

## **Epidemiology of goiter and its predictors among school age children in Leku town, Southern Ethiopia.**

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### **Abstract**

**Background:** A goiter prevalence of 5% or more in school age children is an indication of iodine deficiency in a population. So, school age children can be used to determine the severity of iodine deficiency in the population since they are easily susceptible to iodine deficiency. The study aimed to assess the epidemiology of goiter and associated factors among school aged children in Leku town, Southern Ethiopia.

**Method:** Community-based cross-sectional study was employed from July 15-30/2017. A total of 358 children were selected using simple random sampling technique. Data on school age children were collected from their mothers/caretakers using a pre-tested and interviewer administered structured questionnaire. The presence or absence of goiter was confirmed by physical examination using world health organization guide line. Logistic regression was carried out using SPSS version 20.0 software.

**Results:** The overall magnitude of goiter among school age children was 35.2% (CI: 30.4-40.5%). Maternal education (AOR=2.50, CI: 1.37, 4.57), family monthly income (AOR=2.19, CI=1.09, 4.36), type of salt used (AOR=2.66, CI: 1.15, 6.17), timing of adding salt into food (AOR=2.20, CI: 1.27, 3.82) and using cassava as a food (AOR=2.19, CI: 1.30, 3.68) were identified predictors of goiter.

**Conclusion:** The observed magnitude of goiter is considered as a public health problem in the study area. Women education, adding salt after cooking food, ensuring iodized salt consumption and increasing public awareness on consequences of goiter need to be given emphasis.

**Keywords:** School age children, Leku town, Ethiopia.

**Abbreviations:** AOR: Adjusted Odd Ratio; CI: Confidence Interval; COR: Crude Odd Ratio; EDHS: Ethiopian Demography and Health Survey; FMOH: Federal Ministry of Health; IDD: Iodine Deficiency Disorders; ID: Iodine Deficiency; SD: Standard Deviation; SNNPR: Southern Nation Nationalities and People Region; SPSS: Statistical Package for Social Science; TV: Television; UNICEF: United Nations Children's Fund; WHO: World Health Organization

*Accepted November 23<sup>rd</sup>, 2017*

### **Background**

The term goiter refers to the abnormal growth of the thyroid gland [1]. It is the most observable indication of Iodine Deficiency Disorders (IDDs) [2]. Population consequences of severe iodine deficiency, named iodine deficiency disorders include endemic goiter, hypothyroidism, and cretinism, reduced fertility rate, increased infant mortality, and mental retardation [3]. Twenty-nine percent of the world's population, living

in approximately 130 countries, is estimated to live in areas of iodine deficiency [4].

Globally, about 600 million people had goiter and 230 million have some degree of brain damage due to iodine deficiency during maternity [5]. In the 2011 estimate of the Iodine Global Network, close to 2 billion people had inadequate iodine intake in the globe, where 30% were school aged children. Iodine deficiency (ID) in childhood and adolescence is linked with endemic goiter [6].

Pregnant mothers and school age children are the most vulnerable groups for ID compared to other segment of the population [7]. ID, worldwide public health problem, is not uncommon in mountainous regions of Europe, Asia, South and Central America, and Eastern Africa [8]. Globally, 241 million school children are suffering from IDD while more than 1.5 billion people are at increased risk of ID and IDD is noticed in 57 million African children [9-11].

In Ethiopia, more or less 28 million people suffer from goiter, and more than 35 million people are at risk of ID [12]. Study on prevalence of goiter among children 6 to 12 years of age in Ethiopia in 2005 was 39.9%; 27.7% palpable and 12.2% visible goiter [13]. In the 2011 Ethiopia Demographic and Health Survey (EDHS) report, only 4 among 25 children live in households that utilized iodized salt. The proportion is higher in urban areas (24%) than rural areas (14%) [14].

Besides to the intake of goiterogenic substance containing food items like cassava and millet and coexistent deficiency of micronutrients (like iron and selenium deficiency), poor socio-economic status, maternal education, advanced age of the mother, age and sex of the child were some of the identified factors associated with ID [15-18].

