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Determinants of inadequate minimum dietary diversity among children aged 6–23 months in Ethiopia: secondary data analysis from Ethiopian Demographic and Health Survey 2016

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Abstract

Background: Inadequate feeding practices are a significant reason for the onset of malnutrition in young children, and their consequences are one of the major obstacles to sustainable socioeconomic development and poverty reduction. Dietary diversity is one of the useful indicators to assess the nutrient adequacy and can examine how different food groups contribute to the nutrient adequacy of the diet in a specific area. Minimum dietary diversity is the intake of at least four food types from the seven categories.

Methods: Secondary data analysis of Ethiopian Demographic health survey of 2016 was conducted to explore significant predictors that make children inappropriate to meet minimum dietary diversity. There were 2972 weighted samples, and we have used "SVY" command by STATA 14.0 during data analysis to run the complex survey data. This study has identified the possible factors of inadequate minimum dietary diversity of children.

Results: The proportion of inadequate minimum dietary diversity in Ethiopia was found 85.1%. Frequency of reading newspaper or magazine, frequency of listening to radio, father's educational level and household wealth index were found significant predictors to determine the minimum dietary diversity of children. Dairy products and grain, roots and tubers account more than half of consumed foods. Among breastfed children who attained minimum dietary diversity, majority of them were in the age group of 6–11 months.

Conclusions: Minimum dietary diversity is still low in Ethiopia, and most of mothers feed their child the most and easy accessible food rather than of diverse food. In the way of addressing the Sustainable Development Goal, Ethiopia requires substantial improvement in complementary feeding practices. Appropriate infant and young child feeding messages should to be developed and delivered through mass media.

Keywords: Minimum dietary diversity, EDHS, Inappropriate complementary feeding, Food groups

Background

Globally, inadequate feeding practices and their outcomes are still one of the real impediments to sustainable socioeconomic development and poverty reduction. Countries will not be productive in their endeavors to quicken economic development in any significant long haul sense until optimal child growth and development, particularly thorough appropriate feeding practices, are ensured [1]. In addition, inappropriate feeding practices are a significant reason for the onset of malnutrition in young children [2].

Adequate nutrition allows children to grow, develop, learn, play, participate and contribute, while under

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nutrition robs children of their futures and leaves young lives hanging in the balance. Stunting is one of the main reasons that may make children never grow to their full height, and their brains may never develop to their full cognitive potential [3]. Universally, 151 million children younger than 5 years old were stunted (too short for their age) during 2017, with 75% of such children living in the WHO African Region or World Health Organization (WHO) South East Asia Region. During the year of 2017, 51 million children under the age of five were wasted (too light for their height) which is also a major cause of burden preventing children who survive from reaching their full development potential [4].

Except if massive improvements in child nutrition are made, it will be hard to accomplish the ambitious Sustainable Development Goals (SDGs) which target by 2030 to end all types of malnutrition, including achieving, by 2025, the universally agreed targets on reduction of stunting and wasting in children younger than 5 years of age, and address the nutritious needs of adolescent girls, pregnant and lactating women and older persons [4].

Because of the rapid rate of growth and development during the first 2 years ("critical window"), nutrient needs per body weight of infants and young children are high which makes breast milk insufficient to provide all the needs [2]. Complementary feeding is defined as the process starting other foods and liquids, along with breast milk, when breast milk is no longer sufficient to meet the nutritional requirements of infants. Even though breastfeeding may continue beyond 2 years, the target range for complementary feeding is generally taken to be 6–23 months of age [5].

World Health Organization published document in 2008 presented fifteen indicators to assess infant and young child feeding practice that includes eight cores (early initiation of breastfeeding, exclusive breastfeeding under 6 months, continued breastfeeding at first year, introduction of solid, semisolid or soft foods, minimum dietary diversity, minimum meal frequency, minimum acceptable diet and consumption of iron-rich or iron-fortified foods) and seven optional indicators (children ever breastfed, continued breastfeeding at second years, age-appropriate breastfeeding, predominant breastfeeding under 6 months, duration of breastfeeding, bottle-feeding and milk feeding frequency for non-breastfed children). Indicators for dietary diversity (a proxy for adequate micronutrient-density of foods and liquids other than breast milk), feeding frequency (a proxy for adequate energy intake from non-breast milk sources) and minimum acceptable diet among breastfed and non-breastfed children aged between 6 and 23 months were categorized as the cores list. From these indicators, minimum dietary diversity assesses food intake among children age 6–23 months from at least four food groups. Using four food groups as the cutoff is linked with better-quality diets for both non-breastfed and breastfed children [5].

