Original Article

Prevalence of Goiter and Associated Factors Among Adolescents in Gazgibla District, Northeast Ethiopia

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Gebremedhin Gebremichael, MPH[1], Melake Demena, MPH[2], Gudina Egata, PhD[3], and Berhe Gebremichael, MPH[2]

Abstract

Background: Although goiter is a major public health problem in Ethiopia and affects a large number of people, there was little evidence among adolescents particularly in Northern Ethiopia. This study was, therefore, aimed at investigating the prevalence of goiter and associated factors among adolescents in Gazgibla District, Northeast Ethiopia.

Methods: A community-based cross-sectional study was conducted among 596 adolescents from August 5–30, 2019. Data were collected using a structured questionnaire. Adolescents were assessed for goiter based on World Health Organization criteria. The level of iodine in household salt samples was tested using rapid test kit. Data were entered into EpiData version 3.1 and exported into Statistical Package for the Social Sciences version 22.0 for statistical analysis. Multivariable logistic regression analysis was done to control for all possible confounders and to identify predictors of goiter. Odds ratio along with 95% confidence interval (CI) was estimated to measure the strength of the association. Level of statistical significance was declared at $P \leq .05$.

Results: The prevalence of goiter among adolescents was 42.5% (95% CI: 38.4%, 46.7%). Being a female (adjusted odds ratio [AOR] = 1.83, 95% CI: 1.18, 2.85), family history of goiter (AOR = 3.63, 95% CI: 2.31, 5.69), cabbage consumption at least once per week (AOR = 4.6, 95% CI: 2.42, 8.74), not consuming meat at all (AOR = 2.5, 95% CI: 1.17, 5.32), not consuming milk at all (AOR = 2.19, 95% CI: 1.19, 4.03), and inadequate iodine level of household salt (AOR = 7.05, 95% CI: 3.83, 12.97) were significantly associated with the development of goiter among adolescents.

Conclusions: The prevalence of goiter was very high in the study area. Therefore, the health sector of the district should invest efforts on improving the community's awareness through disseminating key messages about iodized salt and iodine-rich foods.

Keywords
adolescents, Ethiopia, Gazgibla District, Goiter

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Background

Thyroid gland plays a critical role in regulating the metabolic processes of the body by producing thyroid hormones.[1,2] Iodine is an essential component of these hormones. Deficiency of iodine results in goiter which is the abnormal growth of thyroid gland, clinically detected by physical inspection and palpation.[3,4] Goiter is an indicator of chronic iodine deficiency and is a major public health problem in several areas of the world, especially in developing countries.[5]

Globally, 30% of the world's population is affected by iodine deficiency disorders (IDDs). More than 150 000 million people are affected by IDDs.[6] Worldwide, the prevalence of goiter in the general population is estimated to be 15.8% varying between 4.7% in America and 28.3% in Africa.[7]

[1]Gazgibla District Health Office, Asketema, Ethiopia
[2]School of Public Health, College of Health and Medical Sciences, Haramaya University, Harar, Ethiopia
[3]School of Public Health, College of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia

Corresponding Author:
Berhe Gebremichael, College of Health and Medical Sciences, Haramaya University, Harar, Ethiopia.
Email: berhegere09@gmail.com

Ethiopia is among the iodine deficient countries in the world[8] where about 28 million people suffer from goiter and more than 35 million people are at risk of iodine deficiency.[9] Goiter prevalence rates vary significantly from region to region in Ethiopia and in certain areas, the prevalence rate may be as high as 71%.[10] The total goiter prevalence in Ethiopia was 35.8% in which 24.3% and 11.5% were palpable and visible goiter, respectively. The prevalence in 4 regional states of Ethiopia, namely, Southern Nations Nationalities and Peoples Region, Oromia, Benshangul-Gumuz, and Tigray was greater than 30% with maximum of 60%, which is an indication of severe iodine deficiency.[11]

Children and adolescents are particularly vulnerable to IDDs[12] because of puberty related changes in thyroid function that may increase the need for iodine.[13,14] The estimated annual potential cost attributable to IDDs in the developing world prior to widespread salt iodization was $35.7 billion per year versus $0.5 billion per year after salt iodization, giving a benefit cost ratio of 70:1.[15] The productivity loss due to the negative impact of iodine deficiency on health, poor physical growth, compromised intellectual capacity and lower educational attainment in Ethiopia was estimated to be 64 billion Ethiopian Birr (ETB) [2 billion United States Dollars (USD)] between 2006 and 2015.[16]

Different studies revealed that age,[17–20] sex,[17,21–23] socioeconomic status,[18,20,24] family history of goiter,[20] excessive consumption of goitrogenic foods,[21,24–27] and level of iodine in household salt[17,18,22,24,27] have been shown to be the major risk factors for goiter.

