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Iodine Deficiency and Associated Factors among Pregnant Women Attending Antenatal Care at Public Health Facility in Bale Zone, Southeast Ethiopia

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Abstract

Introduction: Iodine deficiency during pregnancy causes maternal hypothyroidism which can lead negative consequences on pregnancy and pregnancy outcome. However, data on the prevalence of iodine deficiency among pregnant women of Bale Zone is limited and unconvincing. The aim of this study was to assess the prevalence of Iodine deficiency and associated factors among pregnant women attending antenatal care in public health facilities in Bale Zone, Southeast Ethiopia.

Methods: An institution based cross-sectional study was carried out in Bale Zone from January to March, 2017. Data were collected by pretested structured interviewer-administered questionnaires from a total of 499 pregnant women who were identified through systematic random sampling. Urinary iodine concentration was measured using inductively-coupled-plasma mass spectrometry. Association between dependent and independent variables was computed by using bivariate and multivariable logistic regression. In the multivariate analysis, variables with a P-value of <0.05 were considered statistically significant.

Results: About 499 pregnant women were interviewed yielding a response rate of 96.5%.The median urinary iodine concentration (MUIC) of the study group was 81.2μg/L. About 56% of the pregnant women had iodine deficiency. The result of multivariate logistic regression showed that inadequate dietary diversity [AOR=1.41; 95 % CI (1.91-2.24)], Consuming cereal in 24 hours [AOR=1.3; 95 % CI (1.03-3.52)], Illiteracy [AOR=3.51; 95 % CI (3.05-7.)]. Mid-Upper Arm Circumference (MUAC)<21cm [AOR=3.6; 95 % CI (3.05-7.03)],were significantly associated with Iodine deficiency.

Conclusion: Iodine deficiency is a public health problem in the study area. The problems could be combated by increasing the consumption of foods with high bioavailable iodine and optimally diversified diet additionally use of home-based goitroigenic reduction techniques such as fermentation and germination.

Keywords: Iodine deficiency; Urinary iodine; Pregnant women; Bale Zone

Introduction

Dietary Iodine is an essential micronutrient needed to ensure thyroid gland works properly[1-5]. During pregnancy the daily iodine requirement increases by 50% because of the higher production, fetal transfer of maternal thyroid hormone and raised renal iodine clearance[6,7]. According to the World Health Organization (WHO), the median urinary iodine concentration (MUIC) is the best marker for assessing iodine status in pregnant women, since over 90% of the dietary iodine eventually appears in the urine[8,9]. Iodine deficiency during pregnancy has been associated with adverse effects on mothers and on birth outcomes. Major problems associated with Iodine deficiency during pregnancy including congenital anomalies, stillbirth, spontaneous abortion, increased prenatal mortality, growth retardation, neurological cretinism, poor cognitive functions

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and delayed psychomotor developments[10]. Approximately one-third of the world's population living in 130 countries consumes inadequate amounts of iodine and is at risk for iodine deficiency[5]. Europe (57%), the Eastern Mediterranean (54%), Africa (43%), Southeast Asia (40%), the Western Pacific (24%), and the Americas (10%) are the country's most affected[11,12]. Globally, Iodine Deficiency Disorders (IDD) affects more 241 million school children[13]. About 38 million newborn babies per year are at risk of iodine deficiency in developing countries[14]. More than 57 million African children suffer from Iodine deficiency disorder[15]. A study carried out in Ethiopia in 2011 revealed that about 50,000 prenatal death, and 685.000 babies were born with mild and severe iodine deficiency disorder[16]. According to WHO, the United Nations (UN) and IGN[17], more than 321 million Africans are at risk of insufficient iodine intake[18] and 80% of Ethiopians are exposed to an iodine deficient environment[19].

