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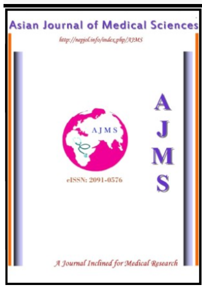

Dietary Diversity is Associated with Nutrient Intakes and Nutritional Status of Children in Ghana

Christina A. Nti*

Department of Family and Consumer Sciences, P.O. BOX LG 91, University of Ghana, Legon, Ghana

Abstract

Objective: The study was conducted with the objective of assessing the possible associations between dietary diversity, nutrient intakes and young child nutritional status in Ghana.

Material & Methods: A cross-sectional survey involving one hundred mothers with young children between the ages of 6 and 18 months was conducted using a combination of methods. Structured interview using questionnaire, dietary assessment and anthropometry were used to collect the data. Dietary diversity was assessed by using food group count. The WHO (1998) recommended daily nutrient needs from complementary foods for infants receiving average breast milk intakes were used to assess the energy and nutrient content of the diets consumed by the children. The WHO (1983) reference was used to assess child nutritional status. The data was analyzed using Statistical Package for Social Science (SPSS) version 16 in Windows.

Results: About 16% of the study children were underweight whiles 8% were both stunted and wasted. The mean dietary diversity score was 4.6. Significant differences were observed between dietary diversity groupings and energy/ nutrient intakes of the children. Generally, as dietary diversity improved, energy and nutrients intakes also increased. Again, dietary diversity was significantly associated with weight-for-age, length-for-age and weight-for-length. As dietary diversity increased, child nutritional status also improved. Children who had low dietary diversity exhibited low scores in terms of weight for age, length for age and weight for length.

Conclusion: High dietary diversity improves energy and nutrients intakes, and hence dietary adequacy, as well as child growth and nutrition.

Key Words: *Dietary Diversity; Nutrient Intakes; Child Nutritional Status*

1. Introduction

The causes of childhood malnutrition are many and complex. Childhood malnutrition is associated with increased susceptibility to infections, poor cognitive and motor development. Again, growth failure during infancy and early childhood has been reported to lead to nutrition and health problems later in life.[1] In Ghana and many other developing countries, poor quality diets and infections are the major reasons attributed to childhood malnutrition. Poor quality diets are low in calories and most essential nutrients. Dietary diversity has long been recognized by nutritionists as a key element of high quality diets.[2] Increasing the variety of foods consumed has been recommended by most dietary guidelines.[3,4] because it is thought to ensure adequate intake of essential nutrients and thus promote good health and nutrition. According to HatlΦy *et al*[5], dietary diversity is defined as either the total number of foods consumed or the total food groups consumed. Nutrients essential for child growth and development do not come from a single food item but rather from a diet composed of a number of food items. A measure of the nutritional quality of the diet may therefore be its diversity. Healthy diets are therefore said to be those that are most varied.[5,6]

Complementary foods fed to young children in Ghana are mostly plant-based and tend to be low in a number

***Correspondence:**
Christina A. Nti, Department of Family and Consumer Sciences, P.O. BOX LG 91, University of Ghana, Legon, Ghana Tel: 233-21- 500300 Ext 2136; Email: cnti@ug.edu.gh

of micronutrients. Emphasizing dietary diversity especially in developing countries is therefore particularly important for micronutrient status, as it ensures appropriate balance of micronutrients, and nutrient adequacy. A number of studies have linked dietary diversity to energy and nutrient intake among both adults and children in developed and developing countries.[5-8] In spite of the well recognized importance of dietary diversity in health and nutrition, not much work has been done on the role dietary diversity plays in child health and nutrition in Ghana. This study was therefore conducted with the objective of assessing possible associations between dietary diversity, nutrient intakes and child nutritional status in Ghana.