Realizing the problem, the Ethiopian government planned to avert ID and to achieve the utilization of adequately iodized salt to 90% by the year 2015. Hence, in order to achieve the set plan, the government designed a national nutrition program and micronutrient guideline, and endorsed a resolution to ensure the availability of iodized salt [19].

A goiter prevalence of 5% or more in school-age children is an indication of iodine deficiency in a population. As a result the goiter rate in school-age children can be used to determine the severity of iodine deficiency in the population since they are easily susceptible to iodine deficiency, accessible as a study group and representativeness of society as a whole [1,20]. Therefore, this study is aimed to determine the magnitude of goiter and its predictors among school age children in Leku town, Southern Ethiopia.

## **Methods**

### ***Study Design, Setting and Populations***

Community-based cross-sectional study was conducted from July 15-30/2017 in Leku town, Sidama Zone, Southern Ethiopia. The town is found at a distance of 27 kilometer (km) from Hawassa; capital city of Southern Nation and Nationalities and People Region, Ethiopia and 299kmsouth of from Addis Ababa; capital city of Ethiopia. The town has five kebeles (*kebele is the smallest administrative unit in Ethiopia*) with a total population of 30,668, of which 15,828 are males, 5374 and 1012 are under 15 and under five children.

The town has five governmental health facilities (one primary hospital and four health posts) and five private clinics rendering preventive, promotive and curative and rehabilitation services for the community of the town and its surrounding community. The study populations were all school age children (6-12 years old) with their parents/ caretakers living in Leku town. Children diagnosed by physicians as mentally and physically not capable for physical examination procedures and interview, and living in the study area for less than six months were excluded.

### ***Sample Size Determination and Sampling Procedure***

Sample size was determined using single population proportion formula considering the following assumption: 95% confidence level, 5% margin of error and proportion of goiter among school age children (37.6%) [21].

$$n = \frac{z_{\alpha/2}^2 p(1-p)}{d^2 (0.05)^2} = (1.96)^2 \times 0.0.376(0.624) = 360$$

From the total five kebeles, two kebeles were selected using simple random sampling technique. Complete enumeration of households found in the two kebeles of the town was carried out and unique identifier was assigned for each household. The team employed simple random sampling technique to identify the study subjects using the unique identifier of the households as a sampling frame. In the selected household if more than one eligible child was found, only one child was taken by lottery method. In case if no eligible study participant identified in the selected household, the data collectors went to the next household until they got eligible child.

### ***Measurement of the Study Variable***

In this study, the presence or absence of goiter was diagnosed clinically using physical examination of thyroid by trained bachelor degree holder nurses. The degree of goiter was graded by using WHO grading system (Grade 0: No palpable or visible goiter/no goiter, grade 1: a mass in the neck that is consistent with an enlarged thyroid which is palpable but not visible when the neck is in normal position and it moves upward as the subject swallows and grade 2: swelling in the neck that is visible when the neck is in normal position and consistent with an enlarged thyroid when the neck is palpated).

### ***Data Collection Tools and Procedure***

Pre-tested and interviewer administered structured questionnaire was used to collect quantitative data. The questionnaire was prepared in English language and translated to Amharic language and back to English language. Physical examination of the thyroid was performed to identify the presence of goiter. Six registered female nurses were participated to collect the data. Training on diagnosis of goiter and data collection procedures was given to data collectors for two days. One medical doctor and the investigators supervised the data collection process and checked filled questionnaire for consistency and completeness.

### Statistical Analysis

After data collection, data were edited and cleaned; each questionnaire was checked for completeness and coded. Data were entered into computer using EPI Info version 3.5.4 and the analysis was done using SPSS version 20.0.

Categorical variables were described using frequency, percentage and figures. Simple binary logistic regression analysis for each independent variable against the dependent variable was executed to observe the impact of each factor on the occurrence of goiter among school age children.

Independent variables found to be significant in the simple binary logistic regression analysis at a cut-off p-value  $\leq 0.2$  with their 95% confidence interval (CI) were included in the multiple binary logistic regressions model. In the multiple binary logistic regressions, the effects of each independent variable on presence of goiter were assessed by controlling possible confounders using stepwise backward logistic regression. Adjusted odds ratios (AOR) with 95% CI and p-value of less than 0.05 were considered to have significant association between the dependent and independent variables.

