Wemakor and Laari *Nutrire* (2018) 43:22
https://doi.org/10.1186/s41110-018-0081-2

Nutrire

RESEARCH

Open Access

Association between household dietary diversity and nutritional status of children (6–36 months) in Wenchi Municipality, Brong Ahafo Region, Ghana

Anthony Wemakor[1*] and Joyce Laari[2,3]

Abstract

Background: One in five Ghanaian children is chronically malnourished. Childhood undernutrition remains a public health concern in Ghana; therefore, research is needed to identify modifiable risk factors to inform health programming. This study evaluated household dietary diversity (HDD) as a determinant of nutritional status of pre-school children in Wenchi Municipality, Ghana.

Methods: An analytical cross-sectional study involving 590 mother-child pairs was conducted in Wenchi Municipality. A two-stage cluster sampling procedure was used; clusters were first selected followed by the selection of children using simple random sampling. Socio-demographic, dietary, and anthropometric data were collected in face-to-face interviews. HDD scores were calculated using data from 24-h dietary recalls based on 12 standard food groups consumed by the households in the past 24 h preceding the survey and categorised into low (1–5 food groups) and high (6–12 food groups) HDD categories using the mean HDD score. Anthropometric indices (stunting, wasting, and underweight) were defined as anthropometric z-scores < − 2 standard deviations using the WHO growth standards. Chi-square and logistic regression analyses were used to study the association between HDD categories and stunting or wasting while controlling for potential confounders.

Results: The mean age of the respondents was 27.3 [95% confidence interval = 26.8–27.8] years, and majority of them (58.3%) were within the age group 20–29 years. The prevalence rates of stunting, wasting, and underweight in the children were 38.6%, 11.0%, and 13.1%, respectively, while 36.4% of the households had low dietary diversity. There was no association between HDD categories and stunting (adjusted OR = 1.18, 95% confidence interval [CI] = 0.79–1.76, *p* = 0.409) or wasting (adjusted OR = 0.97, 95% CI = 0.54–1.73, *p* = 0.910).

Conclusions: There was a high prevalence of stunting in children and many households consumed less diverse diet in Wenchi Municipality. There is a lack of evidence of an association between HDD and stunting or wasting in the population studied. Interventions to improve child growth and HDD are needed to promote and protect child health.

Keywords: Household dietary diversity score, Stunting, Wasting, Wenchi, Ghana

* Correspondence: anthonywemakor@yahoo.com
[1]Department of Nutritional Sciences, School of Allied Health Sciences, University for Development Studies, P. O. Box TL 1883, Tamale, N/R, Ghana
Full list of author information is available at the end of the article

Background

Adequate nutrition throughout early life is fundamental for proper growth, development, and survival but poor nutrition continues to be a major public health problem in developing countries [1]. Globally, an estimated 32% or 186 million and 10% or 55 million children below 5 years of age in developing countries are stunted and wasted, respectively [2]. According to the latest demographic and health survey, 18.8%, 4.7%, and 5.9% of children under 5 years are stunted, wasted, and underweight, respectively, in Ghana [3]. The prevalence of undernutrition in the study region is slightly lower with 17.2%, 4.5%, and 11.0% of the children being stunted, wasted, and underweight, respectively. Undernutrition in children results in life-long consequences, including increased risk of disease, poor cognitive development, lower school performance and increased risk of death in childhood; reduced productivity; and increased risk of chronic disease in adulthood [4–6].

The main causes of child undernutrition are poor quality diets which are low in calories and essential nutrients and repeated infections [7]. These are underpinned by poor child feeding practices, unsanitary environment, restricted access to health services, and household food insecurity. "Food security defines a situation in which all people at all times have physical and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" [8]. Household food security exists when all household members, at all times, have access to enough food for an active and healthy life. Household food insecurity depicts food unavailability at the household level and can negatively affect food consumption, resulting in reduced dietary variety and nutrient intake and, consequently, malnutrition in children. Consequently, some studies have shown positive associations between household food insecurity and poor child nutritional status [9–11] while others have not [12–14].

An indicator of food security at the household level is the household dietary diversity (HDD) score which is a simple count of the number of food groups consumed by a household over a period normally the previous 24 h before the survey [15, 16]. In recent years, dietary diversity scores have become increasingly popular because they correlate well with nutrient adequacy and anthropometric indices of children [17], they are perceived to be important to nutrition and health [18], and quantifying food intake in population studies is challenging.

While a number of studies have examined the association between household food security and child nutritional status [9, 12, 19], very few used household dietary diversity as an indicator of household food security. Similarly, there are a number of studies on individual dietary diversity and child nutritional status [20–24], but again very few on household dietary diversity and child nutritional status. We report the findings of a study conducted to evaluate HDD score as a determinant of nutritional status of children (6–36 months) in Wenchi Municipality in Brong Ahafo Region of Ghana.

