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Minimum Acceptable Diet and Associated Factors among Infants and Young Children aged 6-23 months in Debre Birhan Town, Ethiopia: Community-Based Cross-Sectional Study

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Abstract

Objective: The study aimed to assess the prevalence of minimum acceptable diet and associated factors

Design: A community-based cross-sectional study design was used.

Setting: Three randomly selected urban kebeles in Debre Berhan Town, Ethiopia.

Participants: a total of 531 infants and young children-mother/caregiver pair participated in the study. Cluster sampling was used to select child –mother pair by considering Kebeles (smallest administrative unit) as clusters, and three kebeles were selected randomly. Odds ratio with 95% CI was estimated to measure the strength of association between minimum acceptable diet and the predictor variables. The level of Statistical significance was declared at $p < 0.05$.

Primary outcome: prevalence of minimum acceptable diet and its associated factors.

Results: The overall prevalence of minimum acceptable diet was 168 [31.6 %, 95% CI: (27.7, 35.2)]. The proportion of minimum acceptable diet was higher among female 101 (38.7%). Cereals, roots and tubers were the most consumed food groups (91.1%) and vitamin A was least consumed food group (22.4%). Parent education, growth monitoring utilization, child age, child history of illness, health extension worker advice and practice home garden were significantly associated with minimum acceptable diet.

Conclusion: Generally the prevalence of minimum acceptable diet standard was very low. This inappropriate complementary feeding practice implies poor child growth and development, high risk of malnutrition and micronutrient deficiency. Therefore, interventions in the first 1000 days targeted less educated parents, age-appropriate feeding practices and feeding during illness should be emphasized. The government also encourages child growth monitoring, community based health and nutrition services and urban agricultural practices.

Key Words: Associated factors, Debre Berhan Town, Ethiopia, infants and young Children aged 6-23 months, Minimum acceptable diet

Article summary

Strength and limitation of the study

- This study conducted at community level which is generalizable.
- Relatively the study used large sample size to increase study power.
- Use multivariate analyses to control possible confounders.
- First limitation may be seasonal variation, social desirability bias and recall bias.
- Secondly, the study used cross sectional study design doesn't show temporal relationship.

Introduction

Malnutrition is continued as the global public health challenge and can touches all populations groups. More, under-five children, pregnant and lactating women, adolescents, immunocompromised and low economic class have more risk of malnutrition [1, 2]. Malnutrition is a major cause of mortality, disability and increase in non-communicable diseases. Globally, malnutrition associated with under-five deaths surpasses 9 million, of which 70% occurs among infants. Undernutrition also cause for fetal growth restriction and is attributed to one-fourth neonatal death [3-6]. Poor nutrition during critical periods has short-term and long-lasting irreversible health consequences. Malnutrition reduces; mental development, physical growth, scholastic achievement and adulthood productivity. It also lessens immune system and increase risk of infection, morbidity and mortality [1, 5-8]. Inappropriate nutrition affects human resources

development, economic growth and development. Good nutrition has lifelong positive impact on societal health, human capital, nation development and growth [9, 10].

Minimum acceptable diet (MAD) is the WHO core indicators of infant and young child feeding practices and it is a composite of minimum meal frequency and minimum dietary diversity. MAD defined as a proportion of children aged 6-23 months who received both the minimum number of times and minimum dietary diversity. Receiving MAD is not only prevent from undernutrition, and micronutrient deficiency but also ensure optimal health, growth, and development [11]. A study done in China showed that 41.4% of children aged 6-23 months met MAD [12] and in the Bangladeshi 25% to 44% had minimum meal frequency and 33% to 81% consumed minimum diversified diets [13]. In the Ghana, 29.9 % of children aged 6-23 months receive MAD, while 51.4% met the recommended minimum diversified diet [14].

The Government of Ethiopia launched a revised national nutrition program (NNPII) in 2016 and set a goal to end child undernutrition by 2030. The program was developed to realize Seqota declaration by implementing nutrition sensitive and nutrition specific interventions. Optimum breastfeeding, prevention of micronutrient deficiency and appropriate complementary feeding are the main interventions of NNPII. Different studies that assessing dietary diversity and its associated factors among children aged 6-23 months were conducted in different parts of Ethiopia ([15-23] However, there is a lack of information on the prevalence of minimum acceptable diet and its associated factors. In the 2016 Ethiopia demographic and health survey (EDHS) report, the prevalence of minimum acceptable diet was 7% which is lower than the national target 11% [24] and study done in northwest Ethiopia among orthodox religion followers during fasting season showed that 8.6% of children feed recommended acceptable diet [25]. Thus, identifying factors associated with minimum acceptable diet in diverse culture and socio-economic setting is crucial

to design interventions to the local context. Hence, this study aimed to assess the prevalence of minimum acceptable diet and associated factors among children aged 6-23 months.

Methods

Study design, setting and period

A community-based cross-sectional study design was used from February to March 2018 in Debre Berhan Town, Shewa, Ethiopia. The town is located 130 km from Addis Ababa, capital of Ethiopia. In 2017, the town has 88369 total population, nine kebeles, one referral hospital, three health centers and 14 health posts.

Study participants and Sampling Techniques

The source population was all children aged 6–23 months living in Debre Berhan Town and study population was children aged 6-23 months paired with their mothers living in randomly selected Kebeles. Cluster sampling was used to select participants. Considering kebeles (the smallest administrative unit in Ethiopia) as clusters, three kebeles were selected randomly. Sample size was determined using a single population proportion formula with the assumptions: prevalence of minimum acceptable diet 7% [24], 3% margin of error, 95% confidence level, design effect 1.5 and 10% for none response. The final calculated sample size was 459, but a total of 577 infants and young children aged 6-23 months were found in randomly selected clusters. Due to the nature of cluster sampling, all infants and young children in the selected cluster were included.

Data collection methods and tools

Socio- demographic data were collected using pretested and structured interviewers administered questionnaires developed from prior studies [26-29]. Ten diploma and two BSc nurses were trained for data collection and supervision. Household food security was assessed using Household Food

Insecurity Access Scale (HFIAS) developed by the Food and Nutrition Technical Assistance based on the past four weeks recall method [30].

Infant and young child feeding practices were collected using WHO infant and young child feeding (IYCF) standardized questionnaires based on mother recall of food groups given to the child 24 hours prior to data collection [31]. Finally, all foods the child consumed grouped in to seven food groups: (1) grains, roots, and tubers; (2) legumes and nuts; (3) dairy products; (4) flesh foods; (5) eggs; (6) vitamin A-rich fruits and vegetables; and (7) other fruits and vegetables [31].

Operational definitions

Food secure household: Household head responds no to all questions item numbers 1-9 or responds yes to question item number 1 and experiences rarely in the past one month [30].

Food insecure household: Household head responds at least yes to question item 1 and experiences sometimes in the past one month [30].

Minimum dietary diversity: The proportion of children aged 6-23 months who received at least four food groups of the seven food groups [31].

Minimum meal frequency: Proportion of breastfed and non-breastfed children aged 6-23 months who received solid, semi-solid or soft foods (including two milk feeds for non-breastfed children) minimum number of times or more the previous day [31].

Minimum acceptable diet: Proportion of children aged 6-23 who received both minimum meal frequency and minimum dietary diversity [31].

Timely introduction of complementary feeding: The child initiated solid, semi-solid or soft foods at the age of six months while sustaining breastfeeding [31].

Early initiation of breastfeeding: Proportion of children born in the last 24 months who were put to the breast within one hour after birth [31].

Household Wealth index: proxy measure of household living standards based on available assets like a productive asset, durable assets, domestic animals and housing characteristics [24].

Quality control

Data collection tools initially prepared in English and translated into Amharic and then back to English to check for its consistency. Pretest was done on 5 % of the study sample, two days training was given for data collectors and supervisors, data collection were supervised daily and data were double-entered for cross-validation.

Statistical analysis

Before data enter to computer checked for completeness, accuracy and data were entered, and coded into Epi-Data Version 3.1 and exported to IBM-SPSS 22 Statistical Software for analysis. The household wealth index was computed using principal component analysis (PCA) and categorized into three quintiles: poor, medium and rich.

Bi-variable logistic regression was done to see the association between each independent variable and the dependent variable. Variables with p-value < 0.25 in bi-variable analyses were retained for multivariable logistic regression analysis to control for possible confounders and to identify predictors of anemia. Adjusted odds ratios (AOR) with 95 % confidence intervals were used to measure the strength of the association between the dependent variable and independent variables. Factors with P-value < 0.05 reported as statistically significant.

Results

Socio demographic characteristics of the study participants

From 531 mother-children pair participated in the study, 260 (49%) were males and 271 (51%) were females. The mean (±SD) age of children was (14.7 ±5.1) months and the mean (±SD) age of mothers/caregivers was 27 (±4.4) years. A majority of 500 (94.2%) mothers were married and 467 (87.9%) had formal education (Table1).

Table 1: Socio-demographic characteristics of study population in Debre Berhan Town, Ethiopia, February 2018 (n=531)

Variables		**Frequency**	**%**
Maternal age	19-24	149	28.1
	25-29	253	47.6
	≥30	129	24.3
Maternal religion	Orthodox	505	95.1
	Muslim	15	2.8
	Other*	11	2.1
Maternal ethnicity	Amhara	490	92.3
	Oromo	37	7
	Other**	4	0.7
Maternal education	Have no formal education	64	12
	Primary	137	25.8
	Secondary	155	29.2
	College and above	175	33
Maternal marital status	Single	19	3.6
	Married	500	94.2
	Divorced	7	1.3
	Widowed	5	0.9
Maternal occupation	Housewife	293	55.2
	Merchant	75	14.1
	Employed	147	27.1
	Farmer	16	3
Husband educational status (n=500)	Unable to read and write	6	1.2
	Able to read and write	16	3.2
	Primary	110	22
	Secondary	162	32.4
	College and above	206	41.2

Husband occupation (500)	Employed	361	71.6
	Merchant	110	22
	Farmer	29	5.8
Family size	≤3	190	35.8
	4-5	273	51.4
	≥6	68	12.8
Number of under five	One	430	81
	Two	100	19
	Three	1	0.2
Child age (in completed months)	6-11	175	33
	12-17	176	33.1
	18-23	180	33.9
Child history of illness	Yes	141	26.6
	No	390	73.4

Other*, Other**

Children feeding practices

Almost all, 526 (99.1%) children ever breastfeeding and 482(91.2%) initiated breast feeding within one hour after birth. Nearly fourth fifth, 424 (79.8%) children exclusively breastfed up to six months and 520 (97.9 %) were introduced to complementary food at six months. A majority of 434 (81.7%) were breastfed prior to the survey. More than half, 290 (54.6 %) children met minimum meal frequency (Table 2). Cereals, roots, and tubers were the most consumed food groups (91.1%) and vitamin A was the least (22.4%) consumed food group (figure1).

Table 2: Infant and young children feeding practice among children aged 6–23 months in Debre Berhan Town, North Shewa Zone, Amhara Regional state, February 2018

Variables (n=531)	Frequency	Percent
Ever breastfeed		
Yes	526	99.1

No	5	0.9
Initiation of breastfeeding (n=526)		
≤ 1hour	482	91.6
≥ 1hours	44	8.4
Currently breastfeed (n=526)		
Yes	434	82.5
No	92	17.5
Prelacteal feeding		
Yes	9	1.7
No	522	97.3
Bottle feeding		
Yes	258	48.6
No	273	51.4
Introduction of complementary food		
Yes	520	97.9
No	11	2.1
Age of child complementary food initiated (520)		
<6 months	80	15.1
At 6 months	326	61.4
>6 months	114	21.5
Milk feed for non-breastfed children (n=97)		
Receive at least 2 milk feed	57	58.8
Not receive 2 milk feed	40	41.2
Meet minimum meal frequency		
Yes	290	54.6
No	241	45.4
Meet minimum dietary diversity		
Yes	235	44.3
No	296	55.7

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Prevalence of minimum acceptable diet

The overall prevalence of the minimum acceptable diet was 168 [31.6 %, 95% CI: (27.7, 35.2)]. However, 101 (38.7%) of the females consumed MAD versus males 67 (24.8%). The highest proportion of 74 (40%) children who consumed the minimum acceptable diet were aged 18-23 months (Figure 2).

