


Undernutrition among khat-chewer and non-chewer lactating women in Chiro district, eastern Ethiopia: Comparative cross-sectional study

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Abstract

Objectives: This study aims to assess the prevalence of undernutrition and factors associated with it among khat-chewer and non-chewer lactating women at Chiro district, west Hararghe zone, eastern Ethiopia.

Methods: A community-based comparative cross-sectional study was conducted among 446 (223 khat chewers and 223 non-chewers) randomly selected lactating women who have children aged 6 and 23 months. Data were collected through face-to-face interviews using structured questionnaires followed by weight and height measurements to calculate and categorize nutritional status based on body mass index (kg/m²). Data were entered into EpiData version 3.1 and analyzed using STATA version 14.2. A binary logistic regression model was fitted to check the association between independent variables and undernutrition. The level of statistical significance was declared at a p-value less than 0.05.

Results: The overall prevalence of undernutrition among lactating women was 30.7% (95% confidence interval = 26.6, 35.2). Undernutrition was significantly higher among khat chewers, 39.0% (95% confidence interval = 32.8, 45.6) than non-chewers, 22.4% (95% confidence interval = 17.4, 28.4), (χ^2 (degree of freedom) = 14.4231, $p < 0.0001$). Chewing daily (adjusted odds ratio = 3.14, 95% confidence interval = 1.08, 9.15), reducing number of meals after chewing (adjusted odds ratio = 3.45, 95% confidence interval = 1.29, 9.20), and unavailability of latrine (adjusted odds ratio = 2.98, 95% confidence interval = 1.02, 8.75) were significantly associated with undernutrition among khat-chewer lactating women. Furthermore, age at first pregnancy (<18 years) (adjusted odds ratio = 3.17, 95% confidence interval = 1.17, 8.60), not taking any additional meals (adjusted odds ratio = 3.41, 95% confidence interval = 1.08, 10.7), and hand washing after toilet use (adjusted odds ratio = 6.10, 95% confidence interval = 2.51, 14.8) were significantly associated with undernutrition among non-chewer lactating women.

Conclusion: The overall prevalence of undernutrition is higher than previous studies and is alarming among khat-chewer lactating mothers. Thus, nutritional and public health interventions should target khat-chewer lactating mothers particularly focusing on daily chewer either to improve their dietary practice during and after chewing or to stop khat chewing if possible, in order to reduce the effect of khat on food absorption. Besides, improving latrine coverage and use, and prevention of early pregnancy are of paramount importance in reducing undernutrition among lactating mothers.

Keywords

Undernutrition, lactating women, khat chewing, Chiro, eastern Ethiopia

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Introduction

Undernutrition is a state of imbalance between nutrient supply and the body's demand for energy and nutrients.¹ Maternal undernutrition affects the health and well-being of women and their children.^{2,3} Lactating women are among the most vulnerable population group to undernutrition,^{4–8} because lactation puts additional requirements on maternal energy and protein stores than other stages of a woman's reproductive life.⁹

Furthermore, khat-chewer women are among the most vulnerable groups for undernutrition since khat causes loss of appetite, constipation, and increased gastric fullness or delays in gastric emptying.¹⁰ Also, in low-income settings, lactating women are at a higher risk of undernutrition due to social and biological factors such as illiteracy, poverty, and lack of women empowerment.¹¹ Evidences showed that the educational status of the women, age of the women at first pregnancy (<18 years), maternal healthcare, and women's dietary diversity were associated with undernutrition among lactating women.^{12,13}

In Sub-Saharan Africa, undernutrition during lactation is a persistent problem.¹⁴ In Ethiopia, the prevalence of undernutrition among lactating women ranges from 17.4% to 54.7% with a significant geographical variation.^{15,16} Evidences indicated that the prevalence of undernutrition is higher (54.7%) in areas where khat production and chewing are common¹⁶ than in those areas where it is not common (20.5%).¹⁷ In Bahir Dar and Addis Ababa cities of Ethiopia, 20% and 21.5% of the khat chewers were reported to have underweight, respectively.^{18,19}

Nowadays, khat chewing seemed to be the most commonly practiced and is a problem in East Africa especially in Ethiopia, Somali, Djibouti, and Southern Arab.²⁰ Studies among Yemeni women revealed that the prevalence of khat chewing was 30%.²¹ In Ethiopia, chewing khat is a popular habit in all segments of the Hararghe people. According to the Ethiopian Demographic and Health Survey (EDHS) 2011 report, women aged 15–49 years who ever chewed khat ranged from 1% to 39% (nationally 11%), in Harari region (39%), Dire Dawa city administration (27%), and Oromia region (20%).²² Similarly, a study conducted in the rural Haramaya district, eastern Ethiopia showed that 35% of pregnant women chewed khat daily.²³

To address the nutritional problems of pregnant and lactating women, the Ethiopian government set a target strategic objective by the year 2020 under National Nutrition Program II (NNP-II) to reduce the proportion of undernutrition in women of reproductive age from 27% to 16%.²⁴ through interventions such as micro-nutrients supplementation, nutrition education, community-based nutrition, and nutritional screenings of pregnant and lactating women by engaging health extension workers.

Moreover, to alleviate undernutrition, the government of Ethiopia has tried to capacitate the health extension workers and all other health workers by providing in-service

trainings. However, undernutrition remains the major public health concern of lactating women. A few cross-sectional studies reported the factors associated with undernutrition among lactating mothers in Ethiopia. Most importantly, less is known to what extent khat chewing affects the nutritional status of lactating mothers compared to non-chewer, and there is no study conducted to assess the added risk of khat chewing on malnutrition in a community where khat cultivation and chewing are deeply rooted in the culture and tradition of communities. Thus, this study assessed the prevalence of undernutrition comparing khat-chewer and non-chewer lactating mothers in Chiro district, eastern Ethiopia. Understanding the difference in the prevalence of malnutrition among khat-chewer and non-khat-chewer lactating mothers in a local context (in a community where khat chewing is prominent) is vital to identify priority groups and recommend necessary interventions.

Methods and materials

Study setting

The study was conducted in Chiro district, west Hararghe zone, Oromia regional state, eastern Ethiopia. The district has rural (Chiro woreda) and urban (Chiro town) administrative unit, and it is located at 326 km to the east of Addis Ababa, the capital of Ethiopia. According to data from Chiro woreda and town administration offices, Chiro woreda has 39 kebeles (the lowest administrative units in Ethiopia), with an estimated population of 236,091. The number of lactating mothers who have children 6–23 months of age was estimated to be 10,152. Chiro town has three kebeles with an estimated population of 57,873 of which about 4.3% (2,488) were lactating mothers who have children 6–23 months of age.

