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Urinary Iodine Concentration and the Utilization of Iodized Salt in Households with Children Aged 6–23 Months in Aceh, Indonesia

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ABSTRACT

This study aims to analyze iodine intake and urinary iodine concentration levels and the risk factors of using iodized salt in households with children aged 6–23 months. This is a cross-sectional study that included 83 children aged 6–23 months. Iodine intake was collected using a 24-h food recall method, while Urinary Iodine Concentration (UIC) was analyzed by the spectrophotometry method. The use of iodized salt was analyzed by an iodine-test from the household salt samples, while the characteristics of the samples and mothers' knowledge on iodine was collected through interviews using a structured questionnaire. Data analysis included univariate and bivariate analysis using the logistic regression test at a 95% confidence level. The results showed that 74.7% of households did not use iodized salt and 45.8% of mothers had poor knowledge. The average of urinary iodine concentration was 272.9±172.2 μg/l and 97.6% were in the adequate category, while iodine intake was 1.5±1.9 mg. There was a significant relationship between fathers' education level p=0.046 and mothers' knowledge p=0.002 (OR= 2.18; 95% CI: 1.03–75.6 and OR= -2.34l; 95% CI: 0.02–0.42) with salt iodine utilization. The level of father's education and mother's knowledge were the risk factors for using iodized salt in the household. Efforts should be made to increase the use of iodized salt at the household level through education, promotion, and advocacy as well as monitoring iodized salt circulation in the community.

Keywords: iodine intake, urinary iodine concentration, iodine salt, knowledge

INTRODUCTION

Children aged 6–23 months are at a critical age for growth and development; this age range forms the largest portion of the first 1000 days of life, which starts from nine months of gestation and lasts until two years after birth. Lack of nutrients, both macro and micronutrients, will hinder the growth and development process that will affect the quality of human resources (MoH RI 2010).

Lack of iodine at this age can cause permanent health problems, including congenital growth disorders, which affects level of intelligence and leads to physical growth disorders and enlargement of the thyroid gland. The prevalence of goiter in Indonesia has decreased drastically since the implementation of the salt iodization policy along with the increase in iodine intake from food. World Health Organization data shows that the Total Goiter Rate (TGR) in Aceh in the 1995–1998 period was 5.4%, while the prevalence between districts varied, with the highest in Aceh Tengah District, namely 16.3%, followed by Banda Aceh 11.2%, Aceh Timur 9.1%, Aceh Tenggara 7.6%, Aceh Barat 6.4%, Aceh Selatan 4.3%, Simelue district 3.7%, Aceh Besar 1.1%, and Aceh Utara 0.7% (WHO 2006).

The problem of the thyroid gland is no longer viewed as a serious issue because the prevalence is below 5% and new cases of goiter are rare. An area is considered to have problems of Iodine Deficiency Disorder (IDD) if the goiter parameters <5%; however, iodine deficiency at the biochemical level, which can be seen from urine iodine levels, may show a problem because its prevalence tends to be high (WHO 2007). Basic Health Research data in 2013 shows the prevalence of iodine deficiency is still high in the community at 22.1% in women of childbearing age (15–49 years), 24.3% in pregnant women and 23.9% in breastfeeding mothers (MoH RI

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2013). The high deficiency of iodine in pregnant women and breastfeeding mothers is estimated to have an impact on the occurrence of iodine deficiency in infants and children under five years of age because most of the nutritional needs of early childhood are the result of reserves brought from the womb and the supply of nutrients from breast milk (MoH RI 2013). Meanwhile, starting from the age of six months, all nutrient reserves brought from birth and the supply of breast milk are decreased and depleted so further nutritional needs must be obtained from food.

The problem of iodine deficiency has shifted. Initially, iodine deficiency was synonymous with goiter, which is an enlargement of the thyroid gland as a result of the strenuous activity of the gland in producing hormones, namely Thyroid-Stimulating Hormones (TSH). Currently, iodine deficiency cannot just be identified with the presence of goiter, because deficiency at a mild level can only be detected from the iodine levels in urine or from checking TSH levels in the blood (Buxton & Baguune 2012). The results of the national study showed that 77.1% of households consumed salt with sufficient iodine content, while 14.8% consumed salt with less iodine content, and 8.1% consumed salt that does not contain iodine. The province with the highest proportion of households consuming salt of sufficient iodine content was Bangka Belitung (98.1%), while the lowest was Aceh (45.7%). Nationally, this prevalence has not reached the Universal Salt Iodization (USI) target of at least 90 percent of households consuming salt with sufficient iodine content (Hetzel 2011).