Many studies have been carried out to demonstrate level of median urine iodine and predictors of iodine deficiency in Ethiopia and elsewhere[20-29]. Studies done in different parts of Ethiopia for instance in Ada district, the Aira district, in Sidama Zone, in Haramaya, and in Jimma, the media urine iodine concentration is 85.7µg/l, 88.6µg/l , more than 60% and the median UIC was 15µg/L , 58.1µg/L, and 48 µg/l respectivelyconsistently reported high prevalence of iodine deficiency among pregnant women[24-28]. The previousstudies have also shown that low iodine content in the diet, arises from low iodine levels in the soil, water and crops[26], the consumption of foods like cassava, millet & wheat(containing goitrogenic and phytate)[27]. Deficiencies of minerals and vitamin such as iron and selenium vitamin A deficiency[28], low maternal education,[28,29] and age of the mother[28,29] are some of the factors associated with iodine deficiency. Roughly, 74% of the households of Ethiopia are not access to adequate iodized salt[30]. In developing countries, especially Ethiopia, high prevalence of communicable diseasesandsocio-economic problems has made the obliteration of iodine deficiency more challenging[25]. In Ethiopia, iodine deficiency has remained the public health problem among pregnant women and the prevalence hasbeen reached 77.7% in Ada District, Oromia Region, Ethiopia[24]. Furthermore, stable diet ofEthiopian is mainly composed of cereal (Teff, maize, sorghum, millet) and tubers and roots (ensete, sweet potatoes etc) which lack thediversity to meet nutrient requirements, particularly micronutrients inpregnancy[25]. This study aimed to determine the prevalence and associated factors of iodine deficiency among pregnant women attending antennal care in public health facilities Bale Zone, Southeast Ethiopia.

Method and Materials

Study design and study setting

An institutional based cross-sectional study was conducted in Bale Zone, Southeast Ethiopia in 2017. The Zone is found in Oromia Regional State at 430 km away from Addis Ababa the capital city of Ethiopia. The topography of the land of zone is composed of 14.9% highland, 21.5% midland 63.5% lowland with an altitude of 300–4,377 m and, it receives rain twice a year (in two seasons), with downfalls ranging from 800 to 900 mm on average. The main sources of food include cereal crops, fruit, vegetable and animal products. According to the Bale Zone Finance and Economic Development 2017 Report, the total population of zone is 1,757,383 and out of these females were 896,265. The ANC coverage was 64%. The study period was from January-March, 2017.

Study Population and sampling procedures

The study population consists of pregnant women who are attending antenatal care in selected health facility during the data collection period. Pregnant women who were diagnosed as having goiter were excluded. The sample size was determined using a single population proportion by using assumption: 95% level of confidence, margin of error of 0.05, proportion of iodine deficiency 89%[27] and non-response rate: 10%. Considering a design effect of two, the final sample sizes became 517. Health institution was selected using simple random sampling method.Total pregnant women who were attending antenatal care in the previous three months at the selected health facility were checked. Based on the client load of the health facility, the sample of the study was allocated proportionally. Then the study subjects were selected using systematic random sampling.

Data collection tool and data quality control

Questionnaire was adopted from WHO and EDHS[9,31]. The English version of the questionnaire was translated into Afan-Oromo (the native language of the study area) then translated back to English by English language and public health experts to ensure consistency. The variables addressed in this study were socio demographic, feeding habit, pregnancy related trimesters (I, II& III). Data were collected by pretested structured interviewer-administered questionnaire. Urine samples were collected by air tight plastic urine containers and nutritional status of pregnant women assessed by MUAC. A total of seven data collectors (2 health officers, 2 clinical nurses and 2 laboratory technicians) and one supervisor (health officer) were recruited and participated in the study. Data were collected by health professionals after they had been taking training. The training largely focused on equipping the trainees on the objective of the study, technique of inter-view, collection of samples, and maintaining of ethical issues. The data collection tool was pretested on 5% of the study subjects out of the selected health facilities. During the pretest, the acceptability and applicability of the procedures and tools were evaluated. Moreover during data collection field supervisors were checked the consistency and completeness of collected data in the field and on the daily basis. The investigators were coordinating the overall activities.

