Original Research Article

Preschoolers' household dietary diversity and their nutritional status in Tamale Metropolis

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 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 chi-squared 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. In this study, 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 and maternal knowledge of balance and hygienic food practices.

Keywords: preschoolers, diet, household, dietary diversity, food, nutritional status, relationship, Tamale Metropolis

1. INTRODUCTION

Household dietary diversity serves as a simple indicator of various parameters that affect the nutrition of people [1]. Food security has three important aspects (availability, access, and utilization) [2]. Dietary diversity has been positively linked to the three pillars of food security [3].

Seasonality, location, climate, and agricultural practices are among the factors affecting food availability in any locality [4]. Household accessibility to food has also been shown to be

affected by demographic and socioeconomic factors, accounting for variations in dietary quality [5].

In Ghana, almost one in five preschoolers are 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 [8]. 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 of attaining a 1.8% malnutrition prevalence rate [8]. 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 [9].

Among other factors that have been found to influence preschoolers' nutritional status are 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 mothers who are obese (5%)[10]. Children living in rural areas are 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 to children whose mothers have no education [10].

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. MATERIAL AND METHODS

2.1 Study Design

This study used a cross-sectional design, which allowed for the collection of data at a single point in time. The reason for the choice of this design was that it is economical to conduct in a situation where resource constraints such as money, labor, and time exist [11]. The design was cross-sectional.

2.2 Study Area

This study was conducted in Tamale Metropolis, one of the 26 districts in the northern region of Ghana. There were 115 communities in the metropolis. The population of the metropolis is youthful, with 36.4% under the age of 15 years [7]. Children constitute the largest proportion of households, accounting for 40.4%, and heads of households constitute 16.1%.

2.3 Study population

The sample consisted of preschoolers and their respective mothers in the Tamale Metropolis. This particular group was selected because it is the most vulnerable in terms of nutrition and food insecurity [12]. It also reflects the overall nutritional status and poverty level of a given population [13].

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2.4 Sampling

2.4.1 Sample size

The sample consisted of 357 mother-preschooler pairs. This was determined using the formula by Khalili [14], and a random sampling technique was used to obtain respondents.

2.4.2 Sampling Procedures

Different sampling techniques were employed in this study. Three communities were pursued to participate in this study. 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. In all 122 households were selected from Dungu, 120 from Nyohini, and 115 from Moshi Zongo. A list of households with women bearing children below five years old from each community were used to select the households, resulting in 357 households.

2.5 Data collection

Data was collected using structured questionnaires with open- and closed-ended questions. Data was collected through household visits. Interviews and anthropometric measurements were conducted on preschoolers. All the data were collected between December 2022 and January 2023.

The components of the questionnaires included the following:

2.5.1 Socio-demographic characteristics

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

2.5.2 Household dietary diversity

Data on household dietary diversity were collected using 24-hour recall dietary intake [15]. The information collected on dietary consumption allowed for a calculation of dietary diversity score (DDS), defined as the number of different food groups consumed by family members over 24 hours. Dietary data was collected using a validated 24-hour recall which was not quantified. Respondents visited homes of respondents during the survey. As most women are involved in cooking household meals at home, it was assumed that they had a good ability to remember food eaten [16].

A list of meals, dishes, and all food items and beverages consumed in the last 24 hours were 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 [17]. A recall period of 24-hour was chosen for this study as it is less subject to recall error, less cumbersome for the respondent, and conforms to the recall time period used in many dietary diversity studies [18]. The participants were asked to provide a full description of the ingredients in the mixed dishes.

2.5.3 Anthropometric measurements of preschoolers

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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 the length and height were performed. All measurements were recorded at one decimal place. Length measurements were taken with a preschooler lying correctly in 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 and 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 2 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 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 then 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 the 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 lie between -3SD and -2SD of the standard were regarded as moderately wasting, underweight or stunting respectively [19]. Preschoolers with WHZ, WAZ, or HAZ between -2SD and -1SD were considered mildly wasted, underweight, or stunted, respectively. Preschoolers whose WHZ, WAZ, or HAZ lied between -1SD and +2SD were classified as normal, whereas those lying between +2SD and +3SD were considered overweight [19].

