Advances in Applied Sciences
2023; 8(2): 44-51
http://www.sciencepublishinggroup.com/j/aas
doi: 10.11648/j.aas.20230802.12
ISSN: 2575-2065 (Print); ISSN: 2575-1514 (Online)

Research/Technical Note

Prevalence of Iodized Salt Intake and Iodine Deficiency Disorders Status of Pregnant Women Visiting Bishoftu Hospital and Health Center for Antenatal Care

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To cite this article:
Zeinaba Nagesso. Prevalence of Iodized Salt Intake and Iodine Deficiency Disorders Status of Pregnant Women Visiting Bishoftu Hospital and Health Center for Antenatal Care. *Advances in Applied Sciences*. Vol. 8, No. 2, 2023, pp. 44-51. doi: 10.11648/j.aas.20230802.12

Received: April 19, 2023; **Accepted**: May 19, 2023; **Published**: May 29, 2023

Abstract: Iodine is an essential mineral for normal thyroid function, mammary gland development, and fetal and infant neurological growth. It is a trace element essential to human and animal health, and present in uneven and mostly insufficient quantities in the environment around the globe. Iodine deficiency disorders are among the major public health problems of the world, particularly in pregnant women of developing countries. In Ethiopia about 15.4% of households consume sufficient iodized salt. This study was designed to assess iodized salt intake and assess iodine nutrition status, to evaluate knowledge, attitudes and practice of iodine nutrition and to asses goiter rate of pregnant women attending Bishoftu clinic for antenatal care in Bishoftu town. The study participants (n=208) was randomly selected. Data over socio-demographic, and knowledge, attitude and practice about iodized salt was collected by interview. Goiter was assessed by palpation and graded according to the WHO guideline. In addition, spot urine sample was collected and the level of urinary iodine was determined following the Sandell-Kolthoff reaction. Iodine level in salt samples was determined by following iodometric titration methods. The prevalence of goiter was 8.7% (Grade 1 = 7.7% and Grade 2 = 1%). The median urinary iodine concentration was 194.3µg/l. The consumption of adequately iodized salt was 89%. This study was indicated as there was no problem of iodine deficiency in the study area.

Keywords: Urine, Goiter, Iodine Deficiency Disorder, Urinary Iodine Excretion, Iodized Salt

1. Introduction

Iodine is an essential micronutrient and is a trace element sparsely distributed over the surface of the earth. About 90% of this comes from food while 10% from water. It is essential for the synthesis of the thyroid hormone, which is necessary for human growth and development [1]. It can be found in soil, Seaweed, Seawater and some foods such as sea fish, meat and milk [2].

The prevalence of IDD based on the total goiter rates (visible and palpate) is the highest in the Eastern Mediterranean region 32%, followed by Africa 20%, European 15% and Southeast Asia 12%. However, it is important to recognize that these clinical signs are superficially in severe cases and subclinical deficiency, which is also associated with a range of intellectual and behavioral deficits, affects many more individuals. Nearly one -third of the world's (2.3 billion is considered to be at risk of iodine deficiency, which a large proportion live in Southeast Asia [3]. Iodine deficiency poses a threat throughout the lifecycle and has been associated with mental impairment and goitre in older children and adults and complications with pregnancy, including stillbirth and congenital anomalies [4].

There is no country in the developing world where iodine deficiency is not a public health problem. About 38 million newborns in developing countries every year remain unprotected from the lifelong consequences of brain damage associated with iodine deficiency disorders [5]. Estimation indicates that 54 of the world countries have inadequate iodine nutrition [6]. About 321.1 million African people had

an insufficient iodine intake [7].

In Ethiopia, iodine deficiency has been recognized as a major public health problem for the past six decades [8]. Around 28 million population of the country suffer from goiter, and more than 35 million people are at risk of iodine deficiency. More importantly, 50,000 prenatal deaths are related to iodine deficiency each year in Ethiopia [9]. About 34.5% to 37% of the childbearing women in the country have goiter [10].

The education potential of the nation is unattained as iodine deficiency may cause an intelligence quotient reduction of 13.5 points. The problem is both a threat to the productivity of the workforce and a cause of cretinism and mental retardation [9, 11].

