Infant and Young Child Feeding (IYCF) Practices Among Mothers of Children Aged 6–23 Months in Two Agro-ecological Zones of Rural Ethiopia

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Abstract: It is estimated that 6% of all deaths of under 5 years old children in developing countries can be prevented by appropriate complementary feeding, in particular good dietary diversity and meal frequency. The aim of this paper is to assess infant and young child feeding practices among mothers of children aged 6-23 months in rural Ethiopia. A community based cross-sectional study design was employed among mothers living in two agro-ecological zones. Trained data collectors conducted the interviews, anthropometric measurements, and the blood test for anaemia. To determine the predictors of minimum meal frequency, multivariable logistic regression models were used with 95% confidence intervals. We found that 95.4% of the children were breastfed, of whom 59.7% were initially breastfed within one hour after their birth, 83.3% fed on colostrum, 22.2% received pre-lacteal feeds and 50.9% of the children received complementary feedings by 6 months of age. In the 24 hours preceding the survey date, 39.8% of the children were fed using bottle; 4.6% and 1.9% of them consumed vitamin A-rich and iron-rich foods, respectively. Likewise 50.5%, 22.2%, and 12.0% of the children achieved minimum meal frequency, adequate dietary diversity and minimum acceptable diet, respectively. A significant proportion of children in the lowland fed on colostrum and had adequate dietary diversity compared to the midland agro-ecological zone. However, bottle feeding and minimum meal frequency were higher in the midland zone. There are also associations between the agro-ecological zones and initiation of breast feeding, pre-lacteal feeds, bottle and colostrum feeding. The predictors of poor minimum meal frequency were age of the child, being anaemic, stunting, while predictors of infant dietary diversity were maternal dietary diversity and age of the child. One out of nine children received appropriate diet for their age, which was very low. Mothers of child bearing age should be educated on the importance of infant and young child feeding.

Keywords: Complementary Feeding, Dietary Diversity, Minimum Acceptable Diet, Minimum Meal Frequency, IYCF, Ethiopia

1. Introduction

Adequate and quality complementary food during infancy and early childhood is essential for full growth and development. Poor child feeding practice and high rate of infection reduces cognitive development, educational achievement, productivity [1-3], and growth [4]. WHO recommends the introduction of complementary foods at six months of age, as breast milk alone is not enough to meet the nutritional requirements of 6-23 months of age children. After 6 months of age and with only optimum breastfeeding, children will become malnourished if they do not achieve appropriate dietary diversity and meal frequency [4-6]. Thus, the transition period from exclusive breastfeeding to two years is critical for optimal growth and development of

children who need appropriate, safe, adequate amounts of complementary food [7], whereas suboptimal infant feeding results in under nutrition. Out of the 10.9 million under-five-year deaths that occur worldwide annually, malnutrition is, directly or indirectly, responsible for 60.0% of them. Over 3.4 million children less than five die each year due to inappropriate feeding practices [8].

In many developing countries, inadequate complementary feeding of 6-23 month old children is a major problem. Only 50% of children receive the minimum number of meals, less than one-third achieve minimum dietary diversity, and only 21% meet the criteria for the minimum acceptable diet [9]. In a study conducted in northern Ethiopia, only 10.8% of children achieved adequate dietary diversity and only 44.7% received the minimum meal frequency [10]. According to Alive and Thrive Ethiopia and the Ethiopian Demographic and Health Survey (EDHS) 2011, the extent of achievement of the minimum dietary diversity in the country was 4.8% and the proportion of children who received the minimum acceptable diet was 4.1% [11, 12]. Decreased dietary diversity is associated with stunting [1, 13]. It is estimated that 6% of all under-five-year deaths in developing countries can be prevented by appropriate complementary feeding, in respect of which dietary diversity and meal frequency are the most important issues [1, 14-15].

Understanding the importance of Infant and Young Child Feeding (IYCF) on the nutritional status of children less than two years of age, the WHO established and validated a set of core indicators [16]. A particular challenge related to age-appropriate complementary feeding is ensuring acceptable diet quality through an appropriately diverse diet [17]. Similarly, in Ethiopia, being aware of the low prevalence of appropriate infant and young child feeding practices and the importance of exclusive breastfeeding, the government developed the Infant and Young Child Feeding (IYCF) guidelines in 2004 [18]. Subsequently, there were various levels of interventions to emphasise the importance of appropriate feeding, and messages regarding exclusive breastfeeding even though there is no national evidence-base on the progress made as a result of these interventions.