Measurements

Urinary iodine is the most reliable indicator of the iodine-deficiency status ,because during normal physiological functions, about 90% of body iodine is excreted through urine; as a result estimating the median urine iodine level is supposed to be an important reflection of the burden of iodine deficiency for the entire population[9]. Also, it has been considered as the most reliable measure of the current iodine intake[4]. For biochemical assessment of iodine status, about 10 ml urine samples from pregnant women were collected in a properly labeled and sterilized screw capped plastic bottle. These cups were immediately transferred to a cold box containing ice packs and transported to the storage site. The samples were kept at 6°C in a refrigerator until analysis.

Urinary iodine analysis was performed in the Iodine Laboratory of the Ethiopian Health and Nutrition Research Institute (EHNRI) whereurinary iodine concentration was measured using inductively-coupled-plasma mass spectrometry as suggested and approved by WHO/UNICIEF/ICCIDD[11]. Urinary iodine status of the pregnant women was classified using WHO/UNICEF/ICCIDD recommended cut-off points Iodine Deficiency; for pregnant women are less than150 µg/l[9]. Assessing nutritional status of pregnant women was under taken by the data collectors by using Mid-Upper Arm Circumference (MUAC) on the non-dominant hand with a non-stretch measuring tape. Measurements of Mid-Upper Arm Circumference (cm) of the pregnant women recorded less than 21 cm were considered under nutrition and 21 cm or over was considered as adequate nutritional status.

Data Processing and Analysis

After each questionnaire checked for completeness, the data were entered into a database using Epi Info version 7 statistical packages and then transferred to Statistical Package for Social Sciences (SPSS) version 21 for analysis. Data was first presented using descriptive statistics, including frequencies and proportions. A bivariate analysis was used to see the crude effect of each independent variable on Iodine deficiency (median urine iodine concentration of <150 µg/l). Variables with a P-values of <0.2 were entered into the multivariable logistic regression analysis. Both Crude Odds Ratio (COR) and Adjusted Odds Ratio (AOR) with a corresponding 95% Confidence Interval (CI) were computed to show the strength of the association. In the adjusted analysis, a P-value of <0.05 was used to determine statistical significance.

Results

Socio-demographic characteristics of the study subjects

A total of 499 pregnant women participated in the study giving a response rate of 96.5%. The mean (± Standard Deviation, SD) age of the pregnant women was 26.8 (±6.1) years. The majority of the pregnant women were Oromo in ethnicity 365 (73.1%) and Muslim 272 (54.5%) in religion. One hundred and sixty (38.3%) of the women had no formal education and half of them were housewives. About 308 (61.7%) were literate. More than half of the pregnant women 308 (61.7%) had a family size with more than five children. About 151 (30.3%) of the pregnant women had a monthly income of less than 500ETB. Almost 97.7% of the pregnant women 'were married (Table 1).

Table 1: Socio demographic characteristic among pregnant women attending antenatal care at Public health facilities in Bale Zone, Southeast Ethiopia, 2017 Ethiopia, 2017(n=499)

	Variables	Frequency	Percentage
Age in years	18-24	223	44.7
	25-34	233	46.7
	>=35	43	8.6
Marital status	Married	484	97.%
	Divorced	11	2.2 %
	Widowed	4	0.8%
Religion	Orthodox	183	36.7
	Muslim	272	54.5
	Protestant	44	8.8
Nationality	Oromo	365	73.1
	Amhara	89	17.8
	Tigre	12	2.4
	Gurhage	17	3.4
	Kembata	11	2.2
	Other*	5	1%
Educational status	No formal education	191	38.3%
	Literate	308	61.7%
Occupational status	Housewife	253	50.7%
	Government employee	167	33.5%
	Merchant	65	13.%
	Laborers	14	2.8%
Family size	< 5	191	38.3%
	> 5	308	61.7%
Income ETB**	< 500	151	30.3%
	500-1500	179	35.9%
	>500	58	11.6%
	Unknown	111	22.2%

** Ethiopian birr

Obstetric history, dietary pattern, urine iodine concentration and nutritional status

The diet of the majority of these pregnant women was largely based on cereals 433 (86.8%) and legumes (78.3%). However, only a few, (4.8%) of them ate fish in the 24 hours prior to the survey. In this study, the median urine iodine level was 81.2 µg/ l, and more than 281 of the pregnant women had a urine iodine level (<150 µg/L), suggesting a high prevalence of iodine deficiency in this population. Iodine deficiency was higher among pregnant women with a family size of five or more (159 or 54.5%). About 42.9% of participant's had MUAC of less than 21 cm suggesting under nutrition (Table 2).