Dietary diversity is one of the useful indicators to assess the nutrient adequacy. It is also able to examine how different food groups contribute to the nutrient adequacy of the diet in a specific area [6]. Besides, dietary diversity is a significant predictor of stunting which enables interventions aimed at improving it can play a pivotal role in reducing the long-term burden of stunting among infants and young children [7]. Generally, the nutritional status of children can significantly be determined by the dietary diversity [8].

Most of developing countries are poorly practicing complementary feeding and are even worsening in some of them [9]. In 2005, Productive Safety Net Program (PSNP) was established by the government of Ethiopia, world food program and development partners collaboratively to increase families' long-term resilience to food shortages. The birth of PSNP is gone for empowering the rural poor confronting chronic food insecurity to oppose shocks, make resources and move toward becoming sustenance independent. The impact of PSNP was assessed in 2008 and showed some positive effect on a livelihood and food security [10].

All things considered, Ethiopia has been attacked by El Nino related drought since 2015 which greatly increased food insecurity level and malnutrition rate particularly worsen in some regions. One of the worst droughts in decades (El Nino) brings failure of the main rainy season which is vital for producing more than 80% of Ethiopia's agricultural yield—in a main sector that more than 80% of the country's populations rely on [11, 12]. The current study aimed to explore the predictors of poor complementary feeding by using MDD and provide some critical insights for policy makers as well as helps further research to explore the current situation, trends and reasons for failure of interventions.

Methods

Source of data

The present study examined the 2016 Ethiopia Demographic and Health Survey (2016 EDHS), which is the fourth in a series of Demographic and Health Surveys conducted in Ethiopia in 2000, 2005 and 2011. The 2016 EDHS sample is stratified and was selected in two stages. Administratively, Ethiopia is divided into 11 geographic regions. Each region was stratified into urban and rural areas, which yielded 21 sampling strata. In the first stage, 645 enumeration areas (EAs) were selected with probability proportional to the EA size

and with independent selection in each sampling stratum. An EA is a geographic area that covers an average of 181 residential households as determined in the 2007 Population and Housing Census. In the second stage of selection, a fixed number of 28 households for every cluster were selected with an equal probability systematic selection from the newly created household listing.

The survey had a total of 18,008 households selected for the sample, of which 17,067 were available. Of the available households, 16,650 were successfully interviewed which provides a response rate of 98%. In the interviewed households, there were 16,583 eligible women for individual interviews. Successful interviews were conducted among 15,683 women, yielding a response rate of 95%. Women who had no less than one child living with them who was born in 2014 or later were asked questions about the types of liquids and foods the child had consumed during the day or night before the interview. Mothers who had more than one child born in 2014 or a later year were asked questions about the youngest child living with them [14]. Our analysis was done among last born living children aged 6–23 months, living with the respondent (ever married women of 15–49 years and usual residents), total weighted sample size was 2972.

Variables

Outcome variable

The MDD is defined as the proportion of children aged 6–23 months who consumed foods from at least four food groups out of the seven referenced food groups within a 24-h time. The seven food groups are: 1—grains, roots and tubers, 2—legumes and nuts, 3—dairy products, 4—flesh foods (meat, fish, poultry and liver/organ meats), 5—eggs, 6—vitamin A-rich fruits and vegetables and 7—other fruits and vegetables [4]. In the present study, those children between 6 and 23 months who have taken at least four food groups in the last 24 h before interview are considered as they achieved the MDD adequately. Therefore, the outcome variable is categorized as ("0"—adequate minimum dietary diversity, "1"—inadequate minimum dietary diversity).

