

Factors Associated With Minimum Dietary Diversity Among Children Aged 6 to 23 Months in Debre Berhan Town, Central Ethiopia: Community-based Cross-sectional Study

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Abstract

Background: Minimum dietary diversity (MDD) is the consumption of four or more food groups from the seven food groups. Poor infant and young child feeding (IYCF) practices in the first 2 years of age are among major causes of childhood undernutrition, illness, and mortality. Therefore, this study aimed at investigating MDD and its associated factors among IYC aged 6–23 months in Debre Berhan town, central Ethiopia.

Methods: A community-based cross-sectional study was undertaken from January 1 to 30, 2017. A simple random sampling technique was used to sample 377 IYC aged 6-23 months with mothers/caregivers. An interviewer-administered structured and pretested questionnaire was used to collect data through a face-to-face interview. Data were cleaned and entered into Epidata 3.1, exported to SPSS software version 20. Logistic regression was fitted and an odds ratio with a 95% confidence interval (CI) and p-value less than 0.05 was used to identify factors associated with MDD.

Results: A total of 377 IYC aged 6-23 months with mothers/caregivers were participated in the study. The proportion of children who met the MDD practice was 58.4%. Mother's education [(AOR = 0.15; 95% CI = 0.02-0.88), (AOR = 0.21; 95% CI = 0.05-0.97)], mother's occupation (AOR = 0.28; 95% CI = 0.15-0.54), father's occupation (AOR = 3.45; 95% CI = 1.40-8.54), and number of antenatal care visit by mothers (AOR = 0.54; 95% CI = 0.30-0.97) were factors associated with MDD among IYC.

Conclusion: Even though the study showed better progress as compared to the national prevalence of the consumption of MDD, it is substandard in the study area. Thus, more efforts need to be done to achieve the recommended MDD intake for all children aged between 6 and 23 months. Increasing mothers' level of education, creating employment opportunities for both mothers and fathers', and increasing the frequency of ANC service use are vital interventions to improve IYCF practices in Debre Berhan town.

Background

United Nations Children's Fund (UNICEF) defines undernutrition as the outcome of insufficient food intake in terms of quantity and/or quality and/or poor absorption and/or poor biological use of nutrients consumed as a result of repeated disease (1, 2). Food and Agricultural Organization of the United Nation (FAO) estimates that 1.02 billion people are undernourished worldwide in 2009. Two billion people suffer from different forms of starvation, malnutrition, and related health implications (3). It includes being underweight for one's age, too short for one's age (stunted), dangerously thin for one's height (wasted), and deficient in vitamins and minerals (micronutrient malnutrition) (2). Undernutrition remains a serious problem among children in Sub-Saharan Africa (4). Acute malnutrition can result from food shortages, inappropriate child care or feeding practices, or a combination of these factors (1). The nutrition that children receive during the period from conception to their second birthday, the first 1,000 days, may influence their entire lives. Even if their diet and health improve later in life, the damage done during this period is largely irreversible (5, 6).

Dietary diversity (DD) is defined as the number of different foods or food groups (FGs) eaten over a reference period, not regarding the frequency of consumption. Dietary diversity is a qualitative measure of food consumption that reflects household access to a variety of foods and is also a proxy of micronutrient adequacy of the diet of individuals (7–11). Increasing DD helps ensure adequate intake of essential nutrients. Dietary diversity is a key element of a high-quality diet. A dietary diversity score (DDS) is a simple count of FGs consumed over a certain reference period (12, 13). It is calculated by summing the number of different foods or food groups (FGs) consumed by the individual respondent over a reference or recall period. Reference periods vary from 1 day to 7 days but 1 day is the most commonly used. A food group is defined as a grouping of food items that have similar caloric and nutrient content. Food items cannot be further split into separate foods (10, 14–17). Dietary diversity simple and valid proxy for diet quality across age groups and contexts (10, 18–21).

Dietary diversity indisputably increases the potential for the provision of diverse nutrients and healthy phytochemicals(13). Dietary diversity consisting among others of FGs classified as sources of energy (cereals, tubers, roots), protein providers (pulses, solid food of animal origin), mineral suppliers (pulses, other legumes, vegetables, solid food of animal origin, milk), and vitamin sources (vegetables, green vegetables, fruits, solid food of animal origin) can be recommended as the indicator of a healthy diet. Consumption of food from at least four FGs means that the child has a high likelihood of consuming at least one animal source of food and at least one fruit or vegetable in addition to a staple food (grains, roots, or tubers) and tend to be nutritionally acceptable (10, 13, 22). The minimum dietary diversity (MDD) indicator is calculated as the percentage of children aged 6-23 months who receive foods from four or more FGs among the seven FGs (22). The age of a child between 6 and 23 months is the critical window of opportunity to prevent childhood malnutrition and is a period of growth faltering and malnutrition since children need more energy and nutrient-dense foods to grow and develop (22).