According to the Basic Health Research, data shows an increasing trend in the use of iodized salt from 62.3% in 2007 to 77.1% in 2013. The target of the World Health Organization (WHO) for Universal Salt Iodization (USI) or iodized salt for all is at least 90 percent of households consuming salt with sufficient iodine content; however, this target is yet to be achieved. In 2013, as many as 13 provinces had reached USI, an improvement from only 6 provinces in 2007. The iodine content of household drinking water sources is mostly low or does not contain iodine (92.1%); the proportion is higher in rural areas. Nationally, the proportion of households drinking water with sufficient iodine content is still very low (6.0%), with the proportion in urban areas (7.4%) higher than in rural areas (4.6%) (MoH RI 2013).

The high prevalence of iodine deficiency is strongly influenced by the consumption of iodine in food, the use of iodized salt and the levels of iodine that occur naturally in drinking water. The proportion of household drinking water that does not contain iodine reached 40.1%, while 52.0% contains low iodine. Low levels of iodine from water and foodstuffs shows the importance of consuming iodized salt as an easy source to meet iodine needs. However, the problem is that consumption levels of iodized salt is still very low, especially in Aceh where the proportion of households consuming iodized salt is 45.7% for the sufficient category, 28.8% in the less category, while 25.5% did not consume iodized salt at all (MoH RI 2013).

Aceh is one of the provinces with the lowest level of iodized salt consumption in Indonesia with a coverage rate of only 45.7%; this figure is lower than the coverage figure for iodized salt use in 2007, which was 48%. The coverage rate is very low, the lowest consumption coverage were found in the districts of Pidie (1.5%) and Bireuen (5.5%), while Aceh Besar was in the low category at 14.4% (MoH RI 2013).

The United Nations General Assembly (UNGASS) has agreed to renew the commitment of the World Summit for Children in 1990, namely the achievement of the elimination of IDD and iodine salt for all or Universal Salt Iodization (USI). WHO/UNICEF recommends a Universal target of Salt Iodization (USI) or iodized salt for all in dealing with IDD problems because it is safe and can guarantee the adequate intake of iodine for all individuals. A country is declared to have reached USI if at least 90% of its households use salt containing sufficient iodine. Recent data shows 70% of households in developing countries have used salt containing adequate iodine compared to 20% in the past two decades. The National Action Plan also targets USI as an indicator of the success of the IDD prevention program (WHO 2006).

Iodine deficiency adversely affects the fetus, which may lead to abortion, stillbirth, congenital abnormalities, increased perinatal mortality, increased child mortality, mental retardation, deaf-mutism, spastic diplegia, squint), myxedema creatin (dwarfism, mental retardation, hypothyroidism), and psychomotor disorders. In neonates, it affects the enlargement of adenoids from birth and can cause hypothyroidism. In children and adolescents, it has an impact on adenoids enlargement, juvenile hypothyroidism, mental retardation, and Iodine-Induced Hyperthyroidism (IIT). While in adults there is an impact on adenoids enlargement, hypothyroidism, decreased mental function, increased sensitivity to nuclear radiation, and can also cause physical growth disorders known as cretin or stunting (Gebremariam & Yesuf 2016).

Research in identifying iodine deficiency is currently very limited, even though the lack of iodine intake during growth will lead to growth problems. Iodine deficiency in infants and toddlers will affect their growth and development. The high rate of stunting can describe the high problem of child growth disorders. So far, the analysis of growth disorders in infants and toddlers is still predominantly studied from the aspect of macro-nutrient intake, such as the level of energy and protein intake, while analysis related to iodine consumption has never been carried out. Therefore, this study aims to analyze the intake of iodine and urine iodine levels, the practice of salt consumption in households of under-five children (6–24 months), as well as the factors that influence it.

METHODS

Design, location, and time

This study used a cross-sectional study design conducted in the Peukan Bada Community Health Center work area, Aceh Besar District, which was conducted in May 2016. This research has obtained ethical clearance from the Health Research Ethics Commission of the Faculty of Nursing, Sumatera Utara University, with the number: 954/VI/SP/2016.