Ethiopia had endorsed the mandatory universal salt iodization program in 2011 with the goal of reaching more than 90% coverage by 2015. Consequently, 2 nationwide surveys conducted in 2015 and 2016 found that over 89% of the salt in the country contained iodine.[28,29] However, only 26% of the household salts were adequately iodized ($\geq$15 parts per million [ppm]).[29]

Even though there were studies done on goiter in Ethiopia, most of them were conducted among school-age (aged 6–12 years) children. Evidence about goiter among adolescents was little in Ethiopia,[30] especially in the study area. Therefore, this study was designed to assess the prevalence of goiter and its associated factors among adolescents in Gazgibla District, Northeast Ethiopia.

Methods

Study Setting, Design, and Participants

A community-based cross-sectional study was conducted among adolescents in Gazgibla District, Northeast Ethiopia from August 5–30, 2019. The district is located at a distance of 887 km northeast of Addis Ababa, the capital of Ethiopia. It has 21 kebeles (*kebele is the smallest administrative unit in Ethiopia*) with a total population of 88,044 (43,142 males and 44,902 females) and total households of 20,475. The livelihood of the population is based on agriculture, mainly crop producing subsistence farming. Topographically, the district lies on an elevation ranging from 1,500 to 4,000 m above the sea level.[31] The study population includes adolescents (aged 10–19 years) with their mothers/guardians living in Gazgibla District. Adolescents with serious physical or mental illness were excluded from the study because it was difficult to get the necessary data/measurement from these adolescents. In addition, adolescents who had lived in the study area for less than 6 months were excluded.

Sample Size and Sampling Procedure

The sample size for the prevalence of goiter was determined using a single population proportion formula considering the following assumptions: 95% confidence level, 5% margin of error, 1.5 design effect, and proportion of goiter (37.6%).[17] This provided a sample size of 542. The sample size for the factors associated with goiter was calculated in Open Epi online software with the following assumptions: 95% confidence level, 80% power, equal unexposed to exposed ratio (1:1), and proportion of goiter among females (45.3%) and males (28.8%).[17] This resulted in a sample size of 323. The sample size calculated for the prevalence of goiter (542) was used for this study as it was greater than the calculated sample size for the associated factors. Ten percent was added for nonresponders, yielding a final sample size of 596.

To select the study participants, first the district was stratified into rural and urban kebeles. There were 20 rural and 1 urban kebeles in the district. From the rural kebeles, 5 (25%) of them were selected using simple random sampling. The single urban kebele was also included into the study making the total selected kebeles to be 6. There were a total of 5980 households with eligible adolescents (10–19 years of age) in the 6 selected kebeles. The numbers and lists of eligible households were obtained from the family folders registered by health extension workers, and sampling frame was constructed for each selected kebele. The number of households to be included in this study was proportionally allocated to each selected kebele. Finally, the systematic sampling technique was used to reach individual adolescent. Systematic sampling interval was determined by dividing the number of households to the sample size allocated for each kebele. After determining the interval, the first household was selected randomly. In the case of more than 1 adolescent in the same household, 1 eligible adolescent was selected by lottery method (Figure 1).