So updated information on infant feeding practices from community based studies will help the Ethiopian National Nutrition Program to better monitor the changes in feeding practices and design interventions to increase the recommended feeding practices and thereby contribute to reducing undernutrition in the country. Thus, the aim of this paper was to assess IYCF and factors association with children feeding practices in two agro-ecological zones of rural Ethiopia.

2. Materials and Methods

2.1. Study Area

This study was conducted in Babile, Enderta and Hintalowajirat districts of Ethiopia from January to February 2014. Babile, which is in eastern Ethiopia and 560 km away

from Addis Ababa, is 950 to 2000 meters above sea level, and in this study it represents a lowland agro-ecology zone. In the district, data were collected from 1000-1500 meters above sea level. The major agricultural product for consumption is sorghum and oil seeds; and groundnuts are used as a cash crop. Khat (*Catula edulis*) is also grown extensively as a cash crop. Hintalo Wajirat and Endreta districts (683 km and 773 km away from Addis Ababa) in the northern part of Ethiopia represent midland agro-ecological zones. Data were collected from an altitude of greater than 2000 meters above sea level, where the inhabitants produce cereals (Teff and barley) and are involved in animal husbandry.

2.2. Study Design, Population and Sampling

A community based cross sectional survey was conducted on 216 mother-child pairs from 4 randomly selected kebeles between January and February 2014. After we obtained the number of mothers who had children 6-23 months of age from the lists available to health extension workers, we allocated the sample size in each kebele based on the number of mothers in each kebele. Finally, the required number of mothers in each kebele was selected randomly.

2.3. Data Collection

Data were collected using a structured questionnaire that is based on standardized tools developed by FANTA [19], which is a published operational guideline for measuring dietary diversity. The questionnaire inquires of each of the mothers the type of foods she ate and fed to her index child at home and outside the compound in the last 24 hours. The exact composition of all these foods was also noted. It also asks the kind of foods she fed her child in the last seven days.

The information collected on dietary consumption was used to calculate the dietary diversity score (DDS), the minimum meal frequency (MMF), and minimum acceptable diet (MAD) classification, which were defined at a workshop on dietary diversity [20, 21]. During the data collection, the frequency of consumption and the amount of food consumed was taken into consideration. Since the qualitative recall was conducted over 24 distinguishable hours, the DDS could be calculated over a 24 hours period. Dietary diversity was calculated on the basis seven food groups – see Table 4 [22]. The recall was randomly made on weekdays or on weekend days, since weekends do not have any special significance in the context of our study. We took care not to include atypical days (local feasts or celebrations) in the recall.

Minimum meal frequency, dietary diversity and minimum acceptable diet were defined and calculated according to WHO guidelines [19]. In addition, early initiation of breastfeeding, introduction of solid, semi-solid or soft foods, continued breastfeeding at 1 year, consumption of iron-rich or iron-fortified foods, children ever breastfed and bottle feeding were assessed. The anthropometric measurements conducted for both mothers and children were performed using the standardized procedures recommended by WHO

[23, 24] after completing the interviews. Haemoglobin levels of the mothers and children were measured immediately on site by using portable HemoCue analyser. Anaemia is defined as haemoglobin less than 11 g/dl for children and less than 12 g/dl for mothers after adjustment is made for altitude [25].

2.4. Data Collectors and Data Quality Control

The data were collected by nurses and laboratory technologists, who had experience in collecting data in rural settings, who were native speakers of the local languages, and whom we trained intensively for the purposes of this study. To control the quality of the data, the questionnaire was prepared first in English and then translated into Tigrigna and Afan Oromo languages, which are the local languages in the different zones. The process of data collection was supervised by the principal investigator (KTR). A pre-test survey was conducted on 5% of the total sample size in other rural areas which have similar characteristics. Before the actual survey, solutions to the errors and problems identified during the pre-test survey were integrated into the final version of questionnaire. Two different measurements were taken for anthropometric parameters by different measurers for each study subject. If variation between measurements was observed, the principal investigator (KTR) checked the measurement.

