.9)	146(78.1)	.923
Female	38(22.4)	132(77.6)	
Household income (provider)			
Low	0(0.0)	4(100)	.579
High	79(22.4)	274(77.6)	
Household size			
Small	62(24.1)	195(75.9)	.145
Large	17(17.0)	83(83.0)	

Table 8. Dietary diversity and wasting status of children

Factors	Wasting (%)		P = value
	Wasted	Normal	
DDS (child)			
LDD	15(8.4)	163(91.6)	.682
MDD	13(7.3)	166(92.7)	
DDS (household)			
LDD	4(7.1)	52(92.9)	1.000
MDD	24(8.0)	277(92.0)	
Child age			
Low	18(19.4)	75(80.6)	
Middle	8(6.2)	122(93.8)	.000
High	2(1.5)	132(98.5)	
Child sex			
Male	12(6.4)	175(93.6)	.293
Female	16(9.4)	154(90.6)	
Household income (provider)			
Low	1(25.0)	3(75.0)	
High	27(7.6)	326(92.4)	.280
Household size			
Small	20(7.8)	237(92.2)	.945
Large	8(8.0)	92(82.0)	

3.5 Household Dietary Diversity and Nutritional Status of Children

The results in Table 7 show no significant association between household dietary diversity and height-for-age and weight-for-height, nor any significant association between household dietary diversity and weight-for-height after accounting for certain factors of interest (household income, child sex, household size, and age of child). Owing to the low prevalence of underweight and wasting found in this study, no further analysis (logistic regression) was conducted to determine the strength of the association between the nutritional status of children and household dietary diversity. However, only the age of the child showed a significant association with stunting, wasting, and underweight (*P* = .000) (Table 7).

Table 9. Dietary Diversity and Underweight Status of Children

Factors	Underweight (%)		P = value
	Underweight	Normal	
DDS (child)			
LDD	26(14.6)	152(85.4)	.863
MDD	25(14.0)	154(86.0)	
DDS (household)			
LDD	11(19.6)	45(80.4)	.212
MDD	40(13.3)	261(86.7)	
Child age			
Low	31(33.3)	62(66.7)	.000
Middle	13(10.0)	117(90.0)	
High	7(5.2)	127(94.8)	
Child sex			
Male	23(12.3)	164(87.7)	.261
Female	28(16.5)	142(83.5)	
Household income (provider)			
Low	0(0.0)	4(100)	1.000
High	51(14.3)	302(85.6)	
Household size			
Small	38(14.8)	219(85.2)	.665
Large	13(13.0)	87(87.0)	

3.6 Dietary Diversity and Stunting Status of Children

Regarding the association between household dietary diversity and children's nutritional status, 24.1% of the children from small households were stunted, although there was no significant association between household size and stunted (*P* = .145) 22.4%. Females were stunted, although the association was not significant (*P* = .923) (Table 7). There was a significant association between the age of the child and stunted (p = .00) 22.4% of the children from high-income households, but the association was not significant (p = .579). Households with low dietary diversity had 23.2% of their children stunted and 21.9% stunted children coming from households that met the minimum dietary diversity, although there was no significant association (*P* = 0.831). In all, children had their dietary diversity to be low (21.3%) and those meeting a minimum household dietary diversity had 22.9% of their children being stunted. However, there was no significant association between household or child dietary diversity and stunting (*P* = 0.723) (Table 7).

3.7 Dietary Diversity and Wasting Status of Children

Looking at the association between household dietary diversity and children's nutritional status, 7.8% of the children from small households were wasted, although there was no significant association between household size and wasting (*P* = .945). Females (9.4%) were wasted, although the association was not significant (*P* = .293). There was a significant association between the age of the child and stunting (*P* = .000). Approximately 25% of children from low-income households were wasted, but the association was not significant (*P* = .280). Households that met with low dietary diversity had 7.1% of their children being wasted and 8% wasted children coming from households that had met a minimum dietary diversity, although there was no significant association (*P* = 1.000). Children having their dietary diversity to be low (8.4%) were wasted and those meeting a minimum household dietary diversity had 7.3% of their children being wasted, however there was no significant association between household and child dietary diversity and wasting (*P* = 0.682) (Table 8).