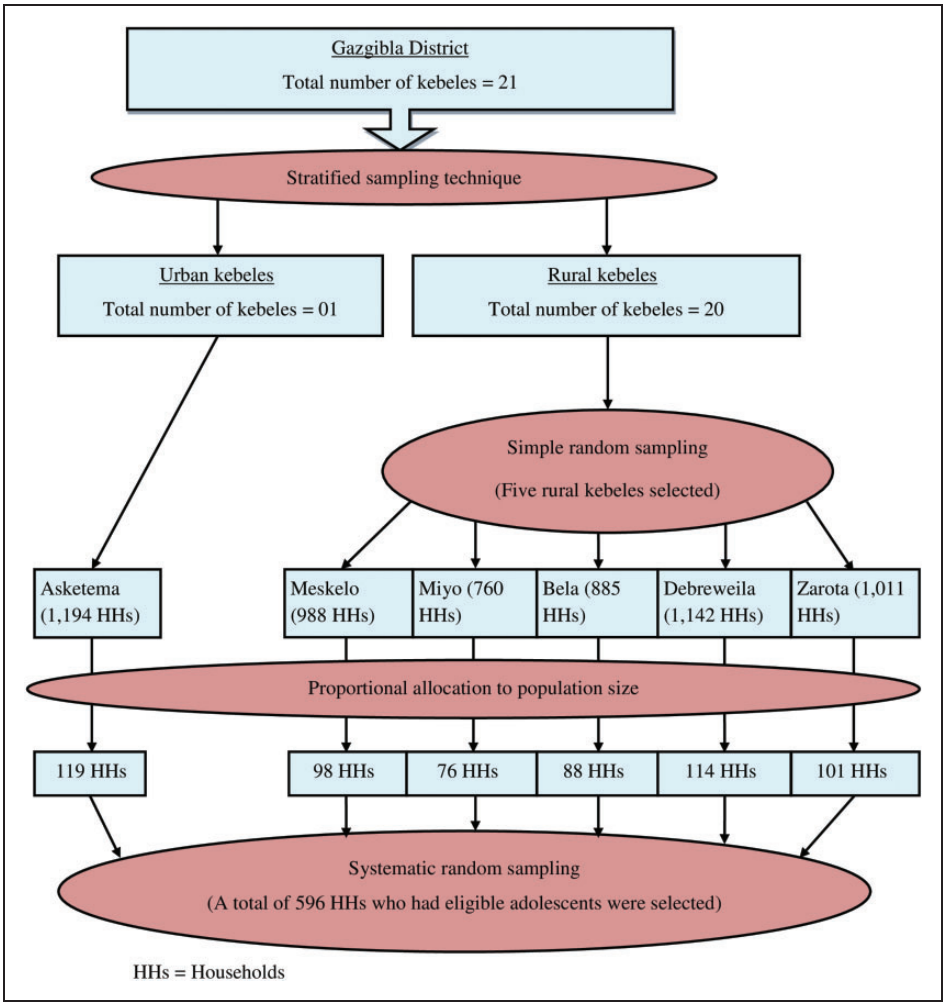

Figure 1. Schematic Presentation of Sampling Procedure Among Adolescents in Gazgibla District, Northeast Ethiopia, August 2019. HHs, households.

Data Collection

Pretested and interviewer administered structured questionnaire was used to collect the data. The questionnaire was prepared in English language and translated to Amharic language and back to English language. Six experienced nurses, who had a diploma, undertook the interview after they had been trained for 2 days. Data were collected on sociodemographic characteristics, dietary habits of the adolescents, and awareness and utilization of iodized salt by mothers/caregivers. Food frequency questionnaire was used to collect the data on the dietary habits of the adolescents from themselves and their mothers/caregivers.

The clinical assessment of the thyroid enlargement (goiter) was done on the anterior neck by 3 trained emergency surgeons as per the recommendation of World Health Organization (WHO).[4] The results of the examination were reported as grade 0 for no palpable or visible goiter; grade 1 for palpable, but not visible goiter; and grade 2 for visible goiter.

The household salt iodine content was measured using a rapid spot testing kit called MBIKITS INTERNATIONAL, which was made in India in October 2018. The test kit was produced with batch number of M 016 and expiry date in April 2020. The iodine levels of the salt samples were expressed in parts per million (sufficient $\geq$15 ppm, medium $<$15 ppm, and no iodine 0 ppm).[5]

Data Processing and Analysis

After collection, data were edited and cleaned; each questionnaire was checked for completeness and coded. Double data were entered into computer using EpiData version 3.1 and then exported into Statistical Package for the Social Sciences statistical software version 22 for statistical analysis. Descriptive statistical analysis

such as frequencies, percentage, and summary measures were used to describe the characteristics of the study participants.

Bivariable logistic regression analysis was used, and crude odds ratio along with 95% confidence interval (CI) was computed to assess the association between each independent variable and the outcome variable. Independent variables with $P < .25$ were included in the multivariable logistic regression analysis. The included independent variables were tested for multicollinearity using variance inflation factor (VIF), and no significant (VIF > 10) collinearity was detected. Model goodness-of-fit was checked by Hosmer and Lemeshow test, and the final model was well fitted with the included variables ($P = .08$). The associated factors were identified by estimating adjusted odds ratio (AOR) along with 95% CI, and statistical significance was declared at $P < .05$.