2.5. Variables

The dependent variable was IYCF. The independent variables were socio-demographic and economic factors, food intake pattern, agro-ecological zone, maternal and children haemoglobin values, antenatal care, place of delivery of index child, history of illness in the past and nutritional status of mother and children.

2.6. Data Processing and Analysis

Data were double entered into EPI data Version 3.1 by different data clerks. Before the analysis, the data were cleaned and edited by KTR using SPSS version 16 and Stata 11. WHO Anthro 2005 was used for calculating the z-scores. For the analysis, the data were transferred to SPSS Version 16.0. IYCF indicators, initiation of breastfeeding within one hour after delivery, DDS, MMF and MAD, proportion of children exclusively breastfed, and number who started complementary feeding at six months were reported in this study. The variables associated with MMF were analysed via univariate and multivariate analysis. P-values of less than 0.1 were used as cutting point to include in multivariable analysis model. Chi-square test was used to determine the associations between feeding practices and agro-ecological zones.

2.7. Ethical Consideration

Ethical clearance was obtained from University College Cork and Haramaya University College of Health and Medical Sciences Institutional Research Ethics Review Committee. The Ethiopian National Ministry of Science and Technology Ethical Review Committee granted the final approval of the protocol. Informed consent was obtained from the caregivers/mothers of the children.

3. Results

Out of the 220 mothers interviewed, 216 (98.2) completed the survey. The four dropouts were due to fear of needles and thus did not provide a blood sample for the haemoglobin test. All of the mothers were biological mothers with 31.5% in age range of 30-34 years. 55.6% of the children were female children, 68.5% of the mothers did not have formal education, 87% were married, and 91.2% were farmers (Table 1).

3.1. Maternal and Children Health Service Utilization

Most of the mothers (82.8%) had antenatal care follow up at least once during their last pregnancy. More than half of them (53.7%) attended four focused ANC as recommended. Only 31.9% of the mothers gave birth to their index child at a health institution. Many of them (61.1%) had more than one child who was less than five years (Table 1).

Table 1. *Descriptive socio-demographic and obstetrics history of mothers in rural Ethiopia.*

Variables / Characteristics	Categories	Number	Percent
Sex of the children	Male	96	44.4
	Female	120	55.6
Age of the children (months)	6-11 inclusive	80	37.0
	12-17 inclusive	106	49.1
	18-23 inclusive	30	13.9
Agro-ecological zone	Lowland	111	51.4
	Midland	105	48.6
Mother age (years)	<24	51	23.6
	25-29	52	24.1
	30-34	68	31.5
	≥ 35	45	20.8
Marital status of mother	Married	188	87
	Others	28	13
Educational status of the mothers	Illiterate	148	68.5
	Attend school	68	31.5
Occupation of father	Farmer	183	84.8
	Merchant	7	3.2
	Others	26	12
Occupation of mothers	Farmer	197	91.2
	Merchant	10	4.6
	Others	9	4.2
Number of children under five	1	84	38.9
	≥ 2	132	61.1
Parity	3 and below	74	34.3
	≥ 4	142	65.7
Ever used contraceptive	No	105	48.6
	Yes	111	51.4
Ante Natal Care follow up	<4	116	53.7
	≥ 4	63	29.2
	Not attended	37	17.1
Place of delivery of index child	Home	147	68.1
	Health institution	69	31.9
Anaemia status of the children	Anaemic	116	53.7
	Non anaemic	100	46.3
Anaemia status of the mother	Anaemic	47	21.8
	Non anaemic	169	78.2
MUAC of the mothers	≤ 22	123	56.9
	>22	93	43.1

3.2. Infant and Young Child Feeding (IYCF) Practices by Agro-Ecology

In this study, 95.4% of the mothers had ever practiced breastfeeding, 50.9% of them introduced timely complementary feeding at 6 months, 59.7% had initiated breastfeeding within 1 hour after birth, 22.2% used pre lacteal feeds, and 95.3% continued breast feeding at one year. Only 1.9% of the mothers fed their babies iron-rich food, and the day before the survey only 39.8% had not bottle fed their children. The mean and standard deviation of dietary diversity for the day preceding the survey were 2.6 ± 0.085 (with 95% CI of 2.48, 2.83). The overall prevalence of children achieving minimum dietary diversity was 22.2% (95% CI =17.0, 28.4). Half of the children (50.5%) received the minimum meal frequency, but only 12% (95% CI =8.0, 17.0) of them received the minimum acceptable diet (combination of dietary diversity and meal frequency). Only 6.2% of the non-breastfed children and 13% of their counterparts were provided with the minimum acceptable diet. There are statistically significant differences between the agro-ecological zones and the initiation of breastfeeding, colostrum feeding, children ever breastfed, use of pre-lacteal feed, bottle feeding, minimum dietary diversity, and minimum meal frequency (Table 2).

