

# Predictors of Underweight Among Lactating Mothers in Dangila District, North West Ethiopia

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## Research

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## Abstract

**Background:** Health extension workers are responsible for providing nutritional services like nutritional assessment and intervention for individuals who are identified as being at nutrition risk within their catchment area. Despite the Ethiopian government's effort to reduce the prevalence of maternal malnutrition through health extension workers, maternal underweight is still a significant public health problem in the country. Hence, this study aimed to identify the predictors of underweight among lactating mothers in Dangila woreda, Amhara Regional State, Ethiopia.

**Methods:** An institution-based case-control study was conducted on 400 lactating women in three primary health care units of Dangila Woreda. A consecutive sampling method was used to select study participants. The data collectors were given appropriate training, and the principal investigator was continuously supervising the data collection process to ensure the accuracy and completeness of the information. A bivariable logistic regression was performed, and the variables with p-value <0.2 in bivariable logistic regression were entered to multivariable logistic regression to control the effect of confounding variables.

**Results:** The present study showed no statistically significant difference between the cases and controls in the sociodemographic characteristics. Besides, most of the cases had inadequate (60.52%) levels of nutritional knowledge compared to the controls. Regarding household food security, the majority (93.88%) of the cases and controls (89.43%) had food security while only 6.12% of the cases and 10.57% of the controls had food insecurity. Age at first pregnancy (AOR=2.138, 95% CI: 1.134-4.031), breastfeeding age (AOR=2.486, 95% CI: 1.281-4.823), and site of delivery (AOR=3.157, 95% CI: 1.407-7.084) were the predictors of underweight among lactating mothers.

**Conclusions:** Age at first pregnancy, site of delivery, and breastfeeding age were the significant predictors of underweight in lactating mothers. Therefore, interventions like promoting institutional delivery, prevention of teenage pregnancy, and enhancing the intake of adequate nutrition during lactation should be taken.

## Plain English Summary

Despite the Ethiopian government's effort to reduce the prevalence of maternal malnutrition through health extension workers, maternal underweight is still a significant public health problem in the country. The present study aimed to identify the factors affecting underweight among lactating mothers at Dangila Woreda, North West Ethiopia.

Four hundred lactating mothers were interviewed in three primary health care units of Dangila Woreda. The study showed that most underweight lactating mothers had inadequate (60.52%) nutritional knowledge levels. Regarding household food security, the majority (93.88%) of the underweight lactating mothers had food security. In summary, the study showed that age at first pregnancy, site of delivery, and breastfeeding age were the most common factors affecting underweight in lactating mothers.

## Background

Underweight is defined as too low body weight for an average healthy adult or child due to the lack of adequate nutrients. Except in severe cases such as ill geriatric communities, disabled persons, chronic disease victims, abandoned people, migrants, and people tormented by wars and natural catastrophes, this unhealthy weight is not much reported in industrialized countries. In some developing countries, underweight is a front-burning issue, leading to adverse health effects and rarely deaths in children, lactating mothers, and older people (1–3).

The global burden of maternal and child malnutrition is still alarmingly high, despite improving health services (4). In low-income and middle-income countries, maternal and child malnutrition is very prevalent, resulting in significant mortality rates (5). Besides, a systematic review and meta-analysis reported a 23.5% overall prevalence of malnutrition among pregnant women in Africa (6). Another systematic review also indicated that the prevalence of malnutrition among the East African countries was high (7). Among the segment of the population, lactating mothers are susceptible for under nutrition due to physiological change during lactation requires extra nutrients for milk production in order to build store (8). In developing countries, poor hygiene and sanitation, poverty, food insecurity, lack of adequate feeding practices for infants and young children, and a high burden of infectious diseases are the major factors responsible for maternal and childhood malnutrition (4). Previous studies in Ethiopia showed a high prevalence of underweight among lactating mothers, and the mean intake of calories and essential nutrients was below the minimum recommended level of requirement (9–12). Furthermore, a mini-review in Ethiopia also revealed that the prevalence of underweight was 50.6% among

lactating mothers in the Northern part of the country (13). Besides, high workload, dietary diversity score, age of women, food insecurity, limited access to nutritional information, delivery place, income level, nutritional education programs, low education level and antenatal care attendance were the main predictors of underweight in lactating mothers (9–12).

The prevention of maternal undernourishment needs intervention at all stages of development and growth due to malnutrition's intergenerational effect (14). The Federal Ministry of Health of Ethiopia established a national nutrition program to address malnutrition in the country effectively. This program was designed to diminish the magnitude of malnutrition among pregnant, lactating mothers, and under-five children in Ethiopia (15). As part of this policy, Ethiopia's health sector has also stepped up its efforts to promote acceptable dietary practices through health education and treatment of severe malnutrition among children and lactating mothers (16).

Health extension workers are responsible for delivering nutritional services such as nutrition evaluation and intervention for individuals classified as at risk for nutrition within their catchment area (17). Despite the Ethiopian government's effort to reduce maternal malnutrition through health extension workers, maternal underweight is still a significant public health problem in the country. In addition, due to the remote nature of the study area, the past nutritional intervention programs were not effectively implemented in the study setting. Besides, research-based data of maternal nutrition from the study populations was minimal. Information on feeding habits, nutritional status, and related factors for lactating women is urgently required to prioritize, design, and implement intervention programs to enhance maternal nutrition. Thus, this study was carried out to assess the predictors of underweight among lactating women in the study setting.