Table 1. Sociodemographic Characteristics Among Adolescents and Their Parents/Caregivers in Gazgibla District, Northeast Ethiopia, August 2019 (n = 576).

Variables	Categories	Frequency	Percentage
Adolescent age (in completed years)	10–14	178	30.9
	15–19	398	69.1
Adolescent sex	Male	285	49.5
	Female	291	50.5
Ethnicity of the adolescent	Amhara	576	99.3
	Agew	4	0.7
Residence	Rural	458	79.5
	Urban	118	20.5
Altitude (in m)	1500–2000	118	20.5
	2001–2500	314	54.5
	>2500	144	25.0
Education status of mothers	Unable to read and write	472	81.9
	Able to read and write	86	14.9
	Primary level (grade 1–8)	10	1.8
	Secondary level (grade 9–12)	2	0.4
	Above secondary	6	1.0
Occupational status of mothers	House wife	322	55.9
	Farmer	213	37.0
	Civil servant	7	1.2
	Merchant	19	3.3
	Others[a]	15	2.6
Current marital status of mothers	Single	14	2.4
	Married	526	91.4
	Divorced	33	5.7
	Widowed	3	0.5
Education status of father (n = 526)	Unable to read and write	400	76.0
	Able to read and write	109	20.7
	Primary level (grade 1–8)	7	1.3
	Secondary level (grade 9–12)	4	0.8
	College and above	6	1.1
Occupation of fathers (n = 526)	Farmer	486	92.4
	Civil servant	12	2.3
	Merchant	18	3.4
	Others[a]	10	1.9
Average family monthly income (in ETB)[b]	<400	132	22.9
	401–800	176	30.6
	801–1600	206	35.8
	>1601	62	10.7
Family history of goiter	Yes	253	43.9
	No	323	56.1

Abbreviation: ETB, Ethiopian Birr.
[a]Daily laborer, private worker.
[b]1USD = 32 ETB.

Ethics Approval and Consent to Participate

Ethical clearance was secured from Institutional Health Research Ethics Review Committee of the College of Health and Medical Sciences at Haramaya University. Informed, voluntary, written, and signed consent was obtained prior to the initiation of the study from the participants or their mothers/caregivers. For adolescents who were aged 18 to19 years, the consent was obtained from themselves. The consent for those who were aged 17 years and below was obtained from their mothers/caregivers, and verbal assent was also obtained from the adolescents themselves. All possible identifiers were excluded from the questionnaires and checklist to ensure participants' confidentiality.

Results

Sociodemographic Characteristics

Out of 596 sampled adolescents, 576 of them with their mothers/caregivers participated in the study (response rate = 96.6%). Refusal of the respondents was the reason for the nonresponders. The mean (± standard deviation) age of the adolescents was 15.29 (±2.42) years, and 291 (50.5%) were females. Majority of the adolescents (99.3%) were Amhara in ethnicity, and 458 (79.5%) were residents of rural areas. Three hundred fourteen (54.5%) of the study participants were living in areas with altitude ranging from 2001 to 2500 m above the sea level. Four hundred seventy-two (81.9%) of the adolescents' mothers/caregivers were unable to read and write, and 322 (55.9%) were house wives. Majority of the adolescents' mothers/caregivers (91.4%) were married. Regarding the fathers of the adolescents, 400 (76.0%) were unable to read and write, and 486 (92.4%) were farmers. Two hundred six (35.8%) of the adolescents were from households with average monthly income of 801 to 1600 ETB (25–50 USD), and 253 (43.9%) had family history of goiter (Table 1).

Dietary Habit of Adolescents

The study revealed that cabbage and millet were relatively the frequently consumed food items by the adolescents. Accordingly, 125 (21.7%) and 44 (7.6%) of the adolescents consumed cabbage and millet at least once per week, respectively. However, the consumption of milk and fish was rare (Table 2).

Iodized Salt Awareness and Use

The study revealed that 485 (84.2%) of the included mothers/caregivers had awareness of iodized salt. Four hundred eighty-three (83.9%) of the mothers/caregivers reported that their households were using iodized salt; of whom, 481 (99.2%) and 475 (97.9%) reported as they keep iodized salt in a dry place and in a container with lid, respectively. In addition, 333 (68.7%) practiced adding the iodized salt after cooking.