In Oromia, Iodine Deficiency Disorder (IDDs) is a major public health problem and it is one of obstacles to the socio-economic progress [12]. The Pregnant women are among groups especially affected by IDD. However, studies on iodine deficiency and IDD are scanty in Bishoftu town thus this study initiated with the objective to investigate prevalence of iodine deficiency disorders and Iodized salt intake in Bishoftu town.

2. Materials and Methods

2.1. Study Area

The study was conducted in Bishoftu town of East Shewa, Oromia region in Ethiopia. Its geographical location is 45km south-East of Addis Ababa with about 200,000 populations. The study depends on one general hospital and three health centers to asses urinary iodine concentration and iodized salt intake of pregnant women attending mother and child specialized clinics in Bishoftu town from January 15 to February, 15, 2016. Cross sectional studies based on MCH clinics was conducted between January 15 to February, 15, 2016. Knowledge, attitude and practice of participants about iodized salt were collected using interview method.

2.2. Study Population, Sample Size Estimation, and Sampling

The pregnant women registered in one hospital and all three health centers from January 15 to 30, 2016, was included in the study. Calculation was based on previous study from Bishoftu health office (Bishoftu health office, 2015) and using an expected IDD prevalence of 10%. The pregnant women was interviewed using questionnaire about their menstrual history, previous miscarriage if it was present, food they consume and monthly income by principal investigator of the project.

The sample size has been estimated as under:

Desired precision (%): 5% Expected prevalence: 10% Confidence level (C.L): 95% Non-response rate: 1 0%

Design effect (1.5)

$$N= \frac{(\text{C.L.}\%)^2 \text{ Prevalence}\%(100-\text{Prevalence}\%)(\text{design effect})}{(\text{Precision}\%)^2}$$

$$N= \frac{(1.96.\%)^2\ 10(100-10)(1.5)}{(10)^2}$$

N=207.

2.3. Knowledge, Attitude and Practice (KAP)

Pregnant women were interviewed by using semi structured comprehensive questionnaire, which was based on knowledge attitude, and practices about salt use pattern and awareness about IDD, dietary, reproductive history were interviewed and their response was recorded on the questionnaire.

2.4. Assessment of Goiter

All pregnant women were physically examined by a trained person. The goiter was graded as Grade 0: None or no goiter (palpable or visible), Grade 1 or palpable: A goiter that is palpable, but not visible when the neck is in the normal position. Grade 2 or visible: A swelling in the neck that is clearly visible when the neck is in a normal position and is consistent with an enlarged thyroid when the neck is palpated. The prevalence of goiter was expressed by Total Goiter Rate (TGR) which is the Sum of goiter grades 1 and 2.). Based on severity, goiter was categorized as mild if TGR = 5.0–19.9%, moderate if TGR = 20-29.9% severe if TGR ≥30% [13].

2.5. Collection and Analysis of Urinary Iodine

Urine sample was collected and level of iodine in urine was conducted by laboratory technologist. About 10 ml spot urine samples was collected from every pregnant women in a properly labeled and sterile screw-caped plastic vials and was immediately transferred to the cool box containing ice bags and was transported to the Ethiopian public health institute laboratory. The samples were kept at -40°C in refrigerator until analysis. Analysis of urinary iodine was done using spectrophotometric procedure. Each sample was analyzed duplicate. It was based on ammonium per sulfate method [14].

Determination of urinary iodine involves the spectrophotometric analysis (measuring the absorbance) of a reaction medium, which utilizes iodine as a catalyst. During this reaction, cerric ammonium sulfate (yellow in color), one of the reactants was reduced to cerrous (colorless) form, which uses iodine as a catalyst. The absorbance value/ optical density (OD) at 405 nm gives information about the iodine content of urine sample. It indicates that the more the absorbance value is the lesser the iodine content. The absorbance value can be used for the determination of the actual iodine concentration using a standard graph prepared by using a range of standard KIO_3 solutions [15].

