Are Children in Food Basket Regions Capable of Meeting the Minimum Dietary Diversity Criteria?: A Case of Southern Highlands Zone of Tanzania

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Abstract. *Background.* The Minimum Dietary Diversity (MDD) score for children 6-23 months old is a population-level indicator designed by the World Health Organization (WHO) to assess diet diversity as part of Infant and Young Child Feeding (IYCF) practices among children 6-23 months old. A total of 450,000 children in Tanzania are acutely undernourished, with over 100,000 sufferings from the most severe form of acute malnutrition, making it a country with one of the highest undernutrition burdens in Eastern and Southern Africa. *Objective.* To determine factors associated with dietary diversity among children 6-23 months old in Southern Hinterland Regions of Tanzania. *Methods.* The study used secondary data from Tanzania Demographic Health Survey (2015-2016). The original data was obtained from a cross-sectional, descriptive, and analytical study of children 6-23 months old in the regions of Mbeya, Iringa, Njombe, Songwe, and Rukwa. The survey employed a two-stage sampling design whereby the first stage involved selecting enumeration areas (clusters), and the final stage was the selection of households. The data were analyzed by using STATA version 14; a logit model was run to identify associations between dietary diversity score as dependent variables and various predictors' variables, also known as independent variables. *Results.* The study found out that only few children aged 6 to 23 months in Southern highlands and hinterlands of Tanzania reached the minimum dietary diversity. Age of children 9-11 months [AOR=3.35; 95 CI=1.23-10.26], age of children 12-23 months [AOR=6.03; 95 CI=2.43-15.02], secondary and higher level of education [AOR=2.42; 95 CI=0.99-5.84] and rich households [AOR=405; 95 CI=2.09-7.81] significantly related to minimum dietary diversity in children aged 6-23 months in Southern Hinterland Regions of Tanzania. *Conclusion.* This study showed that a very low proportion of children aged 6-23 months in southern and hinterland of Tanzania received adequate dietary diversity as measured by the WHO indicators. Factors that consistently affect dietary diversity in common were the age of the child especially lower age and low level of the mother's education and wealth index.

Keywords: Dietary diversity, Infant and Young Child Feeding practices, 6-23 months children, Tanzania

Introduction

In Tanzania, a high prevalence of chronic and acute under nutrition persists. It was estimated that about 450,000 children in Tanzania are acutely undernourished or wasted, with over 100,000 suffering from the most severe form of acute malnutrition (IFPRI, 2014), making it a country with one highest under nutrition burdens in Eastern and Southern Africa (IRIS, 2019). The recently released Tanzania National Nutrition Survey of 2018 reported that 31.8% of children were stunted, 3.6% were wasted, and 14% were underweight. Of all the children aged 6-23 months, the prevalence of minimum dietary diversity (35.1%).

According to TDHS 2015/16, chronic malnutrition or stunting nationally affects 34.7% of children under five. In six regions (Dodoma, Ruvuma, Rukwa, Kigoma, Katavi and Geita), chronic malnutrition (stunting) exceeds 40%. In three regions, more than half of children are chronically malnourished. The three regions are Iringa (51.3%), Njombe (51.5%), and

(51.9%), in Kagera (MoHCDGEC, 2016). Also, in TDHS, 2015/2016, data on dietary diversity are low; Iringa (27.9%), Njombe (34.1%) and Mbeya (26.5%), Rukwa 34.7%, and Ruvuma 26.1% although these are high food-producing regions in Tanzania. Current data (MoHCDGE,2018) on minimum dietary diversity in the respective regions shows Iringa (25.4%), Njombe (23.9%) and Mbeya (30.5%), Rukwa (41.9%), Ruvuma (22.6%).

The Minimum Dietary Diversity (MDD) score for children 6-23 months old is a population-level indicator designed by the World Health Organization (WHO) to assess diet diversity as part of Infant and Young Child Feeding (IYCF) practices among children 6-23 months old. This indicator is one of eight IYCF indicators developed by the WHO to provide simple, valid, and reliable metrics for assessing IYCF practices at the population level (WHO, 2008). It recommends children to consume four or more food groups from the seven food groups daily. Lack of dietary diversity, especially for children 6-23 months, is critical because they require energy and nutrient-dense foods for physical, mental growth and development. However, in many low-income countries, particularly in rural areas, meeting the minimum dietary diversity standard has been a major challenge.