Chiro town has one public hospital, one health center, three health posts, three non-governmental organization (NGO) clinics, and six private clinics. There were seven health centers, thirty-nine health posts, and five private clinics providing health services in the Chiro woreda. In the district, khat is a dominant cash crop produced widely with Sorghum and Maize mixed farms.

Study design and period

The community-based comparative cross-sectional study was conducted from 7 to 30 June 2020 to compare the prevalence of malnutrition among khat-chewer and non-khat-chewer lactating mothers.

Population

All lactating mothers who were residents of Chiro district and have children between 6 and 23 months of age during the study period were considered as the source population, and randomly selected khat-chewer and non-chewer lactating mothers who have children between 6 and 23 months of age

in the selected kebeles of the Chiro district were the study population.

Inclusion and exclusion criteria

All lactating mothers who have children 6–23 months of age and who were permanent residents (lived in the selected kebeles at least for 6 months) were included whereas lactating mothers who were seriously ill and unable to respond for the interview and/or for physical measurement, who have physical deformities due to congenital, developmental, and acquired causes and experienced muscle weakness, difficulty of walking, lack of muscle control, problems with coordination, involuntary movements, restriction in joint motion, lost extremities, and problem with body shape like paraplegia, quadriplegia, amputation, distal deformity, and kyphosis were excluded. We also excluded those who were reported to have pregnancy during data collection period.

Sample size and sampling procedure

The sample size for this study was calculated by considering factors associated with undernutrition among lactating women using EpiInfo version 7 with the following assumptions: two-sided confidence level of 95%, power of 80%, and using a family size ($p_1 = 27.7\%$ and $p_2 = 11.3\%$) from a previous study,¹⁷ and the maximum sample size, $n = 206$ was obtained. Then, by adding 10% for non-response and using a design effect of 2, the final sample size obtained was 454 (227 for khat chewers and 227 for non-khat chewers).

A multistage stratified sampling technique was used to identify study participants. First, the district was stratified into urban (Chiro town) and rural (Chiro woreda) administrations. Then, one kebele from the urban stratum and five rural kebeles from the rural stratum were randomly selected by lottery method. Second, households with khat-chewer and non-chewer lactating mothers were identified and listed separately in each selected kebele through house-to-house census with the assistance of health extension workers. A sampling frame was prepared by registering all the identified eligible khat-chewer and non-chewer lactating mothers in each selected kebele. After that, the number of khat-chewer and non-chewer lactating mothers to be selected was proportionally allocated to each kebele based on the size of their respective study population. Finally, a simple random sampling technique was employed to select the required number of khat-chewer and non-chewer lactating mothers. If the eligible lactating mother is not available at the time of data collection, a revisit was done a minimum of three times.

Data collection tool and procedures

A pre-tested and structured questionnaire adapted from the relevant literature^{13,25} was used to collect data on socio-demographic characteristics, health service-related

conditions, feeding practices, and khat-chewing habits. The questionnaire was first prepared in English and then translated into the local language—*Afaan Oromoo* by a language expert and translated back to English by another language expert to check for its consistency.

The dietary diversity practice of participants was assessed using the qualitative tool of the Food and Agricultural Organization (FAO) for 24-h dietary recall. The individual dietary diversity score (DDS) of women was then calculated by summing up the food items into nine food groups and classified as low (1–3 food groups), medium (4–6 food groups), and high (>6 food groups).²⁶ This tool has been previously used in similar settings in Ethiopia.^{13,27} Data about household food insecurity were collected using a household food insecurity access scale (HFIAS) to measure the degree of food insecurity (access) across households in the past 4 weeks. The HFIAS questionnaire contained nine questions that assess the occurrence of food insecurity on an increasing level. Under each of the nine questions, there is a follow-up the frequency of occurrence questions to determine how often the conditions (1=rarely, 2=sometimes, 3=often) occurred. Then, households were categorized into four levels of household food insecurity (access) food secure, mild, moderately, and severely food insecure.²⁸ Households who did not experience any of the food insecurity (access) conditions or just experienced worry, but rarely in the past 4 weeks were considered as food secure while those with inability to access sufficient food at all times to lead an active and healthy life (includes all stages of food insecurity: mild, moderate, and severe) were considered as food insecure households. Mildly food insecure households were those who worried about not having enough food sometimes or often, and/or are unable to eat preferred foods, and/or eat a more monotonous diet than desired and/or some foods considered undesirable, but only rarely. Moderately food insecure households were who sacrifice quality more frequently by eating a monotonous diet or undesirable foods sometimes or often, and/or have started to cut back on quantity by reducing the size of meals or the number of meals, rarely or sometimes but, did not experience any of the three most severe conditions. Severely food insecure households were those who have graduated to cutting back on meal size or a number of meals often, and/or experienced any of the three most severe conditions (running out of food, going to bed hungry, or going a whole day and night without eating), even as infrequently as rarely.²⁸ This tool was previously validated for use in Ethiopia.²⁹

Principal component analysis (PCA) was used to compute wealth index was using STATA version 14.2. Accordingly, variables were identified based on the composite indicator of household living standards considering the ownership of 22 household assets and conditions (factors) including domestic animals (cattle, sheep, goat, hen, horse/donkey/mules) and durable assets (radio, watch/clock, mobile phone solar, table, chair, bed, own living house, own agricultural land, own

income, bee hive and housing characteristics (water source, type of floor, type of wall, type of roof separate kitchen, separate rooms for cattle, and fuel for cooking)). Then, eigenvalue, proportion, and eigenvectors were used to check for variation in the total data explained (factors that were successively extracted), percentage of total variance explained, and to display weights of variables, respectively. Finally, wealth tercile was performed and categorized as a rich, medium, and poor.³⁰

To determine the outcome variable, undernutrition, body mass index (BMI) was calculated by measuring the weight and height of the participants. Women's weight was measured while they removed their shoes and with light clothes using a portable digital weight scale and recorded to the nearest 0.1 kg. Height was measured using a wooden height-measuring board with a sliding head bar while women were in an upright position with their shoulder level, hands were at the side and their head, scapula, buttock, calve, and heel were in contact with vertical measuring board and recorded to the nearest 0.1 cm. We took both measurements twice and the average values were used for analysis. BMI of the women was calculated by dividing the weight in kilogram for the squared height in meters. The BMI was classified based on the classification for underweight, normal, overweight, and obese.³¹ However, since the objective of this study was to assess undernutrition, we have categorized the outcome variable as "1" if the lactating mother was undernourished (BMI <18.5 kg/m²) and "0" otherwise. The data were collected by two diploma nurses and six health extension workers by face-to-face interview technique through the home-to-home visit.