2. Material and Methods

2.1. Study Design, Setting and Subjects

The study design was cross-sectional. The study was conducted in the Manya Krobo District in the Eastern Region of Ghana. The sample consisted of one hundred mothers with children between the ages of 6 and 18 months receiving complementary foods. House to house visits were conducted to identify mothers with children within the required age group and the objectives of the study were explained to them. Recruitment for participation in the study was based on satisfying the following criteria: a) caregivers with children between 6 and 18 months; b) willingness of caregiver to participate in the study and c) availability of caregiver throughout the study period. For caregivers meeting these criteria, separate lists were complied for both male and female children and every other child on each list was picked to obtain 50 males and 50 females.

2.2. Assessment of Energy and Nutrient Intakes

Five trained local field workers helped with data collection on the dietary intake. Each child was visited three consecutive days, Tuesday to Thursday. On each visit, information was collected on all food items used for meal preparation and the diets consumed were also weighed. In order to weigh the diet consumed, individual portions were served to the children in separate bowls. The bowl was weighed empty, and the weight of each food item was recorded when added. After the child had eaten, the leftovers were weighed and the child's net intake calculated. Information on food consumed was converted into quantitative data of nutrients using Ghana Food Composition Tables[9] and FOOD PROCESSOR PLUS Software. The WHO[10] recommended daily nutrient needs from complementary foods for infants receiving average breast milk intakes were used to assess the energy and nutrient content of the diets consumed by the children. Mean intakes of energy, protein, calcium, iron, thiamin, riboflavin, niacin and vitamin A for each child were computed at the end of the study.

2.3. Assessment of Dietary Diversity

Dietary diversity scores were computed from the quantitative dietary assessment. In this study, food groups count and hence the total food groups consumed was used to assess dietary diversity. Food groups based on the usual child feeding and consumption patterns in Accra reported by Amar-Klemesu and Ruel[11] was adopted, modified and used to assess dietary diversity. The score included nine groups namely staples (including cereal and cereal products, roots, tubers and plantain); meat products; fish and sea foods; eggs; milk and milk products; margarine; legumes, nuts and pulses; fruits; and soups and stews. The highest score a child could obtain on each day was therefore 9, with a score of 1 being assigned to any one food group consumed. Mean dietary score for each child over the period was computed and divided into quartiles based on the distribution within the sample. Individuals with scores below the 25th quartiles were classified to have poor dietary diversity; those between 25th and 50th quartile as having average dietary diversity; 50th to 75th quartile as having good dietary diversity and those above 75th quartile as of very good dietary diversity.

2.4. Assessment of nutritional status

Anthropometric measurement was used to assess the nutritional status of the children. An infant scale with a maximum capacity of 20 kg and 10g accuracy was used to weigh children. To measure length, a locally constructed length board was used. The measures were taken with 0.1 cm accuracy. The data obtained were transformed to Z-scores using WHO[12] reference data. The children's weight-for-age (WAZ), length-for-age (LAZ) and weight-for-length (WLZ) Z-scores were used as indicators to determine their nutritional status. Children with Z-scores below – 2 standard deviation of the median reference WAZ, LAZ, WLZ were classified as either underweight, stunted or wasted respectively.

2.5. Data analysis

Result was analyzed using Statistical Package for Social Sciences (SPSS) Version 16 in Windows. Means and standard deviations were generated for continuous variables and frequency distributions for categorical variables. Statistical significance between continuous variables was tested using the independent-t-test and the chi-squared test for significant differences between categorical variables. The ANOVA and Pearson's correlation coefficient were used to explore associations between child's dietary diversity, nutrient intake and nutrition outcome.

2.6. Ethical clearance

Ethical clearance was obtained from the Ethical Review Board of the School of Allied Health Sciences, University of Ghana. Caregivers consented to be part of the study after the study objectives had been explained to them in a language they understood.