Methods

Study design and area

A population-based analytical cross-sectional study was conducted in Wenchi Municipality of the Brong Ahafo Region in Ghana. The Wenchi Municipality, located in the Western part of the region, is one of the 22 municipalities in the Brong Ahafo Region. It lies within latitudes 7° 30′ South and 8° 05′ North and longitudes 2° 15′ West and 1° 55′ East, covers 1145 km^2 of land area, and shares boundaries with Techiman to the West, Kintampo Municipality to the North, Sunyani to the South and Tain to the East. The total population of the municipality is 89,739, out of which 19,657 are children within the ages of 0–59 months and 23,588 are women in fertile age [25]. The municipality is divided into three (3) operational sub-municipalities namely Wenchi, Subinso, and Droboso, and these have populations of 46,194, 22,605, and 29,485, respectively.

Study population and subjects

The study population comprised of pre-school children aged 6 to 36 months and their mothers/caregivers selected from 30 clusters or communities in the Wenchi Municipality. For a mother-child pair to be eligible for the study, they must be willing to participate and the child should not be sick at the time of the survey or should not have had an episode of diarrhea or malaria in the past week before the survey.

Sample size and sampling technique

The sample size was determined using the single population formula $n = t^2 \times p(1 - p)/m^2$ [26], where n = required sample size, t = confidence level at 95% (standard value of 1.96), p = prevalence of stunting in children under five in Brong Ahafo Region in 2008 (25.0%), and m = margin of error at 5% (standard value of 0.05). This gave 288 which was multiplied by 2 to account for cluster sampling and increased to 590 to take care of incomplete or spoilt questionnaires.

A two-stage cluster sampling procedure was used for the data collection: 30 clusters were selected at the first stage and 20 mother-child pairs in each selected cluster at the second stage. Using probability proportional to size 14, 9 and 7 clusters were drawn from the 3 sub-municipalities Wenchi, Droboso, and Subinso, respectively, using simple random sampling without replacement [27]. From each selected cluster, the mother-child pairs were recruited from households selected using simple random sampling without replacement [28]. Sampling of the households was based on the WHO/EPI cluster survey methodology. We located the center of each selected cluster with the help of a community health volunteer. At the center, a bottle was spun on the ground and all the houses in line with the direction of the bottle top were numbered. One household was selected at random and visited. The second household selected was the one nearest the first household moving in the chosen direction. The procedure was followed until all the 20 households were selected in the selected cluster. For each selected household, only one eligible mother-child pair was selected using simple random sampling if there was more than one.

Data collection methods and tools

The data for the study were collected in September–October 2014 using a semi-structured questionnaire, a standard questionnaire for measuring HDD score [15, 16], and anthropometry. Data were collected on socio-demographic and economic characteristics of parents of sampled children, HDD, child feeding practices, and child anthropometry. The semi-structured questionnaire was designed following literature review [29, 30].

Measurement of household dietary diversity score

The number of different food groups consumed by households within the previous 24 h preceding the survey was investigated through qualitative 24-h dietary recall. As mothers were mostly responsible for the preparation of meals for the households, they were asked to recall all the foods that the household members had consumed in the house in the past 24 h. Mothers were also made to mention all the ingredients used in the preparation of the meals of the households. Based upon these data, it was recorded whether the household consumed food(s) from one or more of the following food groups: (1) cereals, (2) white roots and tubers, (3) vegetables, (4) fruits, (5) meat, (6) eggs, (7) fish and seafood, (8) legumes, nuts, and seeds, (9) milk and milk products, (10) oils and fats, (11) sweets, and (12) spices, condiments, and beverages [15, 16]. Each food group was counted only once irrespective of the number of food items consumed from it. The HDD score could therefore range from 0 to 12 depending upon the number of food groups the family ate from. There is no recommended cut-off value for HDD score, so using the mean HDD score for the study subjects (6) as recommended [16], the HDD score was categorised into two: “Low” HDD score (1 to 5 food groups) and “High” HDD score (6 to 12 food groups).

Anthropometry

Anthropometry was used to assess the nutritional status of children. Weight and height or length were measured for each child using standard techniques [31]. A UNICEF electronic scale (SECA 890) for both mother and child was used to weigh children. Children who were 24 months or above were weighed directly standing on the scale in minimal clothing and those below 24 months were weighed being carried by their mothers.

Standing height was measured for children 24 months and above and recumbent length for children less than 24 months, using an infantometer. Both height and length were measured to the nearest 0.1 cm. During the course of the fieldwork, all equipment were checked for measurement accuracy on a daily basis. Age of children was deduced from date of birth taken from the Child Health Record booklet and date on which the measurements were made.