Poor infant and young child feeding practices have been identified as the leading causes for undernutrition. Dietary diversity is a major requirement if children are to get all essential nutrients; thus low dietary diversity can affect the nutrition status of a child in terms of stunting, wasting, underweight and micronutrient deficiency (Ahmed et al, 2019).

Although there various bodies of evidence about association of low dietary diversity and nutritional outcomes in children (Darapheak et al, 2013; Motbainor et al, 2015; Sié et al, 2017; Solomon, 2017), similar studies that use large-scale data are scarce, particularly in Tanzania. To our understanding and according to literature review, there are limited studies on factors associated with low diet diversity, which is frequently reported in national nutrition surveys reports. Understanding the factors that affect dietary diversity for children in the first 1000 days, particularly from 6 to 24 months, could be helpful to inform the next five years of Nutrition Multisectoral Plan (NMNAP) and propose interventions that focus on improving the quality of complementary foods. Therefore, findings from this study will be important to public health, agriculture, and communication experts in Tanzania and help to work towards the attainment of the Sustainable Development Goal-2 (SDG-2) agenda, which aims to end all forms of malnutrition by 2030 (UN, 2015). The present study examined the factors associated with low dietary diversity in five regions with high food production in Tanzania by using the large available dataset, which represents the whole country.

Methods

The study used secondary data from the Tanzania Demographic Health Survey (2015-2016), which National Bureau of Statistics executed, in collaboration with other government partners (Darapheak et al, 2013). The original data was obtained from a cross-sectional, descriptive, and analytical study of children 6-23 months in the regions of Mbeya, Iringa, Njombe, Songwe, and Rukwa. The survey employed a two-stage sampling design whereby the first stage involved selecting enumeration areas (clusters), and the final stage was selection of households. The data collection procedure has been described and published in the TDHS 2015/16 report (Darapheak et al, 2013).

The researcher followed the protocol for data sharing as imposed by the Tanzania Bureau of Statistics, who are the custodians of TDHS data. The researchers were permitted to use the children's data file, known as KR or Kids file and Mothers file also known as MR file. The two data files were joined by using the unique identification number. The final analysis involved data of 422 children aged between 6 to 23 months.

The outcome variable in this analysis was the Minimum Dietary Diversity for children 6-23 months old. This age group is eligible for complementary feeding. The Minimum

Dietary Diversity was measured by adopting the WHO's Infant and Young Children Feeding guidelines (TNNS, 2018). Our computation of Minimum Dietary Diversity was based on information about food items a child consumed by children in the previous 24 hours preceding the survey. We categorized these food items into seven major food groups based on the WHO's guidelines, namely: (i) grains, roots, and tubers; (ii) legumes and nuts; (iii) flesh foods (meat, fish, poultry, and liver/organ meats); (iv) eggs; (v) vitamin A-rich fruits and vegetables; (vi) dairy products (milk, yogurt, cheese); (vii) other fruits and vegetables.

If a child consumed at least one food item from a food group in 24 hours preceding the survey, the group was assigned a value of one (1), and zero (0) if not consumed. The sum of the consumed food group was then computed to come up with Minimum Dietary Diversity. Therefore, the maximum DDS was seven, meaning that the child consumed all seven food groups, while the lowest was zero, meaning that the child did not eat any of the food groups. The Childs' Minimum Dietary Diversity was classified according to the cut-off points provided by the NBS (Belew et al, 2017) as follows: Dietary Diversity Score below four (DDS < 4) implies that the child failed to meet the Minimum Dietary Diversity criteria while a Dietary Diversity Score which is equal to or above four (DDS $\geq$ 4) signifies that the child was able to meet the Minimum Dietary Diversity criteria.