## Methods

### Study design, area and period

The institution-based case-control study design was conducted in the Northwest part of Ethiopia. Ethiopia is one of the fast-growing and landlocked countries in the Horn of Africa, and Addis Ababa is the capital city. Ethiopia is bordered by Eritrea, Djibouti, Somalia, Kenya, South Sudan, and Sudan. The country comprises nine regional and two administrative states. Amhara region is one of the largest regional states in Ethiopia and has several sub administration units. Among these, Dangila woreda (the study area) is one of the administrative subunits and located at 487 km away from Addis Ababa and 78 kilometers from Bahir Dar, the capital city of Amhara Region. The woreda has 31 districts, and two of them were a town. The remaining 29 districts are rural (agricultural community) and have six health centers and 31 health posts, and 72 health professionals (Figure 1). Based on the district's annual report, it has an estimated total population of 155,562 in the year 2017/2018. From these, 77562 and 77873 were males and females, respectively (18).

### Source population

All lactating mothers visited the Maternal and child health clinic in all the six health centers of Dangila Woreda, during the data collection period.

### Study population for cases

All lactating mothers ( $BMI < 18.5 \text{ kg/m}^2$ ) visited the three selected health centers of Dangila Woreda during the data collection period.

### Study population for controls

All lactating mothers ( $BMI \geq 18.5 \text{ kg/m}^2$ ) visited the three selected health centers of Dangila Woreda during the data collection period.

### Inclusion criteria for cases

All lactating mothers whose body mass index was  $< 18.5 \text{ kg/m}^2$  and gave birth before six weeks prior to the study period and able to give oral consent were included in the study.

### Inclusion criteria for controls

All lactating mothers whose body mass index was  $\geq 18.5 \text{ kg/m}^2$  & gave birth before six weeks prior to the study period and able to give oral consent were included in the study. The controls were unmatched.

### **Exclusion criteria for cases**

All lactating mothers whose body mass index was  $\geq 18.5 \text{ kg/m}^2$  & gave birth before six weeks before the study period, and gave oral consent were included in the study.

### **Exclusion criteria for controls**

Those lactating mothers whose body mass index was  $\geq 18.5 \text{ kg/m}^2$  and had a critical illness, hearing impairment, and physical deformities during the anthropometric measurements were excluded from the study. Lactating mothers whose children age less than six weeks and those lactating mothers whose child's age from 6 weeks to 2 years but non-lactating due to formula feeding were also excluded from the study.

### **Sample size determination**

The sample size was estimated using Epi-info-7 software-based on the assumption of 95% confidence interval, 80% power, control to case ratio of 3:1, frequency of family size in controls 26.02%, adjusted odds ratio of 0.46, and non-response rate of 5% yielding 300 controls and 100 cases (400 study participants).

### **Sampling procedure**

In the study area, there are six health centers. First, the three health centers were selected from the existing six health centers by lottery method. The three selected health centers were called Chara, Abadra, and Gumdry. Secondly, the average monthly number of lactating mothers visiting the Mother and Child Health Clinic & Expanded Programme on Immunization in each selected health centers was calculated. The average number of lactating mothers visiting the Mother and Child Health Clinic & Expanded Programme on Immunization clinic of Chara, Abadra, and Gumdry health centers monthly were 212,186 & 145 respectively. Thirdly, the sample size was allocated proportionally to each of the three selected health centers based on the number of lactating mothers visiting the Mother and Child Health Clinic & Expanded Programme on Immunization during the data collection period. The number of lactating mothers interviewed from Chara, Abadra, and Gumdry health centers was 151, 134, and 104, respectively (Figure 2). Lastly, to select the study participant, every case and every control consecutively were selected. All lactating mothers whose Child's age from 6 weeks to 2 years old who were visiting the Mother and Child Health Clinics during the data collection period were screened using their anthropometric data. Underweight mothers were first identified, and then cases were selected based on the inclusion and exclusion criteria. Cases were lactating mothers diagnosed with underweight ( $\text{BMI} < 18.5 \text{ kg/m}^2$ ), which can be moderate to severe regardless of the types of malnutrition. As the case was identified, three controls were selected consecutively. Controls were lactating mothers without malnutrition (have anthropometric readings of  $\text{BMI} \geq 18.5 \text{ kg/m}^2$ ). The data collectors selected controls and cases from the same Primary Health Care Unit. After measurements, mothers were interviewed based on a validated questionnaire.

### **Data collection procedure and instrument**

In collaboration with expert opinions in the field, the investigators developed the study questionnaire, and the questions were selected based on similar studies in Ethiopia with slight modification (9–11)

The data collector group had four members (three diploma nurses assigned for data collection and one BSC nurse as a field supervisor). They took appropriate training about the data collection instrument. The data collectors were following all the recommended consent forms and steps in the questionnaire. The data were collected through interviewer-administered questionnaires to collect information on the socio-demographic data of lactating mothers, family size, and socioeconomic characteristics like occupation, monthly income, and dietary diversity.

