BMC Nutrition

RESEARCH

Open Access

Consumption of vitamin A-rich foods among lactating mothers in Girawa district, Eastern Ethiopia

Nejib Ahmedteyib Adem[1], Haymanot Mezmur[2], Mohammed Jemal[3], Dawit Firdisa[2*] and Berhe Gebremichael[2*]

Abstract

Background Inadequate consumption of vitamin A during lactation significantly increases the risk of vitamin A deficiency disorders. However, there is scarce evidence on the consumption status of vitamin A-rich foods among lactating mothers in Ethiopia. Therefore, this study aimed to assess the magnitude of inadequate consumption of vitamin A-rich foods and associated factors among lactating mothers visiting public health facilities for child immunization and postnatal care in Girawa District, Eastern Ethiopia.

Method A facility-based cross-sectional study was carried out among 418 lactating mothers who visited public health facilities for child immunization and postnatal care in the Girawa district from January 20 to February 20, 2023. An interviewer-administered questionnaire was utilized to collect the data. The data were entered into EpiData version 4.6 and exported to STATA version 17 for analysis. Both bivariable and multivariable logistic regression analyses were performed to identify the factors associated with inadequate consumption of vitamin A-rich foods.

Results The magnitude of inadequate consumption of vitamin A-rich foods was 88.5% (95% confidence interval (CI): 85–92). A family size ≥ 4 (adjusted odds ratio (AOR) = 2.73, 95% CI = 1.18–6.33), low dietary diversity (AOR = 3.44, 95% CI = 1.36–8.70), household food insecurity (AOR = 3.66, 95% CI = 1.43–9.38) and having < 4 antenatal care (ANC) visits (AOR = 2.79, 95% CI = 1.10–7.06) were significantly associated with inadequate consumption of vitamin A-rich foods.

Conclusion Nearly nine in ten mothers had inadequate intake of vitamin A-rich foods. High family size, low dietary diversity, household food insecurity and fewer ANC follow-up visits were the factors significantly associated with inadequate consumption of vitamin A-rich foods. Therefore, public health measures should focus on family planning, ANC, food security and nutritional counseling/education to improve the consumption of vitamin A-rich foods by lactating mothers.

Keywords Lactating mothers, Inadequate consumption, Vitamin A-rich foods, Girawa district, Ethiopia

*Correspondence:
Dawit Firdisa
firdisadawit@gmail.com
Berhe Gebremichael
berhegere09@gmail.com
[1]Garamuleta General Hospital, Oromia Regional State, Garamuleta, Ethiopia
[2]School of Public Health, College of Health and Medical Sciences, Haramaya University, Harar, Ethiopia
[3]Child Health and Mortality Prevention Surveillance (CHAMPS), College of Health and Medical Sciences, Haramaya University, Harar, Ethiopia

Introduction

Vitamin A is a fat-soluble vitamin that the body obtains from the diet and is stored in the body when intake exceeds physiological needs. It is an essential micronutrient needed in small amounts for the normal functioning of the visual system, immune function, bone and body growth, normal cell development, maintenance of epithelial cellular integrity, and reproduction at all stages of life [1, 2]. Two forms of vitamin A are available in foods: preformed vitamin A and pro-vitamin A carotenoids. Preformed vitamin A is the best food source of the active form of vitamin A (retinol), is the most effective at accessing the body, and is found almost exclusively in animal foods. Provitamin A carotenoids are found in plant foods mainly in the form of beta-carotene, which needs to be converted into retinol by the body [3] .

In developed countries, animal-source food containing vitamin A accounts for nearly 65% of total vitamin A consumption, and plant-source food accounts for 35%. However, in developing countries, 70–90% of vitamin A is consumed as a pro-vitamin A carotenoid because plant-based foods are more affordable than animal products [4]. Even though the best sources of readily bioavailable vitamin A are animal source foods, people in low socioeconomic groups cannot afford to consume these foods on a regular basis. As a result, high rates of vitamin A deficiency are common among resource-poor population groups [5].

Vitamin A deficiency affects mainly children and women during pregnancy and lactation due to increased risk, and it is responsible for more than 600,000 deaths per year, mostly young children and pregnant women [6]. Lactating mothers who live in developing countries are vulnerable to vitamin A deficiency due to increased physiological demand, lactogenesis, inadequate vitamin A intake, an undiversified monotonous diet, and low bioavailability of vitamin A from plant-based diets and infections [7].

Inadequate consumption of vitamin A is one of the most common causes of vitamin A deficiency [8, 9]. Globally, the inadequacy of vitamin A is greater than 40% [10]. In Brazil, 58% of lactating mothers had inadequate intake of vitamin A [11]. Studies conducted in some Asian countries have shown that inadequate consumption of vitamin A ranges from 51.4 to 94% [12–16], whereas as in African studies, inadequate consumption of vitamin A ranges from 58.6 to 100% [17, 18]. The current prevalence of vitamin A deficiency among lactating mothers in Ethiopia is alarmingly high. It ranges from 21.9 to 98.2% [10, 19–21]. A study conducted in Bahir Dar city reported that 98.2% of lactating women had inadequate intake of vitamin A [22]. Additionally, a broader study in the North Mecha District found that 72.3% of lactating mothers experienced overall micronutrient intake inadequacy, which includes vitamin A among other essential nutrients [23]. Furthermore, a systematic review indicated that under-nutrition, which can encompass vitamin A deficiency, is prevalent among lactating mothers in Ethiopia, with a pooled prevalence of 23.84% for under-nutrition overall [24].

Inadequate consumption of vitamin A during lactation significantly raises the risk of health consequences or vitamin A deficiency (VAD) disorders [25]. VAD alters various functions in the body and can lead to many negative health consequences for both mothers and their children. Maternal VAD can lead to night blindness, xerophthalmia, iron deficiency anemia, an increased risk of mother-to-child transmission of HIV, weakened immune systems and increased maternal mortality. The vitamin A-deficient lactating mothers produce breast milk with low vitamin A content, which leads to vitamin A deficiency in their infants [26, 27].