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2.6 Data processing and analysis

Data collected were entered into 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). Comparing the means of the measured variables between the two study locations. Relationships between categorical variables such as household and preschooler dietary diversity and stunting, wasting, and underweight categories were assessed with a 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 participated from Dungu (122), Nyohini (120), and Moshi Zongo (115) resulting in a total of 357.

3.2 Household food consumption and dietary diversity

Household food consumption and dietary diversity was for food groups consumed by the households within the past 24-hour period. All households (100%) consumed foods made from cereals (maize, millet, rice, wheat), 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, garden eggs). Almost all (99.7%) household consumed food made from fish and sea food, 99.7% and 99.2% consumed from sweet and spices (condiments, beverages), 52.1% consumed oil and fats (mostly palm kernel oil and palm oil). More than half (55.7%) of the household consumed from legumes nuts and seeds. However, fruits (vitamin “A” rich fruit and other fruit), roots and tubers, eggs, meat (including organ meat) and dairy products were less consumed food groups (Table 1).

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

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Food groups	Frequency (n)	Percentage (%)
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

The mean dietary diversity for the household showed 6.71(±1.2) food groups out of 12 food groups. Approximately 84% of households were classified as meeting the minimum dietary diversity based on consuming foods from at least 6 or more food groups within a 24-hour day recall (Table 2).

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	

3.3 Food groups consumed and dietary diversity of children

Starchy staples, flesh, meat, and fish were the most consumed food groups with all the children having consumed 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 one-half (31.7%) of the children consumed dairy products, and eggs were the least consumed (3.4%) (Table 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

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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

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 4 or more food groups out of the total 7 food groups within the past 24-hour period (Table 4).

Table 4. Child dietary diversity

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

3.4 Nutritional status of children

Approximately, 22% of the children were stunted (0.39±1.9), 14.3% being underweight (0.57 ±1.0) and few (7.8%) wasted (0.6 ±1.2) as per FAO cut offs for nutritional status of children [20]. Cumulatively, almost 44% of the children in the study had at least one nutritional deficit (stunting, underweight and wasting**)**(Table 4 and Table 5).

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

3.5 Household dietary diversity and nutritional status of children

The results in Table 7 showed no significant association between household dietary diversity and height-for-age and weight-for-height nor any significant association found 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). Due to the low prevalence of underweight and wasting found in this study, no further analysis (logistic regression) was conducted to determine the strength of association between nutritional

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status of children and household dietary diversity. However, it was only the age of a child that shows significant association to stunting, wasting and underweight (*P* = .000) (Table 7).

3.6 Dietary diversity and stunting status of children

Looking at the association between household dietary diversity and children nutritional status, 24.1% of the children from small households were stunted, though there was no significant association between household size and stunted (*P* = .145) 22.4%. Female were stunted although the association is not significant (*P* = .923)(Table 7). There was a significant association between age of child and stunted (p = .00) 22.4%, of children from high income households but the association is not significant (p = .579). Households who met low dietary diversity had 23.2% of their children being stunted and 21.9% stunted children coming from households that have met a 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 and child dietary diversity and stunting (*P* = 0.723) (Table 7).

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)	

3.7 Dietary diversity and wasting status of children

Looking at the association between household dietary diversity and children nutritional status, 7.8% of the children from small household were wasted, though 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 age of child and stunting (*P* = .000). About 25% of children from low-incomehouseholds were wasted but the association was not significant (*P* = .280). Households who met low dietary diversity had 7.1% of their children being wasted and 8% wasted children coming from household 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%

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of their children being wasted, however there was no significant association between household and child dietary diversity and wasting (*P* = 0.682)(Table 8).