Data quality assurance

Two days of training was given to the data collectors about the objectives of the study, data collection tools, procedures of anthropometric measurements, and interview methods. Before commencing the actual data collection, a pretest of the questionnaire was done among 23 lactating women (5% of the sample size) in one kebele not included in the main study, to check the length of time it takes, and wording of the questions and understandability of the language of the questions and necessary modifications were made accordingly.

To reduce anthropometric measurement error, the relative technical error of measurement (% TEM) was done. Portable digital weight scale with a maximum capacity of 150 kg and recorded to the nearest 0.1 kg was used to check for the accuracy of the weighing scale. Besides, data collectors checked and assured the functionality of digital weight scales using known weight every morning before data collection began, and checked that the scale reading is exactly at zero before every weight measurement. The investigators followed the day-to-day activities to make sure the completeness of the questionnaires. Double data entry was done by two data clerks who were blind to the other's entry for consistency checks.

Statistical analysis

The collected data were manually checked for completeness and consistency. Then, entered into EpiData version 3.1 and exported to STATA version 14.2 for cleaning and analysis. The normality of the data was checked using a "swilk" STATA command; mean value and standard deviations were used for normally distributed variables and median and range/interquartile range (IQR) were used otherwise. A binary logistic regression model was fitted to check the association between the endogenous variable (undernutrition) and each exogenous variable. The dependent variable was coded as 1 if the lactating mother was malnourished (BMI <18.5 kg/m²) and 0 if not for both khat chewers and non-chewers. Multi-collinearity was checked and independent variables with standard error (SE) > 2 were removed from the final multivariable logistic regression analysis and those variables that have no collinear effect were included in the binary logistic regression model to check for the possible associations with the outcome variable.

Covariates with a p-value < 0.25 in the bi-variable binary logistic regression were considered as candidates for a multi-variable binary logistic regression to control for potential confounders and to identify factors independently associated with undernutrition. Odds ratio (OR) along with 95% confidence interval (CI) was estimated to measure the strength of the association. Finally, results were presented using frequencies, summary measures, tables, and figures. The fitness of the model was tested by the Hosmer–Lemeshow goodness of fit test. The level of statistical significance was declared at a p-value < 0.05.

Results

Socio-demographic characteristics

In this study, a total of 446 lactating mothers aged 15–49 years (223 khat chewers and 223 non-chewers) participated making a response rate of 98.2%. Half of the respondents, 225 (50.5%) were in the age group of 26–35 years with mean age of 28.3 (standard deviation (SD)= ±6.0) years (khat chewers 29.6 (SD= ±6.1) and non-chewers 27.1 (SD= ±5.7) years). More than 70% of the lactating mothers were 318 (71.3%) rural residents and 347 (77.8%) were Muslim. Of the total, 301 (67.5%) of the lactating mothers had no formal education. Regarding the family wealth index, 81 (36.3%) and 69 (30.9%) of the khat-chewer and non-chewer households were in the poor wealth tercile, respectively (Table 1).

Maternal healthcare service utilization

The mean age of lactating mothers at first pregnancy was 18.0 (SD= ±2.9) years (khat chewers 17.6 (SD= ±3.1) vs non-chewers 18.4 (SD= ±2.8) years) and the minimum age was 15 years. Of the total, 175 (39%) of women have already

Table 1. Socio-demographic characteristics of lactating women in Chiro district, west Hararghe, eastern Ethiopia, 7–30 June 2020 (n=446).

Variables	Category	Khat-chewer (n=223)	Non-chewer (n=223)	Total (n=446)
Age groups, in years	15–25	62 (27.8)	99 (44.4)	161 (36.1)
	26–35	121 (54.3)	104 (46.6)	225 (50.5)
	36–49	40 (17.9)	20 (9.0)	60 (13.5)
Place of residence	Urban	47 (21.1)	81 (36.3)	128 (28.7)
	Rural	176 (79.0)	142 (63.7)	318 (71.3)
Religion	Christian	38 (17.0)	61 (27.4)	99 (22.2)
	Muslim	185 (83.0)	162 (72.6)	347 (77.8)
Marital status	Married	209 (93.7)	212 (95.1)	421 (94.4)
	Divorced or widowed	14 (6.3)	11 (4.9)	25 (5.6)
Educational status of women	No formal education	160 (71.7)	141 (63.2)	301 (67.5)
	Primary school	34 (15.3)	32 (14.5)	66 (14.8)
	Secondary school	14 (6.3)	19 (8.5)	33 (7.4)
	College and above	15 (6.7)	31 (13.9)	46 (10.3)
Educational status of the partner	No formal education	111 (53.4)	99 (46.5)	210 (49.9)
	Primary school	43 (20.7)	51 (23.9)	94 (22.3)
	Secondary school	32 (15.4)	23 (10.8)	55 (13.1)
	College and above	22 (10.6)	40 (18.8)	62 (14.7)
Mothers' occupation	Farmer	54 (24.2)	49 (22.0)	103 (23.1)
	Housewife	81 (36.3)	94 (42.2)	175 (39.2)
	Merchant	70 (31.4)	49 (22.0)	119 (26.7)
	Government employee	11 (4.9)	29 (13.0)	40 (9.0)
	Others ^a	7 (3.1)	2 (0.9)	9 (2.0)
Partner occupation	Farmer	141 (67.5)	128 (60.4)	269 (63.9)
	Merchant	27 (12.9)	28 (13.2)	55 (13.1)
	Daily laborer	18 (8.6)	14 (6.6)	32 (7.6)
	Government employee	21 (10.1)	37 (17.5)	58 (13.8)
	Others ^b	2 (1.0)	5 (2.4)	7 (1.7)
Family size	1–3	32 (14.4)	51 (22.9)	83 (18.6)
	4–6	107 (48.0)	124 (55.6)	231 (51.8)
	≥7	84 (37.7)	48 (21.5)	132 (29.6)
Age of child being breastfed, in months	6–11	49 (22.0)	71 (31.8)	120 (26.9)
	12–24	174 (78.0)	152 (68.2)	326 (73.1)
Sex of child being breastfed	Male	131 (58.7)	115 (51.6)	246 (55.2)
	Female	92 (41.3)	108 (48.4)	200 (44.8)
Household wealth index	Rich	61 (27.4)	86 (38.5)	147 (33.0)
	Medium	81 (36.3)	68 (30.5)	149 (33.4)
	Poor	81 (36.3)	69 (30.9)	150 (33.6)

^aDaily laborer and private work.