Urinary iodine concentrations of <150 µg/l is insufficient, 150–249 µg/l is adequate, 250–499 µg/l, more than adequate and ≥500 µg/l was used as excessive levels of iodine intake in population of pregnant women. In this study, UIC <150 µg/l defined subclinical iodine deficiency and value ≥150 µg/l absence of iodine deficiency. The group with<150 µg/l was

again categorized into <20 µg/l as severe iodine deficiency, 20–49 µg/l as moderate iodine deficiency, and 50–149 µg/l as mild iodine deficiency [16].

2.6. Collection and Analysis of Household Salt

The 20-25 grams of salt from each respondent was collected and stored in airtight polythene pouch. The salt was transported to the laboratory of Ethiopia public health institute for analysis. The laboratory experiment on the level of iodine in salt was conducted. The samples were kept in desiccators at room temperature until iodine content was analyzed. The salt samples were analyzed quantitatively for iodine level by idometric titration method [17].

The method of determining iodine in the salt involves the titration of a solution of salt against standard Sodium thiosulphate ($Na_2S_2O_3 \cdot 5H_2O$) solution to find out the end point. The volume of $Na_2S_2O_3 \cdot 5H_2O$ used up is a direct measure of the content of iodine present in the salt. The Amount of thiosulphate used is proportional to the amount of free iodine liberated from the salt. Starch is added as an external indicator of this reaction and reacts with free iodine to produce blue color and the loss of this color indicates that all remaining free iodine was consumed by thiosulphate. Iodine level < 15ppm was good quality and iodine level >15 ppm was inadequate in their iodine content. The concentration of iodine in salt is calculated based on the titrated volume (burette reading) of sodium thiosulphate as

$$\text{Iodine (ppm)} = \frac{\text{titration volume in ml x 21.15xnormality of sodium thiosulphate x1000}}{\text{Salt sample weight in gram}}$$

3. Results

3.1. Socio Demographic Characteristics of Respondent's

From 208 participants invited to participate in the study, 38% (*n=79*) were between the age of 23-27, followed by those with age range of 18-22 years (34.6). About 95.6% of the study population was literate. Among the study population (59%) were housewife and only 13% were government employee. Forty-three percent of the participants were at the third trimester of gestation.

Table 1. *Socio- demographic characteristics of pregnant women (n=208) in Bishoftu town, 2016.*

Socia demographic Variables

Age of the participant	**Frequency**	**%**
18-22	**72**	34.6
23-27	79	38.0
28-32	40	19.2
33-37	17	8.2
Educational qualification Grade 9 and above	63	30.3
Grade 5-8	95	45.7
Grade 1-4	29	13.4
Can read and write	14	6.7
Unable to read and write	7	3.4
Occupation		
Government employee	27	13.0
Self business	58	27.8
House wife	123	59.0
Trimester		
First	51	24.5
Second	67	32.2
Third	90	43.3
Any abortion/stillbirth in the past		
Yes	198	95.2
No	10	4.8
No of family		
<5	179	86.1
>5	29	13.9
When you had last child birth		
Before 5 years	32	27.4
After 5 years	85	72.6
Where you have delivered your child		
Home	11	9.4
Hospital	106	90.6
What was the mode of delivery?		
Cessations	5	4.3
Normal	112	95.7
Total income		

Age of the participant	Frequency	%
<1000	34	16.3
1000-1500	94	45.2
>1500	80	34.5

3.2. Knowledge of IDD and Iodized Salt of Pregnant Women in Bishoftu Town

More than two-thirds of the surveyed women had heard about iodized salts (84.6%) and 77% responded knew as iodine is important to prevent goiter and for better health. However; none of them know as it is important for better intelligence. About 95.7% of current respondents were kept iodized salt properly at the household level.