A Logit model was run to identify associations between Minimum Dietary Diversity as dependent variables and various predictors' variables, also known as independent variables. The independent variables modeled in this analysis include the number of antenatal and postnatal clinic visits. Others are the age of a child, mother's age, sex, marital status, education level of the mother, household wealth index, family size and place of residence. The selection of the study factors was based on previous studies conducted in sub-Saharan Africa (Solomon, 2017; Victor *et. al.*, 2014; Khamis *et. al.*, 2019) where modifiable socio-economic and health service factors were associated with inappropriate complementary feeding practices. Those studies also suggested that these modifiable factors are essential in formulating specific policy efforts to improve complementary feeding practices. The examined logit model is shown below:

$$\text{Logit Y} = Ln\left(\frac{\pi_i}{1-\pi_i}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 \ldots\ldots \beta_n X_n \quad (1)$$

Whereby Y is outcome variable ('1' if a child's met the Minimum Dietary Diversity criteria or '0' if otherwise); π_i is the probability of a child to have a high dietary diversity score; α is constant (y – intercept); β_s are regression betta coefficients of the respective independent variables; and X_s are the independent variables.

We used the STATA software version 14 to undertake a descriptive analysis of socio-economic variables of interest and estimation of the Logit Model. We presented our results in tables showing frequency distributions, percentages, and parameter estimates of the Logit Model. In the first phase of estimation of Logit Model parameters, we regressed the dependent variable with single independent variables to see if there is any significant relationship. Predictor variables with *p*- values > 0.05 were excluded in the final Logit Model. This implies that only those predictor variables whose parameter estimates yielded *p*-value <0.05 were included in the final Logit Model. We used 95% level of precision to carry out our analysis. Final results were considered significant if the computed *p*-value for parameter estimate was < 0.05.

Results and Discussion

The analysis included a total of 422 children age 6–23 months. Table 1 shows that 67% were age 12–23 months, and the majority of children, 53.7 % (227) were male. In the category of mother's group age 15-25, 43.1% were more than others. Most of mothers in the study areas were married 75.4% and 66.4% had primary education. Nearly half of the mothers 53.7% received antenatal care more than 4 and 50.6 % of mothers did not visit postnatal care. By characteristics of the household, 75.4% of the children resided in urban areas. About 55.9% of children were from families of 2-5 members. The majority of children were from low-income families.

Table 1. Distribution of mothers and children 6-23 months old their socio-demographic variables

Variable	N	%
Child's age		
6-8 months	71	16.8
9-11 months	68	16.1
12-23 months	283	67
Child's sex		
Male	227	53.7
Female	195	46.7
Mothers age		
15-25 years	182	43.1
26-35 years	173	41
36-49 years	67	15.9
Marital status		
Not living with spouse	101	24
Married	321	76
Area of residence		
Urban	104	24.6
Rural	318	75.4
Household size		
2 - 5 members	236	55. 9
>6 members	186	44.1
Wealth index		
Poor	169	40
Middle	111	26.4
Rich	142	33.6
No. of antenatal visits		
<4 visits	226	53.6
>=4 visits	196	46.4
Received postnatal care		
No	214	50.6
Yes	208	49.4

The results in Table 2 show that there is no positive association between children's dietary diversity and other socio-demographic variables. Ability of the child to meet the minimum Dietary diversity has shown significant association with mainly age, mother's education level, residence, household wealth index, and number of antenatal care visits.

Results in Table 2 have shown that there is an association between child's age and failure to meet the minimum dietary diversity (p =0.000, 95% CI). The proportion of infants who were able to meet the minimum dietary diversity criteria, have been shown to decrease as the age increases among age groups, a larger percent is seen in infants aging 6-8 months (90.48%). This explains the increased number of infants whose ages range from 12 to 23 months have attained minimum dietary diversity. Infants whose mothers have not attained any levels of education to primary education were more likely to consume less diversified diets compared to the ones whose mothers have gone to school. Results have shown that among 55 infants whose mothers have no education, only 10 received a minimum diversified diet. The majority of infants in this study had not met the Minimum Dietary Diversity criteria; specifically, those who were living in rural areas exceeded the ones living in urban by 15.7%, the association between dietary diversity and place of residence is statistically significant ($p = 0.002$, CI:95%).