Table 2: Obstetric history, Urine Iodine concentration and Nutritional status among pregnant women attending antenatal care at public health facilities in Bale Zone, Southeast Ethiopia, 2017. (n=499)

Variables		Frequency (%)	
Trimester	I	209	41.9%
	II	220	44.1%
	III	70	14.0%
Gravida	<=2	212	41.8%
	>2	287	57 .5%
UIC	<150 ug/l	281	56.%
	>150 ug/l	218	44%
MUAC	<21 cm	214	42.9%
	>21 cm	285	57.1%
Dietary diversity	<4	298	60%
	>4	201	40%

UIC: Urine iodine concentration

MUAC: mid-upper arm circumference

Factors associated with iodine deficiency

Logistic regression analysis was computed to identify predictors of Iodine deficiency among pregnant women. The variables which had P-values less than 0.2 in bivariate regressions were exported to a multivariable regression. The multivariable logistic regression analysis variables such as inadequate dietary diversity, consuming cereal in 24 hour, MUAC <21mm, illiteracy, were associated with iodine deficiency (Table 3).

Table 3: Factors associated with iodine deficiency in logistic regression analysis among pregnant women attending antenatal care in public health facilities, Bale Zone, Southeast Ethiopia, 2017(N=499).

Variables		Iodine deficiency		Crude OR (95%CI)	Adjusted OR (95% CI)
		Yes	No		
Family size	< 5	96	95	.658 (457-.947)	**
	> 5	185	123	1	1
Consuming cereal in 24 hours	Yes	250	183	1.557 (.926-2.618)	1.303 (1.0330-3.515)*
	No	31	35	1	1
Consuming egg in past 24 hours	Yes	71	75	.637 (.432-.939)	**
	No	21	143	1	1
MUAC	< 21	161	50	4.22 (2.83-6.17)	3.631 (3.05-7.03)*
	>21	120	164	1	
Educational status	Illiterate	120	165	.616 (.426-.892)	1.72 (1.12-2.63)*
	Literate	122	64	1	
Dietary diversity	<4	168	111	1.43 (1.003-2.048)	1.41 (1.91-1.24)*
	>=4	113	107	1	