Explanatory variables

The explanatory variables were found from different literature and grouped as characteristics of the child, parental, family/household, healthcare services and the community. The child characteristics included sex, age [5], birth order and having common childhood illnesses, and the paternal characteristics included for each parent's educational level, literacy level, working status and mother's age, and maternal marital status. The household source of drinking water [13], wealth index and exposure to media were considered as key household characteristics, whereas the nature of residence (urban or rural) was considered as community-level variable. As health service characteristics antenatal visits, place of delivery and timing of post-natal care were included. The information about variables had been described in detail in the EDHS report [14].

Statistical analysis

Complementary feeding indicator (outcome variable) was dichotomized with category 1 for not meeting the indicator criteria and category 0 for meeting the indicator criteria. After the data cleaning is conducted intensively, the outcome variable was examined against different set of independent variables (individual, parental, household, healthcare and community-level characteristics) to identify factors associated with not meeting the indicator criteria. Data analysis was performed by considering sampling weight, and the survey "SVY" commands of Stata version 14.0 were used for adjustments of DHS' complex sampling design when estimating confidence intervals. The analysis of factors is conducted using sampling weights which denote the inverse of the probability that the observation is included because of the sampling design. Bivariate logistic regression was used to examine the impact of each independent variable on the outcome. Variables that satisfied the cutoff point of p value ≤ 0.25 became candidate for the multiple logistic regression model. But those variables with statistical significance of $p < 0.05$ remained in the final model. To look to the final model fitness, Hosmer and Lemeshow goodness-of-fit test was used [15]. Multicollinearity among independent variables was also assessed using variance inflation factor (VIF).

Results

In our study, the minimum dietary diversity was 14.9% which is slightly higher than the EDHS report of 13.8%. Since Ethiopia is one of the developing countries where most of mothers living in rural areas, majority (88.35%) of our respondents were living in there. Majority of the children born were female 1575 (53.03%) and aged between 12 and 17 months (36.73%). Most of mothers (52.25%) aged between 25 and 34 years old and those who have not get into any formal education took the majority (62.02%). Most of mothers (57.43%) have not directly engaged in income generating occupations. But, agricultural works remained highly prevalent work among mothers (21.60%) and fathers (61.47%) of children aged 6–23 months. The current study has revealed that mother's exposure to mass media was low. From the interviewed mothers 1.77% reads newspaper, 13.73% listen to radio and 9.03%

watches television at least once in a week. Most (57.05%) of Ethiopian mothers of children aged 6–23 months provide complementary feeding using improved water sources, and also majority of mothers were living below the middle level of household wealth index. Majority of the respondents (66.3%) waits more than 2 years to give birth to their living youngest child. Ethiopia still has a work to do in institutional delivery because around 62% of delivery was conducted in home. Almost one-third of mothers gave birth to child without having any antenatal care visit in the health institution. Besides, postnatal check-up within 2 months after delivery was not conducted for majority (88.43%) of mothers. Table 1 has shown different individual, parental, household, healthcare and community-level characteristics of last children who are living with their mother and aged between 6 and 23 months.

Minimum dietary diversity rate among children aged 6–23 months was also described with their current breastfeeding status. There was high rate of MDD among breastfeeding children in the all age classification [(6–11 months), (12–17 months), (18–23 months)]. Among breastfed children who attained MDD, majority of them were in the age group of 6–11 months next in 18–23 months which accounts 9.6% and 7.25%, respectively. The least (5.8%) were in 12–17 months age group. From those children who attained the MDD and not breastfeeding, majority rate (5.5%) was from the age group of 18–23 months. The least MDD rate was scored among children aged 6–11 months who were not breastfeeding during the interview (Table 2).