Determination of household wealth index

A household wealth index based on household assets was generated and used as a proxy indicator for socio-economic status (SES) of households. This is based on an earlier concept whereby the sum of dummy variables created from information collected on housing quality, and ownership of household durable goods was used to construct an index [29]. The 14 variables used were radio set, television set, satellite dish, sewing machine, mattress, refrigerator, DVD player, computer, fan, mobile phone, bicycle, motorcycle, animal drawn cart, and car. A household was awarded a score of “1” for each item possessed otherwise a score of “0,” and using principal component analysis, a wealth score was derived for each household and classified into tertile. Each item was counted only once irrespective of the number the household possessed.

Quality assurance

The questionnaires were obtained or first prepared in English, translated into Akan, and then back translated into English to ensure consistency. The questionnaires were also pre-tested in a non-study community to identify and correct inconsistencies, to check clarity of items, ambiguity of language, and feasibility of administration in a community setting. A 3-day training was given to data collectors during which they practiced how to ask the questions and take anthropometric measurements. The data collectors were community health nurses who were familiar with taking weight and height measures of children. The training also covered informed consent procedures, sampling technique, and interviewing skills. During the course of the fieldwork, the questionnaires were checked for completeness on site, and on a daily basis, and the problems identified were rectified.

Statistical analysis

Data analysis was performed with Stata (version 9) and WHO Anthro. Three anthropometric z-scores (height-for-age, weight-for-height, and weight-for-age) were constructed from weight, height, age, and sex data collected on the children comparing with the WHO Child Growth Standards. Children whose height-for-age, weight-for-height, and weight-for-age z-scores were less than − 2 standard deviations were classified as stunted, wasted, and underweight, respectively [32].

Frequencies and percentages were calculated for categorical variables and means and standard deviations for continuous variables. Chi-square and logistic regression analyses were used in assessing the association between exposure and outcome variables. Chi-square was used to explore the crude associations between parents' and children's socio-demographic characteristics and HDD score (exposure variable). Again, chi-square test was used to explore the crude association between parents' and children's socio-demographic characteristics and stunting (outcome variable) or wasting (outcome variable). In establishing the association between HDD score and child stunting or wasting, factors that were statistically significant in the bivariate tests and were controlled for. The level of statistical significance for all analyses was set at $p < 0.05$.

Ethical consideration

The study protocol was approved by the Joint Ethics Board of School of Medicine and Health Sciences and School of Allied Health Sciences, University for Development Studies, Tamale. Written informed consent was obtained from mothers before the administration of the questionnaire and taking of anthropometry data. The mothers of the children were assured of anonymity and confidentiality of the study data. They were also informed that participation was voluntary and that they could withdraw at any time during the process if they felt uncomfortable.

Results

Socio-demographic and economic characteristics of mothers

The mean age of the respondents was 27.3 [95% confidence interval (CI) = 26.8–27.8] years, and 58.3% of them were within the age group of 20–29 years (Table 1). About a quarter of the respondents (27.8%) had no formal education, and 28.8% had education up to junior high school level only. The majority of the respondents were married (82.4%) and Christians (78.5%), while most (43.1%) belonged to the Akan ethnic group. In relation to socio-economic characteristics, most mothers of the children (38.0%) and majority of fathers (51.9%) were engaged in farming. There is some interaction between maternal age and marital status, as more than 70% of mothers aged 15–19 years were not married. Further information on socio-demographic characteristics is provided in Table 1.

Nutritional status of children

The mean age, weight, and height of the children were 18.6 (95% CI = 17.9–19.3) months, 10.4 (95% CI = 10.0–10.9) kg, and 76.2 (95% CI = 75.6–76.9) cm, respectively. Most children (42.4%) were within the ages of 12 to 23 months, and about half were males (50.5%). Table 2 shows information on the nutritional status of children aged 6 to 36 months in the Wenchi Municipality. The mean height-for-age, weight-for-height, and weight-for-age z-scores were − 1.43 (95% CI = − 1.66 to − 1.20), 0.44 (95% CI = 0.27–0.62), and − 0.46 (95% CI = − 0.58 to − 0.34), respectively. The overall prevalence rates of stunting, wasting, and underweight were 38.6% (95% CI = 35.0–43.0), 11.0% (95% CI = 8.5–14.0), and 13.1% (95% CI = 10.3–16.0), respectively. It can be observed that stunting prevalence increased significantly with age ($p < 0.001$) while the rates of wasting and underweight were relatively stable ($p > 0.05$). Four hundred and thirty (430) of the children were below the age of 2 years, so we collected information on their breastfeeding and complementary feeding. About 80% (78.8%) of the children under 2 were reported to have been exclusively breastfed, and 74.9% met the criteria for minimum meal frequency. The mean age of starting complementary feeding was 3.1 months.