Sampling

The subjects were children aged 6–23 months, determined based on the inclusion criteria: 1) Children aged 6–23 months living in the study area; 2) The child was not in a sick state that interferes with the child's eating habits; 3) The mother of the subject was willing to provide informed consent. The number of samples were 83 children aged 6–23 months determined by the Lemeshow formula, which were taken by a simple random sampling method with an aged met criteria.

Data collection

Characteristic data of gender, age, and birth order; as well as family socio-demographic data, including family income, the education level of the mothers and fathers, and number of family members were collected through the interview method using a structured questionnaire. Iodine intake was collected using a repeated 24-h food recall method for three days, while the use of iodine salt was determined by taking salt samples from households and analyzed qualitatively using the iodine test. Salt is shown to contain iodine when there is a change in salt color after the iodine test turns purple, whereas iodine status was collected by examination of Urinary Iodine Cocentration (UIC) using the spectrophotometry method, iodine deficiency was determined if the UIC level was <200 mg/l. Mothers' knowledge of the use of iodized salt was collected through the interview method using a structured questionnaire determined by the scoring method: good if the score was ≥80, moderate if the score was 60–80, and poor if the score was <60.

Data analysis

Data analysis using univariate analysis was done to determine the mean and proportion of each research variable. Analysis of the bivariate and multivariate was tested using the logistic regression test. All statistical tests were carried out at a 95% confidence level (α=0.05).

RESULTS AND DISCUSSION

Sample characteristics and family socio-demographics

The results of the study showed that more than half of the sample were male (59%), were the first or second child (53%), and nearly three-quarters were aged between 12–24 months (63.8%). Based on the socio-demographics, 48.2% of the fathers were between 36–45 years old, while most of the mothers were between 25–35 years old (39.8%). Based on the education level of the fathers, more than half were high school graduates (60.2%), which was also the case with the mothers (53%); while according to occupation, almost half were entrepreneurs (47.0%) and most of the mothers were housewives (89.2%). Most of the sample families (49.4%) had 3–4 family members (Table 1).

Tabel 1. Distribution of sample based on characteristics and family socio-demographics

Sample characteristics and family socio-demographics	Frequency (n)	Percent (%)
Sex		
Male	49	59.0
Female	34	41.0
Birth order		
1–2	44	53.0
3–4	36	43.4
5 or above	3	3.6
Children's ages		
6–11 month	30	36.2
12–24 month	53	63.8
Father's age (years)		
<25	3	3.6
25–35	33	39.8
36-45	40	48.2
>=46	7	8.4
Mother's age (years)		
<25	16	19.3
25–35	48	57.8
36–45	19	22.9
Father's education level		
Did not complete primary school	1	1.2
Elementary school	3	3.6
Junior high school	16	19.3
Senior high school	50	60.2
University	13	15.7
Mother's education level		
Did not complete primary school	3	3.6
Elementary school	3	3.6
Junior high school	16	19.3
Senior high school	44	53.0
University	17	20.5
Father's occupation		
Government employee	11	13.3
Entrepreneur	39	47.0
Farmer/fisherman	9	10.8
Laborer	5	6.0
Trader	7	8.4
Others	12	14.5
Mother's occupation		
Housewife	74	89.2
Working	9	10.8
Number of family members		
3–4 persons	41	49.4
5–6 persons	38	45.8
7 persons or above	4	4.8

The use of iodized salt, nutritional knowledge, and urine iodine levels of children aged 6–24 months

The results of the study (Table 2) revealed that more than a third of the subject households stated that they used iodized salt (36.1%), but based on the results of the qualitative analysis using the iodine-test, almost three-quarters of salt from the households (74.7%) did not contain iodine. Some of the reasons why households did not use iodized salt were mostly because they found the taste of iodized salt to be bitter (34.9%) and partly because iodized salt was not available in their neighborhood, the price is more expensive, and the taste of iodized salt is salty. Almost three-quarters of the salt was stored in plastic containers (74.7%) and closed containers (92.8%), more than half (51.8%) of the households placed the salt near the stove/fireplace, while more than three-quarters of the households obtained the salt from shops around their homes (75.9%). The results also showed that almost half of the respondents had poor knowledge (45.8%), and only 19.3% were in the good knowledge category; this result is the same as the study in Cianjur, where most mothers also had poor knowledge relating to iodine salt (Amalia *et al.* 2015). Meanwhile the results of examining the urine iodine levels of the children aged 6–24 months showed that the average UIC level was 272.9±172.3 μg/l and most were in the adequate and excess category, namely 32.6% and 65.1%, respectively; this condition was caused by the children aged up to 2 years of age who were still breastfeeding so the iodine intake can be obtained from breastmilk. The data is different for the older children, the results of a study in Bogor showed that the prevalence of iodine deficiency reached 40.7% in adolescents (Octavia *et al.* 2015). On a similar note, a study in Norway also revealed that 74% of pregnant women dan 55% of lactating women have a low knowledge score (Garnweidner-Holme *et al.* 2017).