Though good nutrition and appropriate child feeding are vital in the early stages of child development, particularly in the first 1000 days of life (6). Oppositely, inappropriate feeding practice increases the risk of undernutrition, illness, and mortality amongst children less than 2 years of age (23). Globally, only a few children are receiving nutritionally adequate and diversified foods. More than two-thirds of malnutrition-related child deaths are associated with inappropriate feeding practices during the first two years of life (12). Even though DD is well recognized as an important dimension of diet quality but it is difficult to achieve in resource-poor settings where monotonous diets fail to meet many micronutrient needs. This is particularly crucial among vulnerable groups which include women of infant and young children (IYC) (2). In the Republic of the Union of Myanmar, almost all children consumed items from the 'grains, roots, tubers' group followed by 'vitamin A-rich fruit and vegetables and 'flesh foods'. The least commonly consumed food groups were dairy products, legumes and nuts, and eggs (24).

A detailed analysis of the 2011 Ethiopian Demographic and Health Survey showed that only 10.8% of children aged 6–23 months have received minimum dietary diversity (25). However, according to the 2016 Ethiopian Demographic and Health Survey (EDHS) national report, 14% of children had an adequately diverse diet in which they had been given foods from the appropriate number of food groups (26). Similarly, studies conducted in different developing countries and elsewhere revealed low (27–29) and variable levels of MDD practice (23) but high for Sri Lanka (30).

In Ethiopia, FGs consumed by more than 50% of the children in each age group were grains, roots, and tubers, and other fruits and vegetables. Consumption from flesh foods and vitamin-A-rich fruits and vegetables was minimal or nonexistent (6) and children age 6-23 months are much less likely to consume meat, fish, and poultry than other food groups (31). Moreover, different studies conducted in different urban and rural areas of Ethiopia showed variable results (from 12.6–59.9%) for MDD; 59.9% in Addis Ababa, Ethiopia (12), 12.6%, in Dangila town of Northwest Ethiopia (32), 17% at Dabat district of Northwest Ethiopia (33), 27.3% in Wolaita Sodo of Southern Ethiopia (34), 28.5% in the predominantly agrarian society of Bale zone of Southeast Ethiopia (35) and 38% in Bench Maji Zone of Southwest Ethiopia (36).

Minimum dietary diversity was significantly associated with mother's education (34) (23, 27, 30, 32, 34–36), wealth quintile or index (25, 30, 37), urban residence, home gardening, and media exposure (25, 30, 32). It was found that a family who grew vegetables and own livestock, a woman who received education on IYCF during postnatal care visits, maternal knowledge of IYCF, and exposure to IYCF information on mass media were significantly associated with an increase in dietary (12, 30, 32, 37). Besides, age the child and first birth order (32, 34); the age of the mother (33), occupational status of the parents (34), number of children and ANC follow up (36); child illness in the past 1 week and maternal counseling on IYCF during PNC visits; and meal frequency and women involvement at household decision making (38) were factors associated with minimum dietary diversity practice (35).

Even though the impact of consumption of diversified is undeniable in alleviating malnutrition, limited researches were conducted in the field and the available studies showed inconsistent results. In addition, most of the studies conducted in Ethiopia primarily focused on measuring complementary feeding levels in rural communities. Although the above-mentioned studies gave important information on IYCF practices, they had some limitations. Given the socio-cultural, economic, and ecological diversities of towns and the long-lasting high food price in Ethiopia, urban feeding practice in general and child feeding, in particular, was poorly investigated. Therefore, this study aimed to assess minimum dietary diversity and the associated factors among children aged 6–23 months in Debre Berhan town, central Ethiopia. Hence, this study will inform decision-makers, programmers, health professionals, and other stakeholders about the feeding practice of IYCF in an urban highland and take relevant public health lessons and interventions.

Methods

Study design, setting, and participants

A community-based cross-sectional study was conducted to assess meal frequency, minimum dietary diversity, and associated factors among children aged 6–23 months from January 1-30, 2017 in Debre Berhan (DB) town which is located in North Shewa Zone, Amhara Regional State. It is 130 kilometers away from Addis Ababa. Administratively, the town is subdivided into nine Kebeles (the lowest administrative unit in Ethiopia). According to the 2007 census, the town has 94,829 total populations, out of which 50,759 were female and 21,972 were women of reproductive age groups (WRAG). The total area of the town is 18,081.95 hectares. The town has 1 governmental referral hospital, 1 private hospital, 3 health centers, and 17 private clinics.

The source population was all children aged 6–23 months along with their mothers/caregivers who lived in DB town. The study populations were all children of age 6–23 months along with their mothers/caregivers who live in the randomly selected Kebeles of Debre Berhan town. All mothers/caregivers aged 18 and above years old, who have at least one under two years old child and who are permanent residents of the selected Kebeles were eligible respondents for the questionnaire and were interviewed. Nevertheless, those mothers/caregivers who are seriously ill during the study period were excluded from the study since they are unable to give an appropriate response to the questions. The present analysis was restricted to the youngest living children aged 6–23 months, living with the respondent.