3. Results

3.1. Sample Characteristics

The characteristics of the children involved in the study are presented in Table 1. There was no significant difference between both groups in terms of age. The mean age for girls and boys were 14.7 and 14.5 years respectively, with an overall mean age of 14.6 years. Again, there were no significant differences ($p>0.05$) in nutritional status between both sexes in terms of WAZ, LAZ and WLZ scores. The prevalence of underweight among the study children was 15.5% whiles stunting and wasting were 8% for both. The mean dietary diversity score for both groups was 4.6.

Table-1: Sample Characteristics

Characteristics	Females (n= 50)	Males (n= 50)	Overall
Age of Child (mo)	14.7± 1.8	14.5± 1.8	14.6± 1.8
WAZ	-1.44± 1.2	-1.52± 0.9	-1.47±1.05
LAZ	-1.11± 1.0	-1.10± 0.8	-1.11± 0.9
WLZ	-1.03± 1.0	-1.06± 1.1	-1..05± 1.05
Underweight (%)	14.0	17.0	15.5
Stunted (%)	8.0	8.0	8.0
Wasting (%)	8.0	8.0	8.0
Dietary Diversity	5.0± 1.4	4.2± 1.6	4.6± 1.5

3.2. Association between Dietary Diversity, Nutrient Intakes and Child Nutritional Status

As shown in Table 2, significant differences were observed between dietary diversity groupings and energy/nutrient intakes of the children. Generally, as dietary diversity improved, energy and nutrients intakes also increased. Energy and nutrient intakes were particularly higher among children in the "Good/Very Good" dietary diversity groupings. Although no significant differences were observed between the poor and average groupings in terms of energy and nutrient intakes, significant differences were observed between children in these groupings and those in Good/Very good category.

Table-2. Association between dietary diversity and nutrient intakes

Energy/ Nutrient Intakes	Dietary Diversity Groupings			
	Poor	Average	Good	Very Good
Energy	459.1 ± 125.1^a	478.6 ± 169.8^a	534.8 ±120.8^a	747.2 ± 136.8^b
Protein	8.5 ± 4.0^a	8.7 ± 3.3^a	11.2 ± 4.3^b	14.4 ± 4.6^c
Calcium	108.6 ± 77.7^a	122.3 ± 63.4^a	187.5 ± 113.6^b	257.8 ± 107.6^c
Iron	6.7 ± 2.3^a	7.1 ± 2.6^a	7.5 ± 3.4^a	10.4 ± 4.8^b
Vitamin A	414 ± 256.2^a	439.9 ± 371^a	506.9 ± 309^{ab}	697.5 ± 409.4^b
Thiamin	0.18 ± 0.09^a	0.20 ± 0.02^a	0.22 ± 0.1^a	0.32 ± 0.1^b
Riboflavin	0.13 ± 0.05^a	0.14 ± 0.05^{ab}	0.17 ± 0.07^b	0.24 ± 0.07^c
Niacin	2.03 ± 0.6^a	2.07 ± 0.9^a	2.6 ± 0.9^b	3.4 ± 0.8^c

Statistical differences tested with ANOVA, Means and standard deviations presented. Values with different superscripts are significantly different ($p<0.05$)

Tables 3 and 4 show the associations between dietary diversity and child nutritional status. Dietary diversity was significantly associated with WAZ, LAZ and WLZ. As dietary diversity increased, child nutritional status improved.

Table 3. Association between dietary diversity and child nutritional status

Dietary Diversity	Number	Nutritional status (Z-scores)		
		W/A	L/A	W/L
<25th percentile (Poor)	21	- 2.12 ± 0.62^a	- 1.64 ± 0.63^a	-1.42 ± 0.87^a
25th - 50th percentile (Average)	30	- 1.93 ± 1.00^a	- 1.50 ± 0.90^a	-1.25 ± 1.42^a
50th – 75th percentile (Good)	22	- 1.07 ± 1.27^b	- 1.01 ± 0.84^b	-0.83 ± 1.04^b
>75th percentile (Very Good)	27	- 0.74 ± 0.50^c	- 0.28 ± 0.33^c	- 0.64 ± 0.60^c

Statistical differences tested with ANOVA, Means and standard deviations presented. Values in a row with different superscripts are significantly different ($p<0.05$).