By controlling for possible confounders, variables which remained in the final model were frequency of reading to newspaper or magazine, frequency of listening to radio, father's educational level and household wealth index. Those children whose mothers read to newspaper or magazine at least once in a week had 81% less chance to be inadequate for MDD. Furthermore, statistically significant result has shown that the odds of being inadequate to minimum dietary diversity among children whose mothers read to newspaper or magazine less than once in a week was 56% less likely (AOR = 0.44; 95% CI 0.23, 0.83) than those children's mother who do not read at all. Likewise, the odds of being inadequate to MDD among children who had mothers that listen to radio at least once in a week was 57% less likely than (AOR = 0.43; 95% CI 0.30, 0.62) those children who had mothers that did not listen at all. Those fathers who had attained primary education had 41% less likely (AOR = 0.59; 95% CI 0.37, 0.94) odds of having children who are inadequate to minimum dietary diversity than fathers who did not go to formal education. The odds of having inadequate minimum dietary diversity among children living in richest

Table 1 Individual, parental, household, healthcare and community-level characteristics of living children aged between 6 and 23 months, Ethiopia, 2016

Characteristics	*n*	%
Child characteristics		
Sex of child		
Male	1396	46.97
Female	1576	53.03
Age of child (months)		
6–11	1044	35.14
12–17	1091	36.73
19–23	836	28.13
Birth order		
Firstborn	547	18.4
Second to fourth	1284	43.2
Five or more	1141	38.4
Diarrhea[a]		
No	2394	80.54
Yes	573	19.28
Cough		
No	2267	76.29
Yes	705	23.71
Parental characteristics		
Mother's age (years)		
15–24	805	27.08
25–34	1553	52.25
35–49	614	20.67
Mother's education		
No education	1844	62.02
Primary education	904	30.40
Secondary and higher	225	7.58
Mother's occupation		
Not working	1707	57.43
Non agricultural works	590	19.84
Agricultural works	642	21.60
Others	33	1.13
Mother's literacy		
Cannot read at all	2203	74.11
Able to read only parts of sentence	356	11.98
Able to read whole sentence	413	13.91
Mother's marital status		
Currently married	2838	95.49
Formerly married	134	4.51
Reads newspaper or magazine		
Not at all	2777	93.45
Less than once a week	142	4.78
At least once a week	53	1.77
Listen to radio		
Not at all	2177	73.25
Less than once a week	387	13.02
At least once a week	408	13.73

Table 1 (continued)

Characteristics	*n*	%
Watches television		
Not at all	2446	82.27
Less than once a week	258	8.70
At least once a week	268	9.03
Father's education		
No education	1254	42.18
Primary	1177	39.62
Secondary and higher	385	12.96
Don't know and missing	136	5.26
Father's occupation		
Not working	219	7.38
Non agricultural works	678	22.82
Agricultural works	1827	61.47
Others and missing	248	8.33
House hold characteristics		
Source of drinking water		
Improved	1696	57.05
Un improved	1276	42.95
Household wealth index		
Poorest		
Poorer	627	21.09
Middle	666	22.41
Richer	544	18.31
Richest	434	14.61
Healthcare characteristics		
Preceding birth interval		
No preceding birth	549	18.5
< 24 months	451	15.2
≥ 24 months	1972	66.3
Antenatal care visit		
None	1002	33.71
1–3 times	870	29.28
4 and above	987	33.21
I don't know and missing	113	3.80
Mode of delivery		
Non-Cesarean section	2897	97.48
Cesarean section	75	2.52
Place of delivery		
Home	1845	62.05
Health facility	1068	35.95
Other	59	2.00
Post-natal check-up within 2 months		
No	2628	88.43
Yes	232	7.79
I don't know and missing	112	3.78
Community-level factors		
Residence		
Urban	346	11.65
Rural	2626	88.35
Minimum dietary diversity		
Adequate minimum dietary diversity	443	14.9
Inadequate minimum dietary diversity	2529	85.1
Total	2972	

[a] For having diarrhea recently 5 respondents responded "I don't know"

household was 60% (AOR = 0.40; 95% CI 0.21, 0.76) less likely than children who were living in poorest household (Table 3).

Based on our criteria of beta coefficient change greater than twenty percent, there was no significant confounder or interaction observed. The significance level of Hosmer–Lemeshow test for goodness of fit was 0.33. Since the probability is greater than 0.05, we fail to reject the null hypothesis and shows that there is no significant difference between the observed and model-predicted values. Therefore, our final model fit the data well. The final model of this study showed that the mean value of VIF was 1.45 which indicated there was no multicollinearity in the final model (Fig. 1).