Sample size and sampling procedure

For sample size calculation we used single population proportion formula considering the following assumptions using Epi Info StatCalc: 95% confidence level ($Z_{\alpha/2}$), 59.9% proportion of children with minimum dietary diversity in Addis Ababa (12) for prevalence (p), 5% confidence level, and 5% margin of error (d) and which was 369. Adding a 5% non-response rate, the calculated sample size was 387. However, only 377 of the children aged 6–23 months with their mothers/caregivers have participated in this study.

A simple random sampling technique was used to select the sample. First, from nine (9) Kebeles, three (3) Kebeles (06, 07, and 09 kebele) were selected (30%) by lottery method. Then, proportional to population size allocation was done to select the desired samples from each selected Kebele. Lists of all mothers having children age 6–23 months residing in the three selected Kebeles of Debre Behan town were taken from health Extension Workers (HEWs) and respondents were selected from households to obtain a sample of 377. When respondents were not available at the time of data collection, two repeated visits were made before dropping them as non-respondents.

Study variables

Minimum dietary diversity among infants and young children is the dependent variable while independent variables include sociodemographic and economic variables, feeding practice of mothers, and maternal reproductive characteristics. The sociodemographic and economic variables included are; child's age (in months), mother's age, maternal educational level, paternal educational level, maternal religion, maternal marital status, maternal and paternal occupation, family monthly income, and family size. Whereas, feeding practice of mothers was assessed by child's food group consumption. Also, maternal reproductive characteristics considered include parity, gravidity, ANC visit, frequency of ANC visit, and physiological state of the mothers.

Data collection tool, measurements, and quality control

A structured pretested questionnaire was used to collect the required quantitative information through face-to-face interviews with the child's mothers/caregivers. It was first prepared in English and then translated to Amharic (local language), the local survey language, by the language expert and again back to English to check its consistency. It was focused on socio-demographic characteristics of children and parents/caregivers, obstetrics and health

service characteristics of mothers, and dietary diversity feeding practices. The data collection tool regarding the various factors was adapted from different similar works of literature (10, 12, 16, 31, 34, 39) with some modifications to fit with the context.

Questions on maternal and child socio-demographic characteristics were adapted from the Food and Agriculture Organization (FAO) manual of guidelines for assessing nutrition-related knowledge, attitude, and practice (10). Moreover, data on dietary diversity (DD) were collected using the WHO indicators for assessing infant and young child feeding (IYCF) practices (40, 41). The WHO infant and young child feeding indicators had detail descriptions of dietary diversity, including minimum dietary diversity. The dietary diversity data were collected using a 24 hours recall method; that is, mothers were asked to recall all foods given to their child in the past twenty-four hours before the survey. The dietary diversity indicator contains seven foods groups namely: Grains, roots, and tubers; Legumes and nuts; Dairy products (milk, yogurt, and cheese); Flesh foods (meat, fish, poultry, and liver/organ meats); Eggs; Vitamin A-rich fruits and vegetables; and other fruits and vegetables. This was based on the mother's recall of foods given to her child in the past twenty-four hours before the survey. For each of the 7 food groups, a point was added if any food in the group was consumed. Minimum dietary diversity is calculated by summing the number of FGs consumed by the individual using a score of "1" for food items consumed, and "0" for those food items not consumed over the past 24 hours by an individual child. This was used for measuring young children's (6 to 23 months old) dietary diversity and food group consumption frequency.

A pretest was done before the actual data collection on 5% of the sample out of the study area and necessary modifications were made accordingly. Six data collectors who were health professionals and who have had experience experienced were recruited and trained to facilitate the data collection process. Four of the researchers (MPH/MSc. In educational level) supervised the data collection process. The training was given for data collectors for one day on the rationale, objective of the study, confidentiality, the process and technique of data collection including how to use the questionnaires. On daily basis, close supervision was made, and feedback and correction were given to the data collectors. Furthermore, every day, the completeness and consistency of the collected data were checked. EpiData software was used to minimize data entry errors.

Data processing and analysis

All of the returned copies of the questionnaire were manually checked for completeness and consistency of responses. Then, data were entered into EpiData version 3.1 with double-entry verification for cleaning and coding and exported to SPSS version 20 for further analysis. Mean, standard deviation, frequency and percentages were used to summarize descriptive statistics of the data. A binary logistic regression analysis was run to identify associations between the dependent (minimum dietary diversity score-'yes' versus 'no' option) and independent variables. The dependent variable (minimum dietary diversity score) was coded as '1' for those who had consumed four or more foods and '0' for less than four food groups during the previous day. Moreover, variables with P-value <0.25 were included in the multivariable logistic regression model to identify factors independently associated with feeding MDD. Adjusted odds ratio (AOR) with a 95% confidence level was used to measure the strength of association. The fitness of the regression model was tested through Hosmer-Lemeshow goodness of fit. The Adjusted Odds Ratio (AOR) with 95% of confidence intervals was used to notify the strength of association, and at p-values of ≤ 0.05 was used to declare the variables significantly associated with the dependent variable in the multivariable analysis. Finally, data were presented using tables, figures, and text descriptions.