Most studies have shown that the major causes of inadequate vitamin A consumption are low dietary diversity, poor socioeconomic status, low educational status, high family size, food insecurity, poor nutritional knowledge and agricultural practices, poverty, and disparities in households. Moreover, across the world in low-income countries, low-quality, monotonous diets are common and risk a variety of micronutrient deficiencies [8, 21, 28, 29]. In Ethiopia, the most important factors contributing to vitamin A inadequacy include low educational status, food insecurity, and unfavorable nutritional attitudes [22, 23].

Addressing these deficiencies through targeted nutritional interventions is crucial for protecting mothers from anemia, weakened immune function, and susceptibility to infections, all of which can have a negative impact on neonatal outcomes. It also has a positive impact on improving health outcomes in vulnerable populations. Promoting dietary diversity and adequate nutrient intake have also been used as strategies for alleviating nutritional problems that occur due to inadequate intake of micronutrients and food insecurity [30]. Although the government of Ethiopia has launched a revised national nutrition program to prevent and control micronutrient deficiency among pregnant and lactating women as well as under-five children [31], the inadequate consumption of vitamin A-rich foods among lactating mothers is still high [10, 21].

Although many studies have been performed on the consumption of vitamin A-rich foods in developing countries, most have focused on children and pregnant mothers. Research focusing on the consumption of vitamin A-rich foods among lactating mothers is limited in Ethiopia [21], and especially there is no published evidence in the study area. Therefore, this study aimed to assess inadequate consumption of vitamin A-rich foods

and associated factors among lactating mothers visiting public health facilities for child immunization and postnatal care in Girawa District, eastern Ethiopia.

Methods and materials

Study design and setting

A facility-based cross-sectional study was conducted among lactating mothers visiting child immunizations and postnatal care units in public health facilities in Girawa District from January 20 to February 20, 2023. The Girawa District is found in the East Hararghe Zone, Oromia Regional State, Eastern Ethiopia, 580 km from Addis Ababa, the capital city of Ethiopia and 75 km from Harar (zonal city). According to the Girawa District Health Office report, there were 14,652 lactating mothers in 2022. The district has one hospital, nine health centers and 45 health posts. The major food products of the district are cereals, including maize, sorghum, *teff*, wheat, and barley; pulses, such as beans, peas, lentils and other legumes; vegetables, such as potato, sweet potato, spinach, lettuce, cabbage, and pumpkin; and fruits, including mango, avocado, banana and oranges [32].

Population and sampling

Lactating mothers who live in Girawa District, Eastern Ethiopia were source populations whereas among lactating mothers those who visited child immunizations and postnatal care units of public health facilities were the study participants for this study. Lactating mothers who were severely ill were excluded from the study.

The sample size for the magnitude of inadequate consumption of vitamin A-rich foods was estimated by using the single population proportion formula $n = \frac{(Z\alpha/2)2pq}{d2}$, with the following assumptions: the magnitude of inadequate consumption of vitamin A-rich foods among lactating mothers (p) from previous study conducted in Northwest Ethiopia which is 61.1% [21], the 95% confidence level ($Z_{\alpha/2}$) was 1.96, and the degree of precision (d) was 0.05 and 10% for nonresponse. Accordingly, the sample size was 402. The sample size for the factors associated with inadequate consumption of vitamin A-rich foods was calculated by using EPI-Info version 7 Statistical Software considering the following assumptions: 95% confidence level, 80% power of the study, and unexposed to exposed ratios of 1:1 and 10% for the nonresponse rate which resulted in a sample size of 422. The sample size calculated for the associated factors yielded a larger sample size. Thus, the final sample size of this study was set at 422.

From the 10 total public health facilities, six health facilities (Garamuleta General Hospital (GMGH), Girawa Health Center (GHC), Dogu Health Center (DHC), Lafto Health Center (LHC), Oromitu Health Center (OHC) and Melba Health Center (MHC)) were selected randomly using the lottery method. The calculated sample size was proportionally allocated to the selected health facilities (202 to GMGH, 115 to LHC, 150 to GHC, 108 to OHC, 166 to DHC and 90 to MHC) based on the average number of clients who flow to the child immunization and postnatal care units during the three months prior to the study. The study participants were then selected by a systematic random sampling method. The calculated sampling interval (k) for each selected health facility was two. The first study participant for each health facility was selected by the lottery method, and then sampling continued every two participants until the required numbers of samples were achieved.

Data collection methods

An interviewer-administered questionnaire was developed for this study (Additional file 1), thereby reviewing different previous literatures [30, 33–35]. The questionnaire was, then, structured into the following seven sections: [1] sociodemographic characteristics [2], nutrition knowledge of lactating mothers [3], consumption status of vitamin A-rich foods by lactating mothers [4], dietary diversity status of lactating mothers [5], household food security status [6], health services and health conditions of lactating mothers, and [7] water, hygiene and sanitation. Six data collectors—one diploma nurse, two BSc nurses and three BSc midwives—who fluently speak Afan Oromo (the local language) and who were working outside of the study facility—were involved in the data collection. Two supervisors (one BSc midwife and one public health officer), who were familiar with the study setting, supervised the data collection.

The consumption of vitamin A-rich food was assessed using the Helen Keller International food frequency questionnaire (FFQ) with modifications to the local context. The Helen Keller International food frequency method assesses the extent to which communities and populations are at risk of VAD. If at least 70% of the surveyed people are not above the threshold values (had inadequate consumption of vitamin A-rich foods), VAD is likely to be a public health problem in the entire study area [35]. The FFQ asks respondents how many days in the past week they ate the foods listed on a predesigned FFQ. The tool has twenty-eight different food items. Among the twenty-eight food items, twenty-one are available in the study area and are consumed by society. Only major sources of vitamin A (≥100 RE) were taken into consideration. The foods selected for the analysis of the consumption of foods rich in vitamin A included dark green leafy vegetables (DGLVs), carrots, pumpkins, mangos, papayas, sweet potatoes, palm oils, eggs, fishes, livers, and butter.

Maternal dietary diversity was measured by the minimum dietary diversity for a woman, which is a dichotomous indicator/tool that was developed by the FAO. The maternal dietary diversity score was calculated as the sum of the number of different food groups consumed by the mother in the 24 h preceding the survey. A total of ten food groups were considered in this study: [1] grains, roots, tubers and plantains; [2] pulses (beans, peas and lentils); [3] nuts and seeds; [4] milk and milk products; [5] meat/poultry and fish; [6] eggs; [7] DGLVs; [8] other vitamin A-rich fruits and vegetables; [9] other vegetables; and [10] other fruits. Mothers who consumed a minimum of five out of the ten food groups within a 24-hour recall period were considered to have adequate dietary diversity [30].