^bDriver and guard.

experienced one to two pregnancies. The average number of pregnancies with standard deviation was 4 (SD=±2.1) and 3.1 (SD=±1.9) among khat chewers and non-chewers, respectively. More than one-third, 82 (36.8%) of the khat chewers and one-fifth, 48 (21.5%) of non-chewers gave more than four live births. Nearly three-fifth, 264 (59.2%) lactating mothers spaced their children at least 3 years from the last delivery.

In this study, 345 (77.2%) of the lactating mothers had at least one antenatal care (ANC) checkup during their last pregnancy, but only 21 (9.4%) of khat chewers and 29 (13%) non-chewers got fourth visits of ANC. More than half, 124

(55.6%) of khat chewer and two-fifth, 89 (39.9%) of non-chewer lactating mothers delivered their last child at home. The difference between khat-chewers and non-khat chewers on the place of delivery was statistically significant (χ^2 (degrees of freedom (df))=11.01 (1), $p=0.001$). More than three-fourths, 340 (76.2%) of mothers did not attend postnatal care (PNC) follow-up after delivery of their index child. About 119 (53.4%) of khat-chewer and 149 (66.8%) of non-chewer lactating mothers did not attend the monthly nutritional screening. The difference between khat chewers and non-khat chewers was statistically significant for monthly nutritional screening (χ^2 (df)=8.41 (1), $p=0.004$). Only 7%

Table 2. Healthcare service utilization by lactating women in Chiro district, west Hararghe, eastern Ethiopia, 7–30 June 2020 (n = 446).

Variables	Category	Khat chewers (n = 223)	Non-chewers (n = 223)	χ^2 (df)	p-value
Number of pregnancies	≤2	65 (29.2)	110 (49.3)	23.35 (3)	0.000
	3–4	69 (30.9)	64 (28.7)		
	5–6	58 (26.0)	32 (14.4)		
	>6	31 (13.9)	17 (7.6)		
Number of live births	<4	141 (63.2)	175 (78.5)	12.55 (1)	0.000
	>4	82 (36.8)	48 (21.5)		
Age at first pregnancy, in years	<18	136 (61.0)	92 (41.3)	17.37 (1)	0.000
	≥18	87 (39.0)	131 (58.7)		
ANC visits attended	No visit	51 (22.9)	50 (22.4)	1.46 (2)	0.483
	<4	151 (67.7)	144 (64.6)		
	≥4	21 (9.4)	29 (13.0)		
Place of delivery	Home	124 (55.6)	89 (39.9)	11.01 (1)	0.001
	Health facility	99 (44.4)	134 (60.1)		
Mode of delivery	Vaginal (normal)	206 (92.4)	193 (86.6)	5.11 (2)	0.078
	Caesarian section	9 (4.0)	11 (4.9)		
	Episiotomy	8 (3.6)	19 (8.5)		
PNC attended for the index child	Yes	46 (20.6)	59 (26.5)	3.03 (1)	0.219
	No	176 (78.9)	164 (73.5)		
Birth interval for the index child	First birth	30 (13.5)	48 (21.5)	7.27 (2)	0.026
	1–2 years	61 (27.4)	43 (19.3)		
	>2 years	132 (59.2)	132 (59.2)		
Mothers screened for wasting	Yes	104 (46.6)	74 (33.2)	8.41 (1)	0.004
	No	119 (53.4)	149 (66.8)		
History of illness in the past 2 weeks	Yes	14 (6.3)	17 (7.6)	0.31 (1)	0.576
	No	209 (93.7)	206 (92.4)		
Type of illness (disease)	Diarrhea	3 (21.4)	7 (41.2)	3.83 (3)	0.280
	URTI	6 (42.9)	3 (17.7)		
	UTI	2 (14.3)	5 (29.4)		
	Others ^a	3 (21.4)	2 (11.8)		

ANC: antenatal care; PNC: postnatal care; URTI: upper respiratory tract infection; UTI: urinary tract infection.

^aTuberculosis and typhoid fever.

Table 3. Environmental health-related conditions of lactating women in Chiro district, west Hararghe, eastern Ethiopia, 7–30 June 2020 (n = 446).

Variables	Category	Khat chewers (n = 223)	Non-chewers (n = 223)	Total (n = 446)
Household water source	Improved	118 (52.9)	140 (62.8)	258 (57.8)
	Non-improved	105 (47.1)	83 (37.2)	188 (42.2)
Latrine availability	Yes	157 (70.4)	172 (77.1)	329 (73.8)
	No	66 (29.6)	51 (22.9)	117 (26.2)
Hand washing practice after toilet	Yes	142 (63.7)	144 (64.6)	286 (64.1)
	No	81 (36.3)	79 (35.4)	160 (35.9)
Hand washing before food preparation	Yes	189 (84.7)	192 (86.1)	381 (85.4)
	No	34 (15.3)	31 (14.0)	65 (14.6)
A solid waste disposal site	Open field	86 (38.6)	78 (35.0)	164 (36.8)
	In the garden	41 (18.4)	43 (19.3)	84 (18.8)
	In pit	96 (43.0)	102 (45.7)	198 (44.4)

of lactating mothers experienced illness in the past 2 weeks preceding the study (Table 2).

Environmental factors

More than half, 118 (52.9%) of khat chewers and 140 (62.8%) non-chewer lactating women were from households

with access to improved sources of drinking water. In addition, 157 (70.4%) and 172 (77.1%) of households of khat chewers and non-chewer lactating women had a latrine, respectively. Almost two-thirds, 286 (64.1%) of lactating women reported washing their hands after toilet use. Regarding solid waste disposal, 198 (44.4%) of respondents disposed their solid wastes in the pit (Table 3).