Household dietary diversity score

The mean HDD score for the study population was 6.1 (95% CI = 5.9–6.2). Overall, 36.4% of the households were in low HDD score category meaning they consumed foods from at most five (5) food groups in the previous 24 h preceding the survey. Most households consumed 6 food groups (23.7%) but none consumed all the 12 food groups (Table 3).

Association between household dietary diversity and child nutritional status

In order to identify possible confounders to control for in the assessment of the association between HDD score and child nutritional status, we compared the nutritional status of children (stunting and wasting) belonging to low and high DD score categories (Table 4). For stunting, the following characteristics were associated: marital status ($p = 0.009$), sex of the household head ($p = 0.001$), child age ($p < 0.001$), and sex of child ($p = 0.019$). For wasting, the following characteristics were associated: mother's age ($p = 0.014$), mother's religion ($p = 0.010$), household wealth index ($p = 0.010$), and sex of child ($p = 0.003$). Stunting was not related to maternal age, educational level, religion, ethnicity, or occupation, and wasting was not related to maternal educational level, marital status, ethnicity, occupation, or sex of the household head. Also, wasting was not related to the ages of the children.

Table 1 Socio-demographic characteristics of parents and children

Characteristic	Frequency ($n = 590$)	Percent (%)
Age group (years)		
15–19	46	7.8
20–29	344	58.3
30–39	175	29.7
40–45	25	4.2
Highest educational level attained		
No education	164	27.8
Primary	154	26.1
Junior high school	170	28.8
Senior high school	61	10.3
Tertiary	30	5.1
Non-formal	11	1.9
Marital status		
Never married	100	16.9
Currently married	486	82.4
Previously married	4	0.7
Religion		
Christian	463	78.5
Islam	106	17.9
Traditional	14	2.4
Others	7	1.2
Ethnicity		
Akan	254	43.1
Banda	56	9.5
Dagaaba	209	35.4
Others	71	12.0
Occupation		
Petty trading	157	26.6
Pito brewing	40	6.8
Gari processing	14	2.4
Farming	224	38.0
Charcoal production	4	0.7
Salary work	30	5.1
Others	121	20.5
Occupation of father		
Trading	68	11.5
Palm wine tapping	6	1.0
Farming	306	51.9
Salary work	76	12.9
Other	134	22.7
Sex of household head		
Male	450	76.3
Female	140	23.7
Household wealth index		
Low	197	33.4
Medium	197	33.4
High	196	33.2
Age group of child (months)		
6–11	180	30.5
12–23	250	42.4
24–36	160	27.1
Sex of child		
Male	298	50.5
Female	292	49.5

Again we compared low and high DD households with respect to socio-demographic characteristics of mothers and children (see Additional file 1: Table S1). An association was found between mother's age ($p = 0.001$), maternal education level ($p = 0.044$), sex of the household head ($p < 0.001$), household wealth index ($p < 0.001$), or child's age ($p = 0.007$) and HDD.

In the adjusted logistic regression analyses, children belonging to low and high DD score households had similar risks of stunting (adjusted OR = 1.18, 95% CI = 0.79–1.76, $p = 0.409$) and wasting (adjusted OR = 0.97, 95% CI = 0.54–1.73, $p = 0.910$) which were not significantly different (Table 5).

Discussion

We sought to explore the association between HDD and child growth indicators in a municipality in Brong Ahafo Region of Central Ghana. A high prevalence of chronic malnutrition is observed, and HDD is poor but it does not appear to influence the growth of young children in this study population.

A high prevalence of stunting (38.6%) was observed among children 6–36 months in this study population. According to the recent Demographic and Health Survey, one in five children under 5 is stunted nationally and 17.2% of children in the Brong Ahafo region have stunting [3]. The high prevalence of stunting estimated is not unexpected given that the study area was selected based on reports of poor child nutrition [33] in order to evaluate potential risk factors and inform health programming. In agreement with the Ghana Demographic and Health Survey [3], we found that stunting increased with age highlighting problems with complementary feeding as the children transitioned from breastfeeding to the family diet. Sub-optimal complementary feeding practices have been reported to associate with poor