Food insecurity was measured by the Household Food Insecurity Access Scale (HFIAS), which consists of nine occurrence questions that represent a generally increasing level of severity of food insecurity (access) and nine frequency-of-occurrence questions that were asked as a follow-up to each occurrence question to determine how often the condition occurred during the previous 4 weeks [34]. Nutrition knowledge was assessed using a scoring system based on responses to 9 nutrition-related standardized questionnaires with both close and open-ended questions [33].

Operational definitions

Inadequate consumption of vitamin A-rich foods Intake of animal sources of vitamin A for ≤4 days per week or consumption of a weighted source (total intake of animal and plant sources of vitamin A) for ≤6 days per week [35].

Minimum dietary diversity for women Intake of at least five food groups out of 10 food groups [30].

Food insecurity A situation that occurs when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life [36].

Based on the total HFIAS score, household food insecurity can be categorized into four levels:

food secure—if the household scores 0 or 1, mild food insecure—if the household scores from 2 to 8, moderate food insecure—if the household scores from 9 to 16, severe food insecure—if the household scores from 17 to 27 [34].

Adequate nutritional knowledge Lactating mothers who score 7–9 on the basis of nine nutrition-related standardized questionnaires with both close- and open-ended questions.

Fair nutritional knowledge Lactating mothers who score 4–6 on the nine questions.

Poor nutritional knowledge was defined as follows Lactating mothers who scored between 0 and 3 on one of nine questions [33].

Data quality control

To maintain the accuracy and consistency of our data, the questionnaire was translated to the local language (i.e., Afan Oromo) and was pretested on 5% of the total sample size two weeks before the actual data collection. Modifications were made on the questionnaire based on the findings of the pretest. The data collectors and supervisors were trained for two days on the data collection process. The collected data were checked daily for consistency and completeness. Double data entry was performed, and the data were cross-checked to ensure consistency. The principal investigator and supervisors coordinated the overall data collection process.

Data processing and analysis

The collected data were coded, cleaned, and entered into the EpiData version 3.1 software package and exported into STATA version 17 for analysis. Data cleaning was performed to identify outliers/inconsistencies, errors and missing values. Both descriptive and analytical statistics were done. Descriptive statistics such as the mean (with standard deviation) and median (with interquartile range) for continuous data as well as frequency and percentage for categorical data were used to describe the characteristics of participants using tables, figures and text.

To determine the association between the independent variables and the outcome variables, both bivariable and multivariable logistic regression analysis was performed to determine the factors associated with inadequate consumption of vitamin A-rich food sources. Variables with a P value < 0.25 in a bivariable logistic regression analysis were retained and entered into a multivariable logistic regression to control for the potential confounding variable that affects the measurable outcome variable. The model goodness-of-fit test was checked by using the Hosmer and Lemeshow test (p value = 0.11). Finally, a P value < 0.05 and an AOR calculated with 95% CI were used to determine the presence of statistical significance.

Results

Sociodemographic and economic characteristics

A total of 418 lactating mothers participated in the study, with a response rate of 99%. The mean ± standard deviation (SD) of the respondents' ages was 27.58 ± 5.24 years, and 219 (52.4%) of them were aged between 25 and 34 years. A total of 375 (89.7%) lactating mothers were

Muslim religious followers. Three hundred fifteen 315 ((75.4%)) of the lactating mothers were rural residents, and 332 (79.43%) of the lactating mothers were housewives. Three-fourths (75.12%) of the lactating mothers were from households with a family size≥4. More than one-third (34.69%) of the lactating mothers had not attended formal education, and 39.23% had an average monthly income≤1000 Ethiopian women (Table 1).

Maternal nutritional knowledge

Nine questions were used to assess the nutritional knowledge of the respondents. The mean (±SD) maternal nutritional knowledge score was 5.41 (±1.65). The proportion of patients with poor nutritional knowledge was 17% (Fig. 1).

Table 1 Sociodemographic and economic characteristics of lactating mothers visiting child immunizations and postnatal care facilities in public health facilities in Girawa district, Eastern Ethiopia, 2023 ($n=418$)

Variables	Categories	Frequency	Percent
Age (years)	≤24	142	34
	25–34	219	52.4
	≥35	57	13.6
Marital status	Single	4	1
	Married	396	94.7
	Widowed	5	1.2
	Separated/divorced	13	3.1
Residence	Urban	103	24.6
	Rural	315	75.4
Religions	Muslim	375	89.7
	Others (Orthodox, protestant, catholic)	43	10.3
Ethnicity	Oromo	394	94.26
	Amhara	14	3.35
	Others (Gurage, Tigray)	10	2.39
Mothers' educational status	No formal education	145	34.69
	Primary	161	38.52
	Secondary	65	15.55
	College and above	47	11.24
Husbands educational Status	No formal education	106	25.36
	Primary	113	27.03
	Secondary	125	29.9
	College and above	74	17.7
Mothers' occupation	House wife	332	79.43
	Government employee	38	9.09
	Merchant	30	7.18
	Others (student, daily labor)	18	4.31
Husbands' occupation	Farmer	293	70.1
	Government employee	73	17.46
	Merchant	37	8.85
	Others (student, self-employed)	15	3.59
Family size	<4	104	24.88
	≥4	314	75.12
Average monthly income (ETB)	≤1000	164	39.23
	1001–2000	108	25.84
	2001–3000	54	12.92
	>3000	92	22.01

Food security and dietary diversity

The median (±IQR) score of the household food insecurity access scale was 8 (±5) for lactating mothers. Overall, 349 (83.5%) of the lactating mothers were from food-insecure households. One hundred eighty-six (44.5%), 159 (38%) and 4 (1%) of the mothers' households were mildly, moderately and severely food insecure, respectively.