Table 4. Nutrition information and feeding practices of lactating women in Chiro district, west Hararghe, eastern Ethiopia, 7–30 June 2020 (n = 446).

Variables	Category	Khat chewer (n = 223)	Non-chewer (n = 223)	χ^2 (df)	p-value
Have nutrition information/education	Yes	119 (53.4)	130 (58.3)	1.10 (1)	0.294
	No	104 (46.6)	93 (41.7)		
Sources of the nutrition information	Health workers	89 (74.8)	88 (67.7)	1.52 (1)	0.217
	Media	30 (25.2)	42 (32.3)		
Avoiding food during lactation	Yes	8 (3.6)	7 (3.1)	0.07 (1)	0.793
	No	215 (96.4)	216 (96.9)		
Taking additional meal during lactation	Yes	41 (18.4)	93 (41.7)	28.85 (1)	0.000
	No	182 (81.6)	130 (58.3)		
Frequency of meals per day	2 times	91 (40.8)	54 (24.2)	13.99 (1)	0.000
	≥ 3 times	132 (59.2)	169 (75.8)		

Table 5. Khat-chewing frequency and feeding practices of khat-chewer lactating women in Chiro district, west Hararghe, eastern Ethiopia, 7–30 June 2020 (n = 223).

Variables	Category	Frequency (n)	Percent (%)
Khat chewing frequency per week	<3 days	40	17.9
	3–6 days	40	17.9
	Daily	143	64.1
Smoke shisha while chewing khat	Yes	4	1.8
	No	219	98.2
Drinking alcohol before or after chewing khat	Yes	5	2.2
	No	218	97.8
Feeding habit after chewing khat	As usual	70	31.4
	Reduced meal size	103	46.2
	Reduced meal frequency	50	22.4

Maternal feeding and related characteristics

Among 446 lactating mothers, 249 (55.8%) of them reported that they got information about good feeding practices during lactation of which 177 (71.1%) of mothers got information from healthcare workers. The majority, 431 (96.6%) did not avoid any food type due to cultural norms or traditional reasons. However, the practice of taking additional meals during lactation among non-chewers, 93 (41.7%) was significantly higher (χ^2 (df)=28.85 (1), $p < 0.001$) compared to the practice of khat chewers, 41 (18.4%). Almost three-fifths, 132 (59.2%) of khat chewers and three-fourths 169 (75.8%) of non-chewer lactating women had three or more meals per day and the difference was statistically significant (χ^2 (df)=13.99 (1), $p < 0.001$) (Table 4).

Almost all, 218 (97.8%) of khat-chewer lactating women did not use alcohol. Nearly two-thirds, 143 (64.1%) of khat chewers reported they chewed khat daily, and only 4 (1.8%) of them smoked shisha during khat chewing. Meal frequency and meal size of khat-chewer women were reduced after chewing khat among 50 (22.4%) and 103 (46.2%) of participants, respectively (Table 5).

Dietary diversity and household food security

Results from 24-h dietary intake showed that 49 (11%), 150 (33.6%), and 247 (55.4%) of lactating women had high, medium, and low dietary diversity (Table 6). Furthermore, 132 (59.2%) of khat chewers had low dietary diversity as compared to 115 (51.6%) of non-chewers. The difference in dietary diversity was statistically significant (χ^2 (df)=2.66 (2), $p=0.264$). The mean DDS of the participant was 3.7 (SD= ± 1.4) (3.6 (SD= ± 1.4) among khat chewers vs 3.8 (SD= ± 1.3) among non-khat chewers). The difference in mean DDS was statistically insignificant ($t=-0.14$, $p=0.139$) (Table 6). Only one out of ten lactating mothers consumed at least six food groups. Starchy staples, other fruit and vegetables, and legumes were the most commonly consumed food groups, whereas a few participants consumed animal-based food products such as milk, egg, and meats (Figure 1).

Regarding household food security status, a greater proportion of households (68.8%) were food insecure. As such, 17 (7.6%), 122 (54.7%), and 31 (13.9%) khat chewers were mildly, moderately, and severely food insecure, respectively, whereas 21 (9.4%), 93 (41.7%), and 23 (10.3%) non-chewers were mildly, moderately, and severely food insecure, respectively. Food insecurity was significantly higher among khat

Table 6. Household food security and dietary diversity score of lactating mother in Chiro district, west Hararghe, eastern Ethiopia, June 7–30, 2020 (n=446).

Variables	Khat chewer (n=223) Frequency (%)	Non-khat chewer (n=223) Frequency (%)	χ^2 (df)	p-value
Household food security				
Food secure	53 (23.8)	86 (38.6)	13.35 (3)	0.004
Mildly insecure	17 (7.6)	21 (9.4)		
Moderately insecure	122 (54.7)	93 (41.7)		
Severely insecure	31 (13.9)	23 (10.3)		
Women dietary diversity score				
High DD (>5)	23 (10.3)	26 (11.7)	2.66 (2)	0.264
Medium DD (4–5)	68 (30.5)	82 (36.8)		
Low DD (<4)	132 (59.2)	115 (51.6)		

DD: dietary diversity.

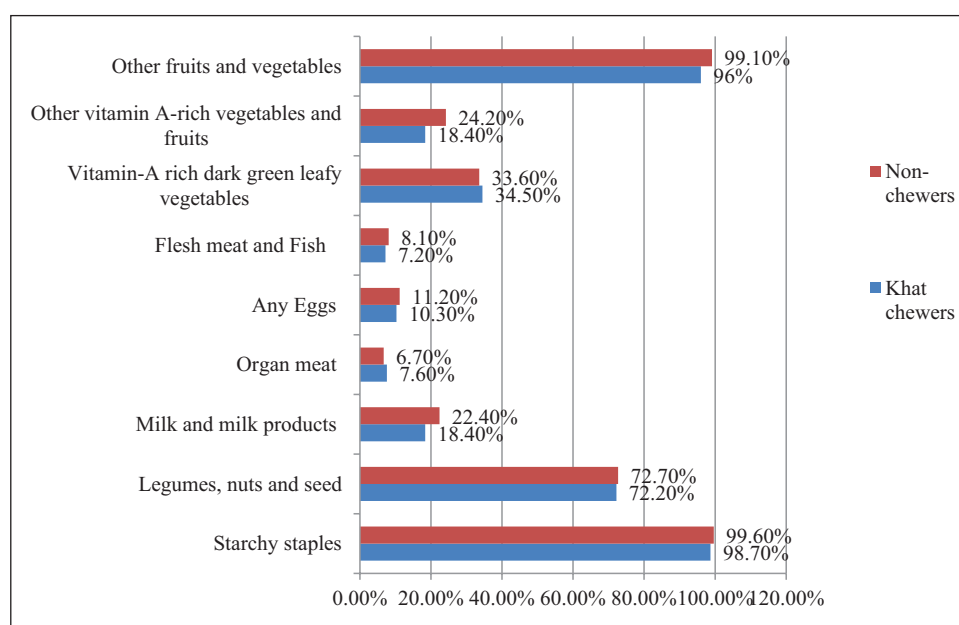


Figure 1. Food groups consumed in the past 24 h by lactating mothers in Chiro district, west Hararghe, eastern Ethiopia, 7–30 June 2020 (n=446).