Discussion

The present study has analyzed the nationally representative data from the 2016 Ethiopia Demographic health survey and reveals the important gaps in meeting the minimum dietary diversity criteria by WHO for children aged 6–23 months. We have found prevalence of minimum dietary diversity rate as 14.9% which is slightly higher than the national EDHS report of 2016 [14]. This can be due to the reason that for analyzing to the factors and to give equal chance for all respondents we have cleaned the data set based on important variables (Table 4).

One of the factors that the current study has identified is the impact of mother's access to mass media. Those mothers who read newspaper or magazine at least once in a week have low chance to be inadequate in meeting minimum dietary diversity of their young infant. This finding is concurrent with the study conducted in Nepal and India [16, 17]. Besides, mothers who listen to a radio within a week are also able to feed different food groups to their child and meet the minimum dietary diversity intake. Listening to radio is found a significantly affecting factor in an Indian study conducted using secondary analysis of the national family health survey [17]. Another study conducted in North West Ethiopia and Bangladesh also came up with the same finding that shows mother's exposure to mass media remains positively associated

Table 2 Types of foods given to children aged 6–23 months a day before the interview, EDHS, 2016

Food groups	Age of a child (months)						*N*
	6–11		12–17		18–23		
	n	%	*n*	%	*n*	%	
Grain, roots and tubers	519	28	734	39.7	596	32.3	1849
Legumes and nuts	186	30	233	38	194	32	613
Dairy products	403	35.4	411	36.1	324	28.5	1138
Flesh foods	46	18.4	122	48.8	82	32.8	250
Eggs	154	31.3	189	38.4	149	30.3	492
Vitamin A-rich fruits and vegetables	206	25.1	346	42.1	269	32.8	822
Other fruits and vegetables	142	28.1	204	40.3	160	31.6	506
Total	1514		2239		1774		5057

Table 3 Minimum dietary diversity among children aged between 6 and 23 months, Ethiopia, 2016

Minimum dietary diversity	Sample size	*n*	%
Minimum dietary diversity, breastfeed (6–11 months)	981	102	9.6
Minimum dietary diversity, non-breastfeed (6–11 months)	63	18	3.5
Minimum dietary diversity, breastfeed (12–17 months)	999	179	5.8
Minimum dietary diversity, non-breastfeed (12–17 months)	93	19	4.9
Minimum dietary diversity, breastfeed (18–23 months)	638	88	7.25
Minimum dietary diversity, non-breastfeed (18–23 months)	198	36	5.5

Variable	VIF	1/VIF
reading_fr~y		
1	1.28	0.779701
2	1.14	0.877813
listning_f~y		
1	1.29	0.777955
2	1.36	0.737564
father_edu~n		
1	1.69	0.590851
2	1.87	0.533791
wealth_index		
2	1.19	0.839580
3	1.25	0.801498
4	1.28	0.781264
5	2.14	0.467723
Mean VIF	1.45	

Fig. 1 Multicollinearity test for predictors in the final model significantly associated with inadequate minimum dietary diversity of children 6–23 months, EDHS 2016

with improving minimum dietary diversity of children [18, 19].

Being richest in household wealth index has been shown negatively associated with inadequate minimum dietary diversity of a child. Similarly, household wealth was found as predictor of minimum dietary diversity in the four South Asian countries where variable is available, indicating the important role of household resources in determining complementary feeding of children [9]. In our study, especially children who were living in a richest household had significantly less chance to be inadequate in meeting the recommended minimum dietary diversity. This was in line with other study conducted in Ethiopia using the 2011 DHS [20].

Moreover, in the present study education level of fathers has been assessed and became statistically associated with meeting the recommended diversity of food. Compared to no education, as the education level of the fathers increased, the children were more likely to get the recommended minimum dietary diversity. The same finding was also found in Nepalese study [21]. This shows that educated fathers can understand the education message that they got from different mass media like radio or newspaper which more likely enable them to be engaged in achieving their children to the minimum dietary diversity. Since EDHS is using cross-sectional study design, the limitations of this study were causal inferences between associated factors and inadequate MDD cannot be made.