Table 2. *Knowledge and practice towards iodized salt of pregnant women (n=208) attending MHC clinics in Bishoftu Town, 2016.*

Variables Heard of message on iodine deficiency diseases/Iodized Salt	Frequency	(%)
No=2	32	15.4
Yes=1	176	84.6
Type of salt used Packed	82	39.4
Non packed	81	38.9
Both	45	21.6
Storage practices		
In the container with cover	199	95.7
In the container without cover	3	1.4
Don't know	6	2.9
Do you think we should take I		
Yes	161	77.4
No	47	22.6
If yes why		
Prevent goiter	78	48.4
Prevent cretinism	3	1.9
Good health	80	49.7
Better Intelligence	0	0
Food rich in I		
Sea food	13	6.25
Iodized salt and oil	98	47.1
Milk and milk product	53	25.5
Meat and meat product	44	21.15

3.3. Urinary Iodine Excretion Level

A total of 208 urine samples were analyzed to determine urinary iodine excretion level and out of which Majority of the study population 145 (69.7%) had UIE >150 µg/l. The median urinary iodine excretion was 194.3 µg/l.

AS described in the following table The median urinary iodine concentration (UIC) pregnant women (*n=208*) attending Bishoftu MHC clinics, measured in spot urine samples collected from all health centers was greater than 100 µg/l and median MUIC of Bishoftu hospital was less than other health centers.

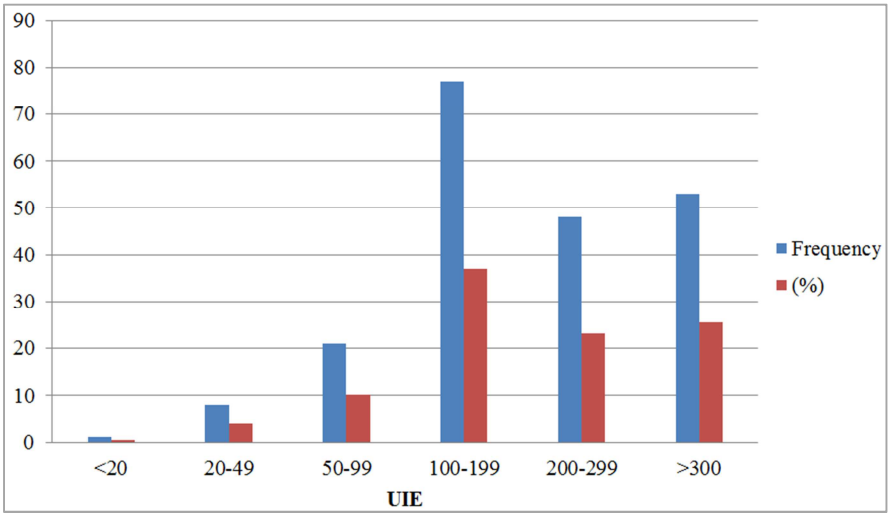

Figure 1. *Distribution of urinary iodine status of pregnant women (n=208) attending Bishoftu MCH clinics, 2016.*

Table 3. *UIE level of pregnant women (n=208) attending Bishoftu MHC clinics, 2016.*

UIE	Bishoftu Hospital (n=54)	Cheleleka Health center (n=50)	Keta Health center (n=51)	Bishoftu Health center (n=53)	Total (n=208)
<20	0 (0%)	0 (0%)	1 (2%)	0 (0%)	1 (0.48%)
20-49	5 (9.3%)	3 (6%)	0 (0%)	0 (0%)	8 (3.8%)
50-99	7 (13%)	6 (12%)	8 (15.7%)	1 (1.9%)	22 (10.6%)
>100	42 (77.8%)	41 (82%)	42 (82.3%)	52 (98.1)	177 (85.1)
MUIC	151.9	188.2	159.45	285.05	194.3

MUIC: median urinary iodine concentration

3.4. Iodine Content of Salt

About eighty nine percent (n=186) of the household consumed adequately iodized salt and only 10.6% of the house hold consumed inadequately iodized salt (<15ppm) as shown in the following table.

Table 4. *Iodine level of salt in household of pregnant women, (n=208) attending MHC clinics in Bishoftu town, 2016.*

Salt iodine content	Frequency	%
<15 ppm	22	10.6
15-30 ppm	69	33.2%
>30 ppm	117	56.2

3.5. Goiter Status of the Study Population

Table 5. *Goiter status of the pregnant women (n=208) attending MHC clinics in Bishoftu, 2016.*

Goiter grade	frequency	percent%
Grade 0	190	91.3
Grade 1	16	7.7
Grade 2	2	1.0
TGR	18	8.7

TGR: Totalgoiterrate

The total goiter rate status of the study population was 8.7% of which only 1% was grade 2 goiters.