### Results

#### Socio Demographic and Economic Characteristics

In the present study, 358 (99.4%) children aged 6-12 were included. The mean age of the study participants was 8.94 years ( $\pm 1.96$ ) standard deviation (SD) with average family size of  $5.43 \pm 1.63$  SD and 188 (52.5%) were females. More than three in five, 227(63.4) parents/caretakers of the children were protestant by religion.

Two hundred fifty eight (72.1%) children were grade one to four and 180 (50.3%) and 188 (52.5%) of their mothers and fathers attended primary and secondary and above education. More than half 194 (54.2%) mothers and 147 (41.1%) of their husbands were house wife and governmental employed by occupation. One hundred sixty eight (46.9%) family members obtained monthly income of 1001 to 2000 Ethiopian birr ( $\approx 43$ -87 USD) and three among five 221 (61.7%) family members possessed television (TV) (Table 1).

#### Dietary and Goiter Related Characteristics

Among the total study participants, 135 (37.7%) utilized iodized salt in their diet and 340 (95%) store the dietary salt kept closed, and only 51 (14.2%) put the salt near to fire. Two hundred forty three (67.9%) added the salt while cooking food, 341 (95.3%), 32 (8.9%), 323 (90.2%) used cabbage, millet and 'habesha' (local) cabbage in their diet as food, respectively. Nearly, nine in ten respondents, 312 (87.2%) heard about goiter, 24 (6.7%) had familial history of goiter and 128 (35.8%) perceived that the cause of goiter was iodine deficiency (Table 2).

#### Magnitude and Predictors of Goiter

The overall magnitude of goiter among school age children

**Table 1.** Socio demographic characteristics of children and their mothers/care takers in Leku town, Southern Ethiopia, 2017

Variables	Category	Frequency (n)	Percentage (%)
Child age (years)	6-10	267	74.6
	>10	91	25.4
Sex of child	Male	170	47.5
	Female	188	52.5
Religion	Protestant	227	63.4
	Orthodox	76	21.2
	Muslim	55	15.4
Child education	Kindergarten	73	20.4
	1-4 grade	258	72.1
	5-8 grade	27	7.5
Family size	$\leq 4$	115	32.1
	>4	243	67.9
Maternal education	No formal education	89	24.9
	Primary education	180	50.2
	Secondary & above	89	24.9
Husband education	No formal education	17	4.7
	Primary education	153	42.7
	Secondary & above	188	52.5
Maternal occupation	Farmer	22	6.1
	Merchant	81	22.6
	Governmental employee	61	17.0
	Housewife	194	54.2
Husband occupation	Farmer	50	14.0
	Merchant	136	38.0
	Governmental employee	147	41.1
	Others*	25	7
Monthly income	$\leq 1000$	41	11.5
	1001-2000	66	18.4
	2001-3000	83	23.2
	>3000	168	46.9
Possession of radio	Yes	255	71.2
	No	103	28.8
Possession of TV	Yes	221	61.7
	No	137	38.3

Others \* include daily laborers, temporary workers with payment

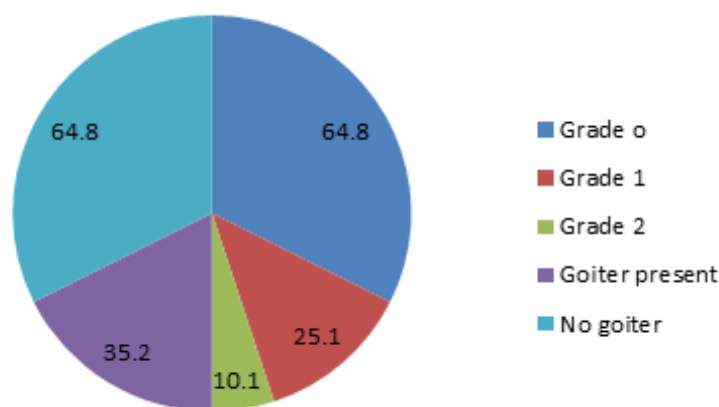
was 126 (35.2%, CI: 30.4-40.5%). The magnitude of grade one goiter was 90 (25.1%) while grade two was 36 (10.1%) (Figure1).