chewers, 170 (76.2%) than non-chewers, 137 (61.4%) (χ^2 (df)=11.38 (3), p=0.001) (Table 6).

Prevalence of undernutrition

A total of 137 (30.7%) (95% CI=26.6, 35.2) lactating women were undernourished. The prevalence of undernutrition was significantly higher among khat chewers, 39.0% (95% CI=32.8, 45.6) than non-chewer lactating women, 22.4% (95% CI=17.4, 28.4) and the difference is statistically significant ($\chi^2=14.42$ (1), p<0.001). The mean BMI of khat-chewer and non-chewer lactating women was 20.3 kg/m² (SD=±3.1) and 21.0 kg/m² (SD=±3.0), respectively (Figure 2).

Factors associated with undernutrition

Bi-variable and multivariable binary logistic regression analyses were run to identify factors associated with undernutrition among khat-chewer and non-khat-chewer lactating mothers. Accordingly, place of residence, partner educational status, household wealth index, age at first pregnancy, birth interval, household water source, latrine availability, hand washing after toilet use, taking an additional meal during lactation were fulfilled p-value<0.25 among non-chewer lactating mothers, and place of residence, household wealth index, place of delivery, the birth interval for the index child, latrine availability, hand washing after toilet use, frequency of khat chewing, and feeding habit after khat chewing were variables that fulfilled p-value<0.25 among

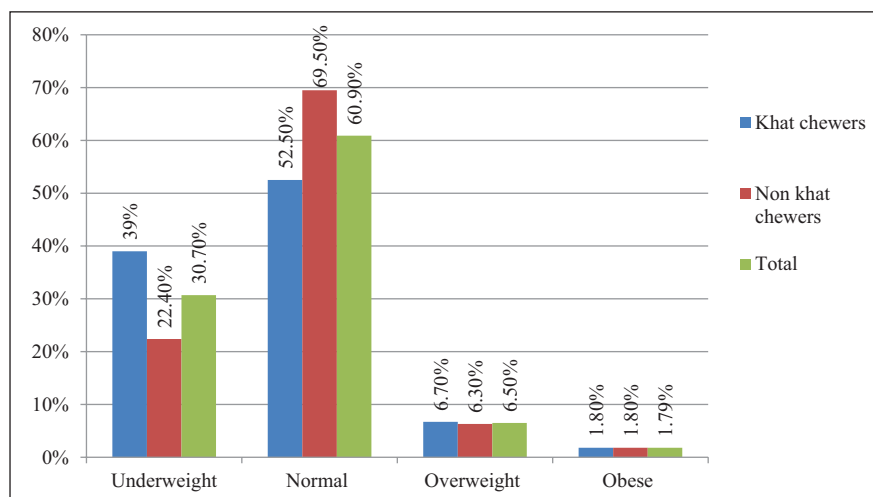


Figure 2. Nutritional status of khat-chewer and non-chewer lactating mother in Chiro district, west Hararghe, eastern Ethiopia, 7–30 June 2020 (n = 446).

khat-chewer lactating mothers and considered for multivariate binary logistic regression.

In the multivariable binary logistic regression, frequency of khat chewing, feeding habit after khat chewing, and latrine availability were factors significantly associated with undernutrition among khat-chewer lactating women. However, age at first pregnancy, taking additional meals during lactation, and hand washing after toilet use were factors significantly associated with undernutrition among non-chewer lactating women.

Lactating women who chewed khat daily were nearly three times more likely to be undernourished than those who chewed less than three days per week (adjusted odds ratio (AOR) = 3.14, 95% CI = 1.08, 9.15). The odds of being undernourished for khat-chewer lactating women who had reduced meal frequency were 3.45 times higher than those who ate as usual (AOR = 3.45, 95% CI = 1.29, 9.20). The odds of being undernourished among chewer lactating women with no latrine were three times higher as compared to those households who had latrine (AOR = 2.98, 95% CI = 1.02, 8.75) (Table 7).

However, non-chewer lactating women whose age at first pregnancy was < 18 years old were three times more likely to be undernourished than women whose age at first pregnancy was ≥ 18 years (AOR = 3.17, 95% CI = 1.17, 8.60). Those non-chewer lactating women who did not take any additional meal during lactation were 3.41 times more likely to be undernourished than those who took additional meals (AOR = 3.41, 95% CI = 1.08, 10.7). The odds of undernutrition among non-chewer lactating mothers who did not wash their hands after toilet use were six times higher than those who wash their hands after toilet use (AOR = 6.10, 95% CI = 2.51, 14.8) (Table 8).

Discussion

This study was aimed to compare the prevalence of undernutrition among khat-chewer and non-chewer lactating women

and to identify factors associated with undernutrition in the study area. We found that the overall prevalence of undernutrition among lactating mothers was 30.7%. Undernutrition was significantly higher among khat chewers than non-chewer lactating women. Frequency of khat chewing, feeding habit after khat chewing, and latrine availability were associated with undernutrition among khat-chewer lactating women whereas age at first pregnancy, taking an additional meal during lactation, and hand washing after toilet use were significantly associated with undernutrition among non-chewer lactating women.