The anthropometric measurement tools were calibrated daily before the measurement by the principal investigator. Weight was taken using a battery-powered digital scale, and the reading was taken to the nearest 0.1kg. Wooden height board was used to measure the height of lactating mothers, and the respondents asked to erect on barefoot while measurement was taken, the reading measurement was taken to the nearest 0.1 cm. Then body mass index Index was computed using the following formula ( $\text{BMI} = \text{weight in kilogram divided by height in meter square for each respondent}$ ). All measurement was taken using standard procedures. Those lactating mothers whose  $\text{BMI} < 18.5 \text{ kg/m}^2$  were counseled on the recommended feeding practices during lactation. The household food insecurity scale established by the Food and Nutrition Technical Assistance was employed to measure the household food security

status of the study participants (19). To ensure the accuracy of the data collection, the entire questionnaire was translated into the local Amharic language and translated back into the English language during the analysis.

### **Study variables**

The presence of underweight was the outcome variable of the study, which could be influenced by the independent variables. Age of the child, age of the mother, educational status of the mother, parity, marital status, limited dietary intake, frequency of antenatal care visits, dietary intake, nutritional knowledge, dietary diversity, household food insecurity, place of delivery, family size, age at first pregnancy were the main independent variables of the study.

### **Data quality control**

The clarity, length of time required, content and wording of the questions of the translated questionnaire was checked by data collectors who can read and write the local language as well as by conducting a pretest in the nearby of the study area where the population lives and share similar language and lifestyle. The reliability, validity, consistency, and accuracy of the measurement was assessed and checked by the technical error of measurement. The data collectors were given appropriate training, and the principal investigator was continuously supervising the data collection process to ensure the accuracy and completeness of the information. A pretest of the data collection instrument was conducted in 5% of the sample size in another woreda. Before applying in the main study, all the relevant modifications were considered.

### **Data analysis**

After the completion of the data collection process, all the questionnaires were checked for completeness, clarity, and consistency accordingly, and the data were entered by using EPI-Data 3.02 version statistical software and analyzed by using statistical package for social science version 23 software. Descriptive statistics were computed to calculate the underweight predictors among lactating mothers, and it was analyzed as per educational status, occupational status, and other variables. A bivariate logistic regression was performed, and the variables with p-value <0.2 in the bivariate logistic regression were entered to multivariate logistic regression to control the effect of confounding variables. The result was presented as proportion, the output of logistic regression as an adjusted odds ratio with 95% confidence intervals. P-value < 0.05 was considered as statistically significant.

### **Operational definition of terms**

**Dietary diversity:** Those lactating mothers who eat 6 and above food groups are considered to be diversified and those lactating mothers who eat below 6 food groups are considered to be not diversified.

**Adequate Knowledge:** If respondents score  $\geq 70\%$  on the knowledge questions (20).

**Inadequate knowledge:** If respondents score < 70% on the knowledge questions (20).

**Lactating mothers:** Women who are currently feeding breast milk for their infant/child.

**Underweight:** When the computed body mass index of lactating mothers < 18.5kg/m<sup>2</sup>.

## **Results**

### **Socio-demographic characteristics of the study participants**

A total of 389 lactating mothers were interviewed, with a 9.25% response rate. The study participants included in the study were 291 lactating mothers whose BMI  $\geq 18.5$  kg/m<sup>2</sup> (controls) and 98 lactating mothers whose BMI <18.5 kg/m<sup>2</sup> (cases). The mean age of the controls was 27.52 $\pm$ 4.75 years, whereas the mean age of the cases was 28.2 $\pm$  5.925 years (Table 1).

The present study showed no statistically significant difference between the cases and controls in the sociodemographic characteristics. Despite this, most of the controls were illiterate, had  $\leq$  four parity,  $\geq$ five family size, 3-6 number of gravidity, nutritional education, and higher frequency of feeding than the cases. Only 11(11.22%) of the cases and 70(24.05%) of the controls have a secondary and above level of education (Table2). Regarding their marital status, 95(96.94%) of the cases and 285(97.94%) of the

controls were married. Besides, most of the cases had inadequate (60.52%) levels of nutritional knowledge compared to the controls (Table 1).

**Table 1:** Socio-demographic characteristics of the study participants (n=389)

	Cases	Controls	COR(95%CI)	AOR(95%CI)	P-value
<b>Socio-demographic variables</b>	<b>Frequency (%)</b>	<b>Frequency(%)</b>			
<b>Age at first pregnancy</b>					
< 18years	28(28.57)	46(18.47)	1.872(1.085,3.231)	2.138(1.134, 4.031)	0.019
≥ 18 years	66(67.35)	203(81.53)	1	1	
<b>Number of gravidity</b>					
≤2	43(43.88)	116(39.86)	1		
3-6	52(53.06)	169(58.08)	0.83(0.520,1.325)		0.435
≥7	3(3.06)	6(2.06)	1.349(0.323,5.633)		.682
<b>Parity</b>					
≤4	91(92.86)	273(93.81)	0.862(0.474,1.566)		0.625
≥5	7(7.14)	18(6.19)	1		
<b>Age groups</b>					
15-19	2(2.17)	4(1.44)	1		
20-24	21(22.83)	64(23.02)	0.656(0.112,3.843)		0.640
25-29	29(31.52)	119(42.81)	0.487(0.085,2.791)		0.420
30-34	24(26.09)	55(19.78)	.873(0.150,5.092)		0.880
35-49	16(17.39)	36(12.95)	0.889(0.147,5.359)		0.898
<b>Maternal educational status</b>					
No education	61(62.24)	153(52.58)	1		
Primary education	26(26.53)	68(23.37)	0.959(0.558, 1.647)	1.101(0.566, 2.144)	0.776
Secondary and above	11(11.22)	70(24.05)	0.394 (0.195, 0.795)	0.682(.285, 1.628)	0.388
<b>Marital status</b>					
Married	95(96.94)	285(97.94)	0.667(0.060,7.435)		0.742
Divorced	2(2.04)	4(1.37)	1(0.053,18.915)		1
Single/separated	1(1.02)	2(0.69)	1		
<b>Occupation</b>					
Housewife	31(31.62)	85(29.21)	1		
Agriculture	53(54.08)	179(61.51)	0.812(0.486,1.356)		0.426
Government employee	14(14.29)	27(9.28)	1.422(0.661,3.056)		0.368
<b>Nutritional knowledge</b>					
Inadequate	46(60.52)	120(45.80)	1.814 (1.078- 3.053)	1.235 (0.658- 2.319)	0.511
Adequate	30(39.47)	142(54.20)	1	1	
<b>Family size</b>					