Table 2. Feeding practices of children by agro-ecological zone in rural Ethiopia.

Variables / characteristics	Categories	Overall N(%)	Lowland N(%)	Midland N(%)	X^2	P-value
Mother told to put baby on breast immediately after birth	Yes	180(83.7)	95(85.6)	85(81.7)	0.59	0.44
	No	35(16.3)	16(14.4)	19(18.3)		
Initiation of breast feeding	Within 1 hrs	129(59.7)	59(53.2)	70(66.7)	1.00	1.00
	Within 24 hrs	61(28.2)	31(27.9)	30(28.6)	0.43	0.51
	Within 3 days	10(4.6)	8(7.2)	2(1.9)	4.36	0.036
	Not given at all	16(7.4)	13(11.7)	3(2.9)	6.31	0.02
Children ever breast fed	Yes	206(95.4)	103(92.8)	103(98.1)	3.44	0.06
	No	10(4.6)	8(7.2)	2(1.9)		
Child fed on colostrum	Yes	180(83.3)	106(95.5)	74(70.5)	24.32	0.0001
	No	36(16.7)	5(4.5)	31(29.5)		
Pre-lacteal food	Not given	168(77.8)	68(61.3)	100(95.2)	36.04	<0.001
	Given	48(22.2)	43(38.7)	5(4.8)		
Bottle fed yesterday	Yes	130(60.2)	50(45.0)	80(76.2)	21.84	<0.001
	No	86(39.8)	61(55.0)	25(23.8)		
Age of starting complementary feeding	<6 months	59(27.3)	36(32.4)	23(21.9)	3.30	0.069
	At 6 months	110(50.9)	51(45.9)	59(56.2)	1.00	1.00
	>6 months	31(14.4)	17(15.3)	14(13.3)	0.7	0.40
	Not started	16(7.4)	7(6.3)	9(8.6)	0.04	0.84
Currently breastfed	No	16(7.4)	10(9.0)	6(5.7)	0.85	0.35
	Yes	200(92.6)	101(91.0)	99(94.3)		
Timely complementary feeding (6-9 months)	No	13(23.6)	5(20.0)	8(26.7)	0.33	0.75
	Yes	42(76.4)	20(80.0)	22(73.3)		
Receive solid, semi-solid or soft foods (6-8 months)	No	12(33.3)	4(28.6)	8(36.4)	0.234	0.73
	Yes	24(66.7)	10(71.4)	14(63.6)		
Continued breast feeding at 1 year	No	3(4.7)	3(7.5)	0(0.0)	NA	NA
	Yes	64(95.3)	37(92.5)	24(100)		
Consumption of iron-rich or iron-fortified foods	No	212(98.1)	110(99.1)	102(97.1)	1.14	0.34
	Yes	4(1.9)	1(0.9)	3(2.9)		
Minimum dietary* diversity	No	168(77.8)	80(72.1)	88(83.8)	4.3	0.038
	Yes	48(22.2)	31(27.9)	17(16.2)		
Minimum meal frequency*	No	107(49.5)	73(65.8)	34(32.4)	24.05	<0.001
	Yes	109(50.5)	38(34.2)	71(67.6)		
Minimum acceptable diet*	No	190(88.0)	97(87.4)	93(88.6)	0.07	0.789
	Yes	26(12.0)	14(12.6)	12(11.4)		

*It is calculated for children 6-23 months of age; NA, not available

Table 3 showed that 58.8% of the children aged 6-11 months inclusive initiated breastfeeding within one hour after birth and 41.3% were fed using bottle. A total of 15%, 40%, and 8.8% received minimum dietary diversity, minimum meal frequency, and minimum acceptable diet, respectively. As the age of the children increased, the proportion of children received minimum meal frequency and dietary diversity increased proportionally.