Operational definitions and measurement

Dietary diversity score: - The number of FGs consumed over 24 hours period before the survey.

Dietary variety: - It is considered here as synonymous with dietary diversity.

Minimum (optimal) dietary diversity: - It is the proportion of children 6-23 months years who received foods from four or more (≥ 4) FGs of the seven (7) FGs on the previous day.

Food Groups: Food groups (FGs) should come from a list of seven food groups: Grains, roots, and tubers; Legumes and nuts; Dairy products (milk yogurt, cheese); Flesh foods (meat, fish, poultry, and liver/organ meat); Eggs; Vitamin A-rich fruits and vegetables; and Other fruits and vegetables.

The terms '**Mother and Maternal**' are used interchangeably in this study.

Ethical considerations

Ethical clearance was obtained from the Institutional Ethical Review Board (IRB) of Debre Berhan University. Support letters were obtained from the Research, Community Service, and Postgraduate coordinating office of College of Health Sciences, Debre Berhan University, and Debre Berhan town Health Office. Since some mothers cannot read and write, informed verbal consent was obtained from each of the participant's mother mothers, after informing them all the purpose, benefits, risk, the confidentiality of the information, and the voluntary nature of participation in the study. Moreover, all data collectors and investigators guaranteed confidentiality of the information obtained from every study subject using code numbers rather than personal identifiers and keeping the questionnaire locked. Participants found to have inappropriate practices regarding their infant or young child feeding had been counseled after the completion of the interview.

Results

Of the total 387 sampled mothers/caregivers who had children 6–23 months, 377 of them participated in the study giving a response rate of 97.4%.

Sociodemographic and economic characteristics of the study subjects

The mean age of the children was 14.3 months with a standard deviation of ± 5.4 . One hundred thirty (34.5%) of the children were in the age category of 12-17 months and a nearly similar proportion of children are in each of the other two age categories. Only 44.7% of the household had one child. Concerning family

size, more than half (62.2%) had four or more household members, and 56.9% of the caregivers were grandmothers. There were two or more children aged under five years old per household among 14.8% of the family. The age of mothers ranges from 20 to 49 years with the mean age of 29.5 years (\pm 5.3 SD) while more than half (56.1%) of mothers fall in the age category of 20-29 years. A similar proportion of mothers and fathers (89.6% and 89.0%) respectively attended formal education. Sixty-one percent of fathers and 36.6% of mothers were government employees. However, 38.1% of the mothers were housewives (and unemployed). About 89% of the mothers were Orthodox Christian and 94.5% were married and living with their partners. Family monthly income ranges from 100 to 20,000 Ethiopian Birr (ETB) with a median of 3,000 with an interquartile range of 3000 (Table 1).

Reproductive characteristics of the mothers

The majority (89.9%) of mothers had at least one antenatal care (ANC) visit for their index child pregnancy while 62.2% of them had four and more ANC visits. Only 4.4% of the mothers were currently pregnant (Table 1).

Minimum dietary diversity (MDD)

Overall, only 220 (58.4%) children aged 6-23 months had received four or more food groups and fulfilled the MDD (Figure 1). Among those who fulfilled their MDD, only 28.2%, 39.5%, and 32.3% of them fall in the age group of 6-11 months, 12-17 months, and 18-23 months respectively. Only 51.7%, 66.9%, and 55.9% of children from the respective age category of 6-11 months, 12-17 months, and 18-23 months fulfilled the recommended MDD.

Table 1
Sociodemographic, economic and reproductive characteristics of the children and mothers, Debre Berhan town, central Ethiopia, 2017 (n = 377).

Variables	Response category	N (%)
Child's age	6-11 months	120 (31.8)
	12-17 months	130 (34.5)
	18-23 months	127 (33.7)
Number of children in the household (n = 374)	One child	167 (44.7)
	2 children	123 (32.9)
	≥ 3 children	84 (22.5)
Number of under 5 years old child (n = 365)	1 child	311 (85.2)
	≥ 2 children	54 (14.8)
Child's caregiver (n = 367)	Mother	158 (43.1)
	Grandmother	209 (56.9)
Family size (n = 296)	≤ 3	112 (37.8)
	4-6	176 (59.5)
	≥ 7	8 (2.7)
Household Head (n = 371)	Father headed	328 (88.4)
	Mother headed	43 (11.6)
Mother's age (n = 374)	20-29 years	210 (56.1)
	30-39 years	152 (40.6)
	40-49 years	12 (3.2)
Mother's religion (n = 374)	Orthodox	334 (89.3)
	Others*	40 (10.7)
Mother's marital status (n = 365)	Married and living with a partner	345 (94.5)
	Others**	20 (5.5)
Mother's education (n = 375)	Cannot read and write	19 (5.1)
	Informal education	20 (5.3)
	Formal education	336 (89.6)
Father's education (n = 364)	Cannot read and write	18 (5.0)
	Informal education	22 (6.0)
	Formal education	324 (89.0)
Mother's occupation (n = 370)	Housewife	141 (38.1)
	Merchant	57 (15.4)
	Private sector employee	34 (9.2)
	Government employee	138 (37.3)
Father's occupation (n = 344)	Daily laborer	37 (10.8)
	Merchant	63 (18.3)
	Private employee	34 (9.9)
	Government employee	210 (61.0)
Family monthly income (Ethiopian Birr)	Below median	161 (42.7)
	Median and above	216 (57.3)
While N stands for frequency % stand is for a percentage		
*Protestant, Muslim, and Catholic		
** Divorced, Widowed, and Separated		