≤4	42(42.86)	125(42.96)	1	
≥5	56(57.14)	166(57.04)	1.004(0.632,1.594)	0.986
<b>Nutrition education</b>				
Yes	64(65.31)	191(65.64)	1	
No	34(34.69)	100(34.36)	1.01(0.63,1.64)	0.95
<b>Frequency of feeding</b>				
< 3 times per day	22(22.45)	42(14.43)	1	
≥ 3 times per day	76(77.55)	249(85.57)	0.58(0.33,1.04)	0.066

COR: Crude odds ratio, AOR: Adjusted odds ratio

### Maternal health and feeding practices

Nearly all (98.63%) controls and cases (98.98%) received antenatal care at least once during their last pregnancies, and also 75.96% of controls and 74.23% of the cases had antenatal care visits of greater than or equal to 4 times (which is recommended). The majority (93.81%) of the controls and 92.86% of cases had 1-4 previous pregnancies. Besides, 8.25% of the controls and 15.31% of the cases gave birth to their last baby at home. Contrastingly, 9.28% of the controls and 17.35% of the cases had no health facility in nearby areas. Approximately more than half of the controls (65.64%) and cases (65.31%) got nutrition education in their community (Table 2).

Regarding household food security, the majority (93.88%) of the cases and controls (89.43%) had food security while only 6.12% of the cases and 10.57% of the controls had food insecurity. Besides, most of the cases and controls had no additional food consumption during their lactation period (Table 2).

### Anthropometric status of the study participants

The mean height, weight, and BMI of the control groups were 1.56±0.07 meter, 53.39±7.51 kg, 21.84±2.37 kg/m<sup>2</sup>, respectively, while the mean height, weight, and BMI of the cases were 1.59±0.08 meter, 44.28±4.09 kg, 17.50 ±0.89 kg/m<sup>2</sup>, respectively (Table 2).

**Table 2:** Dietary intake, maternal health service utilization & food insecurity access scale

	Cases	Controls
	Frequency (%)	Frequency (%)
<b>ANC follow up</b>		
Yes	97(98.98)	287(98.63)
No	1(1.02)	4(1.37)
<b>Numbers of ANC follow up</b>		
< 4 times	22(22.68)	69(24.04)
≥ 4 times	75(77.32)	218(75.96)
<b>Consumption of food differently from household member</b>		
Yes	34(34.69)	92(31.61)
No	64(65.31)	199(68.38)
<b>Age of breast feeding child</b>		
< 6 months	20(20.41)	106(36.43)
6-11 months	56(57.14)	107(36.77)
12-24 months	22(22.45)	78(26.80)
<b>Parity</b>		
≤2	43(43.88)	116(39.86)
3-6	52(53.06)	169(58.08)
≥7	3(3.06)	6(2.06)
<b>Additional food consumption during lactation</b>		
Yes	26(26.53)	104(34.90)
No	72(73.47)	187(64.26)
<b>Food insecurity scale</b>		
Food secure	92(93.88)	347(89.43)
Food insecure	6(6.12)	41(10.57)
<b>Maternal height in meter</b>		
≤1.45	7(7.14)	26(8.93)
>1.45	91(92.86)	265(88.93)
<b>Maternal weight in kg</b>		
≤45	60(61.22)	29(9.97)
>45	38(38.78)	262(90.03)

**ANC: Antenatal care**

#### **Factors associated with the nutritional status of the lactating mothers**

According to the multivariable regression analysis, women who had a child whose age was 6-11 months were 2.486 times more likely to be underweight (BMI < 18.5 kg/m<sup>2</sup>) as compared with those lactating mothers whose child age was <6 months (AOR=2.486, 95% CI: 1.281-4.823, p=0.019). Similarly, women whose age at first pregnancy < 18 years were 2.138 times more likely to be underweight compared with lactating mothers of age at first pregnancy ≥18 years (AOR=2.138, 95% CI: 1.134-4.031, p=0.007). Moreover, lactating mothers whose site of delivery at home was 3.157 times more likely to be underweight compared with those lactating mothers whose

site of delivery was at a health facility (AOR=3.157 95% CI:1.407-7.084, p=0.005). Nonetheless, underweight was not significantly associated with maternal educational status, family size, maternal age, number of meals per day, parity, feeding frequency, consumption of additional foods, ANC follow up, occupational status, dietary diversity score, and age of women (Table 3).