Table 3. Infant and Young Child Feeding (IYCF) practices disaggregated by age in rural Ethiopia.

Children feeding practices	Provided	% (95% CI)
Initiated breasting after birth within 1 hour 6-11 month olds (n=80)	47	58.8(47.2, 69.6)
Initiated breasting after birth within 1hour 12-23 month olds (n=136)	82	60.3(51.5,68.6)
Initiated breasting after birth within 1 hour (all) (n=216)	129	59.7(52.8,66.3)
Currently breast fed 6-11 months(n=80)	75	93.8(86.0,97.9)
Currently breast fed 12-23 months(n=136)	125	91.9(86.0, 96.0)
Bottle feeding children 6-11 months (n=80)	33	41.3(30.3,52.8)
Bottle feeding children 12-23 months(n=136)	53	39.0(30.7,47.7)
Bottle feeding (all) (n=216)	86	39.8(33.3,46.7)
Minimum dietary diversity		
Minimum dietary diversity for 6–11 months (n=80)	12	15.0(8,24.7)
Minimum dietary diversity for 12–17 months (n=106)	26	24.5(16.8,34)
Minimum dietary diversity for 18–23 months (n=30)	10	33.3(17.3,52.8)
Minimum dietary diversity for 6–23 months (N= 216)	48	22.2(17,28.4)
Minimum meal frequency		
Minimum meal frequency for 6–23 months non breastfed (n=32)	16	50.0(31,68)
Minimum meal frequency for 6–23 months breastfed (n=184)	93	50.5(43,58)
Minimum meal frequency for 6–11 months (all) (n=80)	32	40.0(29,51.5)
Minimum meal frequency for 12–17 months (all) (n= 106)	59	55.7(46,65)
Minimum meal frequency for 18–23 months (all) (n=30)	18	60.0(40.6,77)
Minimum meal frequency for 6–23 months all (N=216)	109	50.5(43.6,57)
Minimum acceptable diet		
Minimum acceptable diet for breastfed children (all)(n=184)	24	13.0(8.5,18.7)
Minimum acceptable diet for non-breastfed children(all) (n=32)	2	6.2(N/A)
Minimum acceptable diet 6–11 months (all) (n=80)	7	8.8(3.6,17.2)
Minimum acceptable diet 12–17 months (all) (n=106)	16	15.2(9,23.5)
Minimum acceptable diet 18–23 months (all) (n=30)	3	10.0(N/A)
Minimum acceptable diet for all children (6–23 months) (N=216)	26	12.0(8,17)

Grain, roots and tubers were the most common food items consumed by the children in the last 24 hours (86.6%). 55.6% of them consumed legumes and nuts, 47.2% drank milk, but only 4.6% ate vitamin-A rich fruit and vegetables, and 1.9% ate flesh foods. The extent of consuming diverse food groups in the 24 hours was low among all age groups and it was lower among the 6–11 month olds than among other groups (Table 4).

Table 4. Food groups given in past 24 hours to children aged 6–23 months.

Food groups	Overall 6-23 months (n=216)		Age groups (months)		
	Yes (%)	No (%)	6-11 (n=80) Yes (%)	12-17 (n=105) Yes (%)	18-23 (n=32) Yes (%)
Grain, root and tubers	187(86.6)	29(13.4)	59(73.8)	99(93.4)	29(96.7)
Legumes and nuts	120(55.6)	96(44.4)	36(45)	61(57.5)	23(76.7)
Dairy products	102(47.2)	114(52.8)	34(42.5)	54(50.9)	14(46.7)
Vit A rich fruit & veg	10(4.6)	206(95.4)	2(2.5)	7(6.6)	1(3.3)
Other fruits & vegetables	133(61.6)	83(38.4)	32(40)	80(75.5)	21(70.0)
Flesh foods	4(1.9)	212(98.1)	2(2.5)	1(0.9)	1(3.3)
Egg	11(5.1)	205(94.9)	4(5.0)	6(5.7)	1(3.3)

3.3. Factors Associated with Not Receiving Minimum Meal Frequency

The factors that do not show statistically significant association with receiving minimum meal frequency in the bivariate models, and thus removed from the models, were sex of children, household utilization of iodized salt, family planning utilization, taking deworming tablets in the past three months for mothers, maternal dietary diversity, maternal/child sickness within 15 days before the survey, maternal and paternal education and occupation.