Table 2 Nutritional status of children aged 6–36 months

Age group (months)	Anthropometric z-score mean (95% confidence interval)		
	Height-for-age	Weight-for-height	Weight-for-age
6–11 (*N* = 180)	0.05 (– 0.33, 0.43)	– 0.03 (– 0.31, 0.26)	– 0.16 (– 0.38, 0.07)
12–23 (*N* = 250)	– 1.30 (–1.59, – 1.01)	0.14 (– 0.11, 0.39)	– 0.59 (– 0.76, – 0.43)
24–36 (*N* = 160)	– 3.29 (– 3.72, – 2.86)	1.52 (1.16, 1.87)	– 0.59 (– 0.83, – 0.35)
6–36 (*N* = 590)	– 1.43 (– 1.66, – 1.20)	0.44 (0.27, 0.62)	– 0.46 (– 0.58, – 0.34)
	Prevalence %, (95% confidence interval)		
	Stunting*	Wasting	Underweight
6–11 (*N* = 180)	20.5 (14.6, 26.5)	8.9 (4.7, 13.1)	9.4 (5.1, 13.8)
12–23 (*N* = 250)	33.6 (28.0, 39.5)	11.6 (8.0, 16.0)	12.8 (8.6, 17.0)
24–36 (*N* = 160)	66.9 (59.5, 74.2)	12.5 (7.3, 17.3)	17.5 (12.0, 23.5)
6–36 (*N* = 590)	38.6 (35.0, 43.0)	11.0 (8.5, 14.0)	13.1 (10.3, 16.0)

*Chi-square = 81.3032, $p < 0.001$

growth in children [34]. It is observed that more male children than female children are stunted. In an analysis of demographic and health survey data for 10 sub-Saharan African countries, it was found that stunting is more prevalent in boys than girls [35]. The reason for this observation is unclear but may relate to biological mechanisms conferring greater vulnerability on males [35, 36] or female sex preferences of mothers. Whatever the underlying mechanism is, this finding suggests that caregivers need to pay more attention to the nutrition and health of male children. We however found lower levels of stunting for children of currently married mothers compared to those of currently unmarried mothers and for those in male-headed households compared to those in female-headed households. This may relate to the roles played by husbands and fathers such as provision of resources for food, health care, and other necessities in male-associated households that are enjoyed by children in such households [37]. Stunting was however not related to maternal age, educational level, religion, ethnicity, or occupation.

Table 3 Number of food groups consumed

Number of food groups	Frequency	Percent (%)
2	1	0.2
3	20	3.4
4	59	10.0
5	135	22.9
6	140	23.7
7	127	21.5
8	98	16.6
9	10	1.7
Total	590	100.0

The prevalence of wasting and underweight (11.0% and 13.1%, respectively) are about twice the Brong Ahafo regional figures of 4.5% and 5.9%, respectively [3]. However, children belonging to younger or older mothers, mothers who practice non-Christian religion, and mothers in low/medium wealth index households, and male children are at increased risk of wasting. Childbearing at younger age is a risk factor for adverse mother and child outcomes including undernutrition [38]. This is because younger maternal age is associated with being unmarried, undereducated, and socio-economically disadvantaged, all of which are risk factors of adverse pregnancy outcomes [39]. On the other hand, older maternal age has been associated with increased risk of wasting [40]. The association of wasting to religion and household wealth index may be related to high socio-economic status of parents and associated increased access to food and health care. Wasting was not related to maternal educational level, marital status, ethnicity, occupation, sex of household head, or child age.

Our study did not find an association between HDD and stunting or wasting. Although children belonging to low DD households are 18% more likely to be stunted compared to children in high DD households, this did not reach statistical significance. Household food insecurity primarily results in inadequate dietary intake in children meaning they may not meet their daily energy and nutrient requirements. Secondarily, household food insecurity may be associated with reduced food variety and as a result low dietary diversity. It is therefore to be expected that households with poor food access would have increased risk of child malnutrition but we did not observe this. In a recent study, children living in food secure households were significantly more likely to receive adequate diet compared to children in food insecure households [41].

Table 4 Bivariate analysis of the association between maternal and child socio-demographic variables and child nutritional status