**Table 3:** Associated factors of underweight among lactating women of reproductive age

Variable	Categories	Nutritional status of		COR(95%CI)	AOR(95%CI)	P-value
		lactating	mothers			
		Cases, N (%)	Controls, N (%)			
Age at first pregnancy	<18	28(28.57)	46(18.47)	1.872(1.085-3.231)	2.138(1.134-4.031)	0.019*
	≥18	66(67.35)	203(81.53)	1	1	
Age of baby	<6	20(20.41)	106(36.43)	1	1	0.007*
	6-11	56(57.14)	107(36.77)	2.774(1.558-4.939)	2.486(1.281-4.823)	
	12-23	22(22.45)	78(26.80)	1.495(0.763-2.928)	1.181(0.537-2.596)	
Site of delivery	At home	15(15.31)	24(8.25)	2.011 (1.008-4.011)	3.157(1.407-7.084)	0.005*
	At health facility	83(84.69)	267(91.75)	1	1	
Knowledge about nutrition	Inadequate	46(60.52)	120(45.80)	1.814 (1.078-3.053)	1.235 (0.658-2.319)	0.511
	Adequate	30(39.47)	142(54.20)	1	1	
Dietary diversity score	Adequate	12(12.24)	56(19.24)	1	1	0.347
	Inadequate	86(87.76)	235(80.76)	1.708(0.873-3.340)	1.513(0.638-3.586)	
Additional food consumption during lactation	Yes	26(26.53)	104(35.74)	1	1	0.180
	No	72(73.47)	187(64.26)	1.540(0.926-2.561)	1.567 (0.813-3.021)	
Educational Status of the woman	No education	61(62.24)	153(52.58)	1		0.776
	Primary education	26(26.53)	68(23.37)	0.959(0.558, 1.647)	1.101(0.566-2.144)	
	Secondary & above education	11(11.22)	70(24.05)	0.394 (0.195-0.795)	0.682(.285-1.628)	

Abbreviations: COR, Crude odds ratio; AOR, Adjusted odds ratio; CI, Confidence interval, \*= Statistically significant with p <0.05.

## Discussion

During lactation, women are most vulnerable to undernutrition, where food and nutrient requirements are more significant during this period (3). In this study finding, factors associated with the underweight of lactating women were identified. Accordingly, age at first pregnancy, age of breastfeeding child, and delivery site were the significant predictors of underweight among lactating mothers in the study setting.

The odds of underweight in lactating mothers whose first age of pregnancy <18 years were 2.138 times more likely to be underweight than those whose first age of pregnancy was  $\geq 18$  years (AOR= 2.138, 95% CI: 1.134-4.031). This finding is similar to other findings (21–23). Studies conducted in Ethiopia also showed that women in the youngest age group (15–19) were more likely to be affected by underweight (22). This may be due to in this stage of life; lactating mothers undergo many physical, emotional, and social changes that increase nutritional demand. These changes include but not limited to the following; rapid growth in height and weight, maturation of the sexual organs, changes in the shape of the body, irritation, and anger. They may also be forced to discontinue their education and become dependent throughout their life that can jeopardize their health and physical development resulting in delayed or stunted skeletal growth and anemia. Early sexual activity and the associated health problems like abortion and miscarriage may also endanger women's nutritional status at this age. There may be immature anatomical and physiological conditions in younger women leading to underweight (24,25).

The association between age of breastfeeding child and underweight could be explained by the odds of underweight in lactating mothers whose child's age 6-11 months were 2.486 times more likely than those whose child's age is < 6 months. This is consistent with other study findings (3). This could be because of the increased nutritional requirement of the growing child but not increased food intake by the mother. Another reason could also be giving less attention and care to the mother, workload, and closely spaced pregnancies. Therefore, health professionals and health extension workers should provide nutritional education in different villages, health centers, health posts, and women organizations for the community, particularly for the lactating mothers concerning nutrition during 6-11 months of breastfeeding in the study area.

Lactating mothers who gave birth at home were 3.157 times more likely to be underweight than women who gave birth at a health facility. This is consistent with other findings (21). This could be explained by a reduced risk of obstetric complications in women who deliver at health institutions. Such hazards include excessive bleeding, which could influence the overall health status of lactating women. Besides, women who gave birth at a health facility can get nutrition-related health education from health professionals, which will help them to adopt good behaviors related to nutrition and prevent underweight (21). Mothers who gave birth at home may be susceptible to infection, which indirectly leads to malnutrition.

Nonetheless, underweight was not significantly associated with maternal educational status, family size, maternal age, number of meals per day, parity, feeding frequency, consumption of additional foods, antenatal care follow up, occupational status, dietary diversity score, and age of women. Contrastingly, Berihun *et al* reported that family size of less than five and absence of nutritional education were significant predictors of underweight among lactating mothers (21).