For children in the poor and average dietary diversity categories, no differences were observed in terms of WAZ, LAZ and WLZ scores. However, significant differences were observed between the good and very good category respectively when compared to the poor and average groups.

4. Discussion

The study examined whether dietary diversity, assessed using a scoring of food groups consumed was associated with nutrient intake and child nutritional status in Ghana. In this study, significant differences were observed between dietary diversity and nutrient intakes of children in Ghana. Children whose diets were highly diversified had higher energy and nutrient intake form complementary foods. These findings corroborate other studies conducted in Mali, Kenya and Vietnam. In Mali, Hatløy *et. al.*[5] reported significant association between dietary diversity and nutrient intake. High dietary diversity based on food groups proved to be a stronger determinant of nutrient intake. Similarly, in Kenya, Onyango *et. al.*[8] also confirmed a positive association between dietary diversity and intake of a variety of nutrients. In Vietnam, Ogle *et. al.*[13] reported a significant association between dietary diversity scores and nutrient intake. Those who consumed from more food groups had a higher intake of most nutrients, indicating that increasing the number of food groups has a greater impact on nutrient adequacy. Kennedy *et al.*[14] indicated that dietary diversity score is a significant predictor of adequate micronutrient intake of young Filipino children.

Table-4: Pearson's Correlation Coefficients between nutrient intakes, dietary diversity and child nutritional status

Nutrients	DDS	WAZ	HAZ	WHZ
Energy	0.56 xx	0.31 xx	0.53 xx	0.11 NS
Protein	0.51 xx	0.28 xx	0.49 xx	0.11 NS
Calcium	0.55 xx	0.31 xx	0.47 xx	0.18 NS
Iron	0.34 xx	0.15 NS	0.29 xx	0.06 NS
Vitamin A	0.35 xx	0.06 NS	0.25 x	0.02 NS
Thiamin	0.44 xx	0.18 NS	0.45 xx	0.02 NS
Riboflavin	0.51 xx	0.36 xx	0.40 xx	0.24 x
Niacin	0.53 xx	0.35 xx	0.47 xx	0.18 NS

x Correlation is significant at the 0.05 level (2-tailed); xx Correlation is significant at the 0.01 level (2-tailed)

The study also established a relationship between dietary diversity and child nutritional status. Dietary diversity was significantly associated with WAZ, LAZ and WLZ. As dietary diversity increased, child nutritional status improved. These findings again corroborate those of other investigators in Kenya and Mali. In Kenya, Onyango *et. al.*[8] observed a significant association between dietary diversity scores and WAZ, LAZ and WLZ of children between the ages of 12 and 36 months. In Mali, Hatløy *et. al.*[6] reported a strong association between dietary diversity and children's growth. Lower dietary diversity scores were associated with twice the risk of being stunted or underweight. Arimond and Ruel[15,16] also reported strong and significant association between dietary diversity and height for age scores of children. A difference of 1.6 Z-scores was reported to be observed between children who consumed less food groups and those consumed eight food groups a day. A similar observation was made by Rah *et al.*[17] in Bangladesh. In their study on association between dietary diversity and stunting among children aged 6-59 months in rural Bangladesh, they reported that dietary diversity was a strong predictor of stunting in rural Bangladesh. They concluded that the inclusion of a wide variety of food groups into complementary foods may be essential to improve child nutritional status.

5. Conclusion

Based on the findings of the study, it is concluded that high dietary diversity improves energy and nutrient intakes, child growth and nutrition. The findings highlight the importance of diversity in complementary foods, especially among children who have been weaned off the breast. There is therefore the need to educate mothers to diversify their children's diet for good nutrition.

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