Factors Associated with the minimum acceptable diet

During bi-variable logistic regression analysis: parent education, maternal fruit consumption, head of household, IYCF advice from HEWs, ANC follow-up, growth monitoring utilization, child age, child history of illness, presence of home garden, household food security, and wealth index were significantly associated with minimum acceptable diet. In the multivariable analysis: parent education, ANC contacts, IYCF advice from HEWs, growth monitoring utilization, child history of illness, child age and presence of home garden had significant association to minimum acceptable diet.

Children of mothers who attained secondary education had 4.9 times [AOR=4.9, 95% CI: (1.3, 18.9)] higher odds of MAD and those who attained college and above were 6.4 times [AOR=6.4, 95% CI :(1.5, 26.6)] more odds of meeting MAD as compared to children of mother who had no formal education. Likewise, child whose father had primary education had 6.5 times [AOR=6.5, 95% CI: (1.5, 27.4)] higher odds of meeting MAD than child whose father had no formal education.

The odds of MAD was 1.8 times [AOR=1.8, 95% CI: (1.0, 3.4)] and 2.2 times [AOR=2.2, 95% CI: (1.2, 3.9)] higher among children aged 12-17 and 18-23 months as compared to children aged 6-11 months respectively. Children had no history of illness two weeks prior to the survey had 2.9 times [AOR=2.9, 95% CI: (1.5, 6.0)] more odds of MAD than their counterparts. The odds of MAD among children whose mothers utilized growth monitoring were 1.8 times [AOR=1.8, 95% CI :(1.1, 2.9)] higher than mother did not utilize child growth monitoring. Antenatal care follow-

up significantly associated with MAD. Children of mothers who had four ANC contacts had 2.0 times [AOR=2.0, 95% CI: (1.0, 3.9)] more odds of meeting MAD than their counterparts. Children of mothers who received infant and young child feeding advice had 2.4 times [AOR=2.4, 95% CI: (1.4, 3.9) higher odds to meet MAD than their counterparts (Table 3).

Table 3: Multivariable logistic regression analysis predicting the likelihood of having minimum acceptable diet among children aged 6-23 months in Debre Berhan Town, Amhara region, Ethiopia, 2018, (n=531)

Variables		Meet MAD		COR (95% CI)	AOR(95%CI)
		Yes	No		
Household food security	Yes	116(43.4)	151 (56.6)	3.13 (2.1, 4.6)	1.5 (0.85, 2.5)
	No	52 (19.7)	212 (80.3)	Reference	Reference
Growth monitoring utilization	Yes	102 (40.8)	148 (59.2)	2.2 (1.5, 3.3)	**1.8 (1.1, 2.9)***
	No	66 (23.5)	215 (76.5)	Reference	Reference
Child History of illness	Yes	16 (11.3)	125 (88.7)	Reference	Reference
	No	152 (39.0)	238 (61.0)	4.99 (2.85, 8.72)	**2.9 (1.5, 6.0)***
Maternal education	No education	3 (4.7)	61(95.3)	Reference	Reference
	Grade 1-8	14 (10.2)	123 (89.8)	2.31 (0.64, 8.36)	0.1 (0.3, 4.5)
	Grade 9-12	60 (38.7)	95 (61.3)	12.8(3.9,42.8)	**4.9 (1.3, 18.9)***
	≥College	91 (52.0)	84 (48.0)	22.0(6.7,72.9)	**6.4 (1.5, 26.6)***
Head of household	Father	68 (24.6)	208 (75.4)	Reference	Reference
	Mother	11 (26.2)	31 (73.8)	1.08(0.52,2.3)	1.3 (0.4, 4.1)
	Both	89 (41.8)	124 (59.2)	2.2 (1.5, 3.2)	1.0 (0.6, 1.8)
Child age (in completed months)	6-11	31 (17.7)	144 (82.3)	Reference	Reference
	12-17	64 (36.4)	112 (63.6)	2.65 (1.6,4.35)	**1.8 (1.0, 3.4)***
	18-23	73 (40.6)	107 (59.4)	3.2 (1.9,5.2)	**2.2 (1.2, 3.9)***

Mother fruit consumption per week	≥3 times	139 (35.9)	248 (64.1)	2.2(1.4, 3.5)	1.3 (0.7, 2.3)
	<3 times	29 (20.1)	115(79.9)	Reference	Reference
IYCF Advice from HEW	Yes	84 (45.2)	102 (54.8)	2.6 (1.8, 3.7)	**2.4 (1.4, 3.9)***
	No	84 (24.3)	261 (75.7)	Reference	Reference
Have home garden	Yes	48 (44.4)	60 (55.6)	3.6 (2.3, 5.6)	**2.5 (1.5, 4.3)***
	No	108 (25.5)	315 (74.5)	Reference	Reference
Number of ANC contacts	≥4 ANC	147 (42.0)	203 (58.0)	5.5 (3.3, 9.1)	**2.0 (1.0, 3.9)***
	≤3 ANC	21 (11.6)	160 (88.4)	Reference	Reference
Paternal education	No formal education	8 (15.1)	45 (84.9)	Reference	Reference
	Primary education	33 (30.0)	77 (70.0)	2.6 (1.09, 6.1)	**6.5 (1.5, 27.4)*** .
	Secondary education	39 (24.1)	123 (65.9)	1.7(0.7, 3.9)	2.7 (0.7, 11.1)
	College &above	88 (42.7)	118 (57.3)	3.98 (1.8, 8.9)	2.9 (0.7, 11.6)
Wealth index	Poor	43 (22.9)	145 (77.1)	Reference	Reference
	Medium	59 (33.1)	119 (66.9)	1.7 (1.05,3.6)	0.9 (0.5, 1.8)
	Rich	66 (40.0)	99 (60.0)	2.25 (1.4, 3.6)	1.1 (0.6, 2.1)

*Significant at P-value <0.05

Discussion

The study assessed the prevalence of minimum acceptable diet and associated factors but, the study should be interpreted with caution since our study conducted during post-harvest, this seasonal variation influence study result and the study also indicated point time results.

The study results revealed that 31.6% infants and young children aged 6-23 months consumed according to recommended acceptable dietary standards. Similar studies have been found in Gahanna DHS analysis (29.9%) and Nepal (33%) [14, 32]. However, a higher prevalence than the current study was reported in Indonesia (44.9%), China (41.6%), India (35.6%, 37.7%) and Bangladesh (39.9%) [12, 33-36]. In contrast, a lower prevalence was observed in Philippine (6.7%), Pakistan (8%), Nepal (26.5%) and Uganda (23-26.3 %) [26, 37-39]. The variation could be explained by study period and sample size differences. Proportion of MAD in the present study significantly higher than the prevalence reported in Ethiopia (7%) [24] and (6.1 %) [40]. The possible reason may be due to differences in time period, study setting, sample size and educational status. Our study was conducted in urban setting and on small sample relative to the EDHS sample size. The EDHS report is nationwide result with majority of participants were living in rural. Rural population are less educated, have less IYCF information and have dietary habit variation from urban population. This implies that being urban residence and educated increases access to media and education materials about IYCF.

Our study identify different factors associated with minimum acceptable diet. Parent educational status had significant association with MAD standard. This finding is consistent with study results in Nepal [32], Indonesia [20], Bangladesh [33], Ghana [14], Tanzania [41] and Ethiopia [25]. Mother who had secondary and college level education had five to six times higher odds to feed their children recommended MAD and children whose father had primary education were 6.5 times more likely to meet MAD. This is due to educated parents could have good understanding about infant and young children feeding counseling, materials and messages delivered by health professionals and media. Higher level of education also increase income and higher income enables household access to more diversified diet. Maternal antenatal care follow-up and child

growth monitoring service utilization had significant association with minimum acceptable diet. Mother who had four and above ANC contacts were two times more likely feed their child acceptable diet while children whose mother who utilized child growth monitoring had two times higher odds to get MAD than their counter parts. Similar results were report in Nepal [42] and Philippine [26]. Well baby clinic and ANC follow up are among the six contact points where infant and young child feeding education and counseling delivered to mother. This nutrition advice and counseling may bring maternal behavioral change towards child feeding practices and may encourage mother to provide minimum acceptable diet to a child. So maternal ANC follow up and child growth monitoring utilization should be encouraged to reduce inappropriate infant and young child feeding practices.

Increasing child age associated with meeting minimum acceptable diet. Children aged 12-17 and 18-23 were nearly two times more likely to consume minimum acceptable diet than children aged 6-11 months. This finding is line with study reports from Gahanna [14], Uganda [39], Indonesia [36] and Pakistan [38, 43]. The possible explanation is mother may perceive children aged 6-11 months have small stomach that unable to digest foods prepared from different food groups. Due to this, mother may feed her child only liquid based foods especially cow milk. This implies that nutrition education and counseling targeting age appropriate infant and young child feeding practices should be given to mother/caregiver.

Health extension worker advice about IYCF significantly associated with minimum acceptable diet. Mother who get IYCF advice from health extension workers were 2.4 times more odds to give minimum acceptable diet to her child. This may be justified by community based infant and young child nutrition counseling targeting local context promote and encourage mother to give appropriate complementary feeding. Child health status two weeks prior to the survey associated

with acceptable diet standard. Child had no history of illness were nearly three times higher odds of consuming minimum acceptable diet. This due to the fact that illness cause for loss of appetite that leads to decrease meal frequency and reduce feeding from various food groups; child may prefer only breast milk. Hence, IYCF counseling targeting child feeding during illness should be provided to mothers or caregivers. Presence of home garden associated with minimum acceptable diet. Children from households have home garden had more odds of consuming minimum acceptable diet. This is explained by households have home garden can access fruits or vegetables food groups at home along with staple diet and animal source and this leads to a child to get at least four food groups from seven food groups. The study had its own strength; the study used primary data sources at community level that could be infer to the population, we used relatively large sample size to increase study power, and we also used multivariate analyses to control possible confounders. However the study had limitation; Social desirability bias, and recall bias may affect true estimates and was tried to minimize by probing respondents and providing detail information about the study objectives. Seasonal variation also may affect study result since study was done during post-harvest and cross sectional study design that doesn't show temporal relationship were limitation of the study.

Conclusion

Generally, overall proportion of infants and young children aged 6-23 months consume minimum acceptable diet in the study area was very low. Inappropriate complementary feeding practice implies that child are at high risk of malnutrition, micronutrient deficiencies leads poor liner growth, mental development and poor human capital development. Existed IYCF intervention strategies that promotes child feeding practice targeting feeding during illness, age appropriate feeding, child growth monitoring, maternal antenatal care service, nutrition education and

counselling service should be further strengthen and encouraged. In addition, nutrition education and counseling programs targeted to literacy level should be considered.

Ethical Consideration: Institutional Health Research Ethics Review Committee (IHRERC) of Haramaya University, College of Medicine and Health Sciences ethically approved the study with reference number C/Ac/R/D/01/878/18and data were collected after consent taken from study participant.

Patient consent for publication: Not required

Data availability: Data used to analysis this study are found from corresponding author

Conflict of interest: None declared

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Figure legend

Figure 1: Percentage consumtion of food groups among infant and youn children aged 6-23 months in Debre Berhan Town, Ethiopia, February 2018.

Figure 2: distribution of MAD by sex and age group among infant and young children aged 6-23 months in Debre Birhan Town, Ethiopia 2018.