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)	

3.8 Dietary diversity and underweight status of children

Looking at the association between household dietary diversity and children nutritional status, 14.8% of the children from small households were underweight, though there was no statistically significant association between household size and underweight (*P* = .665). Female children (16.5%) were underweight although the association was not statistically significant (*P* = .261). There was a statistically significant association between age of child and underweight (*P*=.000). Children from low-incomehouseholds, 14.3% were underweight but the association was not statistically significant (*P* = 1.000). Households who 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 having their dietary diversity to being low, 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).

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			

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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)	

4. DISCUSSION

4.1 Household dietary intake

4.1.1Food groups consumed and dietary diversity

The foods consumed by the households in this study were categorized into 12 food groups proposed by FAO [20]. Likewise, McDonald [21] used 12 food groups in assessing dietary intake of households. Other studies in Ghana have however looked at foods consumed in the households under the six food groups of Ghana namely, starchy roots and plantain, grains and cereals, animal products, beans, nuts and oilseeds, fruits and vegetables, fats and oils [22]. From this study, most of the households reported that they consumed more from cereals, and vegetables (vitamin "A" rich vegetable, 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 are farmers, and the major staples cultivated and eaten 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. [23] has 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 in buying such foods for the household. It is worth noting that low income families are likely to have little to eat or either purchase less nutritious and cheap foods which is less likely to meet the nutritional requirement of the household particularly that of children and adolescents [24]. The study showed that the mean household dietary diversity was 6.7059(±1.2), suggesting that on the average, households consumed about 7 food groups in the past 24-hour.

It was also found that about a greater proportion of households had a minimum 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 recommended intake of energy and nutrients are met by individuals in the household. Hoddinott and Yohannes [25] whose results showed that 1% increase in dietary diversity was associated with a 1% increase in per capita consumption, a 0.7% increase in total per capita caloric availability, a 0.5% increase in household per capital daily caloric availability from staples, and a 1.4% increase from non-staples.

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Suggesting that an increase in household dietary diversity corresponds to increased caloric intake from foods which are needed to meet energy needs. Even though dietary diversity was minimum in many households, their diets were higher in starchy staples (seen in the higher consumption from cereals and roots and tubers) which are mainly plant based and raises concern about bioavailability of iron. Plant based foods contain not only non-heme iron but also have 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 [20] hence may be used as a good measure of household food access. Dietary diversity is positively linked to food security [26] which looks at access, availability and utilization of food. Thus, a high dietary diversity is indicative of food security and since the study showed many households having 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 having all the study children consuming them. This was consistent with findings from Steyn et al. [23]. The low consumption of dairy products by the preschoolers is however worrisome since dairy products are the most nutrient dense source of calcium which is needed in preventing osteoporosis in young children [27].

The low consumption of dairy products in the preschoolers could predispose them to an increased risk of nutritional rickets, an example is seen in a study in Nigeria which found that pre-school Nigerians with rickets also had low intake of calcium in their diets [27]. Organ meat and (liver mainly eaten) was found to be the least consumed food group. Similarly, Olumakaiye[28] found among 600 Nigerian children that the least food groups consumed were organ meat and dairy products which compared to Rivera et al. [29] who identified 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 [20] which is easily made bioavailable to the body and Ntab et al. [30] has reported that an increase in eggs and organ meat from a 24-hour recall of Senegalese children contributed immensely to key micronutrients like iron, zinc and phosphorous. These played important roles in the growth and development of young children. Since heme iron is vital in boasting hemoglobin levels and is recommended in food guides. Rivera et al [29] 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. [30] similarly reported high intakes of these food groups in children. Contrary to that, Olumakaiye[28] and Atuobi-Yeboah [31] 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

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respectively [32][33] 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 [34] and sixteen food groups [28] 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 [35] who stated that individuals consuming a more diverse diet was more likely to meet their nutrientional needs and also reflects the nutrient quality of an individual's diet [20]. While assessing whether dietary diversity scores (DDS) are good indicators of nutrient adequacy in preschoolers, Steyn et al. [16] 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 [36] and a prevalence of 28.2% reported by Ali et al. [37] 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 [37]. 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% [37] but slightly high compared to Ghana (11%) reported by the recent demographic health survey in 2014 [36]. 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% [37] and higher than the prevalence in Ghana (5%) reported by the recent demographic health survey in 2014 [36]. Wasting among children under five is not considered a serious problem in Ghana [6] 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. [21] 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[28] 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

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dietary diversity and the risk of child stunting has been reported elsewhere in Cambodia by Darapheak et al. [38] and in Bangladesh by Rah et al. [39]. 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 [35].