Variables	Response category	N (%)
ANC follow up for index pregnancy	Yes	339 (89.9)
	No	38 (10.1)
Number of ANC visits (n=331)	Less than 4	125 (37.8)
	4 and above visits	206 (62.2)
Currently pregnant (n = 364)	Yes	16 (4.4)
	No	348 (95.6)
While N stands for frequency % stand is for a percentage		
*Protestant, Muslim, and Catholic		
** Divorced, Widowed, and Separated		

Grain, roots, and tubers were the most commonly consumed food items 24 hours preceding the survey; it is consumed by 361 (95.8%) of the children followed by dairy products-296 (78.5%). However, the intake of eggs and flesh food was low; of the total children, only 108 and 54 (28.6% and 14.6%) ate eggs and flesh food, respectively. In addition, less than half (44.6%) of children received vitamin-A-rich fruits and vegetables. Moreover, the majority (88.1%) of children also consumed other food categories like fat and oils, sweetened foods, and condiments which are not considered in the dietary diversity score calculation but proved to have a significant impact on health and nutrition (Figure 2).

Factors Associated with Minimum Diet Diversity

Binary and multivariable binary logistic regression analyses were performed. In the bivariate analysis, mother's age and marital status, mother's and father's educational status, mother's and father's occupations, mother's religion, mother's ANC follow-up and the number of ANC visits, and monthly income were found to be significantly associated with infant and young children's MDD score at a p-value of 0.25.

According to the multivariable analysis, only four variables remain associated with infant and young children's MDD score at the p-value of ≤ 0.05 ; namely: mother's education, mother's and father's occupations, and the number of ANC visits by mother. However, the mother's age, marital status, religion, and ANC follow-up, father's education, and family monthly income didn't show any significant association in the multivariable analysis.

Accordingly, the minimum dietary diversity practice of study subjects was 85% times less likely among illiterate mothers than mothers with formal education [AOR= 0.15 (95% CI, 0.02-0.88)]. Similarly, the odds of MDD among IYC having mothers learned informal education were 79% less odds of consuming from 4 or more food groups than those whose mothers attended formal education [AOR= 0.21; 95% CI, 0.05-0.97]. In addition, IYC whose mothers are housewives (not employed) had 72% less odds to consume from four or more food groups than those IYC whose mothers were governmental employees (AOR = 0.28; 95% CI = 0.15-0.54). Likewise, IYC having fathers who are merchants had about 3.5 times more odds to consume from four or more food groups compared with those IYC whose fathers were governmental employees (AOR = 3.46; 95% CI = 1.40-8.54). Furthermore, IYC whose mothers have less than four antenatal care visits had 46% less odds to consume from four or more food groups than those IYC whose mothers had four or more ANC visits (AOR = 0.54; 95% CI = 0.30-0.97) (Table 2).

Table 2
Factors associated with infant and young children's MDD at Debre Berhan town, central Ethiopia, 2017 (n = 377).

Variables		Minimum Dietary Diversity		COR (95% CI)	AOR (95% CI)
		No (N, %)	Yes (N, %)		
Mother's age (n=374)	20-29 years	88	122	4.16 (1.09-15.81)*	
	30-39 years	58	94	4.86 (1.26-18.67)*	
	40-49 years	9	3	1	
Mother's education (n=375)	Cannot read and write	10	9	0.56 (0.22-1.42)	0.15 (0.02-0.88)*
	Informal education	16	4	0.16 (0.05-0.48)***	0.21 (0.05-0.97)*
	Formal education	129	207	1	1
Father's education (n=364)	Cannot read and write	6	12	1.24 (0.45-3.39)	
	Informal education	14	8	0.35 (0.14-0.87)	
	Formal education	124	200	1	
Mother's occupation	Housewife	91	50	0.20 (0.12-0.34)***	0.28 (0.15-0.54)***
	Merchant	14	43	1.13 (0.55-2.29)	0.42 (0.16-1.17)
	Private sector employee	11	23	0.77 (0.34-1.72)	0.41 (0.15-1.15)
	Government employee	37	101	1	1
Father's occupation (n=344)	Daily laborer	28	9	0.19 (0.09-0.42)***	0.80 (0.28-2.25)
	Merchant	22	41	1.10 (0.61-1.98)	3.46 (1.40-8.54)**
	Private sector employee	9	25	1.64 (0.73-3.69)	2.09 (0.80-5.47)
	Government employee	78	132	1	1
Mother's ANC follow-up (n = 375)	No ANC follow-up	23	13	0.37 (0.17-0.75)**	
	Has ANC follow-up	133	206	1	
Number of ANC visits (n = 331)	Less than 4	62	63	0.49 (0.31-0.77)**	0.54 (0.30-0.97)*
	Four and above	67	139	1	1
Monthly income by median	Below median	91	70	0.34 (0.22-0.52)***	
	Median and above	66	150	1	
*p-value <0.05, ** p-value <0.01, ***p-value <0.001					
Abbreviations: COR = Crude odds ratio; AOD = Adjusted odds ratio; ANC = Antenatal care					