In the bivariate logistic regression model, the age of the children, age at starting complementary feeding, children being stunted and anaemic, source of drinking water were identified as significantly associated with the risk of not meeting the minimum meal frequency and they were included in the multivariable analysis. In the final model (multiple variable logistic regression analysis), it was found that the infants who were born in lowland area (AOR = 3.56; 95% CI: 1.35-9.40), who were anaemic (AOR = 3.46; 95% CI: 1.81-6.63), and who were less than 12 months of age (AOR = 2.54; 95% CI: 1.24–5.09) had significantly higher

risk of not meeting the minimum meal frequency (Table 5).

Table 5. Factors associated with not meeting minimum meal frequency (MMF) among 6–23 months of age children in Rural Ethiopia.

	MMF		COR (95% C.I)	AOR (95% C.I)	P-values
	No (n)	Yes(n)			
Age of the children					
< 12 months	48	32	1.96(1.07,3.57)	2.54(1.24,5.09)	<0.09
>=12 months	59	77	1.00	1.00	
Age of starting complementary feeding					
Less than 6 months	27	14	1.13(0.57,2.24)	1.4(0.63,2.92)	0.001
At 6 months	47	32	1.00	1.00	1.00
≥ six months	33	63	0.31(0.14,0.69)	0.34(0.14,0.80)	0.013
Children stunted					
Yes Haz ≤ -2	48	38	1.00	1.00	0.120
No Haz >-2	59	71	0.66(0.38,1.13)	0.58(0.29,1.16)	
Anaemia status of the children					
Anaemic	74	41	3.66(2.0,6.7)	3.46(1.81,6.63)	<0.001
Non anaemic	33	67	1.00	1.00	
Family have toilet					
No	54	41	1.68(0.95,3.0)	0.68(0.35,1.339)	0.269
Yes	53	68	1.00	1.00	
Agro-ecological zones					
Low land	73	38	4.01(2.28,7.07)	3.56(1.35,9.40)	0.01
Midland	34	71		1.00	

COR = Crude Odds Ratio, AOR = Adjusted Odds Ratio

In multiple linear regression model that assessed predictors of infant dietary diversity score in the post-harvest season, significantly associated was found between infant dietary diversity and women dietary diversity score and child age. As dietary diversity of women increased by one unit, the dietary diversity of the child also increased (β=0.2 P=0.042). Similarly, as the age of the child increased by one month, the dietary diversity score of the children increased by 0.84 units (β=0.84, P<0.001).

Table 6. Predictors of dietary diversity among children 6-23 months of age in rural Ethiopia, multivariate linear regression, 2014.

Variables	β(95% CI)	P-values
Women dietary diversity score (WDDS)	0.2(0.01 0.37)	0.042
Age of the child (months)	0.84(0.52, 1.2)	<0.001
Region	0.21(0.16,0.58)	0.07

*only significant variables in bivariate analysis were included in the model

4. Discussion

In order to reduce malnutrition in a developing country like Ethiopia, adequate, safe and acceptable child feeding practice is crucial. For this reason, WHO and UNICEF have recommended eight core infant feeding practices [19, 21]. In this study we found that 51% of the mothers initiated complementary feeding at six month, and 59.7% had initiated breastfeeding within 1 hour after birth. About half (50.5%) of the children received the minimum meal frequency, 22.2% achieved minimum dietary diversity and 12% of them received the minimum acceptable diet.

Appropriate child feeding practices are defined within narrow age ranges and these key feeding practices, within a continuum of child feeding, are used as an indicator of nutritional care practices [26]. In 2011, UNICEF highlighted that breastfeeding is a preventive intervention and the most

important element in reducing child mortality [27]. In contrast, poor breastfeeding and complementary feeding, together with high rates of morbidity and mortality from infectious diseases, are the main reasons for undernourishment in the first two years of life [27]. In addition, appropriate complementary feeding has been shown to be most effective in improving child growth, and in reducing stunting among children 6–24 months of age [8, 27].