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.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

The Author(s) hereby declares 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.

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.

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REFERENCES

1. Bezerra, I.N. and R. Sichieri, *Household food diversity and nutritional status among adults in Brazil.* International Journal of Behavioral Nutrition and Physical Activity, 2011. **8**(1): p. 22.

2. Leyna, G.H., et al., *Food insecurity is associated with food consumption patterns and anthropometric measures but not serum micronutrient levels in adults in rural Tanzania.* Public health nutrition, 2010. **13**(9): p. 1438-1444.

3. Hillbruner, C. and R. Egan, *Seasonality, household food security, and nutritional status in Dinajpur, Bangladesh.* Food and Nutrition Bulletin, 2008. **29**(3): p. 221-231.

4. Swindale, A. and P. Bilinsky, *Household dietary diversity score (HDDS) for measurement of household food access: indicator guide.* Washington, DC: Food and Nutrition Technical Assistance Project, Academy for Educational Development, 2006.

5. Bernal, J.R. and P.A. Lorenzana, *Dietary diversity and associated factors among beneficiaries of 77 child care centers: Central Regional, Venezuela.* Archivos latinoamericanos de nutricion, 2003. **53**(1): p. 52-58.

6. MICS, *Trends in demographic, family planning and health indicators in Ghana, 1960–2003: Trend analysis of Demographic and Health Surveys data.* DHS Trend Reports No, 2011. **2**.

7. Malapit, H.J.L. and A.R. Quisumbing, *What dimensions of women's empowerment in agriculture matter for nutrition in Ghana?* Food Policy, 2015. **52**: p. 54-63.

8. Ewusie, J.E., et al., *Prevalence of anemia among under-5 children in the Ghanaian population: estimates from the Ghana demographic and health survey.* BMC public health, 2014. **14**(1): p. 626.

9. Mutiso, J.M., *ASSESSMENT OF FACTORS INFLUENCING WOMEN'S BEHAVIOUR TOWARDS MATERNAL, INFANT AND YOUNG CHILD FEEDING IN HOMA BAY COUNTY, KENYA*. 2017, UNIVERSITY OF NAIROBI.

10. Hotz, C. and K. Brown, *Assessment of the risk of deficiency in populations and options for its control.* 2004.

11. Lumole, Z.S., *Household dietary diversity and nutritional status of children and women of reproductive age in Madizini township and its hinterland villages*. 2013, Sokoine University of Agriculture.

12. Burke, A.E. and W.C. Shields, *Millennium Development Goals: slow movement threatens women's health in developing countries.* Contraception, 2005. **72**(4): p. 247-249.

13. Nestle, M., *Nutrition and women's health: the politics of dietary advice*. 2001.

14. Khalili, M., et al., *Global dynamic harmony search algorithm: GDHS.* Applied Mathematics and Computation, 2014. **228**: p. 195-219.

15. Oldewage-Theron, W.H., et al., *Situation analysis of an informal settlement in the Vaal Triangle.* Development Southern Africa, 2005. **22**(1): p. 13-26.

16. Steyn, N., et al., *Food variety and dietary diversity scores in children: are they good indicators of dietary adequacy?* Public health nutrition, 2006. **9**(5): p. 644-650.

17. Savy, M., et al., *Use of variety/diversity scores for diet quality measurement: relation with nutritional status of women in a rural area in Burkina Faso.* European journal of clinical nutrition, 2005. **59**(5): p. 703.