**: p> 0.05 Have no association

*: p< =0.05 Have association

Discussion

The median urinary iodine concentration (UIC) is the best marker for assessing iodine status in pregnant women, as > 90% of the dietary iodine eventually appears in the urine[14]. According to the World Health Organization (WHO), the median urine iodine concentration among pregnant women ≥ 150 µg/l defines a population with no iodine deficiency[12]. However, the present study showed that the median urine iodine concentration among pregnant women was 81.2µg/L i.e. below 150µg/L[8]. Moreover, 56% of the pregnant women, the median urine iodine concentration was below the cutoff for iodine adequacy<150 µg/l[14] .The finding was in line with what was reported in Ada district and the Aira district in Oromia Region of Ethiopia 85.7µg/l and 88.6µg/l respectively[25,26]. But, it is clearly lower than the WHO/UNICEF/ICCIDD jointly recommended cutoff point (≥150 ug/l)[9] and reports from India, (125 µg/L)[23], Philippines(335 µg/l[33], Kenya 215.1µg/l[32], and rural residents of Zhejiang province of China 191.2 µg/L[34]. On the other hand,the median urine iodine concentration of current study is higherthan studies that have previously determined the iodine status of pregnant women in different parts of Ethiopia. According to astudy conducted among pregnant women in Sidama Zone, the prevalence of severe iodine deficiency (UIC< 20µg/L) was 60%[29]. A study conducted in Haramaya, Eastern Ethiopia among pregnant women, found a median UIC of 58.1µg/L[28]. A hospital based cross-sectional study conducted in Jimma, South Western Ethiopia among pregnant women reported that 88.9% of participants had iodine deficiency and a median UIC of 48 µg/l[28]. Even though the median urine iodine concentration of the current study shows there is slightly improvement, it is still below the cutoff (WHO ≥ 150 µg/l). The improvement of median urine iodine concentration in the current study may be due to the fact that our study was carried out five years after an obligatory salt iodization program was launched in Ethiopia in 2011. Furthermore, the Federal Ministry of Health has designed a National Nutrition Program and micro nutrient guideline, and endorsed a proclamation for ensuring the availability of iodized salt. Pregnant women who consumed green leafy vegetables in the last 24 hours preceding the date of data collection were 1.3 times more likely to develop iodine dficiency than their counter parts. Our study demonistrated that the high prevalancce of iodine dificiency may be due to the diet of pregnant women because the majority of subjects which was based on cereal (millet, sorghum) and dark green leafy vegetables (cassava, cabbage). These items contain thiocyanate and isothiocyanate that inhibit the uptake of iodine to the thyroid follicular cells and also facilitate the thyroid peroxidase enzyme that cause iodine deficiencyby acting directly on the thyroid gland, or indirectly by altering the regulatory mechanisms of the thyroid gland[10,20]. Lack of education among pregnant women was associated with risk of iodine deficiency andthe goiter rate was found to be higher among illiterate thanliterate participants. In this study pregnant women with no formal education were 1.7 times more likey to have subclinical iodine deficiency than those who had formal education. It has also been demonstrated by other studies that better educated pregnant women are more likely to consume food with high dietary diversity where as illiterate mothers have less ability to understand the adverse consequences of iodine deficiency; an undiversified diet was commonly ob-

served among illiterate pregnant women[26]. A study conducted in Denmark demonstrated that the prevalence of iodine deficiency was less among those with a higher education level[35]. Study carried out in Istanbul among school children showed that those children who had educated care givers had a lower prevalence of iodine deficiency than their counter parts[36]. In France, a study conducted among adults disclosed that as the educational level increases the prevalence of iodine deficiency was decreased[37]. It is possible that educated pregnant women are more likely to purchase iodized salt and consumefood with higher iodine level.
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Conclusion and Recommendation

Conclusion

In this study, the prevalence of ID (low urine iodine level) was high, suggesting a significant public health problem. Inadequate dietary diversity, cereal consumption in the previous 24 hours, illiteracy and under-nutrition (MUAC< 21 ecm) were significantly associated with Iodine deficiency. The problems could be combated through increasing consumption of foods with high bioavailable iodine, optimal diversified foods, and use of home based phytate and goitrogenic reduction techniques.

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Author Contributions: SH conceived and designed the study, performed analysis and interpretation of the data. SH, prepared the manuscript. KB, TT & EG critically reviewed the manuscript. All authors read and approved the final manuscript.

Competing Interests: The authors declare that they have no competing interests

Ethics approval and consent to participate: Ethical approval was obtained from the Ethical and Review committee of the Madda Walabu University. A support of letter from the University was provided to the zonal health office and then communicated to health centers and hospitals. Health center and hospital managers wrote a letter for participants. Written consent was obtained from the participants. All participants had the right to withdraw from the study at any time, without any precondition or disclosure. Moreover, the confidentiality of information obtained was guaranteed by all data collectors and investigators by using code numbers rather than personal identifiers and by omitting the name of the respondents during the data collection procedure.