The mean (±SD) dietary diversity score of the lactating mothers was 4.23 (±1.54). Among the total number of lactating mothers, 304 (72.7%) had low dietary diversity (consuming fewer than five food groups) in the previous 24-hour recall periods. All women consumed starchy staples (grains, white roots and tubers, and plantains), 371 (88.8%) consumed other vegetables (onion, tomato, etc.), and three hundred forty-six (82.8%) consumed dairy products (milk, yogurt and cheese) in the previous 24 h. On the other hand, vitamin A-rich fruits and vegetables (16%), other fruits (15.1%) and meat (10.3%) were the least consumed food groups by lactating mothers (Table 2).

Health services and health conditions of the lactating mothers

According to the study, 267 (63.88%) of the lactating mothers had fewer than 4 ANC visits while pregnant for the index child. The majority of lactating mothers, 380 (90.9%), had received any nutrition-related information or counseling, mainly from health workers. Among the lactating mothers, only 82 (19.6%) were supplemented with vitamin A, and less than half were supplemented; 192 (45.93%) lactating mothers were currently using family planning (Table 3).

Water hygiene and sanitation

The study revealed that tap water was the main source of drinking water for 176 (42.1%) of the mothers. With regard to latrine, 322 (77%) lactating mothers reported that their households had latrine, of which 202 (62.73%) had traditional pit latrine. One hundred seventy-six (42.11%) of the lactating mothers responded that they did not wash their hands with soap after the toilet (Table 4).

Consumption of vitamin A-rich foods

The prevalence of inadequate consumption of vitamin A-rich foods was 88.5% (95% CI: 85–92). Among the plant sources, palm oil (94%), pumpkin (58.9%), dark green leafy vegetables (43.8%) and sweet potato (32.8%) were consumed more often than the other plant sources. Among the animal sources of vitamin A, 90.9% of the mothers consumed milk within the week before the

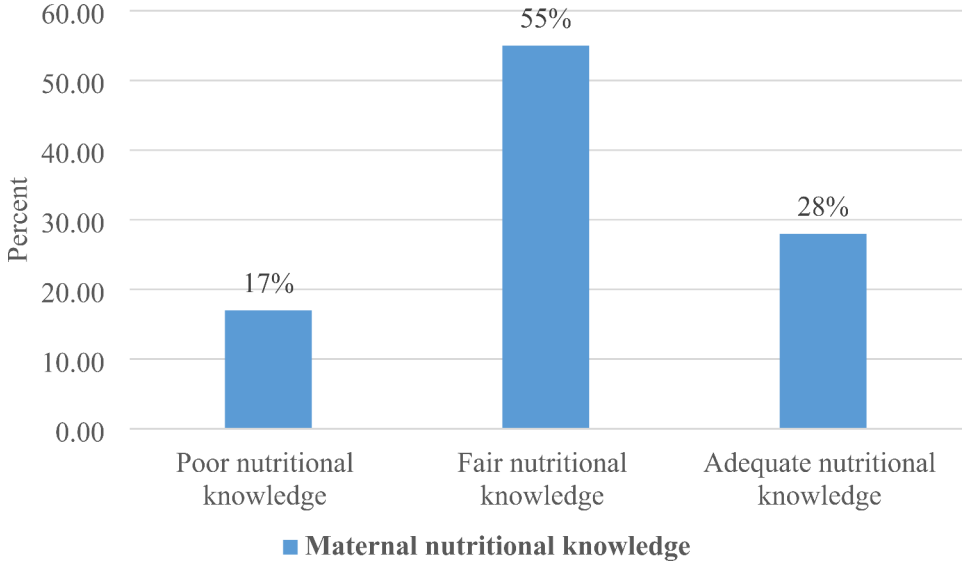

Fig. 1 Maternal nutritional knowledge of lactating mothers visiting child immunizations and PNC clinics in public health facilities in Girawa district, Eastern Ethiopia 2023 ($n=418$)

Table 2 Consumption of dietary diversity among lactating mothers visiting child immunizations and postnatal care facilities in public health facilities in Girawa district, 2023 ($n=418$)

Food items	Frequency	Percent
Grains	418	100
Pulses	138	33
Nuts and seeds	91	21.8
Diary/milk products	346	82.8
Meat, poultry and fish	43	10.3
Eggs	122	29.2
DGLVs	110	26.3
Other vitamin A rich fruit and vegetables	67	16
Other vegetables	371	88.8
Other fruits	63	15.1
Dietary diversity score		
< 5 food groups	304	72.7
≥ 5 food groups	114	27.3

survey. In addition to milk, eggs were the most highly consumed animal source (44%). On the other hand, mango (27.5%), carrot (26.6%) and papaya (14.4%) from plant sources and liver (3.8%) and fish (1.4%) from animal sources were the food groups least consumed by lactating mothers (Table 5).

Factors associated with inadequate consumption of vitamin A-rich foods

The associations between dependent and independent variables were explored by both bivariable and multivariable logistic regression. Accordingly, family size, dietary diversity, household food insecurity and the number of ANC follow-up visits were factors significantly associated with inadequate consumption of vitamin A-rich foods.

The odds of inadequate consumption of vitamin A-rich foods were 2.73 times greater among mothers whose family size was ≥4 (AOR=2.73, 95% CI=1.18–6.33) than among those whose family size was less than 4. Lactating mothers who had low dietary diversity (eating<5 food groups) were 3.44 times (AOR=3.44, 95% CI=1.36–8.70) more likely to have inadequate consumption of vitamin A-rich food than their counterparts were. The odds of inadequate consumption of vitamin A-rich foods were 3.66 times greater among mothers from food insecure households (AOR=3.66, 95% CI=1.43–9.38) than among their counterparts. Lactating mothers who had<4 ANC follow-up visits were 2.79 times (AOR=2.79, 95% CI=1.10–7.06) more likely to have inadequate consumption of vitamin A-rich food than mothers who had≥4 ANC follow-up visits (Table 6).

Discussion

The purpose of this study was to assess the inadequate consumption of vitamin A-rich foods and associated factors among lactating mothers visiting child immunizations and PNC facilities in the Girawa district, Eastern Ethiopia. Accordingly, the prevalence of inadequate consumption of vitamin A-rich food among lactating mothers in the present study was 88.5% (95% CI: 85-92%). Family size, dietary diversity, household food insecurity and number of ANC follow-up visits were the factors significantly associated with inadequate consumption of vitamin A-rich foods.