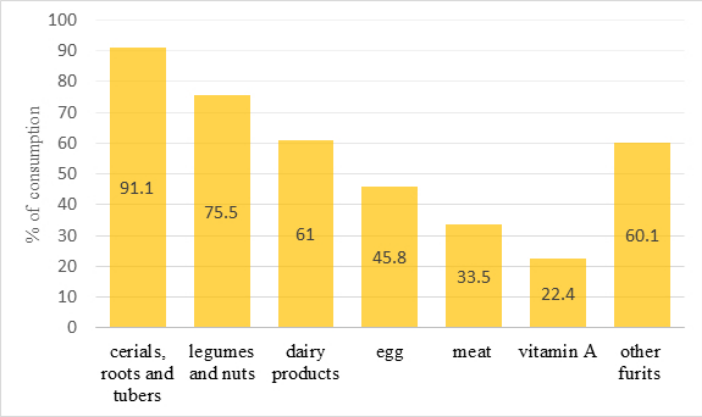

Figure 1: Percentage consumtion of food groups among infant and youn children aged 6-23 months in Debre Berhan Town, Ethiopia, February 2018

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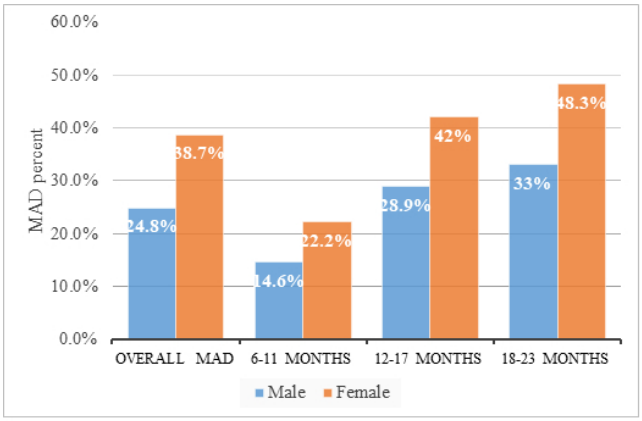

Figure 2: distribution of MAD by sex and age group among infant and young children aged 6-23 months in Debre Birhan Town, Ethiopia 2018

216x121mm (96 x 96 DPI)

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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	1&2
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	3 &4
Objectives	#3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	#4	Present key elements of study design early in the paper	4
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4 & 5
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	5

	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable NA
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable. NA
Bias	#9	Describe any efforts to address potential sources of bias
Study size	#10	Explain how the study size was arrived at 5
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding 7
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions NA
Statistical methods	#12c	Explain how missing data were addressed 5
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy
Statistical methods	#12e	Describe any sensitivity analyses NA
Results		
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable. NA
Participants	#13b	Give reasons for non-participation at each stage NA
Participants	#13c	Consider use of a flow diagram NA
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable. 8-10
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest NA
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable. NA

	Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included 10-12
	Main results	#16b	Report category boundaries when continuous variables were categorized
	Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period NA
	Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses NA
	Discussion		
	Key results	#18	Summarise key results with reference to study objectives 13-16
	Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias. 16
	Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence. 13
	Generalisability	#21	Discuss the generalisability (external validity) of the study results 16
	Other Information		
	Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based 16

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Minimum Acceptable Diet and Associated Factors among Infants and Young Children aged 6-23 months in Amhara Region, Central Ethiopia: A Community-Based Cross-Sectional Study

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Minimum Acceptable Diet and Associated Factors among Infants and Young Children aged 6-23 months in Amhara Region, Central Ethiopia: A Community-Based Cross-Sectional Study

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Abstract

Objective: The primary objective of this study was to assess the prevalence of a minimum acceptable diet and its associated factors.

Design: A community-based cross-sectional study design was used.

Setting: Debre Berhan Town, Ethiopia.

Participants: A total of 531 infants and young children-mother/caregiver pairs took part in the study. A one-stage cluster sampling method was used to select study participants using Kebeles as clusters and three kebeles were selected using a lottery method. Adjusted odds ratio with 95% CI was estimated to measure the strength of association between minimum acceptable diet and the predictor variables and statistical significance declared at $p < 0.05$.

Primary outcome: prevalence of minimum acceptable diet and factors associated with minimum acceptable diet.

Results: The prevalence of minimum acceptable diet was 168 (31.6 %, 95% CI: (27.7, 35.2)). The proportion of females meet the minimum acceptable diet compared to males. Cereals, roots, and tubers were the most consumed food groups (91.1%), while vitamin A was the least consumed food group (22.4%). Parent educational status, having four ANC visits, growth monitoring utilization, age of a child, child history of illness two weeks before the survey, mother received IYCF advice, and children from a household with a home garden were significantly associated with meeting the minimum acceptable diet.

Conclusion: The proportion of infants and young children 6-23 months of age who met optimal complementary feeding was very low and this may put children aged 6-23 months at high risk of poor linear growth and micronutrient deficiency. Education, ANC, IYCF advice, child growth monitoring, age of a child, a child with a history of illness two weeks before the survey, and home gardening practice affect meeting the minimum acceptable diet. Therefore, a mix of appropriate interventions is required to improve the low prevalence of the minimum acceptable diet.

Key Words: Associated factors, Debre Berhan Town, Ethiopia, infants and young children aged 6-23 months, Minimum acceptable diet

Strength and limitation of the study

- The study was conducted at the community level, which is generalizable to the entire population.
- The study used a large sample size to increase study power.
- Use multivariate analyses to control possible confounders.
- The first, limitation of the study was seasonal variation, social desirability bias, and recall bias.
- Second, the study used a cross-sectional study design that didn't show a cause-effect relationship.

Introduction

Proper nutrition from conception to 24 months of age is a critical window period that determines the survival, health, and nutritional status of a child [1]. The introduction of appropriate nutrition at age six months together with sustaining breastfeeding until two years of age warrants optimal growth, development, and maintain healthy life throughout the life cycle [2]. In contrast, inappropriate infant and young child feeding practices lead to stunted growth and poor cognitive development [3].

In many resource-limited countries, like Ethiopia high rate of growth failure occurs within 24 months of age and thereafter decreases [4], and this mainly because of resource limitations and inappropriate child feeding practices [5]. Consumption of acceptable dietary standards has numerous benefits; including enhanced linear growth, better cognitive development, and high school achievement, reduced risk of non-communicable disease, increased body immunity system, and productivity during adult life [1-4, 6, 7]. Meeting a minimum acceptable diet also essential to

reduce macro and micronutrient deficiencies that leads to improving linear growth status [8, 9]. On the other hand, the unmet minimum acceptable diet standard has devastating, long-term, and irreversible health outcomes such as stunted growth and stunted children become small adults with different adverse health effects in the life course [2, 4].

The minimum acceptable diet (MAD) is an infant and young child feeding indicator designed to measure appropriate complementary feeding patterns of children aged 6-23 months and MAD is a composite indicator of the minimum meal frequency and minimum dietary diversity. According to the WHO definition, MAD is the proportion of children aged 6-23 months who consume the minimum meal frequency (MMF) and minimum dietary diversity (MDD) during the previous day or night [10]. The minimum dietary diversity is used to measure the quality of infant and young child's complementary diet of child diet, while minimum meal frequency is used as a proxy measure of energy intake or quantity of food consumed other than breast milk. On the contrary, MAD assesses both micronutrient adequacy and quantity of food consumed during the previous day or night and measures appropriate complementary feeding practices. In other words, MAD measures multiple dimensions of infant and young child diet; those children aged 6-23 months who meet both macronutrient and micronutrient requirements, but MDD and MMF measure one dimension of infants and young child diets; those infants and young children who meet micronutrients and macronutrient respectively [9, 10]. To summarize, assessing MAD important for measuring both energy intake and micronutrient adequacy of a child as compared with measuring only one dimension of diet: quality or quantity of diet. However, studies in different areas including Ethiopia showed that consume the recommended minimum acceptable diet in children aged 6-23 months greatly vary from area to area with the lowest proportion of MAD (8 %, 6.7%, and 6.1%) was reported in Pakistan, Philippines and Ethiopia, respectively [5, 11, 12],

while the highest prevalence of minimum acceptable diet (44.9%, 41.6%, and 39.9%) reported in Indonesia, China and Bangladesh respectively [13-15].

Likewise, in Ethiopia, the proportion of children aged 6-23 months who consume the minimum acceptable diet standard remains low (6.1%-8.6%) [12, 16], whereas stunting and iron deficiency anemia remain a burden for infants and young children 6-23 months of age [17]. The prevalence of anemia among children aged 6-23 months reaches 53.7% to 72% [17, 18], and the prevalence of stunting is 58% [19]. Overall, macronutrient and micronutrient deficiency is a significant problem in Ethiopia, particularly in the Amhara region where the present study was conducted, there is a low rate of minimum acceptable dietary standard and the highest level of child undernutrition has been reported [17, 19, 20]. Thus, determining the prevalence of minimum acceptable diet and identifying factors associated with poor infant and young child feeding practices in a multicultural context and different geographical locations is essential to designing intervention strategies appropriate to the local context. Therefore, the present study aimed to assess the prevalence of minimum acceptable diet and associated factors among children aged 6-23 months in the Amhara region of Ethiopia.

Methods

Study design, setting, and period

A community-based cross-sectional study design was used from February to March 2018 in Debre Berhan Town, Shewa, Ethiopia. The town is located 130 km from Addis Ababa, the capital of Ethiopia. In 2017, the town has a total population of 88369, nine kebeles, one referral hospital, three health centers, and 14 health posts.

Study participants and Sampling Technique

The source population was all infants and young children 6–23 months with mother/caregiver living in Debre Berhan Town, while the infants and young children 6-23 months of age and their mother/caregiver in the randomly selected Kebeles was the study population. A household considered eligible if the infant and young child aged 6-23 months with mother /caregiver living for at least six months in the selected kebeles were included in the study. The child was excluded from the study if the mother/caregiver was absent in the household or the mother/caregiver was unable to respond because of the child's illness or her illness and if the eligible household was closed after three revisits.

The required sample size for the study was calculated using a single population proportion formula with the following assumptions: the proportion of minimum acceptable diet among infants and young children was 7% [17], a margin of error of 3%, power of 80%, 95% confidence level, design effect of 1.5 and 10% non-response rate. The final required sample size for the study was 459 infants and young children aged 6-23 months with a mother/caregiver. A one-stage cluster sampling method was used to select the study population. The town consists of nine kebeles (the smallest administrative unit) in Ethiopia and kebeles were considered as a cluster to select the study population. Among the nine clusters, three clusters were selected randomly and data were collected from every unit in the selected clusters. The total number of eligible infants and young children aged 6-23 months with their mother/ caregiver was taken from the health extension workers (HEWs) records. According to the HEWs record, a total of 577 infants and young children aged 6-23 months-mother pairs were lived in the selected kebeles/clusters. Even though the final calculated sample size required for the study was 459 infants and young children aged 6-23 months pair with mother/caregiver, the total number of 577 infants and young children with mother/caregiver lived in the selected kebeles/clusters. Because of the cluster sampling method,

all eligible (577) infants and young children aged 6-23 months with their mother/caregiver living in the selected clusters were included in the survey.

Data collection methods and tools

Socio-demographic data were collected using pretested and structured interviewer-administered questionnaires developed from prior studies [11, 21-23]. The study was conducted per the Declaration of Helsinki ethical principles for medical research involving human subjects and each study participant gave informed written consent. The mother/caregiver was interviewed and used as a primary source of data for the study, but if the mother was absent caregivers were interviewed to collect the data for the study. Ten diploma and two BSc nurses were trained for data collection and supervision.

Data regarding household wealth were collected using information from ownerships available assets; ownership of livestock, agricultural land, electronics, radio, television, refrigerator, car, bicycle, cart, gold, sofa, source of water, availability of electric city, type of toilet and household characteristics; type of wall, floor, and ceiling [17].