Breastfeeding pattern in developing countries is almost universal; however sub-optimal feeding practices such as delayed initiation of breastfeeding, non-exclusive breastfeeding, pre-lacteal feeding and bottle feeding are prevalent in most of the sub-Saharan countries [28]. The number of the mothers who initiated breastfeeding within one hour after birth in this study (59.7%) is less than reported in a study conducted in Enderta zone of northern Ethiopia (68.3%) [29], but it is more than the number reported by EDHS [12]. It is recommended that a neonate should be breastfed immediately after birth and should be exclusively breastfed up to six months of age. But this is a rare phenomenon in Ethiopia. In our study, for example, about four in ten mothers did not initiate breastfeeding on time, which is a clear manifestation of the severity of the feeding problem in the community.

According to the WHO, complementary food is important to prevent malnutrition and it should be introduced at 6 months of age, when the infant's stomach is ready to digest other foods. In this study, 51% of the mothers had initiated complementary feeding by the sixth month of the child's age, which is less than the percentage of mothers reported in similar studies in northern Ethiopia (79.7%), Mekelle (62.8%), Harar (54.4%) [29-31], and nationally (61%) [32]. Nearly half of the mothers in our survey did not begin providing their infants with additional foods on time. The

most identified reasons for malnutrition were short duration of breastfeeding, low prevalence of exclusive breastfeeding, continued breastfeeding to 1 year, and insufficient dietary diversity [1, 9, 33].

This study revealed that a majority of children in the 6-23 month age group were not exclusively breastfed during their first 6 months of life, used pre-lacteal food, were bottle fed, and did not consume adequate micronutrients based on their poor dietary diversity scores. It is reported that lack of exclusive breastfeeding, inappropriate complementary feeding, food scarcity, and micronutrient deficiencies lead to malnutrition [4, 33]. Use of pre-lacteal foods may lead to lactation failure, inadequate milk production, infection, diarrhoea, and short duration of breastfeeding [35]. It is observed that there is a vicious cycle between pre-lacteal foods and delayed initiation of breastfeeding; consequently, pre-lacteal food may delay the production of breastmilk which may encourage the use of pre-lacteal food. WHO/UNICEF discourages the use of pre-lacteal foods without being medically indicated [27]. It is the recommendation of UNICEF that babies should be fed with cups and spoons. Bottle-feeding is not recommended because improper sanitation and formula preparation with bottle-feeding can introduce microorganisms to the infant that increase the child's risk of illness and malnutrition [27], but this study found that about 39.8% of mothers fed their children using bottle. This finding is greater than national data (28.5%) [12] but lower than a study in Addis Ababa (54.2%) [36]. It is found that deprivation of colostrum, duration of breastfeeding, use of pre-lacteal feeds, age of introduction of complementary feeding and method of feeding are the main factors contributing to under-five stunting [1, 4, 7, 29].

To decrease probability of malnutrition and its consequences, in addition to appropriate breastfeeding, children need to receive complementary foods including at least four of the seven food groups after six months of age [14, 16]. Prevalence of achieving the minimum dietary diversity was 22.2%, with higher prevalence in lowland (27.9%) compared to midland (16.2%). Although this is higher than reported by DHS (4.8%) [12], in Tigray (17.8%) [31], and Ethiopia overall (10.8%) [10], it is hardly promising that so few of these children received adequate dietary diversity. In this study, a majority of the children received a diet primarily based on staple foods (grain, roots and tubers), very few of the children received vitamin A rich fruit and vegetables, egg, and flesh foods. Legumes and nuts were more consumed by the 18-23 months age group compared to the other age groups, while other fruit and vegetables were more commonly consumed among 12-17 months age groups. When poor dietary diversity is prevalent, it negatively affects minimum dietary diversity score and acceptable diet which, in turn, affect growth and development of the children. Generally, the dietary diversity during the previous 24 hours was very poor in the 6–11 months age group, with the lowest intakes reported for vitamin A rich fruit and vegetables and flesh foods (Table 4).

These data indicate that children in this age group start with complementary feeding that is inadequate to meet their daily micronutrient requirements during their transitions from exclusive breastfeeding [7].

The percentage of children in our study who achieved minimum meal frequency (50.5%), is less than the magnitude reported from Sri Lanka (88.3%), Bangladesh (81.1%), and Nepal (76.6) [37-39]. Children should achieve minimum meal frequency to increase the probability of reaching the required levels of energy and micronutrient intakes in developing countries with low or average levels of breast milk intake. Studies show that achievement of minimum meal frequency is associated with improved height for age in children [32].