The prevalence of inadequate consumption of vitamin A-rich foods in the study area was greater than the cutoff value (70%) set by the Helen Keller International Food Frequency Method to declare vitamin A deficiency

Table 3 Health services and health conditions of lactating mothers visiting child immunizations and postnatal care facilities in public health facilities in Girawa district, Eastern Ethiopia, 2023 ($n=418$)

Variables	Categories	Frequency	Percent
ANC visits	Yes	350	83.73
	No	68	16.27
Number of ANC visits	< 4	267	63.88
	≥ 4	83	19.86
Place of delivery	Health facility	381	91.15
	Home	37	8.85
PNC visits	Yes	387	91.15
	No	31	8.85
Number of PNC visits	< 3	374	89.5
	≥ 3	13	3.11
Breast feeding duration	< 6 months	334	79.90
	≥ 6 months	84	20.10
Vaccinated/ Supplemented with nutrients	Yes	348	83.25
	No	70	16.75
Type of vaccination or/and Supplementation	Vitamin A	82	19.6
	Iron folate	336	80.4
	Zinc	7	1.7
	Deworming	142	34
	Tetanus toxoid	155	37.1
Currently use family planning	Yes	192	45.93
	No	226	54.07
Type of family planning they used	Pills	9	4.69
	Injectable	55	28.65
	Implants	104	54.16
	Intrauterine contraceptive device(IUCD)	17	8.85
	Breast feeding	5	2.6
	Other(Bilateral tubal ligation)	2	1.04
Nutrition information or counseling	Yes	380	90.91
	No	38	9.09
Source of information	Health workers	359	85.9
	Health volunteers	78	18.7
	Media	114	27.3
Meal frequency	≤ 3 meals	315	75.36
	> 3	103	24.64
Sicken in the last two weeks	Yes	64	15.31
	No	354	84.69
Type of sick/illness	Chronic illness	24	37.5
	Acute illness	40	62.5
Distance from health facility	≤ 4 km	264	63.16
	> 4 km	154	36.84

Table 4 Water hygiene and sanitation of the lactating mothers visiting child immunization and postnatal care in public health facilities in Girawa district, Eastern Ethiopia, 2023

Variables	Categories	Frequency	Percent
Main source of drinking water	Tap water	176	42.11
	Borehole	39	9.33
	Well (not protected)	80	19.14
	Well(protected)	104	24.88
	Pumping water	19	4.55
Water treatment	Yes	140	33.49
	No	278	66.51
Method of water treatment	Boiling	41	29.28
	Use chemicals	34	24.29
	Filters	65	46.43
Water used for domestic purpose	< 60 L	249	59.57
	≥ 60 L	169	40.43
Time taken to fetch water	< 60 min	241	57.66
	≥ 60 min	177	42.34
Means of transports	Walking	390	93.3
	By donkey	23	5.5
	Motor cycle	5	1.2
Availability of toilet	Yes	322	77
	No	96	23
Type of toilet	Traditional pit latrine	202	62.73
	Ventilated pit latrine	120	37.27
Wash hands with soap after toilet	Always	49	11.72
	Sometimes	193	46.17
	No	176	42.11

a main public health problem in the study area [35]. This magnitude was also in line with the findings of studies conducted in a poor urban population of Bangladesh (87%) [37], Niger (88.8%) [18], Nepal (89%) [12] and other rural Bangladesh (89.1%) [13]. On the other hand, the prevalence of NAFLD in this study was lower than that in studies conducted in Zambia (99.9%) [17], Bahir Dar (98.2%) [10], China (94.5%) [14], and Uganda (>95%) [6]. However, the findings of the current study were greater than those of studies conducted in Brazil (58%) [11], Indonesia (43%) [38], Iran (51.4%) [15], Kenya (58.6%) [39] and Gondar (61.1%) [21]. The possible discrepancy might be due to differences in study periods, study designs, geographical areas, sample sizes, socioeconomic statuses, and seasonal variability, as the Indonesian study covers both seasonality [38], knowledge and skills related to proper dietary practices, measurement tools, and conflict effects. These differences can also be attributed to the fact that the study in Uganda was conducted in post conflict regions [6]. Women in these regions experienced greater food and nutritional insecurity due to food shortages and disrupted economic activities that led to low consumption of vitamin A-rich foods.

In this study, the odds of inadequate consumption of vitamin A-rich food were significantly associated with family size; mothers with a family size≥4 were 2.73 times more likely to have inadequate consumption of vitamin A-rich foods than were those with a family size less than four. This finding was supported by the findings of a study conducted in Gondar town, Northwest Ethiopia [21]. This may be due to a fact that women from higher family size were in difficulties of meeting their

Table 5 Consumption of vitamin A-rich foods among lactating mothers visiting child immunization and postnatal care in public health facilities in Girawa district, 2023 ($n=418$)

Food groups	Frequency	Percent
Main staple	418	100
Spicy, hot piper	345	82.5
DGLV (as food groups)	183	43.8
Peanuts	164	39.2
Carrots	111	26.6
Pumpkin	246	58.9
Spinach	159	38
Mango	115	27.5
Papaya	60	14.4
Sweet potato	137	32.8
Pasta and macaroni	244	58.4
Eggs	184	44
Chicken	15	3.8
Fish	6	1.4
Milk	380	90.9
Meat	77	18.4
Butter	59	14.1
Lentils	259	62
Rice	294	70.3
Pulm oil	393	94
Liver	16	3.8
Consumption of vitamin A rich food		
Adequate	48	11.5
Inadequate	370	88.5

dietary requirements both in quality and quantities and food security issue in women with higher family size and related with inadequate consumption of nutrient intake.

The odds of inadequate consumption of vitamin A-rich foods among mothers with a dietary diversity score<5 (low dietary diversity) were 3.44 times greater than those of their counterparts. These findings are in agreement with those of studies conducted in South Africa [29], Nepal [12], Tanzania [40] and three other regions in Ethiopia, Gondar town [21], Dessie Town [8], and Ataye District [7]. This is because consuming the minimum of five food groups out of ten food groups is related with the higher adequacy of micronutrient intakes including vitamin A and vice versa [30].