Household food security was measured by using Household Food Insecurity Access Scale (HFIAS), a validated tool developed by Food and Nutrition Technical Assistance (FANTA). The HFIAS is based on respondent recall in the past 30 days and asks two closely related questions; nine occurrence questions that examine the experience of food insecurity in the past 4 weeks with two response choices as 1=yes or 0=no. Each occurrence questions followed by a frequency of occurrence question that asks the respondent how often the specific condition occurs in the past 4 weeks with the form of Likert scale response as 1= rarely (1 to 2 times in the past 30 days), 2= sometimes (3 to 10 times in the past 30 days) and 3=often (> 10 times in past 30 days). When

summing up the frequency of occurrence questions, the HFIAS score of household range 0-27 and severity of household food insecurity increase with increase the HFIAS score [24].

Infant and young child feeding practices were collected using WHO infant and young child feeding (IYCF) standardized questionnaires based on the mother recall of food groups given to her child 24 hours before data collection [10]. Finally, all foods the child consumed grouped into seven food groups: (1) grains, roots, and tubers; (2) legumes and nuts; (3) dairy products; (4) flesh foods; (5) eggs; (6) vitamin A-rich fruits and vegetables; and (7) other fruits and vegetables [10].

Measurements

Food secure household: household experience none of food insecurity conditions experience or just experience worry, but rarely in the past four weeks [24].

Food insecure household: household experience one of the three levels of food insecurity conditions; mildly, moderately, and severely food insecurity or access conditions in the past four weeks categorized as food insecure [24].

Minimum dietary diversity: consumption of four or more food groups from the WHO recommended seven food groups within 24 hrs day or night before the survey [10].

Minimum meal frequency: the minimum number of times the child consumes solid, semi-solid, or soft foods (including two milk feeds for non-breastfed children) within 24 hrs day or night before the survey. The minimum number of times is two times for breastfed children aged 6-8 months, three times for children aged 6-23 months, and four times for non-breastfeed children 6-23 months of age [10].

Minimum acceptable diet: consumption of the minimum dietary diversity and minimum meal frequency within 24 hrs day or night before the survey [10].

Timely introduction of complementary feeding: providing a child with solid, semi-solid, or soft foods in addition to breast milk at the age of 6 months [10].

Early initiation of breastfeeding: putting a child to the breast within one hour after birth [10].

Household Wealth index: A proxy measure of living standards derived from information on ownership available assets and household characteristics and household classified into three tertiles categories [17].

Quality control

Data collection tools were initially prepared in English and translated into Amharic and then back to English to check for its consistency. A pretest was done on 5 % of the study sample, two days of training was given for data collectors and supervisors. Principal investigators and supervisors supervised the data collection process and data were double-entered for cross-validation.

Statistical analysis

First, data were checked for accuracy and completeness. Then, data were entered into Epi-Data Version 3.1 and exported to SPSS version 22 for analysis. A STORBE cross sectional reporting guideline was used [25]. Descriptive statistics were used to describe socio-demographic, child feeding practice, and maternal and child health care unitization variables. Frequency and percentage frequency were calculated for categorical data and mean with standard deviation was calculated for continuous data.

Multicollinearity was checked with standard error and predictor with standard error ≥2 was considered collinear and removed from the analysis. Bi-variable logistic regression analysis was done to assess the association between each covariate with MAD. Covariates with p-value < 0.25 during bi-variable logistic regression analysis; parent education, maternal fruit consumption, head of household, IYCF advice from HEWs, ANC follow-up, growth monitoring utilization, age of a

child, a child has a history of illness two weeks before the survey, presence of home garden, household food security, and wealth index were included in a multivariable logistic regression model to control all possible confounders and to identify factors significantly associated with MAD. Unadjusted and adjusted odds ratios with a 95% confidence interval were calculated to estimate the strength association of each explanatory variable with MAD. Variables with P-value < 0.05 in the final model were declared statistically significant.

The explanatory variables were selected based on previous studies done on MAD [11, 15, 26] and the following variables were selected to identify factors associated with MAD.

Maternal related variables: Age of mother categorized as:19-24, 25-29 and ≥30 years of age; educational status of mother: no formal education, primary education, secondary education, and college and above; occupational status: housewife, employed, merchant, and farmer; mother involvement in deciding on what a child to be feed: involved or not involved; mother has a history of illness within two weeks before the survey: yes or no; ANC visits during pregnancy: less than three ANC visits and four and above ANC visits; frequency of maternal fruit and vegetable consumption per week: consume less than three times per week and consume four or more times per week; mother received infant and young child feeding advice HEWs: yes or no; mother utilize child growth monitoring service: yes or no; mother with a history of illness two weeks before the survey; and place of delivery: home delivery or health facility delivery.

Father related variables: Father educational status: have no formal education, primary, secondary, and college or above and father occupation: employed, merchant, and farmer.

Child-related variables: Child sex: male or female; child age: age 6-11 months, age 12-17 months, and age 18-23 months; child initiated to complementary feeding: yes or no; child age at which child introduced with complimentary food: < 6 months, at 6 months, and after 6 months; child

currently bottle feed: yes or no; and child has a history of illness with two weeks before the survey: yes or no.

Household related variables: A household wealth index was constructed based on principal component analysis (PCA) and the household was categorized into three tertiles: poor, medium, and rich; head of household or a person who is responsible for decision making in a household: father, mother or both; household food security; food secure and food insecure; the presence of home garden: yes or no; and family size: categorized ≤3, 4-5, and ≥6 family members.

Minimum acceptable diet (MAD) was categorized into a dichotomous variable: meeting MAD=1 and not meeting MAD=0. A child who meets both the minimum dietary diversity and minimum meal frequency was classified as meeting MAD otherwise classified as not meeting MAD.

Results

Socio-demographic characteristics of the study participants

From 531 mother-children pair participated in the study, 260 (49%) were males and 271 (51%) were females. The mean (±SD) age of children was (14.7 ±5.1) months and the mean (±SD) age of mothers/caregivers was 27 (±4.4) years. A majority of 500 (94.2%) mothers were married and 467 (87.9%) had formal education (Table1).

Table 1: Socio-demographic characteristics of the child with a parent in Debre Berhan Town, Ethiopia, February 2018 (n=531)

Characteristics	**Frequency N (%)**
Maternal age (in years)	
19-24	149 (28.1)
25-29	253 (47.6)
≥30	129 (24.3)
Maternal religion	
Orthodox	505 (95.1)
Muslim	15 (2.8)

Other*	11(2.1)
Maternal ethnicity	
Amhara	490 (92.3)
Oromo	37 (7)
Other**	4 (0.7)
Maternal level education	
Have no formal education	64 (12)
Primary	137 (25.8)
Secondary	155 (29.2)
College and above	175 (33)
Maternal marital status	
Single	19 (3.6)
Married	500 (94.2)
Divorced	7 (1.3)
Widowed	5 (0.9)
Maternal occupation	
Housewife	293 (55.2)
Merchant	75 (14.1)
Employed	147 (27.1)
Farmer	16 (3)
Husband educational status (n=500)	
Have no formal education	53 (4.4)
Primary	110 (22)
Secondary	162 (32.4)
College and above	206 (41.2)
Husband occupation (500)	
Employed	361 (71.6)
Merchant	110 (22)
Farmer	29 (5.8)
Family size	

≤3	190 (35.8)
4-5	273 (51.4)
≥6	68 (12.8)
Number of under-five	
One	430 (81)
≥Two	101 (19.2)
Child age (in completed months)	
6-11	175 (33)
12-17	176 (33.1)
18-23	180 (33.9)
Household wealth index	
Poor	188 (34.4)
Medium	178 (33.5)
Rich	165 (31.1)

Other*, Other**

Infants and young children feeding practices

Almost all, 526 (99.1%) children ever breastfeeding, and 482(91.2%) initiated breastfeeding within one hour after birth. Nearly fourth-fifth, 424 (79.8%) children exclusively breastfed up to six months and 520 (97.9 %) were introduced to complementary food at six months. A majority of 434 (81.7%) were breastfed before the survey. More than half, 290 (54.6 %) children met minimum meal frequency (Table 2). Cereals, roots, and tubers were the most consumed food groups (91.1%) and vitamin A was the least (22.4%) consumed food group (figure1).

Table 2: Infant and young children feeding practice among children aged 6–23 months in Debre Berhan Town, North Shewa Zone, Amhara Regional State, February 2018

Variables (n=531)	Frequency N (%)
Ever breastfeed	
Yes	526 (99.1)
No	5 (0.9)
Initiation of breastfeeding (n=526)	
≤ 1hour	482 (91.6)
≥ 1hours	44 (8.4)
Currently breastfeed (n=526)	

Yes	434 (82.5)
No	92 (17.5)
Prelacteal feeding	
Yes	9 (1.7)
No	522 (97.3)
Bottle feeding	
Yes	258 (48.6)
No	273 (51.4)
Introduction of complementary food	
Yes	520 (97.9)
No	11 (2.1)
Age of child complementary food initiated (520)	
<6 months	80 (15.1)
At 6 months	326 (61.4)
>6 months	114 (21.5)
Milk feed for non-breastfed children (n=97)	
Receive at least 2 milk feed	57 (58.8)
Not receive 2 milk feed	40 (41.2)
Meet minimum meal frequency	
Yes	290 (54.6)
No	241 (45.4)
Meet minimum dietary diversity	
Yes	235 (44.3)
No	296 (55.7)

Maternal and child health service utilization

The majority, 522 (98.3%) mothers delivered their child at a health facility, and nearly, two-third of 350 (65.9%) mothers had four or more antenatal care during pregnancy. One-quarter of infants and young children 6-23 months of age had a history of illness two weeks before the survey (Table 3).

Table 3: Maternal and child health service utilization in Debre Berhan, Ethiopia, February 2018

Variables	Frequency N (%)
Have focused antenatal care follow up during pregnancy	
Yes	350 (65.9)
No	181 (34.1)
Child growth monitoring service utilization	

Yes	250 (47.1)
No	281 (52.9)
Place of delivery	
Health facility	522 (98.3)
Home	9 (1.7)
Postnatal visit	
Yes	205 (38.6)
No	326 (61.4)
Family planning use	
Yes	438 (82.5)
No	93 (17.5)
Received IYCF advice from HEWs	
Yes	186 (35)
No	345 (65)
Maternal history of illness 2 weeks before the survey	
Yes	44 (8.3)
No	487 (91.7)
Child history of illness 2 weeks before the survey	
Yes	141(26.6)
No	390 (73.4)

Prevalence of minimum acceptable diet

The prevalence of minimum acceptable diet was 168 (31.6 %, 95% CI: (27.7, 35.2)). The proportion of female children who consumed MAD was higher compared with male children aged 6-23 months and two fifths (40%) of infant and young children aged 18-23 months consumed minimum acceptable diet (Figure 2).

Factors Associated with the minimum acceptable diet

After adjustment for possible confounders and covariates, mother and father educational status, age of the child, presence of home garden, child-free of illness two weeks before the survey, growth monitoring utilization, four or more ANC visits, and received IYCF counseling from HEWS were significantly associated with meeting minimum acceptable diet (Table 4).