The use of iodized salt is an indicator of the elimination of Iodine Deficiency Disorders (IDD) program, thus one of the targets that must be achieved is 90% of households using iodized salt (Timmer 2012). The quality of salt can be assessed qualitatively by using a rapid test, namely the iodine test, while quantitatively an examination of iodine levels in salt can be performed with <15 mg/kg categorized as poor quality, 15–40 mg/kg as sufficient quality, and >40 mg/kg as excess quality (UNICEF 2019). The results of this study found that the practice of using iodized salt at the household level is still very low; only 36.1% use branded salt containing iodine, however the qualitative test results revealed that only 25.3% had contained iodine. The results of this study were almost the same as several studies in other countries, including the results of the Multicenter study in China, the Philippines, and Croatia. It was found that 44.4% to 96.4% of households had salt with an adequate level of iodine (15–40 mg/kg) (Dold *et al.* 2018). Another study by Kumma et al also showed that the proportion of households having adequately iodized salt was 37.7% (Kumma *et al.* 2018), which was similar to the research results by Hiso et al in which only 30.7% of households used iodized salt according to the standard (>15ppm) (Hiso 2019). Meanwhile, another study also found that 41.8% of households had inadequately iodized salt (Ajema *et al.* 2020).

Different results were found from studies in Saudi Arabia, where salt consumption was inadequate and heterogeneous by region, but most households used salt with iodine levels higher than recommended (Al-Dakheel *et al.* 2018). Studies in several countries have shown that the coverage of the use of iodized salt still low (Knowles *et al.* 2017), but this is contrary to a study in Iraq that revealed that 68.3% of households used adequately iodized salt (Ebrahim & Muhammed 2012).

Factors affecting the use of iodine salt

The results of the study based on the bivariate analysis between family socio-demographic characteristics and mothers' knowledge (Table 3) showed that there was a significant relationship between father's education, the number of family members, and mother's knowledge with the use of iodized salt in the household ($p<0.05$). Meanwhile, further analysis using the multivariate test between father's education, the number of family members and mother's knowledge with the use of iodized salt (Table 4) showed that only the variables of father's education level and mother's knowledge were the risk factors for using iodized salt, where families with fathers who have high school education are at higher risk. Fathers with a lower education level are more at risk for not using iodized salt

Tabel 2. Distribution of samples based on the use of iodized salt and salt storage practices in the household

Use of iodized salt and salt storage practices in the kitchen	Frequency (n)	Percent (%)
Using packaged iodine salt		
Yes	30	36.1
No	53	63.9
The iodine content of salt from the iodine-test results		
Not Iodized	62	74.7
Iodized	21	25.3
Mother's reason for not using iodized salt		
Bad/bitter taste	29	34.9
Not available	6	7.3
The price is more expensive	5	6.0
Causes hypertension	2	2.4
Were used to using local salt	5	6.0
Too salty	4	4.8
Container for storing salt		
Ceramic	3	3.6
Plastic	62	74.7
Glass	2	2.4
Others	1	1.2
Spice holder	2	2.4
Jars	13	15.7
Method of storing salt		
In open container	77	92.8
Closed container	6	7.2
Location of keeping salt		
Near the stove	43	51.8
In the cupboard	17	20.5
On the dining table/shelf	23	27.7
Where to buy salt		
Markets	16	19.3
Stall in the village	63	75.9
Traveling merchant	2	2.4
Supermarkets	1	1.2
Others	1	1.2
Mother's knowledge		
Poor (score<60)	38	45.8
Moderate (score 61–79.9)	29	34.9
Good (score ≥80)	16	19.3
Urinary iodine concentration (UIC)		
Deficiency (<100 µg/l)	1	2.3
Adequate (100-199,9 µg/l)	14	32.6
Excess (≥200 µg/l)	28	65.1