Conclusion

The study revealed different predictors that were significantly associated with the selected WHO recommended complementary feeding practice indicator (minimum

Table 4 Bivariate and multivariate logistic regression between different level predictors and inadequate minimum dietary diversity of children aged 6–23 months, EDHS 2016

Characteristics	COR	Risk for inadequate minimum dietary diversity				
		95% (CI)	*p* value	AOR	95% (CI)	*p* value
Reads newspaper or magazine						< 0.001
Not at all [*R*]						
Less than once a week	0.22	(0.13, 0.38)	0.000	0.44	(0.23, 0.83)	0.012
At least once a week	0.07	(0.03, 0.19)	0.000	0.19	(0.07, 0.46)	0.000
Listen to radio						< 0.001
Not at all [*R*]						
Less than once a week	0.47	(0.29, 0.74)	0.001	0.72	(0.42, 1.24)	0.245
At least once a week	0.23	(0.16, 0.33)	0.000	0.43	(0.30, 0.62)	0.000
Father's education						< 0.001
No education [*R*]						
Primary	0.46	(0.28, 0.75)	0.002	0.59	(0.37, 0.94)	0.028
Secondary and higher	0.25	(0.15, 0.40)	0.002	0.62	(0.36, 1.09)	0.102
Household wealth index						< 0.001
Poorest [*R*]						
Poorer	0.58	(0.31, 1.06)	0.081	0.66	(0.37, 1.17)	0.156
Middle	0.56	(0.31, 1.02)	0.059	0.79	(0.44, 1.41)	0.433
Richer	0.41	(0.22, 0.75)	0.004	0.69	(0.38, 1.27)	0.240
Richest	0.16	(0.08, 0.29)	0.000	0.40	(0.21, 0.76)	0.005

dietary diversity). After lots of variables have been assessed significantly, associated factors were: reading frequency of newsletter or magazine, listening frequency to radio, father's educational level and household wealth index. Minimum dietary diversity is still low in Ethiopia, and the most common food groups consumed were dairy products and grain, roots and tubers. This shows the gap that mothers feed their child the most and easy accessible food rather than of diverse food. This study also came up with the result that increment in the household wealth had a good impact to feed the child to the diverse food groups for better growth and development. By increasing the accessibility, awareness creation using radio, newspaper or magazine was one of the significant game changer methods to improve the inappropriate complementary feeding practice.

Since increasing dietary diversity at the national level is an effective measure to childhood malnutrition reduction and improving the nutritional status of children [8, 22], this study suggests the possible targets of future interventions to improve minimum dietary diversity in Ethiopia. National governments should build the capacity of small-scale producers, particularly women, by ensuring access to public services such as infrastructure, financial services, information and training of appropriate feeding practice. National governments must provide access to education and strengthen social safety nets to ensure that all members of society have income security and can access essential foods and health care. International or local donors should play their pivotal role by funding efforts to achieve the SDGs.

Abbreviations

AOR: adjusted odds ratio; CI: confidence interval; COR: crude odds ratio; DHS: demographic health survey; EAs: enumeration areas; EDHS: Ethiopia demographic health survey; MDD: minimum dietary diversity; PSNP: Productive Safety Net Program; SDGs: Sustainable Development Goals; SVY: survey; WHO: World Health Organization; VIF: variance inflation factor.

Authors' contributions

TE conceived the study, designed, wrote the paper, conducted data analysis, drafted and finalized the manuscript for publication. GK, YB, AM and TM assisted with critical reviewing papers. All authors read and approved the final manuscript.

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Competing interests
The authors declare that they have no competing interests.

Availability of data and materials
Supporting data for the current study are available from the corresponding author on reasonable request. The EDHS data set was retrieved from https://dhsprogram.com/data/available-datasets.cfm.

Consent for publication
Not applicable.

Ethics approval and consent to participate
Secondary analysis of the data is conducted through ethical way of accessing to DHS data. First and foremost, online request to access the data set was sent to the CSA or ORC Macro (Demographic and Health Survey) and we have been authorized to download data from the Demographic and Health Surveys (DHS) online archive.

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