Table 4: Factors associated with meeting minimum acceptable diet among children aged 6-23 months in Debre Berhan town, Amhara region, Ethiopia, 2018, (n=531)

Variables	Meet MAD N (%)	Not meet MAD N (%)	Crude OR (95% CI)	Adjusted OR (95%CI)
Household Food security				
Food secure	116(43.4)	151 (56.6)	3.13 (2.1, 4.6)	1.5 (0.85, 2.5)
Food insecure	52 (19.7)	212 (80.3)	Reference	Reference
Child Growth monitoring utilization				
Yes	102 (40.8)	148 (59.2)	2.2 (1.5, 3.3)	**1.8 (1.1, 2.9)***
No	66 (23.5)	215 (76.5)	Reference	Reference
Children having a history of illness 2 weeks before the study				
Yes	16 (11.3)	125 (88.7)	Reference	Reference
No	152 (39.0)	238 (61.0)	4.99 (2.85, 8.72)	**2.9 (1.5, 6.0)***
Maternal education				
No formal education	3 (4.7)	61(95.3)	Reference	Reference
Primary	14 (10.2)	123 (89.8)	2.31 (0.64, 8.36)	0.1 (0.3, 4.5)
Secondary	60 (38.7)	95 (61.3)	12.8(3.9,42.8)	**4.9 (1.3, 18.9)***
College and above	91 (52.0)	84 (48.0)	22.0(6.7,72.9)	**6.4 (1.5, 26.6)***
Head of household				
Father only	68 (24.6)	208 (75.4)	Reference	Reference
Mother only	11 (26.2)	31 (73.8)	1.08(0.52,2.3)	1.3 (0.4, 4.1)
Both father and mother	89 (41.8)	124 (59.2)	2.2 (1.5, 3.2)	1.0 (0.6, 1.8)
Child age (in completed months)				
6-11	31 (17.7)	144 (82.3)	Reference	Reference
12-17	64 (36.4)	112 (63.6)	2.65 (1.6,4.35)	**1.8 (1.0, 3.4)***
18-23	73 (40.6)	107 (59.4)	3.2 (1.9,5.2)	**2.2 (1.2, 3.9)***

Mother fruit consumption per week				
≥3 times	139 (35.9)	248 (64.1)	2.2(1.4, 3.5)	1.3 (0.7, 2.3)
<3 times	29 (20.1)	115(79.9)	Reference	Reference
The mother receives IYCF counseling from HEW				
Yes	84 (45.2)	102 (54.8)	2.6 (1.8, 3.7)	**2.4 (1.4, 3.9)***
No	84 (24.3)	261 (75.7)	Reference	Reference
Presence of home garden				
Yes	48 (44.4)	60 (55.6)	3.6 (2.3, 5.6)	**2.5 (1.5, 4.3)***
No	108 (25.5)	315 (74.5)	Reference	Reference
Number of ANC visits				
≥4 ANC	147 (42.0)	203 (58.0)	5.5 (3.3, 9.1)	**2.0 (1.0, 3.9)***
≤3 ANC	21 (11.6)	160 (88.4)	Reference	Reference
Father level of education				
No formal education	8 (15.1)	45 (84.9)	Reference	Reference
Primary education	33 (30.0)	77 (70.0)	2.6 (1.1, 6.1)	**1.3 (1.5, 2.4)**
Secondary education	39 (24.1)	123 (65.9)	1.7(0.7, 3.9)	2.7 (0.7, 11.1)
College &above	88 (42.7)	118 (57.3)	3.98 (1.8, 8.9)	2.9 (0.7, 11.6)
Household wealth index				
Poor	43 (22.9)	145 (77.1)	Reference	Reference
Medium	59 (33.1)	119 (66.9)	1.7 (1.05,3.6)	0.9 (0.5, 1.8)
Rich	66 (40.0)	99 (60.0)	2.25 (1.4, 3.6)	1.1 (0.6, 2.1)

*Significant at P-value <0.05

Discussion

The main objective of this study was to assess the prevalence of minimum acceptable diet and identify predictors of minimum acceptable diets among children 6-23 months of age in the study area. The study was conducted in the post-harvest and pre-fasting seasons which may enhance the

consumption of more diversified food groups. Due to this seasonal variation and cross-sectional nature of the study design, the study results should be interpreted with caution.

The study results showed that only 31.6% of children aged 6-23 months meet MAD. This is in line with study reports from the analysis of the Gahanna demographic survey (29.9%) and Nepal (33%) [27, 28]. This finding is lower from Indonesia (44.9%), China (41.6%), India (35.6%, 37.7%) and Bangladesh (39.9%) [13-15, 29, 30], but its higher compared with studies done in Philippines, Pakistan, Nepal, Uganda, and Ethiopia which were (6.7%), (8%), (26.5%), (23-26.3 %) and (6.1%-7%) respectively [11, 12, 17, 31-33]. The possible reason for variation could be explained by the differences in the study setting, period, population, and sample size of the studies.

Children whose parents have formal education had more odds of meeting MAD compared with children whose parents have no formal education. Mothers who had secondary education and above were more likely to provide MAD to their children and children whose fathers attained primary education level had more odds to meet MAD. This is consistent with Nepal [27], Indonesia [34], Bangladesh [15], Ghana [28], Tanzania [35] and Ethiopia [16]. This is maybe due to educated parents may easily capture infant and young child feeding counseling and advice messages provided at health facilities and other media outlets compared with an uneducated parent. Besides, educated parents are more productive, capable, and join to better-paid jobs that have a positive impact on improving household income and household food security. This leads to parents provide adequate diversified and high-quality diet to their children. Hence, Policymakers should strengthen people to achieve higher level grades, and an appropriate IYCF education intervention targeted at uneducated parents should be designed.

Mothers who had four and above ANC visits and those mothers who utilized child growth monitoring service were two times more likely to provide MAD to their children compared with

their counterparts. This is consistent with Nepal [5] and Philippine [11]. This indicated that IYCF counseling and advice provided during ANC follow up and child growth monitoring contact points have a positive impact on infant and young child feeding practice. Therefore, strengthening maternal and child health service utilization has essential roles to increase consumption of minimum acceptable diet.

Children aged 12-17 and 18-23 months had more odds of meeting MAD compared with children 6-11 months of age. The same results were reported in Gahanna [28], Uganda [33], Indonesia [13], and Pakistan [31, 36]. This implies that children aged 6-11 months introduce to less diversified complementary food and they have a more risk of malnutrition compared with older-age children. Hence, the mother should be advised and counseled on age-appropriate infant and young child complementary feeding practices.

Mothers who received infant and young child feeding advice from health extension workers were provided MAD to their children. This indicated that community-based health extension program has a significant contribution to improving age-appropriate child feeding practice. Also, health extension workers have a positive impact on the improvement of maternal and child health service utilization, sanitation, and knowledge of health-seeking behaviors [37, 38]. Therefore, health extension workers program is essential to reduce child growth faltering and inappropriate child feeding practice. Children free of illness two weeks before the survey had more odds of meeting MAD. This is because infection or illness reduces the children's appetite or dietary intake from a variety of food groups and children may prefer breastfeeding over additional food. Hence, a mother should be advised to provide her child more diversified diet and to increase the frequency of feeding during illness. Children from a household with a home garden had more odds of meeting MAD. Because in resource-limited settings, home garden farming is positively associated with

household food security, increase income, and dietary diversity [39]. The home garden practice is also associated with increased food availability and accessibility because a household with home garden farming can access a variety of food groups from backyard farming. Therefore, in resource-poor counties, urban agriculture has a positive contribution to infant and young child diet quality.

Conclusion

Generally, the study result revealed that less than one-third (31.6%) of infants and young children aged 6-23 months meet the minimum acceptable diet. This put children aged 6-23 months at higher risk of stunted growth, poor mental development, and adverse health outcomes in the life cycle. The study also assessed factors associated with the meeting of MAD; mother and father education, age of the child, ANC follow up during pregnancy, child growth monitoring, wealth index, IYCF advice, history of illness within two weeks prior to the survey, and presence of home garden was identified predictors of MAD. Various IYCF education intervention strategies appropriate to the local context should be provided and attention should be given to parent education level, backyard farming, income-generating activities, and maternal and child health service utilization.

Ethical Consideration: Institutional Health Research Ethics Review Committee (IHRERC) of Haramaya University, College of Medicine and Health Sciences ethically approved the study with reference number C/Ac/R/D/01/878/18 and data were collected after informed written consent taken from study participant.

Patient consent for publication: Not required

Data availability: Data used to analyze this study are found from the corresponding author

Conflict of interest: None declared

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Patient and public involvement: Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Author contributions: Conception and original draft writing: AM**,** Study design, data analysis, and interpretation: AM, GE, AS, BK, MA, LG, and AB, Critically review initial draft and finalizing manuscript: GE, AS, BK, MA, LG, and AB, Preparing manuscript: AM and AS. All authors reviewed and approved the final manuscript.

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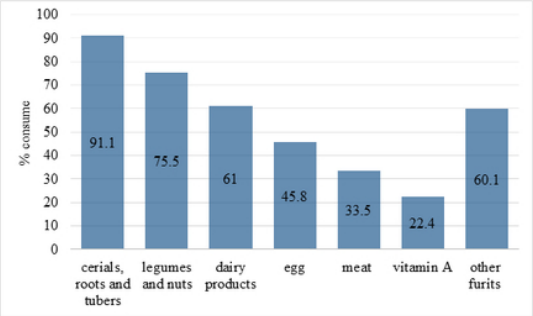
Figure legend

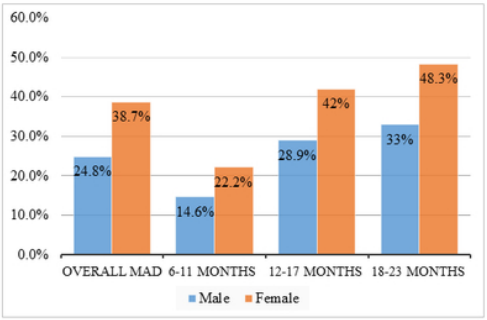
Figure 1: Food groups consumed by infants and young children aged 6-23 months in Debre Berhan Town, Ethiopia, February 2018.

Figure 2: MAD distribution by sex and age group of infant and young children aged 6-23 months in Debre Berhan Town, Ethiopia 2018



Food groups consumed by infants and young children aged 6-23 months in Debre Berhan Town, Ethiopia, February 2018

68x45mm (300 x 300 DPI)



MAD distribution by sex and age group of infant and young children aged 6-23 months in Debre Berhan Town, Ethiopia 2018

68x45mm (300 x 300 DPI)

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	1&2
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	3 &4
Objectives	#3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	#4	Present key elements of study design early in the paper	4
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4 & 5
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	5

	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable NA
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable. NA
Bias	#9	Describe any efforts to address potential sources of bias
Study size	#10	Explain how the study size was arrived at 5
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding 7
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions NA
Statistical methods	#12c	Explain how missing data were addressed 5
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy
Statistical methods	#12e	Describe any sensitivity analyses NA
Results		
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable. NA
Participants	#13b	Give reasons for non-participation at each stage NA
Participants	#13c	Consider use of a flow diagram NA
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable. 8-10
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest NA
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable. NA

Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included 10-12
Main results	#16b	Report category boundaries when continuous variables were categorized
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period NA
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses NA
Discussion		
Key results	#18	Summarise key results with reference to study objectives 13-16
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias. 16
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence. 13
Generalisability	#21	Discuss the generalisability (external validity) of the study results 16
Other Information		
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based 16

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Minimum Acceptable Diet and Associated Factors among Infants and Young Children aged 6-23 months in Amhara Region, Central Ethiopia: A Community-Based Cross-Sectional Study

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Minimum Acceptable Diet and Associated Factors among Infants and Young Children aged 6-23 months in Amhara Region, Central Ethiopia: Community-Based Cross-Sectional Study

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Abstract

Objective: The main objective of this study was to assess the prevalence of a minimum acceptable diet and associated factors.

Design: Community-based cross-sectional study

Setting: Debre Berhan Town, Ethiopia.

Participants: An aggregate of 531 infants and young children mother/caregiver pairs participated in this study. A one-stage cluster sampling method was used to select study participants and clusters were selected using a lottery method. Descriptive statistics were calculated for all study variables. Statistical analysis was performed on data to determine which variables are associated with MAD and the results of the adjusted odds ratio with 95% CI. P-value of < 0.05 considered statistically significant.