Tabel 3. Bivariate analysis of family characteristics and the use of iodine salt

Sociodemography of family and knowledge of mothers	Use of iodine salt		p
	Yes n (%)	No n (%)	
Father's age (years)			
<25	1 (33.3)	2 (66.7)	0.578
25–35	9 (27.3)	24 (72.7)	
36–45	17 (42.5)	23 (57.5)	
>=46	3 (42.9)	4 (57.1)	
Mother's age (years)			
<25	5 (31.3)	11 (68.8)	0.791
25–35	17 (35.4)	31 (64.6)	
36–45	8 (42.1)	11 (57.9)	
Father's education level			
University	8 (61.5)	5 (38.5)	0.012*
Senior high school	19 (38.0)	31 (62.0)	
Junior high school	2 (12.5)	14 (87.5)	
Not completed or elementary school	1 (25.0)	3 (75.0)	
Mother's education level			
University	7 (41.2)	10 (58.8)	0.753
Senior high school	16 (36.4)	28 (63.6)	
Junior high school	6 (37.5)	10 (62.5)	
Not completed or elementary school	1 (16.6)	5 (83.3)	
Father's occupation			
Government employee	7 (63.6)	4 (36.4)	0.488
Entrepreneur	12 (30.8)	27 (69.2)	
Farmer/fisherman	2 (22.2)	7 (77.8)	
Laborer	2 (40.0)	3 (60.0)	
Trader	3 (42.9)	4 (57.1)	
Others	4 (36.3)	7 (63.6)	
Mother's occupation			
Housewife	27 (36.6)	47 (63.5)	0.857
Working	3 (33.3)	6 (66.7)	
Number of family members			
3–4 persons	9 (22.0)	32 (78.0)	0.019*
5–6 persons	19 (50.0)	19 (50.0)	
7 persons or above	2 (66.7)	1 (33.3)	
Expenditure per capita/month (IDR)			
<IDR 550,000	19 (38.0)	31 (62.0)	0.665
≥IDR 550,000	11 (33.3)	22 (66.7)	
Mother's knowledge			
Good	7 (43.8)	9 (56.3)	0.006*
Moderate	16 (55.2)	13 (44.8)	
Poor	7 (18.4)	31 (81.6)	

*Significant $p<0.05$; IDR=Indonesia rupiah

Tabel 4. Multivariate Analysis of factors affecting the use of iodized salt

Factors affecting the use of iodine salt	Use of iodized salt Yes n (%)	No n (%)	OR (95% CI)	p
Father's education level				
Elementary school or below	1 (25.0)	3 (75.0)	1	
Junior high school	2 (12.5)	14 (87.5)	2.20 (0.03–219.6)	0.174
Senior high school	19 (38.0)	31 (62.0)	2.18 (1.03–75.6)	0.046*
University or above	8 (61.5)	5 (38.5)	0.33 (0.30–6.44	0.662
Number of family members				
3–4 persons	9 (22.0)	32 (78.0)	1	
5–6 persons	19 (50.0)	19 (50.0)	2.25 (0.55–164.31)	0.119
7 persons or above	2 (66.7)	1 (33.3)	0.18 (0.07–19.53)	0.899
Mother's knowledge				
Good	7 (43.8)	9 (56.3)	1	
Moderate	16 (55.2)	13 (44.8)	-1.20 (0.062–1.455)	0.135
Poor	7 (18.4)	31 (81.6)	-2.34 (0.02–0.42)	0.002*

*Significant p<0.05; OR:Odds ratio; CI:Confident interval

than those with high-level education (OR=2.18; 95% CI: 1.03–75.6), while mothers who have less knowledge are 2.34 times more at risk of not using iodized salt compared to mothers with good knowledge (OR=-2.34; 95% CI: 0.02–0.42).