In the multiple binary logistic regressions: maternal education, family income, type of salt used, timing of

**Table 2.** Dietary and goiter related characteristics of the study subjects in Leku town, Southern Ethiopia, 2017

Dietary characteristics		Category	Frequency (n)	Percentage (%)
Salt type used		Non-Iodized	193	53.9
		Iodized	135	37.7
		Both	30	8.4
Method of storing salt		Kept opened	18	5.0
		Kept closed	340	95.0
Place of storing		Near to fire	51	14.2
		Away from fire	307	85.8
Timing of adding salt into food		During cooking	243	67.9
		After cooking	115	32.1
Foods included in the diet	Cabbage	Yes	341	95.3
		No	17	4.7
	Millet	Yes	32	8.9
		No	326	91.1
	Soya bean	Yes	16	4.5
		No	342	95.5
	Boyina' (Cassava)	Yes	75	20.9
		No	283	79.1
	'Habesha' Cabbage*	Yes	323	90.2
		No	35	9.8
	Hamicho' (False banana)	Yes	57	15.9
		No	301	84.1
Heard of goiter	Yes	312	87.2	
	No	46	12.8	
Familial history of goiter	Yes	24	6.7	
	No	334	93.3	
Perceived cause of goiter		Iodine deficiency	128	35.8
		Rain water	96	26.8
		Don't know	134	37.4

Habesha' Cabbage\* (local cabbage)



**Figure 1.** Magnitude of goiter among school age children in Leku town, Southern Ethiopia, 2017

adding salt into the food and using 'boyina' (cassava) as food were identified as independent predictors of goiter among school age children.

The present study revealed that children whose mothers did not attend formal education were nearly three times more likely to develop goiter (AOR=2.50, CI: 1.37, 4.57). The study showed that the odds of goiter was two times higher among children whose family monthly income was below ≤ 1000 Ethiopian birr (43 USD) compared

with family monthly income of >3000 Ethiopian birr (AOR=2.19, CI=1.09, 4.36).

On the other hand, type of salt used, timing of adding salt into food and using 'boyina'(cassava) as a food were other important predictors. The occurrence of goiter was nearly three times higher among children using non-iodized salt (AOR=2.66, CI: 1.15, 6.17). It was observed that adding salt into food while cooking contributed to two times increase in goiter prevalence among school age children

(AOR=2.20, CI: 1.27, 3.82). School age children using 'boyina' (cassava) as a food were two times more likely to develop goiter (AOR=2.19, CI: 1.30, 3.68) (Table 3).

## Discussion

In the present study, the magnitude of goiter was found to be 35.2% (CI: 30.4, 40.5%) and magnitude of grade one and grade two goiter was 25.1% and 10.1%. This finding was almost in adjacent with a study conducted in Northwest Ethiopia (37.6%) [21]. The current magnitude of goiter is a significant public health problem in the study area according to the WHO, UNICEF and ICCIDD assessment criteria for the severity of IDD [22]. The magnitude of goiter in this study (35.2%) was also nearly in line with the national total goiter prevalence among school age children in Ethiopia (39.9%) [13].

On the contrary, the magnitude of the current finding is lower than the findings in a study in ten villages of four administrative states of Ethiopia (53.3%) and Pakistan; Islamabad (71.6%) [23,24]. The observed magnitude of goiter in this study was higher than the research findings in northwestern India: Rajasthan (11.4%) [25], India: Gujarat (20.5%) [26], southern Blue Nile area of Sudan (22.3%) [27] and South Africa (25.5%) [28].

The study demonstrated that goiter was more likely to increase among school age children whose mothers did

not attend formal education and family members with a monthly income below 1001 Ethiopian birr. This finding is similar the study done in other areas [15,17]. This might be due that educated mothers can have better access to information and awareness, on cause, consequences and prevention strategies of goiter among children. Family members with better monthly income would have an opportunity to buy iodized salt and include in their diet. In the present study, it was figured out that goiter was higher among school children using non-iodized salt. This finding is consistent with a study in northwest Ethiopia [21].