Primary outcome: Prevalence of minimum acceptable diet and associated factors

Results: The overall prevalence of minimum acceptable diet was 31.6 % (95% CI: 27.7, 35.2). Having mother attending secondary (AOR=4.9, 95% CI: 1.3, 18.9) and college education (AOR=6.4, 95% CI: 1.5, 26.6), paternal primary education (AOR=1.3, 95% CI: 1.5, 2.4), grouped in the aged group of 12-17 months (AOR=1.8, 95% CI: (1.0, 3.4) and 18-23 months (AOR=2.2, 95%CI: 1.2, 3.9), having four ANC visits (AOR=2.0, 95% CI: 1.0, 3.9), utilizing growth monitoring (AOR=1.8, 95% CI: 1.1, 2.9), no history of illness two weeks before the survey (AOR=2.9, 95% CI: 1.5, 6.0) and living in the household with home garden (AOR=2.5, 95% CI: 1.5, 4.3) were positively associated with increase the odds of minimum acceptable diet.

Conclusion: Generally, the result of this study showed that the prevalence of minimum acceptable was very low. Parent educational status, ANC visits, IYCF advice, child growth monitoring practice, age of a child, a child has no history of illness two weeks before the survey, and home gardening practice were the predictors of minimum acceptable diet. Therefore, comprehensive intervention strategies suitable to the local context are required to improve the provision of MAD.

Key Words: Associated factors, Debre Berhan Town, Ethiopia, Infants and Young Children aged 6-23 months, Minimum Acceptable Diet

Article summary

Strength and limitation of the study

- The study was conducted at the community level, which increases the probability of generalizability to the entire population that the sample was drawn.
- This study used relatively a large sample size using a design effect to increase the power of the study and its generalizability
- This study used a multivariate logistic regression analysis to control all possible confounders.
- Seasonal variation, social desirability bias, and recall bias were the limitation of the study.

Introduction

Proper nutrition from conception to 24 months of age is a critical window period that determines the survival, health, and nutritional status of a child [1]. The introduction of appropriate nutrition at age six months together with sustaining breastfeeding until two years of age warrants optimal growth, development, and maintain healthy life throughout the life cycle [2]. In contrast, inappropriate infant and young child feeding practices lead to stunted growth and poor cognitive development [3].

In many resource-limited countries, like Ethiopia high rate of growth failure occurs within the first 24 months of age and thereafter decreases [4], and this is mainly because of resource limitations and inappropriate child feeding practices [5]. Consumption of acceptable dietary

standards has numerous benefits; including enhanced linear growth, better cognitive development, and high school achievement, reduced risk of non-communicable disease, increased body immunity system, and productivity during adult life [1-4, 6, 7]. Meeting a minimum acceptable diet also essential to reduce macronutrient and micronutrient deficiencies that lead to improving linear growth status [8, 9]. On the other hand, the unmet minimum acceptable diet standard has devastating, long-term, and irreversible health outcomes such as stunted growth. Moreover, stunted children become small adults with different adverse health effects in their life course [2, 4].

The minimum acceptable diet (MAD) is an infant and young child feeding indicator designed to measure appropriate complementary feeding patterns of children aged 6-23 months. It is a composite indicator of the minimum meal frequency and minimum dietary diversity. According to the WHO definition, MAD is the proportion of children aged 6-23 months who had consumed the minimum meal frequency (MMF) and minimum dietary diversity (MDD) during the previous day or night [10]. The minimum dietary diversity is used to measure the quality of infant and young child's complementary diet of child diet, while minimum meal frequency is used as a proxy measure of energy intake or quantity of food consumed other than breast milk. Furthermore, MAD assesses both micronutrient adequacy and quantity of food consumed during the previous day or night and measures appropriate complementary feeding practices. Similarly, MAD measures multiple dimensions of infant and young child diet; those children aged 6-23 months who meet both macronutrient and micronutrient requirements, but MDD and MMF measure one dimension of infants and young child diets; those infants and young children who meet micronutrients and macronutrient respectively [9, 10].

To summarize, assessing MAD is very important for measuring both energy intake and micronutrient adequacy of a child simultaneously than one dimension of diet (diet quality or quantity of diet). However, studies in different areas including Ethiopia showed that consuming the recommended minimum acceptable diet in children aged 6-23 months greatly vary from area to area with the lowest proportion of MAD (8%, 6.7%, and 6.1%) was reported in Pakistan, Philippines, and Ethiopia, respectively [5, 11, 12]. On the other hand, the highest prevalence of minimum acceptable diet (44.9%, 41.6%, and 39.9%) was reported in Indonesia, China, and Bangladesh respectively [13-15].

Likewise, in Ethiopia, the proportion of children aged 6-23 months who consume the minimum acceptable diet standard has been reported [12, 16]. However, the prevalence of MAD in the Ethiopian demographic and health survey (EDHS) was the national average estimate derived from a sample population vary with dietary habits, culture, geographical setting, socioeconomic status, residence, educational status, access to health services, and safe drinking water. Besides, the report didn't identify all remained potential factors associated with MAD. Furthermore, a study in northwest Ethiopia was conducted among orthodox religious follower mothers during a fasting period indicate that orthodox religious followers limit consummation of animal and animal products. Furthermore, the mother may not prepare a separate dish from animal source food to their children. As a result, these practices may influence the prevalence of MAD in population, geographical location, and setting. In contrast, this study was conducted during non-fasting periods and in an urban population with diverse religions, and relatively it has similar characteristics in child feeding practice, dietary habits, health service, education, water, and sanitation service. Macro and micronutrient deficiency are a significant problem in Ethiopia stunting and iron deficiency anemia remain a burden for infants and young children 6-23 months of age [17]. The

prevalence of anemia among children aged 6-23 months reaches 53.7% to 72% [17, 18], and the prevalence of stunting is 58% [19].

In the Amhara region, child malnutrition is a very severe public health problem with the prevalence of stunting and the infant mortality rate was higher than in other regions in the country. Also, the Amhara region has a low rate of minimum acceptable diet standard and the highest level of child undernutrition has been reported [17, 19, 20]. This is maybe because of inappropriate infant and child feeding practices in the first 1000 days. Therefore, determining the prevalence of MAD and identifying factors associated with MAD in the study area has an important role to design cultural, geographical, and situation-specific intervention strategies appropriate to the local context. This in turn will help to reduce the burden of child undernutrition and other health problems related to malnutrition in the region including the study area. Therefore, the present study aimed to assess the prevalence of minimum acceptable diet and associated factors among children aged 6-23 months in the Amhara region of Ethiopia.

Methods

Study design, setting, and period

A community-based cross-sectional study design was used from February to March 2018 in Debre Berhan Town, North Shewa, Central Ethiopia. The Town is located 130 km away from Addis Ababa, the capital of Ethiopia. In 2017, the Town has an 88,369 total population, nine kebeles, one referral hospital, three health centers, and 14 health posts.

Study participants and Sampling Technique

All infants and young children 6–23 months with mother/caregiver living in Debre Berhan Town and randomly selected kebeles were considered as the source and study population for this study

respectively. A household considered eligible if the infant and young child aged 6-23 months with mother /caregiver living for at least six months in the selected kebeles were included in the study. The child was excluded from the study if the mother/caregiver was absent in the household or the mother/caregiver was unable to respond because of the child's illness or her illness and if the eligible household was closed after three revisits.

The required sample size for the study was calculated using a single population proportion formula with the following assumptions: the proportion of minimum acceptable diet among infants and young children was 7% [17], a margin of error of 3%, power of 80%, 95% confidence level, design effect of 1.5 and 10% non-response rate. The final required sample size for the study was 459 infants and young children aged 6-23 months with a mother/caregiver. A one-stage cluster sampling method was used to select the study population. The town consists of nine kebeles (the smallest administrative unit in Ethiopia) and kebeles were considered as a cluster to select the study population. Among the nine clusters, three clusters were randomly selected and data were collected from every unit in the selected clusters. The total number of eligible infants and young children aged 6-23 months with their mother/ caregiver was taken from the health extension workers (HEWs) record. According to the HEWs record, a total of 577 infants and young children aged 6-23 months-mother pairs were lived in the selected kebeles/clusters. Even though the final calculated sample size required for the study was 459 infants and young children aged 6-23 months pair with mother/caregiver, the total number of 577 infants and young children with mother/caregiver lived in the selected kebeles/clusters. Because of the nature of the cluster sampling method, all eligible (577) infants and young children aged 6-23 months with their mother/caregiver living in the selected clusters were included in the survey.

Data collection methods

Socio-demographic data were collected using pretested and structured interviewer-administered questionnaires developed from prior studies [11, 21-23]. The study was conducted per the Declaration of Helsinki ethical principles for medical research involving human subjects and each study participant gave informed written consent. The mother/caregiver was interviewed and used as a primary source of data for the study, but if the mother was absent caregivers were interviewed to collect the data for the study. Ten diploma and two BSc nurses were trained for data collection and supervision respectively.

Data regarding the household wealth were collected using information from ownerships available assets; ownership of livestock, agricultural land, electronics, radio, television, refrigerator, car, bicycle, cart, gold, sofa, source of water, availability of electric city, type of toilet and household characteristics; type of wall, floor, and ceiling [17].

Household food security was measured using Household Food Insecurity Access Scale (HFIAS), a validated tool developed by Food and Nutrition Technical Assistance (FANTA). The HFIAS is based on respondent recall in the past 30 days and asks two closely related questions; nine occurrence questions that examine the experience of food insecurity in the past 4 weeks with two response choices as 1=yes or 0=no. Each occurrence questions followed by a frequency of occurrence question that asks the respondent how often the specific condition occurs in the past 4 weeks with the form of Likert scale response as 1= rarely (1 to 2 times in the past 30 days), 2= sometimes (3 to 10 times in the past 30 days) and 3=often (> 10 times in past 30 days). When summing up the frequency of occurrence questions, the HFIAS score of household range 0-27 and severity of household food insecurity increase with increase the HFIAS score [24].

Infant and young child feeding practices were collected using WHO infant and young child feeding (IYCF) standardized questionnaires based on the mother recall of food groups given to her child

24 hours before data collection [10]. Finally, all foods the child consumed grouped into seven food groups: (1) grains, roots, and tubers; (2) legumes and nuts; (3) dairy products; (4) flesh foods; (5) eggs; (6) vitamin A-rich fruits and vegetables; and (7) other fruits and vegetables [10].

Measurements

Food secure household: A household that did not experience any food insecurity conditions or just experience worry, but rarely in the past four weeks [24].

Food insecure household: A household that experience one of the three levels of food insecurity conditions; mildly, moderately, and severely food insecurity or access conditions in the past four weeks categorized as food insecure [24].

Minimum dietary diversity: consumption of four or more food groups from the WHO recommended seven food groups within 24 hrs. day or night before the survey [10].

Minimum meal frequency: the minimum number of times the child consumes solid, semi-solid, or soft foods (including two milk feeds for non-breastfed children) within 24 hrs. day or night before the survey. The minimum number of times is two times for breastfed children aged 6-8 months, three times for children aged 9-23 months, and four times for non-breastfeed children 6-23 months of age [10].

Minimum acceptable diet: consumption of the minimum dietary diversity and minimum meal frequency within 24 hrs. day or night before the survey [10].

Timely introduction of complementary feeding: providing a child with solid, semi-solid, or soft foods in addition to breast milk at the age of 6 months [10].

Household Wealth index: A proxy measure of living standards derived from information on ownership available assets and household characteristics and household classified into terciles category [17].

The explanatory variables used for determinant analysis were selected based on similar studies [11, 15, 25] and the following variables were selected to identify factors associated with MAD.