References

1. Pearce, E.N., Lazarus, J.H., Moreno-Reyes, R., et al. Consequences of iodine deficiency and excess in pregnant women: An overview of current known and unknowns. (2016) Am J Clin Nutr 104(3): 918–923.
Pubmed | Crossref | Others
2. Skeaff, S.A. Iodine deficiency in pregnancy: The effect on neurodevelopment in the child. (2011) Nutrients 3(2): 265–273.
Pubmed | Crossref | Others
3. Bath, S.C., Rayman, M.P. A review of the iodine status of UK pregnant women and its implications for the offspring. (2015) Environ Geochem Health 37(4): 619–629.
Pubmed | Crossref | Others
4. Pearce, E., Andersson, M., Zimmermann, M.B. Global iodine nutrition: Where do we stand in 2013? (2013) Thyroid 23(5): 523-528.
Pubmed | Crossref | Others
5. Andersson, M., Zimmermann, M.B. Global iodine status in and trends over the past decade. (2012) J Nutr 142(4): 744–750.
Pubmed | Crossref | Others
6. Zimmermann, M.B. Role of iodine in human growth and development. (2011) Semin Cell Dev Biol 22(6): 645–652
Pubmed | Crossref | Others
7. Zimmermann, M.B. The importance of Adequate iodine during pregnancy and infancy. (2016) World Rev Nutr Diet 115: 118–124.
Pubmed | Crossref | Others
8. Donnay, S., Arena, J., Lucas, A., et al. Iodine supplementation during pregnancy and lactation. Position statement of the working group on disorders related to iodine deficiency and thyroid dysfunction of the Spanish society of endocrinology and nutrition. (2014) Endocrinol Nutr 61(1): 27-34.
Pubmed | Crossref | Others
9. World Health Organizations. Assessment of Iodine Deficiency Disorders and Monitoring Their Elimination. A Guide for Program Managers, 3rd ed.; (2007) WHO: Geneve, Switzerland.
Pubmed | Crossref | Others
10. Melse-Boonstra, A., Jaiswal, N. Iodine deficiency in pregnancy, infancy and childhood and its consequences for brain development. (2010) Best Practice & Research Clinical Endocrinology and Metabolism 24(1): 29–38.
Pubmed | Crossref | Others
11. WHO, UNICEF, ICCIDD. Assessment of iodine deficiency disorders and monitoring their elimination. A guide for programme managers. (2007) 3rded. Geneva: WHO.
Pubmed | Crossref | Others
12. WHO. Iodine deficiency in Europe (2007) A continuing public health problem.
Pubmed | Crossref | Others
13. Zimmermann, M.B., Connolly, K., Bozo, M., et al. Iodine supplementation improves cognition in iodine-deficient schoolchildren in Albania: a randomized, controlled, double-blind study. (2006) American Journal of Clinical Nutrition 83: 108-114.
Pubmed | Crossref | Others
14. Wolde-Gebriel, Z., Demeke, T., West, C.E., et al. Goitre in Ethiopia. (1993) Br J Nutr 69(1): 257–268.
Pubmed | Crossref | Others
15. Abuye, C., Ayana, G., Umeta, M., et al. Thyroid responses to varying doses of oral iodized oil in school children in Awassa, Ethiopia.