Discussion

This study revealed proportion minimum dietary diversity (MDD) and its predictors among infants and young children in central Ethiopia. More than half (58%) of IYC in Debre Berhan Town consumed the recommended level of MDD in this study. The result is comparable with the result of a study conducted in Addis Ababa, Ethiopia (12), which reported an MDD of 59.9%. However, the finding of this study is higher than that of studies conducted in Dangila town of Northwest Ethiopia (32), at Dabat district of Northwest Ethiopia (33), in Wolaita Sodo of Southern Ethiopia (34), in the predominantly agrarian society of Bale zone of Southeast Ethiopia (35) and Bench Maji Zone of Southwest Ethiopia (36). This finding is lower than a study done in Sri Lanka (30), however, it is much higher than the reported national EDHS findings (42). Furthermore, it is higher than other studies done in Ghana (28), east Delhi, India (29), and Bangladesh (27). In which 14% of children had an adequately diverse diet in which they had been given foods from the appropriate number of food groups.

The discrepancies might be due to the difference in difference in food security, staple food, feeding habit, climate, and agro-ecological factors. Moreover, differences in countries setting, the self-reported measurement, and the recall method could also affect the estimated minimum dietary diversity score. However, in general terms, compared to the target set to positively impact the nutritional health of infants and young children by the Ethiopian government by 2020/25, this MDD is low and makes it difficult to achieve both the local governmental target and the international sustainable development goal target.

The improvement in infant and young child feeding (IYCF) practices plays a critical role in the improved nutrition, health, and development of a child (43) and it is due to this reason that the world health organization recommends the consumption of at least four food groups (22). In this case, if a child fed on, at least from four food groups on the previous day, it is assumed that; in most populations, the child could have a higher probability to consume at least one animal-source food and at least one fruit or vegetable in addition to the usual or staple food items (grain, root or tuber).

Dietary diversity consisting among others of food groups classified as sources of energy (cereals, tubers, roots), protein providers (pulses, solid food of animal origin), mineral suppliers (pulses, other legumes, vegetables, solid food of animal origin, milk), and vitamin sources (vegetables, green vegetables, fruits, solid food of animal origin) can be recommended as the indicator of a healthy diet (13). In this study, grain, roots, and tubers were the most commonly consumed food items 24 hours preceding the survey followed by dairy products. Similarly, in the Republic of the Union of Myanmar, almost all children consumed items from the 'grains, roots, tubers' group (24). In addition, food groups consumed by more than 50% of the children in this study were legumes and nuts, dairy products, and other fruits and vegetables. These are similar to food group consumption in a study conducted in other areas of Ethiopia (12,32,34–36,38), in a study done in Sri Lanka (30) and Bangladesh (27), and in the Republic of the Union of Myanmar (24). However, in some of these studies, the consumption of legumes and nuts was lower than that of dairy products while consumption of other fruits and vegetables was very low (32,33,36,38). Food groups consumed by more than 50% of the children in both Halaba and Zeway areas of Ethiopia were only grains, roots, and tubers, and other fruits and vegetables (6). This difference might be attributed to the difference in sociodemographic and economic characteristics, food security, staple food, feeding habit, climate, and agro-ecological factors. While some of these areas are highland and the rest are lowland with the availability of fruits and vegetables.

Moreover, in this study, children were found to take protein source food groups rarely (flesh foods) which can lead them to protein-energy malnutrition and developmental delay. About 15% and 45% consumed flesh foods and vitamin A fruits and vegetables respectively in this study. While this result is comparable for flesh foods consumption with the studies conducted in different areas of Ethiopia (12,33,36), but the consumption of vitamin A fruits and vegetables is variable. In contrast, this result is lower than studies conducted elsewhere in Ethiopia (27,34). Furthermore, in a study conducted in Halaba and Zeway areas of Ethiopia, consumption from flesh foods and vitamin-A-rich fruits and vegetables was minimal or almost nonexistent (6). Similarly, the result of this study is higher for the consumption of flesh foods with the study conducted in different areas of Ethiopia (32,35,38). The difference might be attributed to the complex influence of sociodemographic, economic, environmental characteristics as well as differences in study settings. This implies that the majority of children in Debre Berhan town are not getting animal proteins which can hamper their developmental process and expose them to protein deficiency disorders. However, dairy products were consumed by 57.0% of the children. In Malawi, eggs, flesh foods, and dairy were consumed by only 8.2%, 26.9%, and 27.6% of the children. While consumption of eggs and dairy is greater in this study compared to the result of the study conducted in Malawi (44), the consumption of flesh foods is lower. Cereals oil (but not fat) and alcohol and beverages were consumed always by about 85%, 91%, and 71% respectively while fish was never consumed by about 79% within the last 7 days.