Maternal/child characteristic	Stunting			Wasting		
	No ($n = 362$), frequency (%)	Yes ($n = 228$), Frequency (%)	Chi-square test p value	No ($n = 525$), frequency (%)	Yes ($n = 65$), frequency (%)	Chi-square test p value
Age group of mother (years)			0.250			0.014
15–19	25 (51.0)	24 (49.0)		41 (83.7)	8 (16.3)	
20–29	211 (61.3)	133 (38.7)		317 (92.2)	27 (7.8)	
30+	126 (64.0)	71 (36.0)		167 (84.8)	30 (15.2)	
Highest educational level attained			0.479			0.210*
No education	113 (64.6)	62 (35.4)		153 (87.4)	22 (12.6)	
Primary	90 (58.4)	64 (41.6)		137 (89.0)	17 (11.0)	
Junior high school	109 (64.1)	61 (35.9)		157 (92.4)	13 (7.6)	
Senior high school	33 (54.1)	28 (45.9)		50 (82.0)	11 (18.0)	
Tertiary	17 (56.7)	13 (43.3)		28 (93.3)	2 (6.7)	
Marital status			0.009			0.615
Married	310 (63.8)	176 (36.2)		431 (88.7)	55 (11.3)	
Currently unmarried	52 (50.0)	52 (50.0)		94 (90.4)	10 (9.6)	
Religion			0.223			0.010
Christian	290 (62.6)	173 (37.4)		420 (90.7)	43 (9.3)	
Others	72 (56.7)	55 (43.5)		105 (82.7)	22 (17.3)	
Ethnicity			0.780			0.053
Akan	153 (60.2)	101 (39.8)		236 (92.9)	18 (7.1)	
Banda	33 (58.9)	23 (41.1)		47 (83.9)	9 (16.1)	
Dagaaba	134 (64.1)	75 (35.9)		182 (87.1)	27 (12.9)	
Other tribes	42 (59.2)	29 (40.8)		60 (84.5)	11 (15.5)	
Occupation of mother			0.637			0.314*
Pito brewing	22 (55.0)	18 (45.0)		38 (95.0)	2 (5.0)	
Farming	144 (64.3)	80 (35.7)		193 (86.2)	31 (13.8)	
Salary work	18 (60.1)	12 (39.9)		28 (93.3)	2 (6.7)	
Others	178 (61.3)	118 (38.7)		266 (89.9)	30 (10.1)	
Sex of household head			0.001			0.660
Male	293 (65.1)	157 (34.9)		399 (88.7)	51 (11.3)	
Female	69 (49.3)	71 (50.7)		126 (90.0)	14 (10.0)	
Household wealth index			0.047			0.010
Low	118 (59.9)	79 (40.1)		175 (88.8)	22 (11.2)	
Medium	134 (68.0)	63 (32.0)		166 (84.3)	31 (15.7)	
High	110 (56.1)	86 (43.9)		184 (93.9)	12 (6.1)	
Age group of child (months)			< 0.001			0.528
6–11	143 (79.4)	37 (20.6)		164 (91.1)	16 (8.9)	
12–23	166 (66.4)	84 (33.6)		221 (88.4)	29 (11.6)	
24–36	53 (33.1)	107 (67.0)		140 (87.5)	20 (12.5)	
Sex of child			0.019			0.003
Male	169 (56.7)	129 (43.3)		254 (85.2)	44 (14.8)	
Female	193 (66.1)	99 (33.9)		271 (92.8)	21 (7.2)	

*Fisher's exact test was used for comparison because of small sample sizes.

Table 5 Multivariate analysis of the association between household diversity score and child nutritional status

Variable	Unadjusted model		Adjusted model	
	OR (95% CI)	*P* value	OR (95% CI)	*P* value
Stunting				
Household dietary diversity				
High (6–12 food groups)	1.00		1.00	
Low (1–5 food groups)	0.94 (0.66–1.32)	0.714	1.18 (0.79–1.76)*	0.409
Age group of child (months)				
6–11			1.00	
12–23			2.32 (1.45–3.70)	< 0.001
24–36			9.48 (5.65–15.89)	< 0.001
Sex of child				
Male			1.00	
Female			0.63 (0.44–0.92)	0.017
Age group (years)				
15–19			1.20 (0.57–2.54)	0.628
20–29			1.00	
30+			0.98 (0.65–1.49)	1.185
Marital status				
Currently married			1.00	
Currently unmarried			2.05 (1.19–3.53)	0.010
Household wealth index				
Low			0.98 (0.62–1.54)	0.915
Medium			0.64 (0.41–0.99)	0.050
High			1.00	
Wasting				
Household dietary diversity				
High (6–12 food groups)	1.00		1.00	
Low (1–5 food groups)	0.88 (0.51–1.52)	0.645	0.97 (0.54–1.73)[£]	0.910
Age group of child (months)				
6–11			1.00	
12–23			1.41 (0.72–2.75)	0.317
24–36			1.52 (0.74–3.13)	0.255
Sex of child				
Male			1.00	
Female			0.37 (0.21–0.66)	0.001
Age group (years)				
15–19			2.52 (1.02–6.22)	0.044
20–29			1.00	
30+			2.44 (1.36–4.36)	0.003
Household wealth index				
Low			1.97 (0.92–4.21)	0.080
Medium			3.17 (1.56–6.45)	0.001
High			1.00	

*Adjusted model controlled for child's age, child's sex, mother's age, mother's marital status, and household wealth index
[£]Adjusted model controlled for child's age, child's sex, mother's age, and household wealth index

Several studies have reported associations between individual DD and child nutritional status [22, 23] while others have not [10, 24]. Some studies reported an association between HDD score and stunting or underweight [9–11] while others like ours did not [12–14]. The lack of association between HDD and child nutritional status in our study area may reflect a lack of association between household diet and child nutrition in the area or our study's lack of sufficient power to detect this association if it exists. It is observed that food insecure households protect their children from the effects of food insecurity by prioritising their nutrition over that of adults [42]. So mothers may skip meals to enable their children to eat and by so doing protect them from the ill effects of household food insecurity.