Despite food insecurity is the major emerging challenge among the lactating mothers in Ethiopia (26), the majority (93.88%) of the cases and controls (89.43%) in the present study had food security. In contrast, only a few cases and controls had food insecurity problems. In previous studies, women who had food security had a better nutritional status than their counterparts (12,27). However, the present study did not reveal a significant association with the underweight of lactating mothers. Besides, most of the cases and controls had no additional food consumption during their lactation period. Despite this, nutritional intervention programs and routine anthropometric measurement should be practiced efficiently among lactating mothers at the community level to reduce the risk of malnutrition. On top of this, most of the cases had inadequate (60.52%) nutritional knowledge levels compared to the controls. Hence, health professionals & health extension workers should increase awareness of the community about the essence of balanced nutritional status of lactating mothers. Accordingly, effective implementation of the above measures at the community levels will eradicate maternal underweight and foster healthier generations' buildup in the future.

### **Limitations of the study**

Since it is a few facility-based studies, it may not be representative of the general population. Hence, further investigation should be considered in a multicenter setting or at a community level to get representative findings of the general population. Besides, the knowledge questions may not reliably assess lactating mothers' nutritional knowledge and the possible recall bias since some question requested about past events.

## **Conclusions**

Undernutrition (BMI <18.5 kg/m<sup>2</sup>) in women of reproductive age was associated with factors such as age at first pregnancy, site of delivery, and age of breastfeeding child. Interventions like promoting institutional delivery, preventing teenage pregnancy, and improving adequate nutrition intake during lactation should be taken.

## List Of Abbreviations

**AOR:** Adjusted odds ratio

**ANC:** Antenatal care

**BMI:** Body mass index

**CI:** Confidence interval

**COR:** Crude odds ratio

## Declarations

### Ethics approval and consent to participate

This study's ethical approval was obtained from the Institutional Review Board of Bahir Dar University, College of Medicine and Health Sciences (Approval Number: APHRI/278/2019). At all levels, officials were contacted with a formal letter obtained from Amhara Public Health Research Institute to secure permission. The permission letter was submitted to Awi Health Bureau, Dangila Woreda Health Office, and Health Centers included in the study area.

The data collectors explained the stud's objectives, potential risks, and benefits of participating in the study for each study participant before data collection. Informed written consent was obtained from the respondents before the interview. The collected data were kept confidential and used for research purposes only. The respondent's name was not included in the questionnaire & they have the right to withdraw from the study at any time if they are not comfortable with the study.

### Consent for publication

Written consent for publication was obtained from the study participants to disseminate their data to the public anonymously.

### Availability of data and materials

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

### Competing interests

The authors declare that there is no conflict of interest.

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### Authors' contributions

All authors were equally contributed to the conception, design, data collection, analysis, and preparation of the manuscript.

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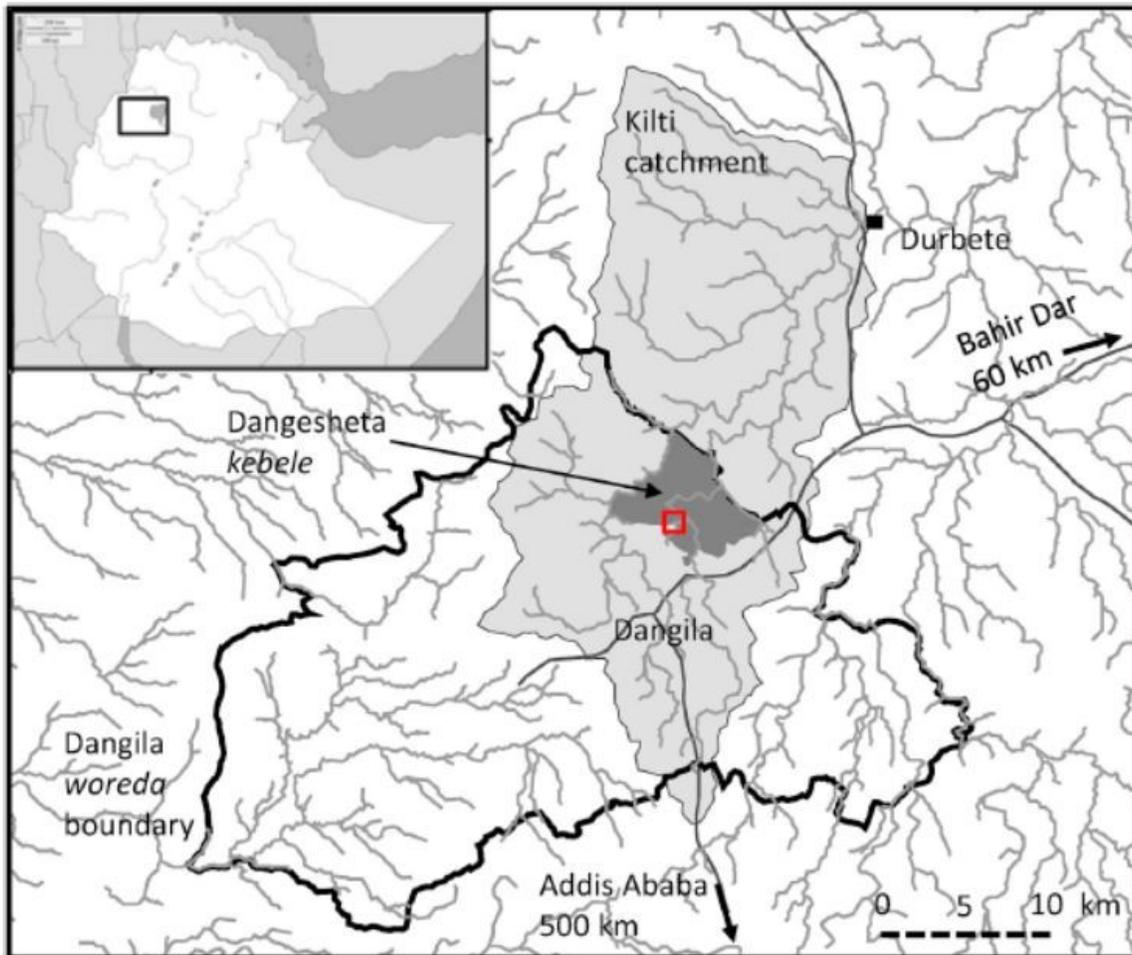
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## References

