ANALYSIS

24(105), September - October, 2020

ISSN
2321–7359
EISSN
2321–7367

Medical Science

Assessment of dietary iodine intake for females of childbearing age from Amman, Jordan

Ahmad A. Obeidat✉

Department of Clinical Nutrition, Collage of Applied Medical Sciences, Taibah University, Yanbu, Saudi Arabia

✉**Corresponding author**
Assistant Professor of Clinical Nutrition, Department of Clinical Nutrition, Collage of Applied Medical Sciences, Taibah University, Saudi Arabia
Email: aobeidat@taibahu.edu.sa

Article History
Received: 03 June 2020
Reviewed: 05/June/2020 *to* 22/July/2020
Accepted: 22 July 2020
E-publication: 28 July 2020
P-Publication: September - October 2020

Citation
Ahmad A. Obeidat. Assessment of dietary iodine intake for females of childbearing age from Amman, Jordan. *Medical Science*, 2020, 24(105), 2985-2992

ABSTRACT

Introduction: Jordan has one of the highest prevalence rates of hypothyroidism, and this condition is more prevalent in women and especially pregnant women. Iodine insufficiency during fetal development and childhood is associated with cognitive disturbances. The aim of this research study is to measure the daily consumption of dietary iodine in females of childbearing age in Amman City and determine how this consumption relates to sociodemographic characteristics. *Subjects and Methods*: A nonrandomized, cross-sectional study was carried out in 802 females. The inclusion criteria were healthy pregnant and nonpregnant females of reproductive age from 18 to 45 years old living in Amman. Females with any chronic disease were excluded from the study. Iodine intake and sociodemographic characteristic were measured by validated questionnaires. *Results:* Optimum iodine adequacy was detected in only 9.6% of participants. The highest average dietary iodine intake (μg/d) was from milk (36.4±36.5), followed by

yoghurt (27.5±27.5), white fish (18.8±33.9), red fish (15.2±23.7), eggs (10.2±10.1), shrimp and oysters (9.9±22.7), nuts (9.2± 13), cheese and cheddar (7.8±7.3), meat (7.7±6.3), bread (5.6±4.5), apple juice (2.9±4.8), as well as fruits and vegetables (2.4±2.8). Findings showed that the average iodine intake was affected significantly ($p<0.05$) by pregnancy and smoking. *Conclusion*: Normal iodine status was detected in only 9.6% of participants. The highest average dietary iodine intake was from milk and the lowest from fruits and vegetables. Factors affecting average iodine intake in females of childbearing age in the Amman region were related to pregnancy and smoking. It is highly important to raise awareness of Jordanian women of childbearing age about their dietary iodine intake.

Keywords: Amman, childbearing age, iodine intake, women.

1. INTRODUCTION

Iodine is an essential trace element with a major physiological role in the formation of thyroid hormones triiodothyronine and thyroxine (Schroeder & Privalsky, 2014). The functions of the thyroid gland can be affected by suboptimal serum iodine levels. Iodine contributes to growth, brain development, and normal neurologic function in infants (Mirmiran et al., 2012). Recommended daily iodine intake increases with age. According to the World Health Organization (WHO), children < 6 months need 90 μg/d, then the required intake increases in children > 6 months and adults > 12 years to 120 μg/d and 150 μg/d, respectively. The iodine requirement for pregnant and lactating women is up to 250 μg/d, which is the highest (Mohammadi et al., 2018). An inadequate iodine level during pregnancy may cause serious health issues for mothers and fetuses (Sheila, 2011). Iodine deficiency in mothers increases the risk of miscarriage and congenital abnormalities in their fetuses. Fetal growth impairment and cretinism for children could be traced to iodine deficiency in pregnant women (Zimmermann & Andersson, 2012; Zhao et al., 2019).

Milk, yoghurt, cod, shrimp, fish sticks, tuna, egg, boiled navy beans, cooked potato with peel, baked seaweed, apple juice, and fortified bread are the best food sources of iodine (Kane et al., 2016). However, no detailed studies have been conducted to determine the dietary iodine intake for females of childbearing age in Jordan. Therefore, the aim of this research is to measure the daily consumption of dietary iodine intake in females of childbearing age from Amman City and find out how this consumption relates to sociodemographic characteristics.