On the other hand, timing of adding salt into food and using boyina (cassava) as food were noticed as independent predictors of goiter occurrence among school age children. Adding iodized salt into food while cooking increased the probability of goiter among children. This could be explained as when the iodized salt is introduced into food while cooking, it will lose its iodine content through heat. It was also observed that using cassava as a food increased the occurrence of goiter among school age children. This study is in line with a study by Gaitan and the finding in Southwest and Southern Ethiopia [29].

## Limitations

The following limitations need to be taken into account in the findings of this research. First, the findings of this

**Table 3.** Multiple binary logistic regressions model predicting presence of goiter among school age children in Leku town, Southern Ethiopia, 2017

Variables	Category	Presence of goiter		COR (95% CI)	AOR (95% CI)	P-value
		No	Yes			
Maternal education	No formal education	51	38	1.58 (0.75, 3.32)	2.50 (1.37, 4.57)	0.012
	Primary education	121	59	1.33 (0.79, 2.24)	1.16 (0.65, 2.08)	0.085
	Secondary & above	60	29	1.00	1.00	
Paternal education	No formal education	6	11	3.46 (1.17, 10.22)	1.54 (0.72, 3.25)	0.26
	Primary education	101	52	1.42 (0.93, 2.19)	1.14 (0.64, 2.05)	0.653
	Secondary & above	125	63	1.00	1.00	
Family income	≤ 1000	31	10	1.24 (0.93, 5.07)	2.19 (1.09, 4.36)	0.027
	1001-2000	53	13	2.22 (0.78, 4.2)	2.05 (1.15, 3.65)	0.015
	2001-3000	42	41	0.73 (0.59, 2.33)	1.93 (1.13, 3.29)	0.016
	>3000	106	62	1.00	1.00	
Presence of Radio	Yes	166	89	0.63 (0.40, 0.99)	0.85 (0.50, 1.43)	0.125
	No	66	37	1.00	1.00	
Type of salt used	Non-iodized	116	77	2.97 (1.29, 6.81)	2.66 (1.15, 6.17)	0.023
	Iodized	94	41	1.29 (0.55, 3.03)	1.79 (0.73, 4.37)	0.191
	Both	22	8	1.00	1.00	
Place of storing	Near to fire	28	23	2.20 (1.20, 4.06)	1.72 (0.91, 3.28)	0.097
	Away from fire	204	103	1.00	1.00	
Timing of adding salt into food	During cooking	144	99	2.79 (1.74, 4.47)	2.20 (1.27, 3.82)	0.005
	After cooking	88	27	1.00	1.00	
Using cassava as food	Yes	43	32	1.78 (1.01, 3.14)	2.19 (1.30, 3.68)	0.003
	No	189	94	1.00	1.00	

study are only based on physical examination by palpation using World Health Organization grading system as a result the specificity and sensitivity are low due to inter-observer variation and the level of urinary iodine excretion was not measured [30,31]. Second, the cross sectional nature of the data could not show the direct causality of goiter among school age children.

## **Conclusion**

In general, the magnitude goiter among school age children was high. Maternal education, family income, type of salt used, timing of adding salt into food and using 'boyina' (cassava) as a food were independent predictors of goiter occurrence among school age children in Leku town, Southern Ethiopia. Women education, adding salt after cooking food, ensuring iodized salt consumption and increasing public awareness on consequences of goiter need to be given emphasis.

## **Declarations**

### ***Ethical Approval and Consent to Participate***

Ethical clearance was obtained from the Institutional Review Board of Hawassa University, College of Medicine and Health Sciences. Supportive letter was taken from Leku town health office. Since the study participants are below age 18 years old, parental/care taker informed verbal and written consent was secured and the Institutional Review Board committee approved their participation. An assent was also taken from children prior to palpation of their thyroid gland. Children diagnosed as having goiter were referred to the nearby health facility to for further investigation.

### ***Availability of Data and Materials***

All the data that support the findings of this study will be available from the corresponding author on reasonable request.

### ***Authors' Contribution***

DTH conceived the study, monitored the data collection process, analyzed the data and wrote the manuscript. DJT participated in designing the study, supervising data collection process and writing the manuscript. Both authors read and approved the manuscript.

## **Acknowledgement**

The authors acknowledge Leku town health office for facilitating the data collection process. The study participants need to be given respect, without their consent and the provision of the demanded information; this research work would not have been come into existence.

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