Table 2. Consumption Frequency of Food Items Among Adolescents in Gazgibla District, Northeast Ethiopia, August 2019 (n = 576).

Variables	Categories	Frequency	Percentage
Frequency of maize consumption	At least once per week	5	0.9
	At least once per month	18	3.1
	Never	553	96.0
Frequency of millet consumption	At least once per day	11	1.9
	At least once per week	44	7.6
	At least once per month	206	35.8
	Never	315	54.7
Frequency of cabbage consumption	At least once per week	125	21.7
	At least once per month	255	44.3
	Never	196	34
Frequency of egg consumption	At least once per week	24	4.3
	At least once per month	225	39.1
	Never	327	56.6
Frequency of meat consumption	At least once per month	110	19.1
	Never	466	80.9
Frequency of milk consumption	At least once per week	6	1.0
	At least once per month	193	33.5
	Never	377	65.5
Frequency of fish consumption	Never	576	100

Table 3. Distribution of Goiter by Sociodemographic and Feeding Habit Characteristics Among Adolescents in Gazgibla District, Northeast Ethiopia, August 2019 (n = 576).

	Goiter among adolescents	
Independent variables	Yes	No
Age (in completed years)		
10–14	64 (36.0%)	114 (64.0%)
15–19	181 (45.5%)	217 (54.5%)
Sex		
Male	97 (34%)	188 (66%)
Female	148 (50.9%)	143 (49.1%)
Residence		
Rural	197 (43%)	261 (57%)
Urban	48 (40.7%)	70 (59.3%)
Altitude (in m)		
1500–2000	48 (40.7%)	70 (59.3%)
2001–2500	147 (46.8%)	167 (53.2%)
>2500	50 (34.7%)	94 (65.3%)
Frequency of millet consumption		
At least once per week	29 (52.7%)	26 (47.3%)
At least once per month	69 (33.5%)	137 (66.5%)
Never	147 (46.7%)	168 (53.3%)
Frequency of cabbage consumption		
At least once per week	80 (64.0%)	45 (36.0%)
At least once per month	110 (43.0%)	145 (66.9%)
Never	55 (28.1%)	141 (71.9%)
Status of egg consumption		
Yes	70 (28.1%)	179 (71.9%)
No	175 (35.5%)	152 (64.5%)
Status of meat consumption		
Yes	15 (13.6%)	95 (86.4%)
No	230 (49.4%)	236 (50.6%)
Status of milk consumption		
Yes	43 (21.6%)	156 (78.4%)
No	202 (53.6%)	175 (46.4%)
Iodine level of salt		
<15 ppm	223 (53.9%)	191 (46.1%)
>15 ppm	22 (13.9%)	140 (86.1%)

Iodine Level of Household Salt and Prevalence of Goiter

The iodine rapid test result showed that 406 (70.5%) of the sampled household salts were iodized. However, only 162 (28.1%) of the salt samples had adequate levels of iodine (≥15 ppm), whereas the remaining 244 (42.4%) samples had inadequate levels of iodine (1–14 ppm).

The overall prevalence of goiter among adolescents was 245 (42.5%, 95% CI: 38.4%, 46.7%). The prevalence of grade 1 goiter was 187 (32.5%) while grade 2 was 58 (10%). The prevalence of goiter was higher in female adolescents (50.9%) and among adolescents who were aged 15 to 19 years (45.5%). It was also higher among adolescents who live in rural areas (43%) and altitude of 2001 to 2500 m (46.8%). The occurrence of goiter was more prevalent among adolescents who consumed millet (52.7%) and cabbage (64%) at least once per week. On the other hand, the magnitude of goiter was higher among adolescents who did not consume egg (35.5%), meat (49.4%), and milk (53.6%). Furthermore, adolescents with inadequately iodized household salt (<15 ppm) had more goiter prevalence (53.9%) than their counterparts (Table 3).

Factors Associated With Goiter

Bivariable and multivariable analysis were done in the binary logistic regression to identify factors associated with goiter. Accordingly, sex, family history of goiter, frequency of cabbage consumption, eating status of meat, eating status of milk, and iodine level of household salt were significantly associated with goiter among adolescents ($P < .05$).