The overall prevalence of undernutrition among lactating mothers in this study was consistent with the finding from Samre woreda southeastern zone of Tigray region (31%) and Addis Ababa (27.1%), Ethiopia.^{7,32} But, it is lower than the finding from Dedo and Seqa Chekorsa districts in south-west Ethiopia (41%)³³ and Babile woreda in eastern Ethiopia (41.7%–54.7%).¹⁶ This could be due to differences in study season and approaches. For instance, the Babile study was a longitudinal study and compared undernutrition during the post-harvest season (41.7%) and pre-harvest season (54.7%). In disparity, it was higher than studies conducted in Womberma district (25.6%), Ambo district (21.5%), Offa woreda in Wolayita zone (15.8%), and Kolkata, India (24.8%).^{13,34–36} These discrepancies might be due to differences in socio-demographic characteristics (study in Ambo was only for rural women) and poor feeding practices in the current study participants due to lack of taking extra meals during lactation period, prominent use of khat, and lower intake of animal source foods.³⁷ Besides, difference in feeding culture and the study time or period in which the current study was conducted during the recurrent food insecurity period.

The current study revealed that the prevalence of undernutrition among khat chewers was significantly higher compared to their counterparts. This finding was in line with

Table 7. Factors associated with undernutrition among khat-chewer lactating mothers in Chiro district, west Hararghe, eastern Ethiopia, 7–30 June 2020 (n = 446).

Variables	Category	Undernutrition		COR (95% CI)	AOR (95% CI)
		Yes (n = 87)	No (n = 136)		
		n (%)	n (%)		
Place of residence	Urban	10 (21.3)	37 (78.7)	1	1
	Rural	77 (43.8)	99 (56.2)	2.88 (1.35, 6.15)	0.99 (0.26, 3.77)
Household wealth index	Poor	40 (49.4)	41 (50.6)	2.53 (1.24, 5.13)	0.99 (0.34, 2.91)
	Medium	30 (37.0)	51 (63.0)	1.52 (0.74, 3.12)	0.64 (0.23, 1.77)
	Rich	17 (27.9)	44 (72.1)	1	1
Place of delivery	Home	58 (46.8)	66 (53.2)	2.12 (1.21, 3.70)	1.55 (0.74, 3.23)
	Health facility	29 (29.3)	70 (70.7)	1	1
Birth interval for the index child	First birth	10 (33.3)	20 (66.7)	0.97 (0.42, 2.24)	1.87 (0.48, 7.21)
	1–2 years	32 (52.5)	29 (47.5)	2.13 (1.15, 3.96)	1.87 (0.87, 4.02)
	>2 years	45 (34.1)	87 (65.9)	1	1
Latrine availability	Yes	50 (31.9)	107 (68.1)	1	1
	No	37 (56.1)	29 (43.9)	2.73 (1.51, 4.93)	2.98 (1.02, 8.75)*
Hand washing after toilet use	Yes	46 (33.1)	93 (66.9)	1	1
	No	41 (48.8)	43 (51.2)	1.93 (1.11, 3.36)	0.61 (0.22, 1.72)
Frequency of khat chewing (per week)	<3 days	7 (17.5)	33 (82.5)	1	1
	3–6 days	12 (30.0)	28 (70.0)	2.02 (0.70, 5.83)	1.85 (0.55, 6.24)
	Daily	68 (47.6)	75 (52.4)	4.27 (1.77, 10.29)	3.14 (1.08, 9.15)*
Feeding habit after khat chewing	As usual	16 (22.9)	54 (77.1)	1	1
	Reduced meal size	44 (42.7)	59 (57.3)	2.52 (1.27, 4.97)	2.16 (0.97, 4.80)
	Reduced number of meal	27 (54.0)	23 (46.0)	3.96 (1.80, 8.71)	3.45 (1.29, 9.20)*

CI: confidence interval; COR: crude odds ratio; AOR: adjusted odds ratio.

*p-value < 0.05; 1: reference category.

Table 8. Factors associated with undernutrition among non-chewer lactating mothers in Chiro district, west Hararghe, eastern Ethiopia, 7–30 June, 2020 (n = 446).

Variables	Category	Undernutrition		COR (95% CI)	AOR (95% CI)
		Yes (n = 50)	No (n = 173)		
		n (%)	n (%)		
Place of residence	Urban	10 (12.4)	71 (87.6)	1	1
	Rural	40 (28.2)	102 (71.8)	2.78 (1.31, 5.93)	1.90 (0.44, 8.17)
Partner's educational status	No formal education	28 (28)	72 (72)	4.10 (1.78, 9.45)	1.55 (0.57, 4.24)
	Primary	12 (22.6)	41 (77.4)	3.81 (1.56, 9.30)	0.21 (0.03, 1.61)
	Secondary	6 (20)	24 (80)	4.10 (1.63, 10.3)	1.01 (0.25, 5.20)
	College and above	4 (10)	36 (90)	1	1
Household wealth index	Poor	19 (27.5)	50 (72.5)	3.25 (1.36, 7.75)	0.75 (0.15, 3.60)
	Medium	22 (32.4)	46 (67.6)	4.09 (1.74, 9.64)	1.47 (0.37, 5.82)
	Rich	9 (10.5)	77 (89.5)	1	1
Age at first pregnancy, in years	<18	33 (35.9)	59 (64.1)	3.75 (1.93, 7.29)	3.17 (1.17, 8.60)*
	≥18	17 (13.0)	114 (87.0)	1	1
Birth interval for the index child	First birth	16 (33.3)	32 (66.7)	2.14 (1.02, 4.49)	29.9 (2.15, 414)
	1–2 years	9 (20.9)	34 (79.1)	1.13 (0.48, 2.66)	1.59 (0.50, 5.06)
	>2 years	25 (18.9)	107 (81.1)	1	1
Household water source	Improved	24 (17.1)	116 (82.9)	1	1
	Not improved	26 (31.3)	57 (68.7)	2.20 (1.16, 4.18)	0.96 (0.34, 2.66)
Hand washing after toilet use	Yes	17 (12.1)	123 (87.9)	1	1
	No	33 (39.8)	50 (60.2)	4.78 (2.44, 9.34)	6.10 (2.51, 14.8)*
Taking additional meal during lactation	Yes	9 (9.9)	84 (90.3)	1	1
	No	41 (31.5)	89 (68.5)	4.30 (1.97, 9.39)	3.41 (1.08, 10.7)*

CI: confidence interval; COR: crude odds ratio; AOR: adjusted odds ratio.