1. Dewan M. Malnutrition in Women. *Stud Home Community Sci.* 2008;2(1):7–10.
2. Fraise AP, Maillard JY, Sattar SA. Russell, Hugo & Ayliffe's: Principles and Practice of Disinfection, Preservation and Sterilization. Russell, Hugo & Ayliffe's: Principles and Practice of Disinfection, Preservation and Sterilization. 2012.
3. Hailelassie K, Mulugeta A, Girma M. Feeding practices, nutritional status and associated factors of lactating women in Samre Woreda, South Eastern Zone of Tigray, Ethiopia. *Nutr J.* 2013;12(28).

4. Ahmed T, Hossain M, Sanin KI. Global burden of maternal and child undernutrition and micronutrient deficiencies. *Ann Nutr Metab.* 2012;61(suppl):8–17.
5. Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, et al. Maternal and child undernutrition: global and regional exposures and health consequences. *Lancet.* 2008;371(9608):243–60.
6. Desyibelew HD, Dadi AF. Burden and determinants of malnutrition among pregnant women in Africa: A systematic review and meta-analysis. *PLoS One.* 2019;14(9):e0221712.
7. Akombi BJ, Agho KE, Merom D, Renzaho AM, Hall JJ. Child malnutrition in sub-Saharan Africa: A meta-analysis of demographic and health surveys (2006-2016). *PLoS One.* 2017;12(5):e0177338.
8. Kominiarek MA, Rajan P. Nutrition Recommendations in Pregnancy and Lactation. *Med Clin North Am.* 2016;100(6):1199–1215.
9. Serbesa ML, Iffa M, Geleto M. Factors associated with malnutrition among pregnant women and lactating mothers in Mieso Health Center, Ethiopia. *Eur J Midwifery.* 2019;3:1–5.
10. Gebre B, Biadgilign S, Taddese Z, Legesse T, Letebo M. Determinants of malnutrition among pregnant and lactating women under humanitarian setting in Ethiopia. *BMC Nutr.* 2018;4(1):11.
11. Bekele H, Jima GH, Regesu AH. Undernutrition and Associated Factors among Lactating Women: Community-Based Cross-Sectional Study in Moyale District, Borena Zone, Southern Ethiopia. *Adv Public Heal.* 2020;2020:10.
12. 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):913–922.
13. Sserwanja Q, Kawuki J. Prevalence of Underweight and Associated Factors among Lactating Women in Ethiopia: A Mini-review. *J Adv Med Med Res.* 2020;32(8):1–9.
14. Blössner M, Onis M De, Organization WH. Malnutrition: quantifying the health impact at national and local levels [Internet]. *Environmental Burden Disease Series.* 2005 [cited 2019 Aug 12]. Available from: [https://www.who.int/nutgrowthdb/publications/quantifying\\_health\\_impact/en/](https://www.who.int/nutgrowthdb/publications/quantifying_health_impact/en/)
15. Walls H, Johnston D, Vecchione E, Adam A, Parkhurst J. The role of evidence in nutrition policy-making in Ethiopia: Institutional structures and issue framing. *Dev Policy Rev.* 2019;37:293–310.
16. EDHS 2016 Team. Ethiopian Demographic and Health Survey. Report. 2016.
17. Pallas SW, Minhas D, Pérez-Escamilla R, Taylor L, Curry L, Bradley EH. Community health workers in low- and middle-income countries: What do we know about scaling up and sustainability? *Am J Public Health.* 2013;103(7):e74-82.
18. Central Statistical, Authority. 2007 population and housing census of Ethiopia. 2007.
19. Salvador Castell G, Pérez Rodrigo C, Ngo de la Cruz J, Aranceta Bartrina J. Household food insecurity access scale (HFIAS). *Nutr Hosp.* 2015;31(3):272-8.
20. Zerihun E, Egata G, Mesfin F. Under Nutrition and its Associated Factors among Lactating Mothers in Rural Ambo District, West Shewa Zone, Oromia Region, Ethiopia. *East African J Heal Biomed Sci.* 2016;1:39–48.
21. Berihun S, Kassa GM, Teshome M. Factors associated with underweight among lactating women in Womberma woreda, Northwest Ethiopia; a cross-sectional study. *BMC Nutr.* 2017;3(1):46.
22. Teller C, Yimer G. Levels and Determinants of Malnutrition in Adolescent and Adult Women in Southern Ethiopia. *Ethiop J Heal Dev.* 2000;14(1):57–66.
23. Bhandari S, Sayami JT, Thapa P, Sayami M, Kandel BP, Banjara MR. Dietary intake patterns and nutritional status of women of reproductive age in Nepal: Findings from a health survey. *Arch Public Heal.* 2016;74(1):1–11.
24. Smith J. Nutrition and the pregnant adolescent: a practical reference guide. by Mary Story and Jamie Stang (editors). Center for leadership, education, and training in maternal and child health. University of Minnesota, Minneapolis, MN. 2000. 247 pages. *Journal of Midwifery & Women's Health.* 2001.
25. Bhandari SD, Joshi S. Perception and Perceived Experiences about Prevention and Consequences of Teenage Pregnancy and Childbirth among Teenage Mothers: A Qualitative Study. *J Adv Acad Res.* 2017;3(1):164-7(1):164–72.
26. Endalew B, Muche M, Tadesse S. Assessment of food security situation in ethiopia: A Review. *Asian J Agric Res.* 2015;9:55–68.
27. Motbainor A, Worku A, Kumie A. Household food insecurity is associated with both body mass index and middle upper-arm circumference of mothers in northwest Ethiopia: A comparative study. *Int J Womens Health.* 2017;9(379–389).