Female adolescents were 1.83 times more likely to have goiter than males (AOR = 1.83, 95% CI: 1.18, 2.85). The odds of goiter was 3.63 times higher among adolescents whose families had history of goiter (AOR = 3.63, 95% CI: 2.31, 5.69). The occurrence of goiter was 4.6 times more likely among adolescents who consume cabbage at least once per week (AOR = 4.6, 95% CI: 2.42, 8.74). On the other hand, adolescents who did not consume meat at all were 2.5 times more likely to develop goiter (AOR = 2.5, 95% CI: 1.17, 5.32). Similarly, adolescents who did not consume milk were 2.19 times more likely to have goiter compared to those who did consume (AOR = 2.19, 95% CI: 1.19, 4.03). Adolescents from families who use salt with inadequate levels of iodine (<15 ppm) were 7.05 times more likely to have goiter compared to their counterparts (AOR = 7.05, 95% CI: 3.83, 12.97) (Table 4).

Discussion

The prevalence of goiter in this study was 42.5%. Adolescent sex, family history of goiter, frequency of cabbage consumption, eating status of meat, eating status of milk, and iodine level of household salt were identified as associated factors of goiter among adolescents.

Ethiopia has endorsed the universal iodization of salt since 2011 and more than 89% of the household salts are iodized in the country.[28,29] However, the prevalence of goiter in the study area is very high as per the WHO classification.[5] This might be due to inadequate level of iodine in the household salt and consumption of iodine poor foods.

The prevalence of goiter in this study was in line with the national prevalence in Ethiopia (39.9%).[11] However, the prevalence was found to be higher than a report on global burden of iodine deficiency of world (16%) and African (27%) populations.[32] The prevalence was also higher in this study than other studies done among children in different parts of the world which ranges from 5.5% to 35.9%.[33–42] Likewise, the prevalence of goiter

Table 4. Factors Associated With Goiter Among Adolescents in Gazgibla District, Northeast Ethiopia, August 2019 (n = 576).

Independent Variables	Goiter Among Adolescents		COR (95% CI)	AOR (95% CI)[a]
	Yes	No		
Age (in completed years)				
10–14	64 (36.0%)	114 (64.0%)	1.00	1.00
15–19	181 (45.5%)	217 (54.5%)	1.49 (1.03, 2.14)*	1.37 (0.87, 2.25)
Sex				
Male	97 (34%)	188 (66%)	1.00	1.00
Female	148 (50.9%)	143 (49.1%)	2.01 (1.43, 2.81)**	1.83 (1.18, 2.85)*
Father's education				
No formal education	221 (43.4%)	288 (56.6%)	3.58 (1.02, 12.62)*	1.85 (0.38, 8.90)
Formal education	3 (17.6%)	14 (82.4%)	1.00	1.00
Family average monthly income (in ETB)[b]				
<400	49 (37.1%)	83 (62.9%)	0.87 (0.47, 1.62)	0.45 (0.18, 1.11)
401–800	87 (49.4%)	89 (50.6%)	1.45 (0.80, 2.60)	0.78 (0.34, 1.77)
8001–1600	84 (40.8%)	122 (59.2%)	1.02 (0.57, 1.82)	0.79 (0.35, 1.79)
>1601	25 (40.3%)	37 (59.7%)	1.00	1.00
Family history of goiter				
Yes	154 (60.9%)	99 (39.1%)	3.97 (2.80, 5.63)**	3.63 (2.31, 5.69)**
No	91 (28.2%)	232 (71.8%)	1.00	1.00
Frequency of millet consumption				
At least once per week	29 (52.7%)	26 (47.3%)	1.28 (0.72, 2.26)	1.75 (0.81, 3.74)
At least once per month	69 (33.5%)	137 (66.5%)	0.58 (0.40, 0.83)*	0.92 (0.57, 1.48)
Never	147 (46.7%)	168 (53.3%)	1.00	1.00
Frequency of cabbage consumption				
At least once per week	80 (64.0%)	45 (36.0%)	4.56 (2.82, 7.37)**	4.60 (2.42, 8.74)**
At least once per month	110 (43.0%)	145 (66.9%)	1.95 (1.31, 2.90)*	2.05 (1.23, 3.43)*
Never	55 (28.1%)	141 (71.9%)	1.00	1.00
Status of egg consumption				
Yes	70 (28.1%)	179 (71.9%)	1.00	1.00
No	175 (35.5%)	152 (64.5%)	2.94 (2.07, 4.18)**	1.66 (0.98, 2.83)
Status of meat consumption				
Yes	15 (13.6%)	95 (86.4%)	1.00	1.00
No	230 (49.4%)	236 (50.6%)	6.17 (3.48, 10.96)**	2.5 (1.17, 5.32)*
Status of milk consumption				
Yes	43 (21.6%)	156 (78.4%)	1.00	1.00
No	202 (53.6%)	175 (46.4%)	4.19 (2.83, 6.21)**	2.19 (1.19, 4.03)*
Awareness on iodized salt				
Yes	187 (38.6%)	298 (61.4%)	1.00	1.00
No	58 (63.7%)	33 (36.3%)	2.80 (1.76, 4.46)**	1.23 (0.19, 7.77)
Type of salt used by households				
Iodized	185 (38.3%)	298 (61.7%)	1.00	1.00
Noniodized	60 (64.5%)	33 (35.5%)	2.93 (1.84, 4.65)**	0.95 (0.15, 5.95)
Iodine level of salt				
<15 ppm	223 (53.9%)	191 (46.1%)	7.43 (4.56, 12.12)**	7.05 (3.83, 12.97)*
>15 ppm	22 (13.9%)	140 (86.1%)	1.00	1.00