Our study has some limitations. Firstly, we used a cross-sectional study design which does not study causal link. Secondly, the use of a 24-h dietary recall for estimating HDD increases the risk of recall bias and may not reflect the usual dietary pattern. Thirdly, we used cluster sampling to recruit the study participants but did not control for clustering in the analysis. Consequently, we computed confidence intervals for estimates instead of standard deviations. Finally, our sample size may have been inadequate to detect an association between HDD and child nutritional status (if it exists) in our study population. Despite these limitations, our study provides some important insights into the relationship between household diet and child nutritional status in Central Ghana.

Conclusions

In conclusion, both stunting in children and low HDD are prevalent in the study area. We did not observe an association between HDD and stunting or wasting in this study population. Interventions aimed at improving child growth and HDD are needed to promote and protect child health.

Additional file

Additional file 1: Table S1. Association between parents' or children's socio-demographic characteristics and household dietary diversity score category. (DOCX 20 kb)

Abbreviations

CI: Confidence interval; EPI: Expanded Programme on Immunisation; HDD: Household dietary diversity; SES: Socio-economic status; UNICEF: United Nations Children's Fund; WHO: World Health Organization

Acknowledgements

We are very grateful to the mothers who were interviewed and to the enumerators who undertook the data collection.

Funding

The study was funded by the authors.

Availability of data and materials

The minimal dataset analysed during the current study can be obtained from the corresponding author upon reasonable request.

Authors' contributions

JL conceived the study and undertook the data collection. AW analysed the data and drafted the manuscript. JL edited the manuscript, and both authors approved the final version of the manuscript.

Ethics approval and consent to participate

The study was approved by the Joint Ethics Committee of the School of Medicine and Health Sciences and School of Allied Health Sciences, University for Development Studies, Tamale, Ghana. The mothers gave informed consent before they were interviewed.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Publisher's Note

Author details

[1]Department of Nutritional Sciences, School of Allied Health Sciences, University for Development Studies, P. O. Box TL 1883, Tamale, N/R, Ghana. [2]Department of Community Health, School of Allied Health Sciences, University for Development Studies, P. O. Box TL 1883, Tamale, N/R, Ghana. [3]Tamale Central Hospital, P. O. Box TL 2649, Tamale, N/R, Ghana.

Received: 9 June 2018 Accepted: 29 August 2018
Published online: 05 October 2018

References

1. Latham MC. Human nutrition in the developing world. Rome: Food and Agriculture Organization of the United Nations; 2004.
2. World Health Organization, Monitoring of the achievement of the health-related millennium development goals: report by the secretariat. World Health Organization (updated April 1), 2010.
3. GSS, GHS, and ICF International., Ghana demographic and health survey 2014. 2015.
4. Victora CG, et al. Maternal and child undernutrition: consequences for adult health and human capital. Lancet. 2008;371(9609):340–57.
5. Allen LH, Gillespie SR. What works? A review of the efficacy and effectiveness of nutrition interventions: Asian Development Bank; 2001.
6. Barker DJP. Mothers, babies and health in later life: Elsevier Health Sciences; 1998.
7. Ruel MT, Menon P. Child feeding practices are associated with child nutritional status in Latin America: innovative uses of the demographic and health surveys. J Nutr. 2002;132(6):1180–7.
8. Food and Agriculture Organization.., Rome declaration on world food security and world food summit plan of action. 1996.
9. Betebo B, et al. Household food insecurity and its association with nutritional status of children 6–59 months of age in east Badawacho District, South Ethiopia. J Environ Public Health. 2017:2017.
10. Bukania ZN, et al. 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. 2014:2014.
11. Mahmudiono T, Sumarmi S, Rosenkranz RR. Household dietary diversity and child stunting in East Java, Indonesia. Asia Pac J Clin Nutr. 2017;26(2):317.
12. Osei A, et al. Household food insecurity and nutritional status of children aged 6 to 23 months in Kailali District of Nepal. Food Nutr Bull. 2010;31(4): 483–94.
13. McDonald C, et al. Household food insecurity and dietary diversity as correlates of maternal and child undernutrition in rural Cambodia. Eur J Clin Nutr. 2015;69(2):242.
14. Kac G, et al. Household food insecurity is not associated with BMI for age or weight for height among Brazilian children aged 0–60 months. PLoS One. 2012;7(9):e45747.
15. Swindale A, Bilinsky P. 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.