Maternally related variables: Age of mother categorized as:19-24, 25-29 and ≥30 years of age; educational status of mother: no formal education, primary education, secondary education, and college and above; occupational status: housewife, employed, merchant, and farmer; mother involvement in deciding on what a child to be feed: involved or not involved; mother has a history of illness within two weeks before the survey: yes or no; ANC visits during pregnancy: less than three ANC visits and four and above ANC visits; maternal fruit and vegetable consumption per week: consume less than three times per week and consume four or more times per week; mother received infant and young child feeding advice HEWs: yes or no; mother utilize child growth monitoring and promotion: yes or no; mother with a history of illness two weeks before the survey; and place of delivery: home delivery or health facility delivery.

Father-related variables: Father educational status: have no formal education, primary, secondary, and college or above and father occupation: employed, merchant, and farmer.

Child-related variables: Child sex: male or female; child age: age 6-11 months, age 12-17 months, and age 18-23 months; child initiated to complementary feeding: yes or no; child age at which child introduced with complimentary food: < 6 months, at 6 months, and after 6 months; child currently bottle feed: yes or no; and child has a history of illness with two weeks before the survey: yes or no.

Household related variables: A household wealth index was constructed based on principal component analysis (PCA) and the household was categorized into terciles: poor, medium, and rich; head of household or a person who is responsible for decision making in a household: father,

mother or both; household food security; food secure and food insecure; the presence of home garden: yes or no; and family size: categorized ≤3, 4-5 and ≥6 family members.

Minimum acceptable diet (MAD) was categorized into a dichotomous variable: meeting MAD=1 and not meeting MAD=0. A child who meets both the minimum dietary diversity and minimum meal frequency was classified as meeting MAD otherwise classified as not meeting MAD.

Quality control

Data collection tools were initially prepared in English and translated into Amharic and then back to English to check for its consistency. A pretest was done on 5 % of the study sample, two days of training were given for data collectors and supervisors. The principal investigator and supervisors have supervised the data collection process. Data were double-entered for cross-validation.

Statistical analysis

First, data were checked for accuracy and completeness. Then, data were entered into Epi-Data Version 3.1 and exported to SPSS version 22 for analysis. A STROBE cross-sectional reporting checklist was used [26]. Descriptive statistics were used to describe socio-demographic, child feeding practice, and maternal and child health care unitization variables. Frequency and percentage were calculated for categorical data and the mean with standard deviation was calculated for continuous variables.

Multicollinearity between explanatory variables was checked with standard error; a variable with a standard error of ≥2 was dropped from the analysis. To select the appropriate analysis method between cluster-level analysis and ordinary logistic regression for a cluster sampling method, first, we fitted a null model and examined community variation or random effects. The measure of community variation (random-effects) was estimated with intra-class correlation coefficient (ICC)

and the ICC result was 3%. Since the community variation was less than 5%, the use of an ordinary logistic regression analysis model is sufficient instead of a cluster-level analysis. Bi-variable logistic regression analysis was done to assess the association between each covariate with MAD. Covariates with p-value < 0.25 during bi-variable logistic regression analysis; parent education, maternal fruit consumption, head of household, IYCF advice from HEWs, ANC follow-up, growth monitoring utilization, age of a child, a child has a history of illness two weeks before the survey, presence of home garden, household food security, and wealth index were included in a multivariable logistic regression model to control all possible confounders and to identify factors significantly associated with MAD. Unadjusted and adjusted odds ratios with a 95% confidence interval were calculated to estimate the strength association of each explanatory variable with MAD and if the percentage difference between unadjusted and adjusted odds ratio of a variable greater than 10%, a variable considered confounder. Variables with P-value < 0.05 in the final model were declared statistically significant. A two-factor product term was used to test interaction effects and P value of < 0.05 was considered significant.

Results

Socio-demographic characteristics of the study participants

Among 577 infants and young children aged 6-23 months living in the selected clusters, 531 mother-children pairs took part in the study making a response rate of 92.0%. Seven infants and young children were excluded according to exclusion criteria and thirty-nine study participants declined to participate in the study. The mean (±SD) age of children was (14.7 ±5.1) months and the mean (±SD) age of mothers/caregivers was 27 (±4.4) years. Out of the study participants, 500 (94.2%) were married and 467 (87.9%) had formal education (Table1).

Table 1: Socio-demographic characteristics of the child with a parent in Debre Berhan Town, Ethiopia, February 2018 (n=531)

Characteristics	Frequency N (%)
Maternal age (in years)	
19-24	149 (28.1)
25-29	253 (47.6)
≥30	129 (24.3)
Maternal religion	
Orthodox	505 (95.1)
Muslim	15 (2.8)
Other*	11 (2.1)
Maternal ethnicity	
Amhara	490 (92.3)
Oromo	37 (7)
Other**	4 (0.7)
Maternal level education	
Have no formal education	64 (12)
Primary	137 (25.8)
Secondary	155 (29.2)
College and above	175 (33)
Maternal marital status	

Single	19 (3.6)
Married	500 (94.2)
Divorced	7 (1.3)
Widowed	5 (0.9)
Maternal occupation	
Housewife	293 (55.2)
Merchant	75 (14.1)
Employed	147 (27.1)
Farmer	16 (3)
Husband educational status (n=500)	
Have no formal education	53 (4.4)
Primary	110 (22)
Secondary	162 (32.4)
College and above	206 (41.2)
Husband occupation (500)	
Employed	361 (71.6)
Merchant	110 (22)
Farmer	29 (5.8)

Family size	
≤3	190 (35.8)
4-5	273 (51.4)
≥6	68 (12.8)
Number of under-five	
One	430 (81)
≥Two	101 (19.2)
Child age (in completed months)	
6-11	175 (33)
12-17	176 (33.1)
18-23	180 (33.9)
Household wealth index	
Poor	188 (34.4)
Medium	178 (33.5)
Rich	165 (31.1)

Other*, Other**

Infants and young children feeding practices

Almost all, 526 (99.1%) children ever breastfeeding, and 482(91.2%) initiated breastfeeding within one hour after birth. Nearly fourth-fifth, 424 (79.8%) children exclusively breastfed up to six months and 520 (97.9 %) were introduced to complementary food at six months. A majority of 434 (81.7%) were breastfed before the survey. More than half, 290 (54.6 %) children met

minimum meal frequency (Table 2). Cereals, roots, and tubers were the most consumed food groups (91.1%) and vitamin A was the least (22.4%) consumed food group (figure1).

Table 2: Infant and young children feeding practice among children aged 6–23 months in Debre Berhan Town, North Shewa Zone, Amhara Regional State, February 2018

Variables (n=531)	Frequency N (%)
Ever breastfeed	
Yes	526 (99.1)
No	5 (0.9)
Initiation of breastfeeding (n=526)	
≤ 1hour	482 (91.6)
≥ 1hours	44 (8.4)
Currently breastfeed (n=526)	
Yes	434 (82.5)
No	92 (17.5)
Prelacteal feeding	
Yes	9 (1.7)
No	522 (97.3)
Bottle feeding	
Yes	258 (48.6)
No	273 (51.4)
Introduction of complementary food	
Yes	520 (97.9)

No	11 (2.1)
Age of child complementary food initiated (520)	
<6 months	80 (15.1)
At 6 months	326 (61.4)
>6 months	114 (21.5)
Milk feed for non-breastfed children (n=97)	
Receive at least 2 milk feed	57 (58.8)
Not receive 2 milk feed	40 (41.2)
Meet minimum meal frequency	
Yes	290 (54.6)
No	241 (45.4)
Meet minimum dietary diversity	
Yes	235 (44.3)
No	296 (55.7)

Maternal and child health service utilization

The majority, 522 (98.3%) mothers were delivered their child at a health facility, and nearly two-thirds of mothers 350 (65.9%) had four or more antenatal care during pregnancy. One-quarter of infants and young children 6-23 months of age had a history of illness two weeks before the survey (Table 3).

Table 3: Maternal and child health service utilization in Debre Berhan, Ethiopia, 2018

Variables	Frequency N (%)

Have focused antenatal care follow up during pregnancy	
Yes	350 (65.9)
No	181 (34.1)
Child growth monitoring service utilization	
Yes	250 (47.1)
No	281 (52.9)
Place of delivery	
Health facility	522 (98.3)
Home	9 (1.7)
Postnatal visit	
Yes	205 (38.6)
No	326 (61.4)
Family planning use	
Yes	438 (82.5)
No	93 (17.5)
Received IYCF advice from HEWs	
Yes	186 (35)
No	345 (65)
Maternal history of illness 2 weeks before the survey	
Yes	44 (8.3)
No	487 (91.7)
Child history of illness 2 weeks before the survey	

Yes	141(26.6)
No	390 (73.4)

Prevalence of minimum acceptable diet

The prevalence of minimum acceptable diet was 31.6 % (95% CI: 27.7, 35.2). The proportion of female children who consumed MAD was higher compared with male children aged 6-23 months and two-fifths (40%) of infant and young children aged 18-23 months consumed minimum acceptable diet (Figure 2).

Factors Associated with the minimum acceptable diet

After adjustment, mother and father higher level of education, increase child age, home garden practice, a child with no history of illness two weeks before the survey, focused ANC visits, participating in growth monitoring and promotion, and receiving IYCF advice were positively associated with MAD. Children whose mother attained secondary education had nearly five times (AOR=4.9, 95% CI: 1.3, 18.9) and college education were more than six times more likely to receive higher MAD (AOR=6.4, 95% CI: 1.5, 26.6). While children whose fathers attained primary education had more than three times greater odds of MAD (AOR=1.3, 95% CI: 1.5, 2.4). Similarly, children who were aged 12-17 were almost two times (AOR=1.8, 95% CI: 1.0, 3.4), and those who were aged 18-23 months were more than three times had higher odds of MAD compared with children aged 6-11 months. Mothers who attained four ANC visits were two times (AOR=2.0, 95% CI: 1.0, 3.9) more likely to offer MAD compared with mothers who had less than four ANC contact points. Likewise, mothers who participated in growth monitoring program nearly two times (AOR=1.8, 95% CI: 1.1, 2.9) more likely to provide MAD to their children than. Children who had no history of illness two weeks before the survey were nearly three times more likely to

get MAD (AOR=2.9, 95% CI:1.5, 6.0) than children with a history of illness. Children from the households with a home garden farming had more than two times higher odds of MAD (AOR=2.5, 95% CI: 1.5, 4.3) (Table 4). A two-factor product terms were used to test interaction effects between explanatory variables, but there were no interaction tests found significant.