3.6. Health Center Based Distribution Prevalence of Goiter

As shown in the following table 6 iodine deficiencies is mild in all Health center except Cheleleka health center; that indicate the presence of mild iodine deficiency. Cheleleka health center had no iodine deficiency and a goiter prevalence was<5%.

Table 6. *Goiter rate prevalence of pregnant women by health center.*

Goiter Grade	Bishoftu Hospital (n=54)	Cheleleka HC (n=50)	Keta HC (n=51)	Bishoftu HC (n=53)
Grade 0	47 (87%)	49 (98%)	46 (90.2%)	48 (90.6%)
Grade 1	6 (11.1%)	1 (2%)	4 (7.8%)	5 (9.4%)
Grade 2	1 (1.9%)	0 (0%)	1 (2%)	0 (0%)

4. Discussion

4.1. Coverage of Iodized Household Salt

Household iodized salt is one means of measuring the community iodine level. Universal salt iodization (USI) is globally accepted as the most cost-effective public health strategy to prevent iodine deficiency [4]. The present study household's iodized salt consumption was 89.4% and it was greater when compared to similar study in rural kebele of Ada district that was 39% [18]. It was also the highest among the study conducted in our country such as study in Akaki kality on school aged children, Assosa town, in Burie and Womberma district of west Gojjam, Gondar town, Bale goba town, Shebe-Senbo district of Jimma which were 20%, 26.1%, 1.1%, 33%, 29.7%, 26.2% respectively [19-24]. In Ethiopia the proportion of households utilizing iodized salt was 15.40%. [10]. Community based cross sectional studies conducted in 2014 indicates that the prevalence of adequately iodized salt is 53% and iodized salt coverage is 89% in Ethiopia [25].

In Africa Countries with successful iodized salt programs achieving a household coverage of more than 90% are: Burundi, Kenya, Nigeria, Uganda, Tunisia, Namibia, Zimbabwe, and Libya. Countries with promising household coverage rates of between 80 and 90% are: Rwanda, Sao Tome & Principe, Cote d'Ivoire, Lesotho, Comoros, the

Congo Brazzaville, and Tanzania [7]. Where as in Burundi, Kenya, Nigeria, Tunisia, Uganda and Zimbabwe it is more than 90% [7].

The current household iodized salt coverage was better than that of Sudan, Mauritania, Guinea- Bissau and Gambia, which were less than 10% [7]. In South Sudan in a 2005 survey, households consuming iodized salt had increased from 40 to 73% [26].

(ICCID) indicates that South Sudan, Sudan and Ethiopia have only 35% or fewer households with access to iodized salt [7].

Another study in Senegal indicates that an average iodine concentration in salt was 22 ppm. [27]. In one country to implement high coverage of iodized household salt awareness, availability, accessibility, and affordability must undergo [26].

4.2. Urinary Iodine Status of Pregnant Women

School-aged children have traditionally been used as a proxy of the iodine status in the general population. It is critically important that the iodine status of pregnant women should be assessed, in addition to that of children [28]. In the current study the median UIE was 194.3 µg/l which indicate adequate iodine nutrition or as none of iodine deficiency in the study area. It was greater when it is compared to previous study in the same district of rural area of Ada'a that was 85.7 µg/l [18]. the current study was greater than another study done in different parts of Ethiopia such as studies on pregnant women visiting Jimma University Specialized Hospital for Antenatal Care, in rural women from sidama zone southern Ethiopia and in Burie and Womberma district of West Gojjam of pregnant women which was (37.2 µg/L, 48µg/L. 50 µg/l) respectively [29, 11 and 21]. Reason why current study MUIC was high is may be because of geographical area is different from another area especially Gojjam which is among the highest prevalence of goiter in our country. Another reason why current study MUIC was high is may be because of government policy of salt iodization. When this study is compared to another study conducted outside of Ethiopia such as Senegal, Indian Orissa, and South Sudan Median urinary iodine concentration was 92.20µg/l, 125 µg /l and 152 µg/ml respectively [30, 31, 27]. It was greater.