The current study also showed that there was a significant association between inadequate consumption of vitamin A-rich foods and household food insecurity, as mothers from food insecure households were 3.66 times more likely to have inadequate consumption of vitamin A-rich food than their counterparts were. This finding was supported by the findings of studies conducted in South Africa [29], Malawi [41], southern Ethiopia [42] and southwestern Ethiopia [43]. A possible explanation may be that food security promotes the consumption of adequate quantities and quality of food, which contributes to having a better minimum dietary diversity score and adequate micronutrient intake [29]. However, these findings are inconsistent with those of a study conducted in Bahir Dar city, which revealed that household food insecurity is not significantly associated with inadequate micronutrient intake [10]. This discrepancy might be explained by the fact that the women in Bahir Dar city were residing in urban areas, had high educational and socioeconomic status, experienced greater food security and had complete micronutrient assessments.

Furthermore, inadequate consumption of vitamin A-rich foods was associated with the number of ANC follow-up visits. Lactating mothers who had<4 ANC follow-up visits were 2.79 times more likely to have inadequate consumption of vitamin A-rich food than mothers who had≥4 ANC follow-up visits. This finding was supported by a study conducted in Nepal [44]. The possible reason might be that the mothers who frequently attended ANC follow-up visits had health and nutritional information, as well as advice and counseling from health professionals at health facilities, and had better chances of improving their nutritional knowledge and healthy dietary practices.

The findings of this research may provide valuable insights for policymakers and relevant stakeholders concerning the intake of vitamin A-rich foods among lactating mothers. Additionally, it may act as a baseline for subsequent epidemiological and nutritional studies, including systematic reviews and meta-analyses. However, the results of the study should be interpreted considering the following limitations into account. Given that the study employs a cross-sectional design, it may not adequately capture the temporal relationship between the independent and dependent variables. Furthermore, the findings may not be generalizable to all lactating mothers within the community, as the research was conducted in a health facility setting. This study may be subject to recall bias, as the questions concerning the consumption of vitamin A-rich foods, dietary diversity, and food security were based on participants' recollections. There is also a risk of social desirability bias influencing the findings. To reduce these biases, data collectors underwent training to effectively prompt respondents, starting with their most recent experiences. Moreover, respondents were given sufficient time to enhance their ability to recall information from their long-term memory.

Conclusions

According to the Helen Keller threshold values, the inadequate consumption of vitamin A-rich foods among lactating mothers was very high, and vitamin A deficiency was a major public health problem in the study population. High family size, low dietary diversity, household food insecurity and fewer ANC follow-up visits were

Table 6 Bivariable and multivariable logistic regression of factors associated with inadequate consumption of vitamin A-rich foods among lactating mothers visiting child immunizations and postnatal care facilities in the Girawa district, Eastern Ethiopia, 2023 ($n=418$)

Variables	Category	Consumption of vitamin A rich foods N (%)		COR (95% CI)	AOR (95% CI)
		Inadequate	Adequate		
Residence	Urban	82(79.61)	21(20.39)	1	1
	Rural	288(91.43)	27(8.57)	2.73(1.46–5.08) *	1.10(0.45–2.66)
Mothers' educational status	No formal Education	132(91.03)	13(8.97)	3.88(1.65–9.14) *	0.87(0.14–5.63)
	Primary	146(90.68)	15(9.32)	3.72(2.62–8.54) *	2.23(0.42–11.86)
	Secondary	58(89.23)	7(10.77)	3.16(1.15–8.71) *	2.64(0.58–11.91)
	College and above	34(72.34)	13(27.66)	1	
Husband educational status	No formal Education	98(92.45)	8(7.55)	3.65(1.48–8.99) *	1.21(0.18–8.07)
	Primary	103(91.15)	10(8.85)	3.07(1.31–7.15) *	0.65(0.13–3.29)
	Secondary	112(89.60)	13(10.40)	2.57(1.16–5.65) *	0.67(0.15–3.01)
	College and above	57(77.03)	17(22.97)	1	1
Mothers' occupation	House wife	303(91.27)	29(8.73)	3.24(1.40–7.51) *	0.42(0.09–1.90)
	Government employee	29(76.32)	9(23.68)	1	1
	Merchant	23(76.67)	7(23.33)	1.02(0.33–3.15)	0.16(0.02–0.90)
	Others[+]	15(83.33)	3(16.67)	1.55(0.36–6.60)	0.38(0.05–2.85)
Family size	< 4	82(78.85)	22(21.15)	1	1
	≥ 4	288(91.72)	26(8.28)	3.02(1.63–5.61) *	2.73(1.18–6.33) **
Average monthly income (ETB)	≤ 1000	152(92.68)	12(7.32)	3.29(1.52–7.15) *	0.43(0.08–2.09)
	10,001 – 2000	98(90.74)	10(9.26)	2.55(1.12–5.81) *	0.31(0.06–1.58)
	2001–3000	47(87.04)	7(12.96)	1.75(0.68–4.48)	0.58(0.16–2.16)
	> 3000	73(79.35)	19(20.65)	1	1
Number of ANC follow up	< 4	246(92.13)	21(7.87)	4.49(2.33–8.64) *	2.79(1.10–7.06) **
	≥ 4	60(72.29)	23(27.71)	1	1
	None	64(94.12)	4(5.88)	6.13(2.00-18.77) *	2.31(0.54–9.92)
Distance from health facility	≤ 4 km	227(85.98)	37(14.02)	1	1
	> 4 km	143(92.86)	11(7.14)	2.12(1.05–4.28) *	1.14(0.46–2.77)
Meal frequency	≤ 3	287(91.11)	28(8.89)	2.47(1.32–4.61) *	0.83(0.31–2.24)
	> 3	83(80.58)	20(19.42)	1	1
Availability of toilet	Yes	278(86.34)	44(13.66)	1	1
	No	92(95.83)	4(4.17)	3.64(1.27–10.40) *	2.35(0.71–7.83)
Wash hands	Always	38(77.55)	11(22.45)	1	1
	Sometimes	172(89.12)	21(10.88)	2.37(1.05–5.33) *	1.14(0.41–3.12)
	No	160(90.91)	16(9.09)	2.89(1.24–6.74) *	0.72(0.23–2.21)
Nutrition knowledge	Poor	63(88.73)	8(11.27)	1.74(0.72–4.17) *	0.35(0.09–1.32)
	Fair	212(91.77)	19(8.23)	2.46(1.27–4.80)*	0.89(0.33–2.39)
	Adequate	95(81.90)	21(18.10)	1	1
Dietary diversity	< 5 food groups	284(93.42)	20(6.58)	4.62(2.48–8.61) *	3.44(1.36–8.70) **
	≥ 5 food groups	86(75.44)	28(24.56)	1	1
Food security status	Food secure	48(69.57)	21(30.43)	1	1
	Food insecure	322(92.26)	27(7.74)	5.22(2.73–9.95) *	3.66(1.43–9.38) **