Table 4: Factors associated with meeting minimum acceptable diet among children aged 6-23 months in Debre Berhan town, Amhara region, Ethiopia, 2018, (n=531)

Variables	Meet MAD N (%)	Not meet MAD N (%)	Crude OR (95% CI)	Adjusted OR (95%CI)
Household Food security				
Food secure	116(43.4)	151 (56.6)	3.13 (2.1, 4.6)	1.5 (0.85, 2.5)
Food insecure	52 (19.7)	212 (80.3)	Reference	Reference
Child Growth monitoring utilization				
Yes	102 (40.8)	148 (59.2)	2.2 (1.5, 3.3)	**1.8 (1.1, 2.9) ***
No	66 (23.5)	215 (76.5)	Reference	Reference
Children having history of illness 2 weeks before the study				
Yes	16 (11.3)	125 (88.7)	Reference	Reference
No	152 (39.0)	238 (61.0)	4.99 (2.85, 8.72)	**2.9 (1.5, 6.0) ***
Maternal education				
No formal education	3 (4.7)	61(95.3)	Reference	Reference
Primary	14 (10.2)	123 (89.8)	2.31 (0.64, 8.36)	0.1 (0.3, 4.5)

Secondary	60 (38.7)	95 (61.3)	12.8(3.9,42.8)	**4.9 (1.3, 18.9) ***
College and above	91 (52.0)	84 (48.0)	22.0(6.7,72.9)	**6.4 (1.5, 26.6) ***
Head of household				
Father only	68 (24.6)	208 (75.4)	Reference	Reference
Mother only	11 (26.2)	31 (73.8)	1.08(0.52,2.3)	1.3 (0.4, 4.1)
Both father and mother	89 (41.8)	124 (59.2)	2.2 (1.5, 3.2)	1.0 (0.6, 1.8)
Child age (in completed months)				
6-11	31 (17.7)	144 (82.3)	Reference	Reference
12-17	64 (36.4)	112 (63.6)	2.65 (1.6,4.35)	**1.8 (1.0, 3.4) ***
18-23	73 (40.6)	107 (59.4)	3.2 (1.9,5.2)	**2.2 (1.2, 3.9) ***
Mother fruit consumption per week				
≥3 times	139 (35.9)	248 (64.1)	2.2(1.4, 3.5)	1.3 (0.7, 2.3)
<3 times	29 (20.1)	115(79.9)	Reference	Reference
The mother receives IYCF counseling from HEW				
Yes	84 (45.2)	102 (54.8)	2.6 (1.8, 3.7)	**2.4 (1.4, 3.9) ***
No	84 (24.3)	261 (75.7)	Reference	Reference
Presence of home garden				
Yes	48 (44.4)	60 (55.6)	3.6 (2.3, 5.6)	**2.5 (1.5, 4.3) ***

No	108 (25.5)	315 (74.5)	Reference	Reference
Number of ANC visits				
≥4 ANC	147 (42.0)	203 (58.0)	5.5 (3.3, 9.1)	**2.0 (1.0, 3.9) ***
≤3 ANC	21 (11.6)	160 (88.4)	Reference	Reference
Father level of education				
No formal education	8 (15.1)	45 (84.9)	Reference	Reference
Primary education	33 (30.0)	77 (70.0)	2.6 (1.1, 6.1)	**1.3 (1.5, 2.4)**
Secondary education	39 (24.1)	123 (65.9)	1.7(0.7, 3.9)	2.7 (0.7, 11.1)
College &above	88 (42.7)	118 (57.3)	3.98 (1.8, 8.9)	2.9 (0.7, 11.6)
Household wealth index				
Poor	43 (22.9)	145 (77.1)	Reference	Reference
Medium	59 (33.1)	119 (66.9)	1.7 (1.05,3.6)	0.9 (0.5, 1.8)
Rich	66 (40.0)	99 (60.0)	2.25 (1.4, 3.6)	1.1 (0.6, 2.1)

*Significant at P-value <0.05

Discussion

General findings

The objective of this study was to assess the prevalence of MAD and associated factors among children 6-23 months of age in the Amhara region, central Ethiopia. Our study results showed that the prevalence of MAD among children aged 6-23 months was 31.6%. The study also identified different factors associated with MAD; educational status, number of ANC visits during index child pregnancy, child growth monitoring and promotion utilization, age of a child, children free of illness two weeks before the survey, IYCF advice, and home garden were associated with MAD. Children whose parents attained formal education were positively associated with increasing

MAD. Children whose mother achieved secondary and college-level education had greater odds of MAD compared with children whose mother had no formal education. Likewise, children whose fathers had primary education were more likely to receive higher odds of MAD than children whose fathers had no formal education. A mother who attained four and above ANC visits and those who participated in child growth monitoring and promotion programs were more likely to provide MAD to her child. Children aged 12-17 and 18-23 months and those whose mother received IYCF advice from HEWs had greater more odds of MAD compared with children aged 6-11 months and those whose mother didn't receive IYCF advice from HEWs. As well, children from households have a home garden farming, and those who had no history of illness two weeks before the study had higher odds of MAD. However, the study results should be interpreted with caution because the study was used a cross-sectional study that doesn't establish a causal relationship and it is conducted during post-harvest and pre-fasting seasons that may be associated with improved child's consumption of diversified diets from animal and plant food sources.

Comparison with similar studies

Previous studies assessed the prevalence of MAD and associated factors among children aged 6-23 months. In our study, the prevalence of MAD was consistent with the analysis of the Gahanna demographic survey (29.9%) and study from Nepal (33%) [27, 28]. However, the current finding is lower than study reported in Indonesia (44.9%), China (41.6%), India (35.6%-37.7%) and Bangladesh (39.9%) [13-15, 29, 30]. In contrast, the prevalence of MAD in the present study greater than studies result in the Philippines (6.7%), Pakistan (8%), Nepal (26.5%), Uganda (23-26.3 %), and Ethiopia (6.1%-7%) [11, 12, 17, 31-33]. The possible reasons for the variation may be due to differences in a study setting, period, population, and sample size. Our study identified factors associated with MAD that are consistent with similar studies done across the world. In line

with the current study results, a similar study in Indonesia, Bangladesh, Ethiopia, Nepal, Ghana, and Tanzania established an affirmative association between parental educational status and improved consumption of MAD [13, 15, 16, 27, 28, 34]. Study in Nepal and Philippine showed that the number of ANC visits were positively associated with MAD [5, 11], and study in the urban Philippine and Ghana asserted that mother participation in child growth monitoring and promotion associated with improved child's dietary diversity and frequency of consumption [35, 36]. Also, study findings from Indonesia, Gahanna, Uganda, and Pakistan demographic survey analysis asserted that children who were aged 12 to 17 and 18-23 months were more likely to have greater odds of MAD [13, 28, 33, 37]. A study in the agro-pastoral community of Ethiopia found that the provision of IYCF advice has a positive impact on the child feeding practice [38].

Possible mechanisms

Parent who attained formal education significantly increase the odds of minimum acceptable diet. The possible mechanisms between the parents' higher level of education and improved minimum acceptable diet; an educated parent may have a good understanding about the significance of the recommended infant and young child feeding and easily adopt IYCF counseling and education services provided by health care providers. Furthermore, higher education achievement has a positive relationship with improved household income and household food security because educated parents may be employed in a better-paid job and this may increase their purchasing power of diversified and high-quality diet to their children. During ANC and child growth monitoring and promotion contact points, the mother/caregiver could receive optimal infants and young children feeding counseling that may increase the odds of minimum acceptable diet. The odds of MAD were higher among children who were aged 12-17 and 18-23 months. The possible reason for the association between greater odds of MAD and increasing age may be due to the

mother's perception of young children's stomach incompetent to digest solid or semi-solid diets. Hence, the mother may introduce only a milk-based diet and start the introduction of diversified solid and semi-solid diet after the child age reaches 12 months. Children who were illness-free within two weeks before the survey and those who were lived in the household having a home garden had greater odds of MAD. This is because illness reduces child appetite, dietary intake and nutrient absorption lead to lower odds of MAD. On the other hand, home garden farming in resource-limited settings positively associated with improved income, household food security, and dietary diversity [39]. Thus, children who lived in higher income and food secure households may receive age-appropriate feeding with different food groups. Besides, home garden farming had a positive relationship with increased food availability and accessibility, and mothers may provide their children with a variety of food groups.

Policy implication and future research

The government of Ethiopia launched a revised national nutrition program (NNP II) to end child malnutrition by the year 2030 and appropriate complementary feeding for children aged 6-23 months is one of the main intervention approaches of NNP II to hunger. However, the current study findings indicated that less than one-third of children aged 6-23 months meet the minimum acceptable diet, and several factors influence the provision of MAD. This denotes that children aged 6-23 months at higher risk of growth failure, poor mental development, and adverse health outcomes. Thus, the government of Ethiopia needs to strengthen existing nutrition programs and strategies to increase the age-appropriate child feeding practices in the country. Also, the government and other NGOs need to consider situation-specific nutrition interventions program to improve the prevalence of minimum acceptable diet. More attention should be given to improve the minimum acceptable diet for uneducated parents, the mother having fewer ANC visits and

those who didn't participate in growth monitoring and promotion services, child feeding during illness, and encourage home garden farming practice. Parental educational status has a positive impact on the minimum acceptable diet. Similar studies affirmed that advanced educational status associated with improved health services utilization such as ANC and growth monitoring and promotion services utilization which in turn positively impact the provision of optimum infants and young children feeding practices [35, 40]. In 2003, the government of Ethiopia launched a health extension program to provide essential primary health care services to all people and begin to deploy community-based health workers called health extension workers and study in Ethiopia showed that health extension workers have a positive influence on the improvement of maternal and child health service utilization and health-seeking behaviors [41, 42]. Ultimately, nutrition information offer during health service utilization contact points may promote appropriate children feeding practice. Comprehensive nutrition education and counseling and a wide range of health service programs through community-based health workers, mother-to-mother support groups, religious leaders, and idea influencers should be strengthened to improve the provision of minimum acceptable diet in Ethiopia.

Ethical Consideration: Institutional Health Research Ethics Review Committee (IHRERC) of Haramaya University, College of Medicine and Health Sciences ethically approved the study with reference number C/Ac/R/D/01/878/18 and data were collected after informed written consent taken from study participant.

Patient consent for publication: Not required

Data availability: Data used to analyze this study are found from the corresponding author

Conflict of interest: None declared

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Patient and public involvement: Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Author contributions: AM: Conception and original draft writing**,** AM, GE, AS, BK, MA, LG, and AB: Study design, data analysis, and interpretation, GE, AS, BK, MA, LG, and AB: critically review initial draft and finalizing manuscript, AM and AS: preparing the manuscript. All authors reviewed and approved the final manuscript.

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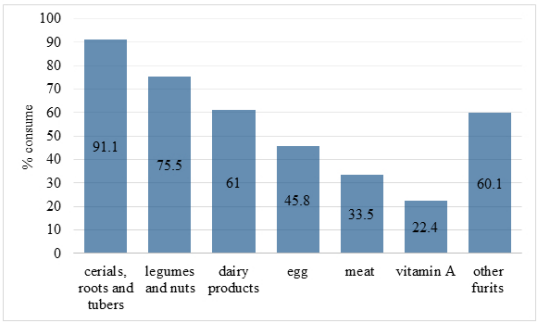
Figure legend

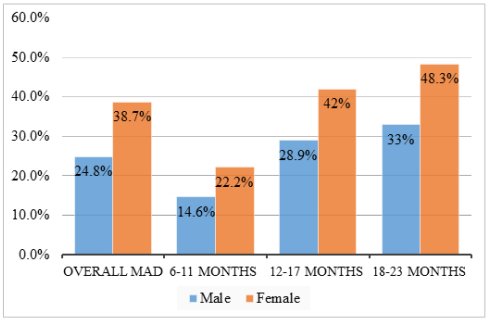
Figure 1: Food groups consumed by infants and young children aged 6-23 months in Debre Berhan Town, Ethiopia, February 2018.

Figure 2: MAD distribution by sex and age group of infant and young children aged 6-23 months in Debre Berhan Town, Ethiopia 2018



Food groups consumed by infants and young children aged 6-23 months in Debre Berhan Town, Ethiopia, February 2018

68x45mm (400 x 400 DPI)



MAD distribution by sex and age group of infant and young children aged 6-23 months in Debre Berhan Town, Ethiopia 2018

68x45mm (400 x 400 DPI)

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

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In your methods section, say that you used the STROBE cross sectionalreporting guidelines, and cite them as:

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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	1&2
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	3 &4
Objectives	#3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	#4	Present key elements of study design early in the paper	4
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4 & 5
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	5

	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable NA
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable. NA
Bias	#9	Describe any efforts to address potential sources of bias
Study size	#10	Explain how the study size was arrived at 5
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding 7
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions NA
Statistical methods	#12c	Explain how missing data were addressed 5
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy
Statistical methods	#12e	Describe any sensitivity analyses NA
Results		
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable. NA
Participants	#13b	Give reasons for non-participation at each stage NA
Participants	#13c	Consider use of a flow diagram NA
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable. 8-10
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest NA
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable. NA

Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included 10-12
Main results	#16b	Report category boundaries when continuous variables were categorized
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period NA
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses NA
Discussion		
Key results	#18	Summarise key results with reference to study objectives 13-16
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias. 16
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence. 13
Generalisability	#21	Discuss the generalisability (external validity) of the study results 16
Other Information		
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based 16