In this study, mother's education, mother's and father's occupations, and the number of ANC visits are variables significantly associated with MDD of infants and young children. It was found that the odds of MDD mothers who cannot read and write are less compared to mothers who had formal education. This finding is consistent with studies conducted in North West Ethiopia (32), South Asian countries (23), Sri-Lanka (30), and secondary data analysis of Demographic Health Survey 2007 in Bangladesh (27) and where mother's higher educational attainment and the overall literacy rate was a significant determinant factor for appropriate diversified infant feeding practices. That is, children of mothers with no formal education were twice as likely not to meet the minimum dietary diversity criteria as mothers with secondary or higher level of education. Similar positive impact of education on diverse feeding practices is also reported in previous studies in Ethiopia (32,34–36). This could be since educated mothers might be more likely to have more information and knowledge; understood educational messages delivered through different media outlets, engaged in paid works, and might learn about child feeding in the curricula at school. This could increase the purchasing power of different food groups and feeding diversified foods for their children. Therefore, improvements in education leading to higher levels of mothers' education can result in better minimum dietary diversity practices. Programs to improve minimum dietary diversity need to target mothers with low levels of education and design promotional materials that take account of low mothers' levels of education.

Our study also showed that occupation was associated with minimum dietary diversity practices. Children whose mothers are housewives (not employed) had less odds to consume from four or more food groups than those children whose mothers were governmental employees and having fathers who are merchants have better minimum dietary diversity practices compared with those children whose fathers were governmental employees. This finding is consistent with studies conducted elsewhere (27,34). This could be because employed mothers and fathers were more likely to have more income. Mothers who are housewives do not earn income and fathers who were government employees may earn less than those who were merchants.

In addition, the frequency of ANC visits (not ANC visits) has a significant association with the attainment of better minimum dietary diversity. Mothers who have less than four ANC visits had less odds to consume from four or more food groups than those IYC whose mothers had four or more ANC visits. There is no previous study that showed such an association but some showed the association between ANC visits and minimum dietary diversity practice (23,36). This may be related to different access to ANC nutritional counseling as it provides more opportunities to get more information and knowledge. Therefore, improving ANC service provision and its frequency and maternal counseling on IYCF practice during frequent ANC visits is recommended.

The findings of this study have a significant contribution in identifying factors associated with dietary diversity practice problems of infants and young children. This study shares the common limitation of the cross-sectional study, difficult to make the causal association. It may not also accurately reflect children's past feeding experience since it considers only 24-hour feed. Even though adequate training was given to data collectors and supervisors and mothers were informed about the objectives of the study, there, there might still be social desirability and recall bias in reporting the type of food given to children. Moreover, seasonal variations might affect the result and this study does not take account of the quality and quantity of food consumed by the children. Nevertheless, the study has successfully shown important trends that can be used in the formulation of other studies and interventions to improve the IYCF practice in the study area.

Conclusions

In this study, the consumption of minimum dietary diversity among children aged between 6 and 23 months was found to be substandard low compared with other areas and national proportion of MDD; can expose children to macro and micronutrient deficiencies. Even though this study showed a good proportion

of MDDD, it still needs more effort to achieve the target of the health sector development program of the country as well as the WHO recommendation level. Educational status of the mother, occupational status of both the mother and father and the number of ANC visits were the factors that were found to be associated with providing the minimum dietary diversity, while fathers' education level was not so important in promoting IYCF. Children from mothers who cannot read and write, mothers who were not employed (housewife), from father's occupational status, and mothers with inadequate antenatal care need special attention. Improvement of mothers' level of education, creating employment opportunities for both mothers' and fathers', and increasing the frequency of ANC service utilization and maternal counseling is highly recommended to improve infant and young child feeding practice. Further, IEC and BCC sessions for nutrition education will improve the feeding practice of infants and young children and adding protein-rich food and fruits to their diet.