3.8 Dietary Diversity and Underweight Status of Children

Regarding the association between household dietary diversity and children's nutritional status, 14.8% of the children from small households were underweight, although there was no statistically significant association between household size and underweight (*P* = .665).

Female children (16.5%) were underweight, although this association was not statistically significant (*P* = .261). There was a statistically significant association between the age of the child and being underweight (*P* = .000). Children from low-income households (14.3 %) were underweight, but this association was not statistically significant (*P* = 1.000). Households that met low dietary diversity had 19.6% of their children being underweight and 13.3% underweight children coming from households that had met a minimum dietary diversity, although there was no significant association (*P* = .212). Children with low dietary diversity (14.6 %) were underweight, and those meeting a minimum household dietary diversity had 14% of their children being underweight; however, there was no significant association between household and child dietary diversity and underweight (*P* = .863) (Table 9).

4. DISCUSSION

4.1 Household Dietary Intake

4.1.1 Food groups consumed and dietary diversity

The foods consumed by households in this study were categorized into 12 food groups proposed by the FAO (FAO, 2011). Similarly, McDonald (McDonald et al., 2015) used 12 food groups to assess the dietary intake of households. Other studies in Ghana have, however, looked at foods consumed in households under the six food groups of Ghana: starchy roots and plantains, grains and cereals, animal products, beans, nuts and oilseeds, fruits and vegetables, fats, and oils (Nti, 2008). “In this study, most of the households reported that they consumed more cereals and vegetables (vitamin “A” rich vegetables, dark green and leafy vegetables, and other vegetables within the past 24 hours. They reported maize, rice and millet as main examples of cereals consumed with *bra, ayoyo* leaves, tomato, pepper, onion, okro baobab leaves as main examples of vegetables eaten. Predominantly, they were farmers, and the major staples cultivated and consumed were maize, millet, yam, and rice. Less than half of the households however reported consuming flesh or organ meat with dairy products being the least consumed food group. This was not surprising, since Carletto et al., (2013) indicated that in developing countries, diets consumed mostly include starchy staples, with few or no animal products, and may be high in fats and sugars. The low consumption of meat and dairy products could be attributed to the fact that these products are quite expensive, and the high monthly income (more than 100 Ghana Cedis) reported by almost half of the households may have made it difficult for them to buy such foods. It is worth noting that low-income families are likely to have little to eat or purchase less nutritious and cheap foods that are less likely to meet the nutritional requirements of the household, particularly that of children and adolescents” (Adamu et al., 2012). This study showed that the mean household dietary diversity was 6.7059(±1.2), suggesting that, on average, households consumed approximately seven food groups in the past 24 hours.

It was also found that a greater proportion of households had minimal dietary diversity. This is encouraging, as there is diversification in the diets of more households in the Tamale Metropolis, which is important in ensuring that the recommended intake of energy and nutrients is met by individuals in the household. Hoddinott and Yohannes, (2002) found that a 1% increase in dietary diversity was associated with a 1% increase in per capita consumption, 0.7% increase in total per capita caloric availability, 0.5% increase in household per capita daily caloric availability from staples, and 1.4% increase from non-staples.

This suggests that an increase in household dietary diversity corresponds to increased caloric intake from foods needed to meet energy needs. Although dietary diversity was minimal in many households, their diets were higher in starchy staples (seen in the higher consumption of cereals, roots, and tubers), which are mainly plant-based and raise concerns about the bioavailability of iron. Plant-based foods contain not only non-heme iron but also inhibitors, such as polyphenols and phytates, which could inhibit the absorption of non-heme iron from foods. Household dietary diversity is not only indicative of diet quality, but also reflects the economic ability of a household to access a variety of foods (FAO, 2011) hence, it may be used as a good measure of household food access. Dietary diversity is positively linked to food security (Steyn et al., 2006), which considers the access, availability, and utilization of food. Thus, high dietary diversity is indicative of food security, and since the study showed many households with high dietary diversity, it can be said that many households were food secure.