The proportion of the children who received the minimum acceptable diet was 12%. This is similar to the number reported by Mekbib *et al* (11.9%) [31], but higher than reported by EDHS (5.2%) [12]. This clearly shows that children in the study area are not getting adequate nutrient and energy intakes. The minimum acceptable diet is an indicator of standards of dietary diversity (a proxy for nutrient density) and feeding frequency (a proxy for energy density) and hence is a useful method to track progress of the children feeding.

With respect to dietary diversity, our study indicates that diversity of different food groups offered during the past 24 hours was low, with the lowest rates reported for vitamin A rich fruit and vegetables and flesh foods (Table 4). Children in the 6–23 months of age group go through a reasonably rapid dietary transition from exclusive breastfeeding to complementary feeding. Additionally, during this dietary change, they are also prone to some diseases like diarrhoea [40, 41]. During this period, children need more nutritious food to overcome the adverse effects of such diseases. Unfortunately, the current findings show that the children in this age group were not receiving appropriate complementary foods as recommended by the WHO. Our findings are similar to a national study and another study in the northern part of Ethiopia [12, 31].

Our data also indicate that anaemic children are at higher risk of not achieving the minimum meal frequency compared to the non-anaemic children. This suggests that food shortage and/or inappropriate meal frequency led to anaemia in these children. This finding is also reinforced by the very small percentage of children who were fed iron-rich food (only 1.9%). This percentage is less than previously documented in Ethiopia [32]. There is no association between antenatal care (ANC) and meeting minimum meal frequency. This may be due to the fact that health professionals providing antenatal care were more focused on the mothers' pregnancy-related information than on child health care practices [31], and a relatively small percentage (29.2%) of mothers attended ANC during pregnancy of this index child. Most mothers in rural Ethiopia do not have adequate knowledge on the importance of feeding frequency, so most families prefer to give to their children a large amounts of food at once

(which children may have difficulty consuming) rather than feeding smaller amounts more frequently [31].

To our knowledge, there are no previous studies that investigated the association between minimum meal frequency dietary diversity and agro-ecological zones in Ethiopia. However, there is a report of regional variations in Nepal [37]. Our study showed that a large proportion of children in the lowland zone do not receive minimum meal frequency compared to those from the midland zone even though the reasons for the difference should be further explored.

The most commonly consumed food groups by children in both seasons were grains, roots and tubers, followed by legumes, and other fruit and vegetables. There was a slight decrease in the other fruit and vegetables category in the lean season. Higher consumption of grains, roots and tubers and other fruit and vegetables are typical characteristics of the Ethiopian diet [42, 43]. However, higher rate of legume consumption is more typical of the northern Ethiopian regions [31]. Consumption of milk is significantly decreased during lean season in both agro-ecological zones. However, our data indicate that all children did drink milk in the midland region in the 24 hours preceding the survey. The consumption of milk in these study areas is higher than reported in others studies [31, 42], and lower than reported by Mesfin *et al.* [43] and Regessa [44]. Similarly, consumption of meat and egg were low in this study as most communities in rural parts of Ethiopia do not consume meat regularly [42]. Consumption of meat and egg by our study participants was lower than reported in other studies in similar setting [31, 43].

We found that very few of the children were fed foods rich in vitamin A and iron. These micronutrients are a prerequisite for healthy growth and development in early life and also have great impact on adult health and wellbeing [45]. It is recommended that children from 6-23 months should consume 7-11 mg/day iron as their iron stores at birth are depleted after six months [46]. Unfortunately, our data demonstrate that this age group is at high risk of iron deficiency as most of the children do not fed on iron-rich animals foods.

5. Conclusion

Poor IYCF practices are reported in the present study, apart from the high proportion of children who were breastfed. Even though dietary diversity of the lowland community is better than midland community in this assessment during pre-harvest season, both are far below the WHO recommendations for IYCF practices. Appropriate IYCF should be a high priority to build the health of future generations in both agro-ecological zones. Health information should be given to mothers regarding all components of IYCF during their visits/contacts with health workers/health extension. This is particularly relevant in lowland agro-ecological zones.

Acknowledgements

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