[+]= Student, daily labor, * = Significant at $p<0.25$, ** = Significant at $p<0.05$, 1 = Reference group, COR = Crude odds ratio, AOR = Adjusted odds ratio, CI = Confidence interval, ETB = Ethiopian birr

the factors significantly associated with inadequate consumption of vitamin A-rich foods. Therefore, the health offices of the Girawa district, in collaboration with other stakeholders, should focus on family planning, ANC, food security and nutrition counseling/education to improve the consumption of vitamin A-rich foods by lactating mothers. Further research with an advanced study design is recommended to address seasonal variability and other variables that were not included in this study.

Abbreviations

AOR Adjusted odd ratio
ANC Antenatal care
CI Confidence interval
DGLV Dark green leafy vegetable
EPI Expanded program of immunization
ETB Ethiopian Birr

FAO	Food and Agricultural Organization
FFQ	Food Frequency Questionnaire
HFIAS	Household Food Insecurity Access Scale
IQR	Interquartile range
MCH	Maternal and child health
MDDS	Minimum dietary diversity score
PNC	Postnatal care
SD	Standard deviation
VAD	Vitamin A deficiency
WHO	World Health Organization

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s40795-024-00985-0.

Supplementary Material 1

Acknowledgements
We would like to express our gratitude to the staff of Girawa District public health facilities, study participants, data collectors and supervisors for their tremendous support and assistance during the data collection process.

Author contributions
NAA, BG, HM, MJ and DF made significant contributions to the work reported, whether it was in the conception, study design, execution, acquisition of data, analysis, and interpretation, or all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; agreed on the journal to which the article has been submitted; and agreed to be accountable for all aspects of the work.

Funding
The research funding for this work was obtained from Haramaya University. However, the funding organization did not participate in the planning of the research, fieldwork, analysis, interpretation, or manuscript writing.

Data availability
Data can be obtained by contacting the corresponding author.

Declarations

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Ethics approval and informed consent
The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from Haramaya University, College of Health and Medical Sciences, Institutional Health Research Ethics Review Committee (IHRERC) with reference number IHRERC/003/2023. Informed consent was obtained from the heads of health facilities and participants aged 18 years or older. For participants younger than 18 years of age, informed consent was obtained from their respective parent(s)/guardian(s). The confidentiality and privacy of the study participants were ensured through the use of an anonymous questionnaire.

Received: 10 February 2024 / Accepted: 18 December 2024
Published online: 30 December 2024

References

1. Noh MFM, Gunasegavan RDN, Mustar S. Vitamin A in health and disease. Vitamin A: IntechOpen; 2019.
2. Debelo H, Novotny JA, Ferruzzi MGJAN. Vitam a. 2017;8(6):992–4.
3. Alashry Aia, Morsy TJJESP. Overv Vitam A. 2021;51(1):29–42.
4. Yang C, Zhao A, Lan H, Zhang J, Ren Z, Szeto IMY, et al. Fruit and vegetable consumption and serum vitamin A in lactating women: a cross-sectional survey in urban China. Food Sci Nutr. 2021;9(10):5676–88.
5. Abebe H, Abebe Y, Loha E, Stoecker BJ. Consumption of vitamin a rich foods and dark adaptation threshold of pregnant women at Damot Sore District, Wolayita, Southern Ethiopia. Ethiop J Health Sci. 2014;24(3):219–26.
6. Nankumbi J. Vitamin A rich foods consumption of women and children from selected region in Uganda. 2022.
7. Getacher L, Egata G, Alemayehu T, Bante A, Molla A. Minimum dietary diversity and associated factors among lactating mothers in Ataye district, North Shoa zone, Central Ethiopia: a community-based cross-sectional study. Journal of Nutrition and Metabolism. 2020;2020.
8. Koricho Z, Atomssa G, Mekonnen T, Tadesse S. Dietary vitamin a intakes among pregnant women attending antenatal care in health facilities in Dessie Town, North East Ethiopia. J Hum Nutr Dietetics. 2020;33(5):678–85.
9. Eyeberu A, Getachew T, Tiruye G, Balis B, Tamiru D, Bekele H et al. Vitamin A deficiency among pregnant women in Ethiopia: a systematic review and meta-analysis. Int Health. 2023:ihad038.
10. Awoke M, Menber Y, Desyibelew HD, Dagne S, Tadesse T, Wassihun Y. Micronutrient intake inadequacy and its associated factors among lactating women in Bahir Dar City, Northwest Ethiopia, 2021. PLoS ONE. 2022;17(7):e0271984.
11. da Silva AGCL, de Sousa Rebouças A, Mendonça BMA, Silva DCNe, Dimenstein R, Ribeiro KDS. Relationship between the dietary intake, serum, and breast milk concentrations of vitamin A and vitamin E in a cohort of women over the course of lactation. Matern Child Nutr. 2019;15(3):e12772.
12. Henjum S, Torheim LE, Thorne-Lyman AL, Chandyo R, Fawzi WW, Shrestha PS, et al. Low dietary diversity and micronutrient adequacy among lactating women in a peri-urban area of Nepal. Public Health Nutr. 2015;18(17):3201–10.
13. Islam S, Jubayer A, Nayan MM, Islam MH, Nowar A. Assessment of nutrient adequacy and associated factors among lactating women of rural Bangladesh using observed intake: findings from Bangladesh Integrated Household Survey 2018–2019. Food Science & Nutrition; 2019.
14. Ding Y, Indayati W, Basnet TB, Li F, Luo H, Pan H, et al. Dietary intake in lactating mothers in China 2018: report of a survey. Nutr J. 2020;19(1):1–13.
15. Mardani M, Abbasnezhad A, Ebrahimzadeh F, Roosta S, Rezapour M, Choghakhori R. Assessment of nutritional status and related factors of lactating women in the urban and rural areas of Southwestern Iran: a population-based cross-sectional study. Int J Community Based Nurs Midwifery. 2020;8(1):73.
16. Puwanant M, Boonrusmee S, Jaruratanasirikul S, Chimrung K, Sriplung H. Dietary diversity and micronutrient adequacy among women of reproductive age: a cross-sectional study in Southern Thailand. BMC Nutr. 2022;8(1):1–11.
17. Kaliwile C, Michelo C, Titcomb TJ, Moursi M, Donahue Angel M, Reinberg C, et al. Dietary intake patterns among lactating and non-lactating women of reproductive age in rural Zambia. Nutrients. 2019;11(2):288.
18. Wessells KR, Young RR, Ferguson EL, Ouédraogo CT, Faye MT, Hess SY. Assessment of dietary intake and nutrient gaps, and development of food-based recommendations, among pregnant and lactating women in Zinder, Niger: an Optifood linear programming analysis. Nutrients. 2019;11(1):72.
19. EPHI. Ethiopia national food consumption survey. Ethiopian Public Health Institute Addis Ababa, Ethiopia; 2013.
20. Tikuye HH, Gebremedhin S, Mesfin A, Whiting S. Prevalence and factors associated with undernutrition among exclusively breastfeeding women in Arba Minch Zuria District, Southern Ethiopia: a cross-sectional community-based study. Ethiop J Health Sci. 2019;29(1).
21. Aserese AD, Atenafu A, Sisay M, Sorrie MB, Yirdaw BW, Zegeye MK. Adequate vitamin a rich food consumption and associated factors among lactating mothers visiting child immunization and post-natal clinic at health institutions in Gondar Town, Northwest Ethiopia. PLoS ONE. 2020;15(9):e0239308.
22. Awoke M, Menber Y, Desyibelew HD, Dagne S, Tadesse T, Wassihun YJP. Micronutrient intake inadequacy and its associated factors among lactating women in Bahir Dar city, Northwest Ethiopia, 2021. 2022;17(7):e0271984.
23. Menber Y, Gashaw S, Belachew T, Fentahun NJFN. Micronutrient inadequacy among lactating mothers in rural areas of North Mecha District, Amhara Region. Ethiopia. 2024;11:1354459.
24. Girma B, Nigussie J, Molla A, Mareg MJM, Journal CH. Under-nutrition and associated factors among lactating mothers in Ethiopia: a systematic review and meta-analysis. 2022;26(11):2210–20.