4.2 Children's Dietary Intake

4.2.1 Food groups consumed and dietary diversity

Diets consumed in the household may reflect the dietary intake of preschoolers, and as reported at the household level, starchy staples were also the most common food groups consumed by all the study children. This result is consistent with the findings of Steyn et al., (2013). However, the low consumption of dairy products by preschoolers is worrisome because dairy products are the most nutrient-dense source of calcium, which is needed to prevent osteoporosis in young children (Thacher et al., 1999).

The low consumption of dairy products in preschoolers could predispose them to an increased risk of nutritional rickets, as seen in a study in Nigeria, which found that pre-school Nigerians with rickets also had a low intake of calcium in their diets (Thacher et al., 1999). Organ meat (liver mainly eaten) was the least consumed food group. Similarly, Olumakaiye, (2013) found that among 600 Nigerian children, the least consumed food groups were organ meat and dairy products, compared to Rivera et al. (Rivera et al., 2003), who found that foods consumed by young children in some regions of Kenya and Mexico contained very few animal products. Organ meat is a good source of heme iron (FAO, 2011), which is easily bioavailable to the body, and Ntab et al., (2005) reported that an increase in eggs and organ meat from a 24-hour recall of Senegalese children contributed immensely to key micronutrients, such as iron, zinc, and phosphorous. These factors play an important role in the growth and development of young children. Heme iron is vital for boasting hemoglobin levels and is recommended in food guidelines. Rivera et al., (2003) stated that caregivers need to be encouraged to make deliberate efforts to incorporate more organ meat such as liver and kidneys into the diets of their children. An encouraging proportion of the preschoolers consumed from green leafy vegetables such as hibiscus (*bra)* and jute (*ayoyo)* leaves as well as vitamin "A" rich fruits and vegetables which are rich sources of vitamin "A". Ntab et al., (2005) similarly reported high intakes of these food groups in children. Contrary to that, Olumakaiye, (2013) and Atuobi-Yeboah, (2010) recounted that food groups that were less consumed by their study children were vitamin "A" rich fruits and vegetables. This may be because their study children involved those children aged between six months to twenty-three months who were on complementary feeding and thus were now gradually being introduced to a variety of foods particularly fruits and vegetables. This study showed that the mean preschoolers dietary diversity score (DDS) was 3.57 (±0.85) based on 7 food groups. Suggesting that on average the preschoolers consumed seven (4) food groups in the past 7 days. Other studies in two African countries, Kenya and Malawi that have looked at dietary diversity of children using nine food groupings found the mean DDS to be 6 and 7.1 respectively (Onyango, 2003; Ferguson et al., 1993) which is somehow different from the present study due the difference in number of food groups. Other studies have however looked at different food groupings, 10 food groups (Kennedy et al., 2007) and sixteen food groups (Olumakaiye, 2013) in calculating their dietary diversity. This study also found that more than half of the preschoolers had minimum dietary diversity signifying that household meals contributed more to preschoolers meeting their nutrient adequacy. This agrees with Arimond, and Ruel, (2004) who stated that individuals consuming a more diverse diet was more likely to meet their nutritional needs and also reflects the nutrient quality of an individual's diet (FAO, 2011). While assessing whether dietary diversity scores (DDS) are good indicators of nutrient adequacy in preschoolers, Steyn et al. (2006) noted that children with a dietary diversity score of less than 3 had low nutrient adequacy.