The results of this study indicate that the mother's knowledge and father's education are factors that influence household practices of using iodized salt. Mother's knowledge and father's education level have a positive relationship on the use of iodized salt, where mothers with good knowledge and fathers with higher education level tend to have better practices of using iodized salt; the prevalence of using iodized salt is higher in mothers who have good knowledge, and fathers who were educated at the university level. The results of this study are almost the same as several other studies. Studies in Ethiopia have also shown that knowledge is one of the factors that affect the use of iodized salt in the household (Yeye *et al.* 2016). Likewise, a study by Tariku and Mazengia (2019) also showed that educational status, packaging, and knowledge of iodine affect household use of iodized salt. Another study also showed that a higher monthly income and formal education of respondents were found to be associated with the presence of adequately iodized salt at home (Kumma *et al.* 2018). This is also in line with a study in Ababa City, where mothers' knowledge and educational status were significantly associated with the use of iodized salt (Bazezew *et al.* 2018), and a study in Iraqi households comprising of family members with a university education were shown to be using iodized salt at a higher rate than those who were illiterate or could only read/write (Ebrahim & Muhammed 2012). Other variable effects of using iodine salt include the use of packaged salt, not exposing the salt to sunlight, storing salt in a dry place, and storing salt in a container with a lid; these factors were significantly associated with the availability of adequately iodized salt at the household level (Meselech *et al.* 2016).

The low use of iodized salt in the community can also be influenced by government policies in the form of advocacy, promotion, and education, as well as ensuring the availability of iodized salt in the community. Experience from Nepal revealed that an increase in the coverage of iodized salt consumption must be carried out using various strategies, such as salt iodization programs, followed by continuous advocacy, strong legislation mandating iodization, routine monitoring at border stations, consumer education through communication campaigns, and periodic program reviews (Paudyal *et al.* 2020). Community empowerment models can also increase knowledge and practice relating to IDD (Setyani *et al.* 2019)

The results of this study indicate that iodine intake from food in children aged 6–23 months is still low and the use of iodized salt at the household level is still very low when compared to the USI target of 90% of households using iodine salt. The results of this study (Table 2) showed that the low use of iodized salt is influenced by various factors, such as community perceptions about iodized salts, such as it having a bitter taste and can cause hypertension. Other factors include the price of iodized salt which is considered to be more expensive, limited availability in the villages, and the circulation of non-iodized salt by salt traders. This research was only conducted in the coastal and urban areas, so the results can only describe the use of iodized salt in areas that have similar characteristics and socio-demographics.

CONCLUSION

The prevalence of children aged 6–23 months with an iodine intake from food less than the RDA was still high (45.8%), however the mean Urinary Iodine Concentration (UIC) levels were 72.9767 µg/l and most UIC levels were in the adequate category. The use of iodized salt in households with children aged 6–23 months is still low. A higher level of fathers' education and good knowledge from the mothers were the risk factors for using iodized salt in the household. Efforts should be made to increase the use of iodized salt at the household level through education, promotion, and advocacy as well as the monitoring of iodized salt circulation in the community.

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AUTHOR DISCLOSURES

The authors have no conflict of interest.

REFERENCES

Al-Dakheel MH, Haridi HK, Al-Bashir B M, Al-Shangiti AM, Al-Shehri SN, Hussein I. 2018. Assessment of household use of iodized salt and adequacy of salt iodization: A cross-sectional National Study in Saudi Arabia. Nutr J 17(35):1–7. https://doi.org/10.1186/s12937-018-0343-0.

Amalia L, Permatasari II, Khomsan A, Riyadi H, Herawati T, Nurdini R. 2015. Pengetahuan, sikap, dan praktek gizi ibu terkait iodium dan pemilihan jenis garam rumah tangga di wilayah pegunungan Cianjur. J Gizi Pangan 10(2):133–140. https://doi.org/10.25182/jgp.2015.10.2.%25p.

Bazezew MM, Yallew WW, kassahun Belew A. 2018. Knowledge and practice of iodized salt utilization among reproductive women in Addis Ababa City. BMC Res Notes 11(1):1–8. https://doi.org/10.1186/s13104-018-3847-y.

Buxton C, Baguune B. 2012. Knowledge and practices of people in Bia District, Ghana, with regard to iodine deficiency disorders and intake of iodized salt. Arch Public Health 70(5):1–9. https://doi.org/10.1186/0778-7367-70-5.