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; COR, crude odds ratio; ETB, Ethiopian Birr.

[a]Final model goodness-of-fit using Hosmer–Lemeshow test ($P = .08$).

[b]1 USD = 32 ETB.

*P .05–.01. **P <.01.

in this study was higher than various study reports among children in Ethiopia which showed a prevalence ranging from 26.3% to 62.1%.[17–19,22,24,43–45] On the other hand, the prevalence in this study was lower than other study findings.[27,44,46] The variations might be due to differences in sociodemographic characteristics, study scale, altitude and rainfall, feeding habits, access to iodized salt and iodine-rich foods, and ways of cultivating the lands.

According to the study, female adolescents were more likely to have goiter than males. This is in agreement

with various studies.[17,19,23,25,35,46,47] This may be due to differences between the sexes in levels of the hormones and sex steroids that affect thyroid function. These differences may be particularly pronounced during puberty.[13]

The odds of goiter was higher among adolescents whose families had history of goiter. This is consistently supported by other studies.[17] The significantly higher rate of positive family histories of goiter indicates the importance of genetic factors in goiter development.[48]

The occurrence of goiter was more likely among adolescents who consume cabbage at least once per week. This is consistent with other studies.[21,24,25,27] Cabbage is one of the goitrogenic foods, which can decrease the iodine absorption and utilization in our body and, in turn, increases the risk of iodine deficiency and goiter. On the other hand, adolescents who did not consume meat and milk at all were more likely to develop goiter. This could be explained as animal sources of food are good sources of iodine.

This study revealed that adolescents from families who use salt with inadequate levels of iodine were more likely to have goiter compared to their counterparts. This is similar to other study findings.[17,18,22,24] This could be because adequately iodized salt has both preventive and corrective effects for iodine deficiency goiter and is the main solution for eradicating IDDs.

Since the study is a cross-sectional, it will not show the temporal relation between the independent and dependent variables. There is also a possibility of recall bias since the questionnaire for the dietary habits was based on recall knowledge. Despite these limitations, the study can be utilized as an input, with other similar studies, in conducting systematic reviews and meta-analyses to produce pooled estimates. It can also be used as baseline information for further epidemiological and nutritional studies in similar settings. Moreover, the results of this study can help clinicians in decision making with regard to goiter diagnosis in the study area or similar settings.

Conclusions

The prevalence of goiter was very high and a major public health issue in Gazgibla District. Being female, family history of goiter, cabbage consumption at least once per week, not consuming meat and milk at all, and inadequate iodine level of household salt were positively associated with the development of goiter among adolescents. Therefore, the health sectors of the study area should focus on disseminating messages to increase the awareness of the community on how to prevent goiter through the consumption of iodized salt and iodine-rich foods.

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Authors' Contributions

GG initiated the research, wrote the research proposal, conducted the research, did data entry and analysis, and wrote the research and manuscript. MD, GE, and BG involved in the write up of the proposal, data analysis, interpretation, and manuscript writing. All authors read and approved the final manuscript.

Declaration of Conflicting Interests

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ORCID iD

Berhe Gebremichael https://orcid.org/0000-0002-0669-8521

Supplemental Material

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