25. WHO. Global prevalence of vitamin A deficiency in populations at risk 1995–2005: WHO global database on vitamin A deficiency. 2009.
26. Ongosi AN. Nutrient intake and nutrition knowledge of lactating women (0–6) months postpartum) in a low socio-economic area in Nairobi. Kenya: University of Pretoria; 2010.
27. WHO. Vitamin A supplementation in postpartum women. 2011.
28. Nguyen PH, Nguyen H, Gonzalez-Casanova I, Copeland E, Strizich G, Lowe A, et al. Micronutrient intakes among women of reproductive age in Vietnam. PLoS ONE. 2014;9(2):e89504.
29. Chakona G, Shackleton C. Minimum dietary diversity scores for women indicate micronutrient adequacy and food insecurity status in South African towns. Nutrients. 2017;9(8):812.
30. FAO, MINIMUM DIETARY DIVERSITY FOR. WOMEN: an updated guide to measurement-from Collection to Action. FOOD & AGRICULTURE ORGANIZATION; 2021.
31. FDRE, National Nutrition Programme II. 2016–2020 The government of the Federal Democratic Republic of Ethiopia. 2016.
32. GDHO. Girawa District Health Office report. 2022.
33. Nti CA, Hayford J, Opare-Obisaw C. Nutrition knowledge, diet quality and nutritional status of people living with HIV (PLHIV) in Ghana. Food Public Health. 2012;2(6):219–27.
34. Coates J, Swindale A, Bilinsky P. Household Food Insecurity Access Scale (HFIAS) for measurement of food access: indicator guide: version 3. 2007.
35. Persson V, Vitamin. A intake, status and improvement using the dietary approach: studies of vulnerable groups in three Asian countries. Acta Universitatis Upsaliensis; 2001.
36. Napoli M, De Muro P, Mazziotta M. Towards a food insecurity Multidimensional Index (FIMI). Master in human development and food security. 2011:1–72.
37. Ahmed F, Azim A, Akhtaruzzaman M. Vitamin A deficiency in poor, urban, lactating women in Bangladesh: factors influencing vitamin A status. Public Health Nutr. 2003;6(5):447–52.
38. Rahmannia S, Diana A, Luftimas DE, Gurnida DA, Herawati DMD, Houghton LA, et al. Poor dietary diversity and low adequacy of micronutrient intakes among rural Indonesian lactating women from Sumedang district, West Java. PLoS ONE. 2019;14(7):e0219675.
39. Tenge C, Assessment of dietary intake of vitamin a-rich foods and associated factors among lactating, mothers attending Lunga Lunga health centre., In Sinai slum, Nairobi County, Kenya. Afr J Food Agric Nutr Dev. 2023;23(7).
40. Ndau E, Walters D, Wu D, Saleh N, Mosha T, Horton S et al. Factors influencing vitamin A status of lactating mothers in Manyara and Shinyanga regions of Tanzania. Tanzan J Agricultural Sci. 2016;15(1).
41. Kang Y, Hurley KM, Ruel-Bergeron J, Monclus AB, Oemcke R, Wu LSF, et al. Household food insecurity is associated with low dietary diversity among pregnant and lactating women in rural Malawi. Public Health Nutr. 2019;22(4):697–705.
42. Boke MM, Geremew AB. Low dietary diversity and associated factors among lactating mothers in Angecha districts, Southern Ethiopia: community based cross-sectional study. BMC Res Notes. 2018;11(1):1–6.
43. Fufa DA, Laloto TD. Assessment of dietary diversity and associated factors among lactating mothers in Debub Bench District. Heliyon. 2021;7(8):e07769.
44. Singh DR, Ghimire S, Upadhayay SR, Singh S, Ghimire U. Food insecurity and dietary diversity among lactating mothers in the urban municipality in the mountains of Nepal. PLoS ONE. 2020;15(1):e0227873.

Publisher's note