Abbreviations

ANC: Antenatal Care; AOR Adjusted Odds Ratio; BF: breast-feeding; CI: Confidence Interval; COR: Crude Odds Ratio; DB: Debre Berhan; DD: Diet Diversity; DDS: Dietary Diversity Score; EDHS: Ethiopian Demographic and Health Survey; ETB: Ethiopian Birr; FAO: Food and Agricultural Organization; FGs: Food Groups; IYC: Infant and Young Child; IYCF: Infant and Young Child Feeding; MDD: Minimum Dietary Diversity; SD: Standard Deviation; SPSS: Statistical Package for Social Sciences; SSA: Sub-Saharan Africa; UNICEF: United Nations Children Fund; WHO: World Health Organization; WRAG: Women of Reproductive Age Groups

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from the Institutional Ethical Review Board (IRB) of Debre Berhan University. Support letters were obtained from the Research, Community Service, and Postgraduate coordinating office of College of Health Sciences, Debre Berhan University, and Debre Berhan town Health Office. Since some mothers cannot read and write, informed verbal consent was obtained from each mother, after clearly informing the purpose, benefits, and confidentiality of the information. Moreover, all data collectors and investigators guaranteed confidentiality of the information obtained from every study subject using code numbers rather than personal identifiers and keeping the questionnaire locked.

Consent for publication

This manuscript is a grant-winning work of TGD from the Department of Public Health, Debre Berhan University, Ethiopia. All authors agreed to the publication of this article in this journal. We declare that the funding body had no role in the design of the study, the collection, analysis, and interpretation of the data, the writing of this manuscript, and in the decision to submit it for publication.

Availability of data and materials

All data generated or analyzed during this study will be supplied upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

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The Debre Berhan University sponsored the fieldwork of this research.

Authors' contributions

TGD conceived the study, developed the tool, coordinated the data collection activity, carried out the statistical analysis, drafted, and revised the manuscript. GTG participated in the design of the study, and tool development. KBM participated in tool development. KBM, BTD, and TBG approved the proposal with some revisions. BTD, GTG, KBM, and TBG read and critically analyzed, and reviewed the manuscript. All authors read and approved the final manuscript.

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Figures

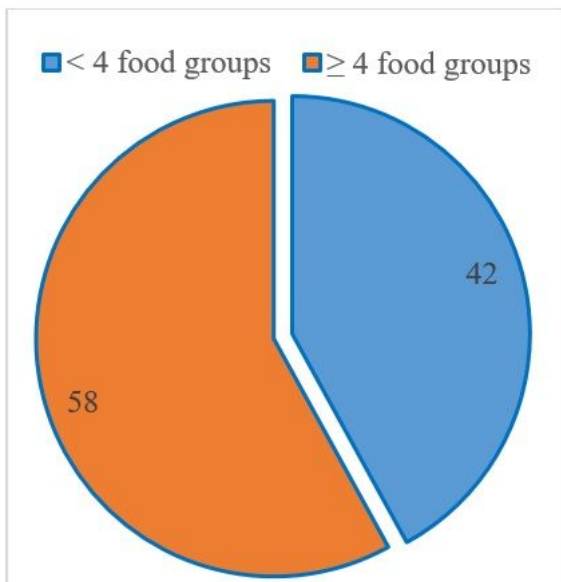


Figure 1

Minimum dietary diversity score of children 6-23 months in Debre Berhan town, central Ethiopia, 2017 (n = 377).

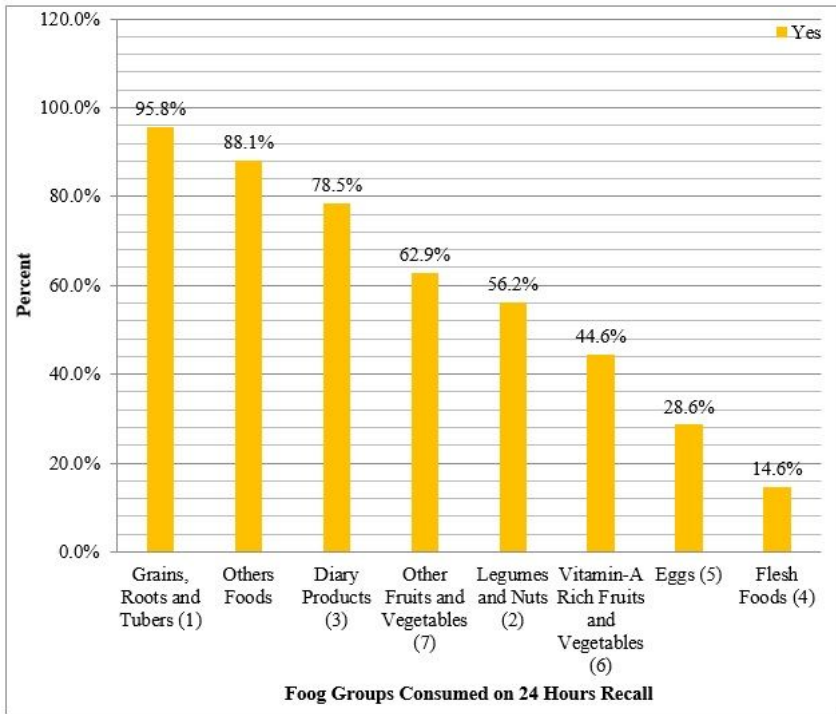


Figure 2

Types of food groups consumed by children aged 6-23 months in Debre Berhan town, central Ethiopia, 2017 (n = 377).