## Figures



**Figure 1**

Map of Dangila woreda administration state in Amhara region. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

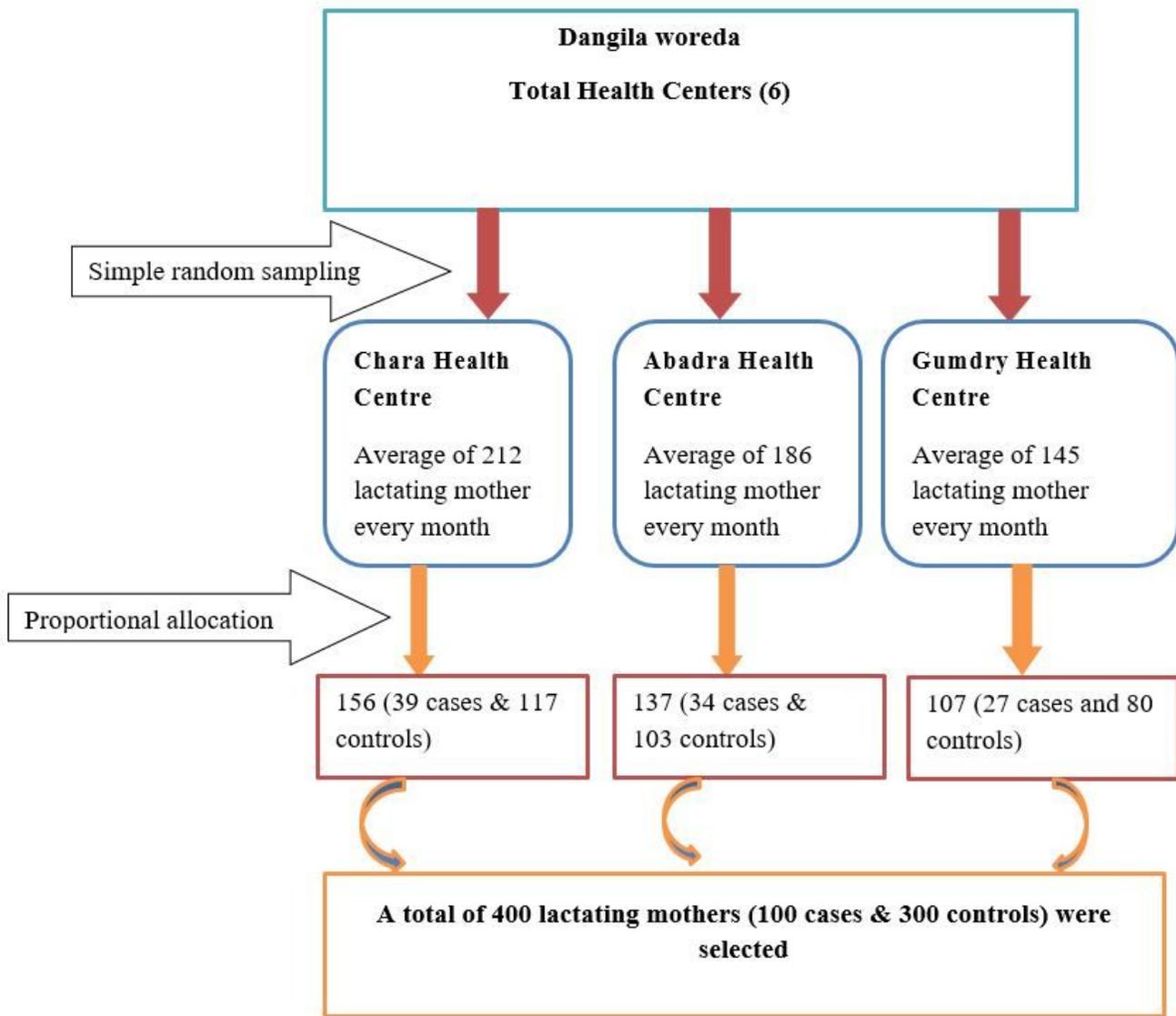


Figure 2

Schematic presentation of sampling procedure.