(2000) Ethiop J Health Dev 14(1): 49-55.
Pubmed | Crossref | Others

16. WHO, UNICEF, ICCIDD. Assessment of iodine deficiency disorders andmonitoring their elimination. A guide for programme managers. 3rded. (2007) Geneva: WHO.
Pubmed | Crossref | Others
17. Andersson, M., Karumbunathan, V., Zimmermann, M.B. "Global iodine status in 2011 and trends over the past decade. (2012) Journal of Nutrition 142(4): 744-750.
Pubmed | Crossref | Others
18. Kedir, H., Berhane, Y., Worku, A. Subclinical Iodine Deficiency among Pregnant Women in Haramaya District, Eastern Ethiopia: A Community-Based Study. (2014) Hindawi Publishing Corporation Journal of Nutrition and Metabolism.
Pubmed | Crossref | Others
19. Ugo, J., Chinwe, E. A pilot study of iodine and anthropometric status of primary school children in Obukpa, a rural Nigerian community. (2012) Journal of Public Health and Epidemiology 4(9): 246–252.
Pubmed | Crossref | Others
20. Gidey, B., Alemu, K., Atnafu, A., et al. Availability of adequate iodized salt at household level and associated factors in rural communities in Laelay Maychew District, Northern Ethiopia: a cross-sectional study. (2015) Journal of Nutrition and Health Sciences 2(1): 1
Pubmed | Crossref | Others
21. Gaitan, E. Goitrogens in food and water. (1990) Annu Rev Nutr 10(1): 21–37.
Pubmed | Crossref | Others
22. Kapil, U., Pandey, R.M., Prakash, S., et al. Assessment of iodine deficiency in school age children in Nainital District, Uttarakhand State. (2014) Asia Pac J Clin Nutr 23(2): 278-281.
Pubmed | Crossref | Others
23. Gebremariam, H.G., Yesuf, M.E., Koye, D.N. Availability of Adequately Iodized Salt at Household Level and Associated Factors in Gondar Town, Northwest Ethiopia. (2013).
Pubmed | Crossref | Others
24. Fereja, M., Gebremedhin, S., Gebreegziabher, T., et al. Prevalence of iodine deficiency and associated factors among pregnant women in Ada district, Oromia region, Ethiopia: a cross- sectional study. (2018) BMC Pregnancy Childbirth 18(1): 257.
Pubmed | Crossref | Others
25. Talila, K., Christel, A., Judith, L., et al. Iodine status in pregnant women and school children of the Aira district in Ethiopia. (2017) NFS Journal 7: 1–7.
Pubmed | Crossref | Others
26. Zenebe, N., Teshome, G., Raesh, P.N. Determining the Magnitude of Iodine deficiency in pregnancy and the effects of maternal iodine. (2014).
Pubmed | Crossref | Others
27. Ersino, G., Tadele, H., Bogale, A., et al. Clinical assessment of goiter and low urinary iodine concentration depict presence of severe iodine deficiency in pregnant Ethiopian women: a cross-sectional study in rural Sidama, Southern Ethiopia. (2013) Ethiop Med J 51(2): 133-141.
Pubmed | Crossref | Others
28. Workie, S.B., Abebe, Y.G., Gelaye, A.A., et al. Assessing the status of iodine deficiency disorder (IDD) and associated factors in Wolaita and Dawro Zones School Adolescents, southern Ethiopia. (2017) BMC Res Notes 10(1): 156.
Pubmed | Crossref | Others
29. WHO (World Health Organization). Iodine deficiency in Europe. A continuing public health problem. (2007) Geneva: World Health Organization.
Pubmed | Crossref | Others
30. Central Statistical Agency of Ethiopia and Ethiopia Demographic and Health Survey 2011. (2011) Addis Ababa and Calverton: CSA Ethiopia and MEASURE DHS-ICF Macro.
Pubmed | Crossref | Others
31. BuKyung, K., Jee-Yeong, J., Kwang-Hyuk, S., et al. Current Iodine Nutrition Status and Awareness ofIodine Deficiency in Tuguegarao, Philippines Hindawi Publishing Corporation. (2014) International Journal of Endocrinology.
Pubmed | Crossref | Others
32. Kishoyian, G.M., Njagi, E.N., Orinda, G.O., et al. Prevalence of iodine deficiency disorders and urinary iodine excretion among primary school children in Makina and Kilimani in Nairobi, Kenya, (2014) IJIRD 3(5): 671–679
Pubmed | Crossref | Others
33. Zou, Y., Lou, X., Ding, G., et al. A cross-sectional comparison study on the iodine nutritional status between rural and urban residents in Zhejiang province, China. (2014) BMJ Open 4(6):e005484.
Pubmed | Crossref | Others
34. Knudsen, N., Bulow, I., Laurberg, P., et al. Low socioeconomic status and familial occurrence of goitre are associated with ahigh prevalence of goiter. (2003) Eur J Epidemiol 18(2): 175–181.
Pubmed | Crossref | Others
35. Gur, E., Ercan, O., Can, G., et al. Prevalence and risk factors of iodine deficiency among school children. (2003) Trop Pediatr J 49(3): 7168–71 26.
Pubmed | Crossref | Others
36. Valeix, P., Faure, P., Peneau, S., et al. Lifestyle factors related to iodine intakes in French adults. (2009) Public Health Nutr 12(12): 2428–2437.
Pubmed | Crossref | Others