4.3 Nutritional Status of Children (Stunting, Wasting and Underweight)

The prevalence of stunting in the sampled population was 22.1%. This result is lower than the Northern region prevalence of 33.1% reported in the GDHS in 2014 and a prevalence of 28.2% reported by Ali et al., (2017) in a most recent study in northern region. The reason for the lower prevalence in this study could be because the GDHS prevalence was an average for the region, suggesting that other places in the region could have slightly lower or slightly higher prevalence. This steady decline in the prevalence could also be due to an approach put forward in eliminating stunting prevalence in the Northern region since 2008. The prevalence of stunting in the region was 32.4% in 2008 and increased to 37.4% in 2011, but then decreased to 33.1% in 2014 and 28.2% in 2017 (Ali et al., 2017). The recent prevalence of 22.1% in this study can be explained by this trend of steady

declination in prevalence of stunting in the region. This finding shows that stunting though has decline but it is still an important public health problem in Northern region of Ghana.

The prevalence of underweight among children was 14.3%. In this study, a child was considered underweight if he/she had a WAZ < -2 from the median of the WHO reference population. This study showed that, prevalence of underweight was low in Tamale Metropolis compared to Northern regional prevalence of 19.3% (Ali et al., 2017) but slightly high compared to Ghana (11%) reported by the recent demographic health survey in 2014 (GDHS, 2014). Underweight among children under five is not a big problem in Ghana but calls for concern when it comes to Tamale Metropolis and northern region.

Furthermore, the wasting prevalence of children was 7.8%. In this study, a child was classified wasted if he/she had a WHZ < -2 from the median of the WHO reference population. Current study finding was slightly lower compared with Northern regional prevalence of 9.9% (Ali et al., 2017) and higher than the prevalence in Ghana (5%) reported by the recent demographic health survey in 2014 (GDHS, 2014). Wasting among children under five is not considered a serious problem in Ghana (MICS, 2011) but the 7.8% gotten from this study has revealed that the wasting rate has reach a stage where it needs a critical public health concern.

4.4 Household Dietary Diversity and Children's Nutritional Status

Findings from this study did not show any relationship between household dietary diversity and nutritional status of preschoolers. Although it was surprising to observe no relationship, similar studies by McDonald et al., (2015) who assessed the dietary diversity of 900 households in rural Cambodia also reported no significant relationship between household dietary diversity and nutritional status of the preschoolers. This agreed with Olumakaiye, (2013) who also found that dietary diversity did not mediate the effect of household foods security on child stunting, wasting or underweight in Bangladesh, Ethiopia, and Vietnam. This could mean that the nutritional status of preschoolers does not necessarily depend on household dietary diversity. Evidence on this topic is however mixed. An inverse relationship between dietary diversity and the risk of child stunting has been reported elsewhere in Cambodia by Darapheak et al., (2013) and in Bangladesh by Rah et al., (2010). "Notwithstanding, a lack of diversity in preschoolers, may be problematic since they need energy and an array of essential nutrients from a diversified diet for rapid mental and physical development" (Arimond & Ruel, 2004).

5. CONCLUSION

These results show no significant relationship between household dietary diversity and preschoolers' nutritional status. Therefore, there should be improvements in household food security and maternal knowledge of balance and hygienic food practices.

This study found that a higher proportion of households (84.3%) consumed from at least 7 or more food groups in the past 24 hours per day. However, they rarely consumed dairy products, and egg was found to be the least food group consumed.

CONSENT

All participants consented to participate in the study. Informed consent for participation in the study had been obtained verbally. The aims and objectives of the study were explained to the participants before obtaining their informed consent to participate. Participants consented to publication of this research findings.

ETHICAL APPROVAL

This study was approved by the Ethics Committee of University for Development Studies, Tamale, Ghana with approval number UDSEC/20181015/CMNST/255.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

ACKNOWLEDGEMENTS

The author wishes to thank all the research assistants Adam Abdul-Kadir and Tampulu Justice for the data they assisted in collecting. The mothers, and preschoolers are appreciated for taking part in this study. Further appreciation goes to the Ethics Committee of University for Development Studies for the ethical approval.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/129522