16. Kennedy G, Ballard T, Dop MC. Guidelines for measuring household and individual dietary diversity: Food and Agriculture Organization of the United Nations; 2011.
17. Hooshmand S, Udipi S. Dietary diversity and nutritional status of urban primary school children from Iran and India. J Nutr Disorders Ther S. 2013; 12:2161–0509.
18. Martin-Prevel Y, et al. The 2008 food price crisis negatively affected household food security and dietary diversity in urban Burkina Faso. J Nutr. 2012;142(9):1748–55.
19. Singh A, Singh A, Ram F. Household food insecurity and nutritional status of children and women in Nepal. Food Nutr Bull. 2014;35(1):3–11.
20. Ocampo-Guirindola ML, et al. Association between dietary diversity score and nutritional status of filipino children aged 6-23 months. Philippine Journal of Science. 2016;145(1):57–69.
21. Amugsi DA, Mittelmark MB, Oduro A. Association between maternal and child dietary diversity: an analysis of the Ghana demographic and health survey. PLoS One. 2015;10(8):e0136748.
22. Ogechi UP, Chilezie OV. Assessment of dietary diversity score, nutritional status and socio-demographic characteristics of Under-5 children in some rural areas of Imo state, Nigeria. Malays J Nutr. 2017;23(3):425–35.
23. Rah J, et al. Low dietary diversity is a predictor of child stunting in rural Bangladesh. Eur J Clin Nutr. 2010;64(12):1393.
24. Ekesa B, Blomme G, Garming H. Dietary diversity and nutritional status of pre-school children from Musa-dependent households in Gitega (Burundi) and Butembo (Democratic Republic of Congo). Afr J Food Agric Nutr Dev. 2011;11(4):4896–911.
25. GSS, 2010 population & housing census report : district analytical report : Wenchi municipality. 2014.
26. Snedecor, GW and GW Cochran, Statistical methods. 1989.
27. Barreiro, P.L. and J.P. Albandoz, Population and sample. Sampling techniques. Management Mathematics for European Schools MaMaEusch (994342-CP-1-2001-1-DECOMENIUS-C21, 2001.
28. Grais RF, Rose AM, Guthmann J-P. Don't spin the pen: two alternative methods for second-stage sampling in urban cluster surveys. Emerging themes in epidemiology. 2007;4(1):8.
29. Garenne, M. and S. Hohmann-Garenne, A wealth index to screen high-risk families: application to Morocco. J Health Popul Nutr, 2003: p. 235-242.
30. Arimond M, Ruel MT. Dietary diversity is associated with child nutritional status: evidence from 11 demographic and health surveys. J Nutr. 2004; 134(10):2579–85.
31. World Health Organization, Physical status: the use of and interpretation of anthropometry, report of a WHO expert committee. 1995.
32. World Health Organization and Unicef, WHO child growth standards and the identification of severe acute malnutrition in infants and children: joint statement by the World Health Organization and the United Nations Children's fund. 2009.
33. GSS, GHS, ICF Macro. Ghana demographic and health survey 2008. Accra, Ghana: Ghana Statistical Service, Ghana Health Service, and ICF Macro; 2009.
34. Brennan L, McDonald J, Shlomowitz R. Infant feeding practices and chronic child malnutrition in the Indian states of Karnataka and Uttar Pradesh. Economics & Human Biology. 2004;2(1):139–58.
35. Wamani H, et al. Boys are more stunted than girls in sub-Saharan Africa: a meta-analysis of 16 demographic and health surveys. BMC Pediatr. 2007; 7(1):17.
36. Garenne M. Sex differences in health indicators among children in African DHS surveys. J Biosoc Sci. 2003;35(4):601–14.
37. Lamb ME. The history of research on father involvement: an overview. Marriage Fam Rev. 2000;29(2-3):23–42.
38. Gibbs CM, et al. The impact of early age at first childbirth on maternal and infant health. Paediatr Perinat Epidemiol. 2012;26(s1):259–84.
39. Kramer KL, Lancaster JB. Teen motherhood in cross-cultural perspective. Ann Hum Biol. 2010;37(5):613–28.
40. Omondi D, Kirabira P. Socio-demographic factors influencing nutritional status of children (6-59 months) in Obunga slums, Kisumu City. *Kenya* Public Health Research. 2016;6(2):69–75.
41. Agbadi P, Urke HB, Mittelmark MB. Household food security and adequacy of child diet in the food insecure region north in Ghana. PLoS One. 2017; 12(5):e0177377.
42. Leonard WR. Household-level strategies for protecting children from seasonal food scarcity. Soc Sci Med. 1991;33(10):1127–33.