Table 2. Factors associated with the ability to meet the minimum dietary diversity criteria among children aged 6-23 months

Variable	Minimum Dietary Diversity				p
	Not met		Met		
Age of child (months)	**(n)**	**%**	**(n)**	**%**	
6 to 8	(57)	90.48	(6)	9.52	0.000***
9 to 11	(46)	74.19	(16)	25.81	
12 to 23	(192)	64.65	(105)	35.35	
Child's sex					
Male	(152)	71.7	(60)	28.3	0.420
Female	(143)	68.1	(57)	31.9	
Mother's age (years)					
15 – 25	(123)	70.69	(51)	29.31	0.867
26 – 35	(122)	68.54	(56)	31.46	
36 – 49	(50)	71.43	(20)	28.47	
Marital status					
Not living with spouse	(74)	74	(26)	26	0.307
Married	(221)	68.63	(101)	37.37	
Mother's education					
No education	(55)	84.62	(10)	15.38	0.000***
Primary education	(194)	71.59	(77)	28.41	
Secondary or higher education	(46)	53.49	(40)	46.51	
Household size					
2 – 5	(157)	68.78	(68)	30.22	0.951
>6	(138)	70.05	(59)	29.95	
Residence					
Rural	(229)	74.11	(80)	25.89	0.002***
Urban	(66)	58.41	(47)	41.59	
Wealth index					
Poor	(130)	82.8	(27)	17.2	0.000***
Middle	(87)	75	(29)	25	
Rich	(78)	52.35	(71)	47.65	
Number of ANC visits					
< 4	(163)	74.77	(55)	25.23	0.024***
>=4	(132)	64.71	(72)	35.29	
Postnatal care					
No	(171)	69.51	(75)	30.49	0.835
Yes	(124)	70.45	(52)	29.55	

The results of logit analysis indicates that high dietary diversity was found to be related with child's age, mother level of education and household wealth index. We found no evidence of any relationship between high dietary diversity with child's sex, mother's age, marital status, household size, number of antenatal care and postnatal care visits (Table 3).

The regression coefficient for an age of the child was positive, implying that children aged 9 – 11 and 12 – 23 had a higher likelihood of meeting minimum dietary diversity than their counterparts aged 6 – 8 months (Table 2). The results show that the Odd of children aged 9 – 11 months and 12 – 23 to meet the Minimum Dietary Diversity were 3.35 and 6.03, respectively, higher than that of their 6 – 8 months counterparts. This difference was statistically significant at a 95% level of confidence (p <0.05).

Table 3. Predictors of DDS among children in Southern Highland Hinterland Regions of Tanzania

Variable	Adjusted Odd Ratio (AOR)	Std. Error	Z	*p*	95% C.I	
					Lower	Higher
Child Age						
9 – 11 months	3.35	1.923	2.34	0.019^{S}	1.23	10.26
12 – 23 months	6.04	2.807	3.58	0.000^{S}	2.43	15.02
Residence						
Urban	0.84	0.249	-0.59	0.558	0.46	1.50
ANC Visit						
Visited	1.28	0.299	1.07	0.282	0.81	2.03
Mother education						
Primary	1.52	0.594	1.07	0.210	0.70	3.27
Secondary	2.42	1.099	1.95	0.000^{S}	0.99	5.89
Wealth status						
Middle	1.48	0.471	1.25	0.210	0.79	2.76
Rich	4.05	1.358	4.17	0.000^{S}	2.09	7.81
Constant	0.02	0156	0.626	0.000	0.08	0.84

Note. Reference categories: *Child age* = 6 – 8 months; *Residence* = Rural; *ANC Visit* = Not attended; *Mother Education* = No education; *Wealth Status* = Poor

The study demonstrated that as the age of a child increases, the child was likely to receive a more diverse diet: children aged 18–23 months were more likely to receive a variety of foods than younger children. This finding is consistent with the studies conducted in Ethiopia (Dafursa & Gebremedhin, 2019). The variation in diet given to younger children is lower than the older and tends only to improve dietary diversity score (DDS) with the increasing age (Dafursa & Gebremedhin, 2019).

The 95% confidence interval reveals that the Odds of children 9-11 months to meet the minimum dietary diversity in the survey regions was between 1.23 to 10.26. Meaning that at population levels, the likelihood of those children to meet the minimum dietary diversity was between 1.23 to 10.26 higher than that of their colleagues aged 6 – 8 months when all other factors are the same. Similarly, at *ceteris peribus*, the Odds of children 12-23 months to meet the minimum dietary diversity in the survey regions was between 2.43 to 15.02. Meaning that at population levels the likelihood of those children to meet the minimum dietary diversity was between 2.43 to 15.02 higher than that of their colleagues aged 6 – 8 months, when all other factors are the same (Table 2).