The present study was better of all those study this is because of the government adopted a strategy for the virtual elimination of IDD by the year 2015 through universal salt iodization (Adish A et al. 2013). These is may be because of Awareness given to the community Towards IDD and iodized salt, policy implementation of the government on salt iodization and the geographical location of the study area.

4.3. Goiter Prevalence

Goiter prevalence is one of the indications of iodine deficiency in the community. In the current study prevalence of goiter was 8.7% so there was mild iodine deficiency in the area. It was low goiter prevalence when it is compared to study in the same area of rural kebele that was 20% [18]. Another study in parts of the country such as study in Burie and Womberma district of Gojjam was 30.1% and in rural women from Sidama Zone Southern Ethiopia the total goiter rate was 15.9% [21, 11]. Another study among women in Ethiopia indicate Total goiter prevalence of 35.8% this demonstrates that more than 6 million women were affected by goiter and Goiter prevalence in four regional states (Southern Nation Nationalities and People, Oromia, Benshangul-Gumuz and Tigray) was greater than 30%. In the rest of the regions except Gambella, the IDD situation was mild to moderate. [10]. The current study was better than all of this study may be because of several reasons such as the geographical location of study area that was at low land area and consumption of iodine rich food such as milk and its products. When the current study is compared to criteria for tracking progress towards eliminating IDD it indicate that TGR was 8.7% which indicate prevalence of mild iodine deficiency and status of iodine nutrition was with MUI excretion of 194.3 µg /l. This indicates none of iodine deficiency in the study area. The house hold consumption of iodized salt was 89% indicate almost met the criteria of elimination of IDD. Generally the study area had not too much iodine deficiency problem and a little improvement is required to meet the criteria for tracking progress towards eliminating iodine deficiency disorders.

5. Conclusion and Recommendation

5.1. Conclusion

The iodine deficiency in the study area is only with goiter prevalence of 8.7% and 89% of household's iodized salt consumption. Median UIE was 194.3 µg /l. this indicate low prevalence of iodine deficiency in the study area. High rate of goiter was recorded in participants at lower age category (18-22) and those in their first trimester of pregnancy. The current study indicates high median urinary iodine excretion this may be because of high consumption of dietary source of iodine. The geographical location of the study area is in the rift valley land and can be rich in iodine. The iodine content of food depends on the iodine content of the soil where it is grown. The iodine present in the upper crust of earth is leached by glaciations and repeated flooding and is carried to, the lowland therefore, plants grow on this land may be a rich source of iodine. The study community had also a high coverage of iodized salt. This maybe because of presence of iodized salt widely in the market and most of the study population nearest to the media and can have information about iodine deficiency and iodized salt.

5.2. Recommendation

Iodine deficiency is not as such a problem in the study area but to increase their knowledge towards iodine deficiency and iodized salt giving awareness to the community at the household's level by health extension will be important. Adjusting the program of learning and teaching in the health

center about iodine deficiency, how to use iodized salt, different diets as source of iodine and cause of iodine deficiency such as cretinism, reduce intelligence, abortion and other cause of iodine deficiency for pregnant women during their check up for improvement of their iodine nutrition consistently. Further study has to be conducted in the whole community on goiter status, urinary iodine excretion, household using iodized salt and their knowledge and practice towards iodized salt and IDD as well as the consequence of iodine deficiency on human health at different age groups.

5.3. Limitation of the Study

The study was only depend on the pregnant women attending health center and do not concern those whom do not attend health center and other community such as school age children.

Acknowledgements

First of all I would to thanks Allah for giving me Health and ability to do all things.

Second I would like to thanks Dr. Getachew for his greatest advice, comment and help throughout my work.

Thirdly I would like to thanks Oromia Biro and Bishoftu Health office, Bishoftu Hospital, (Keta, Bishoftu and Chaleleka) health center, sister Sofia Abdu for goiter palpation and also for those workers help me through sample collection.

Finally I would like to thanks all my family especially my husband Mohammed Desta who help me ideally and financially.

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