*p-value < 0.05; 1: reference category.

studies from Addis Ababa among khat-chewer adults.¹⁹ This might be because khat contains the active ingredient, cathinone (β -keto amphetamine) which possesses amphetamine-like euphoriant effects and suppresses appetite (anorexiant) and could contribute to undernutrition.²⁰ It was previously reported that delay in gastric emptying or delay in intestinal absorption contributes to malnutrition among the khat users.¹⁰ Moreover, among khat chewers, daily chewing was three times more likely to be undernourished than those who chewed less than three days per week. Frequent khat use was associated with various health effects, including esophagitis, gastritis, duodenal ulcer, loss of appetite (restrictive dietary behavior), constipation, sleeping disturbance, and mania which might have a direct or indirect effect on the occurrence of undernutrition.^{23,38}

Concerning feeding practice after chewing khat, mothers who got a reduced number of meals were 3.5 times more likely to be undernourished as compared to those who were taking meals as usual. This was comparable with the study conducted in Addis Ababa.¹⁹ This could be due to increased nutritional requirements during lactation and the decrement of nutritional intake because of the effects amphetamine found in khat. Physiologically explained, amphetamine suppresses appetite by increasing the synaptic availabilities of norepinephrine and dopamine in the hypothalamus, and subsequently activates the norepinephrine and dopamine-dependent mechanisms that attenuate the central nervous system control of food intake. In addition to the catecholamine effects, the interaction between hypothalamic dopamine and neuropeptide, an orexigenic neuropeptide, plays a key role in the anorectic effect of amphetamine. Amphetamine also induces hypothalamic Neuropeptide Y neurons which reduces the expression of Neuropeptide Y at both transcriptional and post-translational levels.³⁹ Moreover, low awareness of the harmful effects of khat use on the nutritional status might be the other possible reason.

Taking at least two additional meals (550kcal) per day during lactation is recommended for all lactating women to compensate for the cost of energy due to lactation.⁴⁰ This study has shown that non-chewer lactating women who did not take any additional meal were 3.41 times more likely to be undernourished than their counterparts. A similar finding was reported from the study conducted in Raya district, Alamata, southern Tigray.⁴¹ The reason behind this might be women with less number of meals may not get adequate nutrients in their diets that meet the increased nutrient requirements during lactation which in turn results in undernutrition due to nutrient depletion.

In this study, women's dietary diversity was much below the recommended level for lactating mothers. Data on food consumption showed that cereals, legumes, and other vegetables were the main food groups commonly consumed but animal products, organ meat, eggs, fruits, and vegetables were less frequently consumed. This result is concordant with previous studies in Anlemo woreda, Hadiya zone, and rural Tigray.^{25,42} This might be related to a lack of awareness

about the importance of dietary variety and also the availability and accessibility of those food groups in the market places in the study area.

Non-chewer lactating women whose age at first pregnancy <18 years were 3.2 times more likely to be undernourished than their counterparts. This finding was comparable with a study in Womberma district³⁴ and Gog district.¹² This might be because younger mothers will face double burdens to meet the increased nutritional demand for their immature anatomical and physiological conditions as well as for their child.⁴³ Another possible reason could also be giving less attention to adolescents' nutrition, early marriage, preconception nutritional screening, and counseling by the government as well as other non-governmental organizations in the study area which increased the risk of undernutrition.

In this study, the absence of latrine and poor hand washing practice were also factors associated with undernutrition. The odds of being undernourished among khat-chewer lactating women from households with no latrine were three times higher compared to those from households with latrine. This is supported by a study conducted in Southern Ethiopia.⁴⁴ However, the odds of undernutrition among non-chewer lactating women who had poor hand washing practice after toilet use was six times higher than their counterparts. This finding is comparable with the study conducted in the Adama district.⁴⁵ The reason might be because poor hygiene and sanitation practice results in an increased risk of infection, which results in undernutrition by decreasing food intake, alteration of absorption, and metabolism.

Strength of the study

Major strengths of this study were being a community-based for generalizability and being the first study in Ethiopia, which assessed the association of khat chewing and undernutrition in lactating mothers.

Limitations of the study

This study has got some limitations: recall bias might have occurred since some of the questions were about the past event which needs a recall. This was minimized by probing respondents to memorize the events. The use of nine food groups using the guideline of 2011 to assess the DDS might affect the comparability, measurability, and the quality of data. Also, women could hide or under-report their actual feeding practices or khat-chewing habits. In addition, the type and amount (in grams) of khat chewed per day were not measured. Finally, we have excluded participants with reported pregnancy without doing pregnancy test.

Conclusion

This study has shown that the prevalence of undernutrition among lactating women is high. Moreover, the prevalence of undernutrition among khat-chewer lactating women is

alarming, and it is a public health concern. Chewing khat daily, feeding habits after chewing, and availability of the latrine was significantly associated with undernutrition among khat-chewer lactating women. However, age at first pregnancy, taking additional meals during lactation, and handwashing after toilet use were significantly associated with undernutrition among non-chewer lactating women. Thus, nutritional and public health intervention should target khat-chewer lactating mothers, particularly focusing on daily chewer either to improve their dietary practice during and after chewing or to stop khat chewing if possible, in order to reduce the effect of khat on food absorption. Besides, improving latrine coverage and use, and prevention of early pregnancy are of paramount importance in reducing undernutrition among lactating mothers. Further research with strong study designs might be needed to identify the effects of chewing khat on the nutritional status of lactating women.

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Author contributions

All authors were involved in the conception and design, data management or analysis, and interpretation, and took part in drafting the manuscript or revising it critically for important intellectual content. All authors read and approved the final draft of the manuscript.

Availability of data

All data used in this study are contained and presented in this document.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical considerations

Ethical clearance was obtained from the Institutional Health Research Ethics Review Committee (IHRERC) of the College of Health and Medical Sciences, Haramaya University (reference no. IHRERC/134/2020). A support letter was obtained from the west Hararghe zonal health department, Chiro town and woreda health offices. For all study participants, brief orientation was given about the study's possible risks, benefits, confidentiality, privacy, voluntary participation, the right to withdraw at any time, and the time the questionnaire would take before the data collection begins.

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Informed consent


Written informed consent was obtained from legally authorized representatives of subjects who were minor or from all subjects

before the study. Personal identification was not written on the questionnaire and confidentiality of all information was kept. Lactating mothers who were found to be undernourished were counseled about feeding and then linked to the village's health extension workers for the supplementary feeding programs.

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Supplemental material

Supplemental material for this article is available online.

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