Similarly, the regression coefficient for mothers' with secondary education was positive, implying that children whose mothers' had secondary education had a higher likelihood of meeting minimum dietary diversity as compared to their counterparts whose mothers' had no education (Table 2). The results show that the Odds of meeting the Minimum Dietary Diversity among children whose mothers' had secondary education was

2.42 higher than that of their counterparts whose mothers had no education. This difference was statistically significant at a 95% level of confidence (p <0.05).

The 95% confidence interval reveals that the Odds of children whose mothers had secondary education to meet the minimum dietary diversity in the survey regions was between 0.99 to 5.89. Meaning that, when all other factors are the same, at population levels the likelihood of those children to meet the minimum dietary diversity was between 0.99 to 5.89 higher than that of their colleagues whose mothers had no education (Table 3).

Regarding wealth status, the analysis results revealed that the regression coefficient for rich households was positive, implying that children belonging to wealthy households had a higher likelihood of meeting minimum dietary diversity than their counterparts who are coming from poor households (Table 3). The results show that the Odds of meeting the Minimum Dietary Diversity among children whose households are categorized as rich was 4.05 higher than that of their counterparts whose households are poor. This difference was statistically significant at a 95% level of confidence (p <0.05).

The 95% confidence interval reveals that the Odds of children belonging to rich households to meet the minimum dietary diversity in the survey regions was between 2.09 to 7.81. Meaning that, when all other factors are the same, at population levels the likelihood of those children to meet the minimum dietary diversity was between 2.09 to 7.81 higher than that of their colleagues from poor households (Table 3).

The study also showed that feeding a child from diversified food sources is significantly associated with a higher household income. This is supported by previous studies conducted in Tanzania, Ethiopia, and Indonesia (Victor et al, 2014; Dafursa & Gebremedhin, 2019; Serkataji, 2020), which reported that children from a family of highest wealth quintile were more likely to eat four or more food groups. This could be attributed to the fact that children from a family of higher monthly income might feed diversified foods as their families could be more likely to afford to have diversified foods than children from a low household income.

We have also found out that mother level of education Regarding the age, it was found out that children age 9 - 11 months were 3.35 more likely to meet the Minimum Dietary Diversity than their 6 – 8 months counterparts. This difference was statistically significant at a 95% level of confidence (p <0.05). The 95% confidence interval reveals that the Odd Ratio of children 9-11 months to meet the Minimum Dietary Diversity in the survey regions was between 1.23 to 10.26, meaning that at population levels, the likelihood of those children to meet the minimum dietary diversity was between 1.23 to 10.26 higher than that of their colleagues aged 6 – 8 months, when all other factors are the same.

It was revealed that mother's with a secondary and higher level of education were significantly associated with feeding their children diversified food sources compared to those mothers who had no formal education. This finding is consistent with a study done in North West Ethiopia, where mothers' higher educational attainment and overall literacy rate were a significant determinant factor for appropriate diversified infant feeding practices (Beyene, 2015). This good feeding practices could be due to the fact that educated mothers might be more likely to have more information; understood educational messages delivered through different media outlets, and might learn about child feeding in the curricula at school

Model evaluation results yielded the coefficient of determination (R^2) of 0.126; and the Goodness-of- the fit Hosmer Lameshaw Chi-Square of 63.81 (8 degree of freedom) with p value of 0.111, which was not significant. Non-significant HL statistic indicates that the model was good enough and the results are tenable. The coefficient of determination (R^2) in Logistic Regression models is also known as pseudo R^2 as it is used as a supplementary statistic for model evaluation, unlike when it is used in linear regression where its explanatory power is more robust.

Limitation of the Study

The following limitation should be noted while interpreting the findings of the study. The DDS was assessed based on a single day recall; hence it may not precisely show the usual dietary behavior of the households in the surveyed areas.

This survey used a cross-sectional design so a cause-and-effect relationship cannot be considered; a future study can use another study method to identify the causality.

Conclusion and Recommendations

In conclusion, this study showed that factors that consistently affect dietary diversity in common were the age of the child especially lower age, and low level of the mothers' education and wealth index. The study highly recommends that measures should be taken to educate parents and caregivers about how to prepare the diversified diet from locally available food groups for complimentary after 6 months.

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