Dold S, Zimmermann MB, Jukic T, Kusic Z, Jia Q, Sang Z. Quirino A, San Luis TO, Fingerhut R, Kupka R *et al.* 2018. Universal salt iodization provides sufficient dietary iodine to achieve adequate iodine nutrition during the first 1000 days: A cross-sectional multicenter study. J Nutr 148(4):587–598. https://doi.org/10.1093/jn/nxy015.

Ebrahim SM, Muhammed NK. 2012. Consumption of iodized salt among households of Basra city, south Iraq. East Mediterr Health J 18(9):980–984. https://doi.org/10.26719/2012.18.9.980.

Garnweidner-Holme L, Aakre I, Lilleengen AM, Brantsæter AL, Henjum S. 2017. Knowledge about iodine in pregnant and lactating women in the Oslo area, Norway. Nutrients 9(5):493. https://doi.org/10.3390/nu9050493.

Hetzel BS. 2011. ICCIDD – 25 yeas old! IDD Newls 39(1):1–20.

Hiso DE, Roba KT. 2019. Utilization of iodized salt and associated factor in Zuway Dugda District, Arsi Zone, Oromia Regional State, South East Ethiopia. East Afr J 13(1):75–80.

Knowles JM, Garrett GS, Gorstein J, Kupka R, Situma R, Yadav K, Yusufali R, Pandav

C, Aaron GJ, Universal Salt Iodization Coverage Survey Team. 2017. Household coverage with adequately iodized salt varies greatly between countries and by residence type and socioeconomic status within countries: Results from 10 national coverage surveys. J Nutr 147(5):1004S–1014S. https://doi.org/10.3945/jn.116.242586.

Kumma WP, Haji Y, Abdurahmen J, Mehretie AY. 2018. Factors affecting the presence of adequately iodized salt at home in Wolaita, Southern Ethiopia: Community based study. Int J Food Sci 2018(4394908):1–9. https://doi.org/10.1155/2018/4394908.

[MoH RI] Ministry of Health Republic of Indonesia. 2010. Riset Kesehatan Dasar Jakarta (ID): MoH RI.

[MoH RI] Ministry of Health Republic of Indonesia. 2013. Riset Kesehatan Dasar Tahun 2013. Jakarta (ID): MoH RI.

Meselech Regassa D, Tsedeke Wolde H, Befirdu Mulatu J. 2016. Utilization of adequately iodized salt on prevention of iodine deficiency disorders at household level and associated factors in Lalo Assabi District, West Ethiopia. Nutr Food Sci 6(2):471. doi:10.4172/2155-9600.1000471.

Octavia L, Karyadi E, Alisjabana B, Widjaja M. 2015. Status mikronutrien remaja putri dengan riwayat berat badan lahir rendah (BBLR). J Gizi Pangan 10(2):117–124. https://doi.org/10.25182/jgp.2015.10.2.

Paudyal N, Chitekwe S, Rijal S, Parajuli K, Pandav C, Maharjan M, Houston R, Gorstein J. 2020. The evolution, progress, and future direction of Nepal's universal salt iodization program. Matern Child Nutr e12945. https://doi.org/10.1111/mcn.12945.

Setyani A, Martiyana C, Yunitawati D, Riyanto S, Asturiningtyas IP. 2019. Empowerment of communities in increasing knowledge, attitudes, and practice of childbearing age about iodine deficiency disorders. MGMI 11(1):25–38. https://doi.org/10.22435/mgmi.v11i1.2495.

Timmer A. 2012. Iodine nutrition and universal salt iodization: A landscape analysis in 2012. IDD Newsl 40:5–9.

[UNICEF] United Nations Children's Fund. 2019. Guidance on the Monitoring of Salt Iodization Programmes and Determination of Population Iodine Status. New York (USA): UNICEF.

[WHO] World Health Organization. 2006. Vitamin and Mineral Nutrition Information System (VMINS). Table Indonesia: Iodine deficiency+goitre prevalence. WHO Library Cataloguing. https://www.who.int/vmins/database/iodine/countries/en/ [Accessed 2nd February 2016].

[WHO] Word Health Organization. 2007. Assessment of the Iodine Deficiency Disorders and Monitoring Their Elimination. Geneva (CH): WHO.

Yeye AB, Baraki N, Endale BS. 2016. Availability of adequately iodized salt at household level and associated factors in Dire Dawa, Eastern Ethiopia. International Journal of Public Health Science 5(4):392–399. https://doi.org/10.11591/.v5i4.4841.