18. Ruel, M.T., *Is dietary diversity an indicator of food security or dietary quality? A review of measurement issues and research needs.* Food and Nutrition Bulletin, 2003. **24**(2): p. 231-232.

19. WHO, E.C., *Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies.* Lancet (London, England), 2004. **363**(9403): p. 157.

20. FAO, *Guidelines for measuring household and individual dietary diversity*. 2011, FAO Rome, Italy.

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21. McDonald, C., et al., *Household food insecurity and dietary diversity as correlates of maternal and child undernutrition in rural Cambodia.* European Journal of Clinical Nutrition, 2015. **69**(2): p. 242.

22. Nti, C.A., *Household dietary practices and family nutritional status in rural Ghana.* Nutrition research and practice, 2008. **2**(1): p. 35-40.

23. Carletto, C., A. Zezza, and R. Banerjee, *Towards better measurement of household food security: Harmonizing indicators and the role of household surveys.* Global Food Security, 2013. **2**(1): p. 30-40.

24. Adamu, A., G. Adjei, and C. Kubuga, *Effects of dietary patterns on the nutritional status of upper primary school children in tamale metropolis.* 2012.

25. Hoddinott, J. and Y. Yohannes, *Dietary diversity as a food security indicator.* Food consumption and nutrition division discussion paper, 2002. **136**(136): p. 2002.

26. Steyn, N., et al., *Foods and beverages that make significant contributions to macro- and micronutrient intakes of children in South Africa–do they meet the food-based dietary guidelines?* South African Journal of Clinical Nutrition, 2006. **19**(2): p. 66-76.

27. Thacher, T.D., et al., *A comparison of calcium, vitamin D, or both for nutritional rickets in Nigerian children.* New England Journal of Medicine, 1999. **341**(8): p. 563-568.

28. Olumakaiye, M., *Dietary diversity as a correlate of undernutrition among school-age children in southwestern Nigeria.* Annals of Nutrition and Metabolism, 2013. **63**: p. 569-569.

29. Rivera, J.A., et al., *The effect of micronutrient deficiencies on child growth: a review of results from community-based supplementation trials.* The Journal of nutrition, 2003. **133**(11): p. 4010S-4020S.

30. Ntab, B., et al., *A young child feeding index is not associated with either height-for-age or height velocity in rural Senegalese children.* The Journal of nutrition, 2005. **135**(3): p. 457-464.

31. Atuobi-Yeboah, A., *Determinants of nutritional status among children 6-24 months in communities in the Upper Manya Krobo district of Ghana.* Legon: University of Ghana, Legon, 2010.

32. Onyango, A.W., *Dietary diversity, child nutrition and health in contemporary African communities.* Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology, 2003. **136**(1): p. 61-69.

33. Ferguson, E.L., et al., *Seasonal food consumption patterns and dietary diversity of rural preschool Ghanaian and Malawian children.* Ecology of Food and Nutrition, 1993. **29**(3): p. 219-234.

34. Kennedy, G., et al., *Dietary diversity score is a useful indicator of micronutrient intake in non-breast-feeding Filipino children.* The Journal of nutrition, 2007. **137**(2): p. 472-477.

UNDER PEER REVIEW

35. Arimond, M. and M.T. Ruel, *Dietary diversity is associated with child nutritional status: evidence from 11 demographic and health surveys.* The Journal of nutrition, 2004. **134**(10): p. 2579-2585.

36. GDHS, *Ghana Demographic Health Survey*. 2014, University of Ghana.

37. Ali, Z., et al., *The effect of maternal and child factors on stunting, wasting and underweight among preschool children in Northern Ghana.* BMC Nutrition, 2017. **3**(1): p. 31.

38. Darapheak, C., et al., *Consumption of animal source foods and dietary diversity reduce stunting in children in Cambodia.* International archives of medicine, 2013. **6**(1): p. 29.

39. Rah, J., et al., *Low dietary diversity is a predictor of child stunting in rural Bangladesh.* European journal of clinical nutrition, 2010. **64**(12): p. 1393.

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DEFINITIONS, ACRONYMS, 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