2. SUBJECTS AND METHODS

Subjects

A nonrandomized, cross-sectional study using a closed questionnaire carried out at the Amman governorate of Jordan within a period of March to August 2019. Females were recruited from clinics at King Hussein Medical Center (KHMC). The inclusion criteria were healthy pregnant and nonpregnant females of reproductive age. Excluded from this study were females under the age of 18 and older than 45 years and with any acute or chronic disease such as diabetes, kidney problems, liver disease, anemia, lung disorder, autoimmune disease, or irritable bowel syndrome. Figure 1 shows the study flow chart for recruiting participants according to inclusion and exclusion criteria.

Methods

Face-to-face interviews and electronic data collection were carried out for 802 eligible participants, 352 of which were pregnant. The questionnaire was composed of two parts: personal information and a food frequency questionnaire for measuring dietary iodine intake. A validated food frequency questionnaire was used to measure daily dietary iodine intake, which was selected from Combet and Lean's (2014) research. Personal information was collected by a structured questionnaire, which covered nationality, family members, age, marital status, pregnancy trimester, weight, height, body mass index (BMI), family income, education level, occupation, residence, smoking, and use of iodine supplementation.

Statistical Analysis

Statistical analyses were performed with SPSS software version 23. Data were classified into two groups: continuous data that presented as means plus or minus standard deviation (mean ± SD), or discontinuous or ordinal data that presented as number and percentage. Comparisons between 2 and $\geq$3 groups were made with a Mann-Whitney test and Kruskal-Wallis test, respectively. The results were also expressed as odds ratios (OR) and 95% confidence intervals (95% CI) to determine the potential independent socioeconomic variables related to low iodine intake. WHO recommended that adequate iodine intake for pregnant and

nonpregnant women were 250 μg/d and 150 μg/d, respectively (WHO, 2007). The p-value of <0.05 was considered statistically significant.

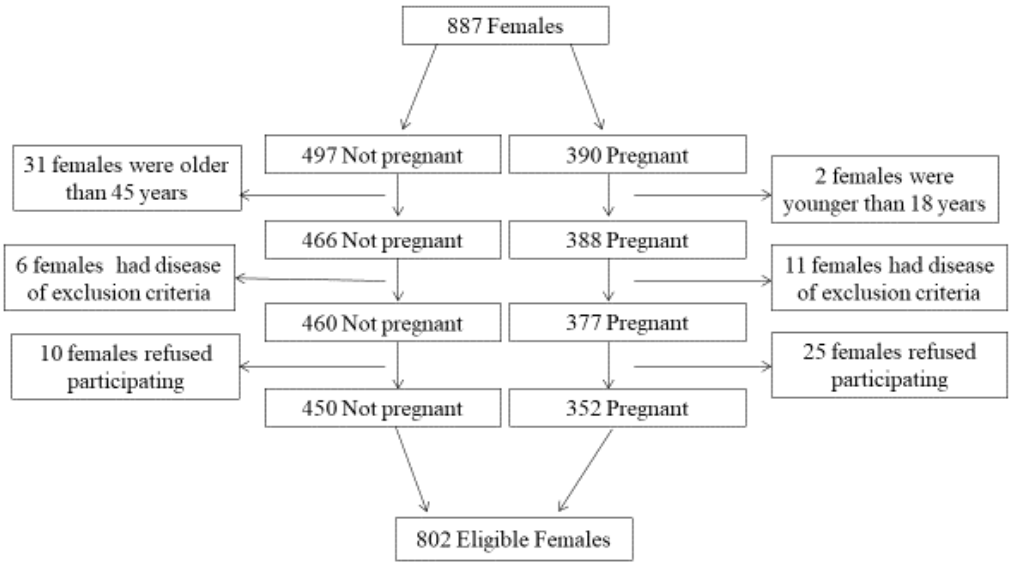

Figure 1 Study flow chart for recruiting the participants

3. RESULTS

From the total sample, 9.6% (n= 77 out of 802) were considered to have an adequate iodine intake, while only 5.1% (n=18 out of 352) of pregnant women had a normal dietary iodine intake. Table 1 shows the characteristics of the study sample. The mean age (±SD) of the whole sample was 27.4±6.6 years. Overall, the average family size was 4.9 members, and the average weight, height, and BMI was 61.9 kg, 158.4 cm, and 24.6kg/m^2, respectively. The highest average dietary iodine intake (μg/d) was observed to be from milk (36.4±36.5), followed by yoghurt (27.5±27.5), whitefish (18.8±33.9), redfish (15.2±23.7), egg (10.2±10.1), shrimp and oysters (9.9±22.7), nuts (9.2± 13), cheese and cheddar (7.8±7.3), meat (7.7±6.3), bread (5.6±4.5), apple juice (2.9±4.8), and fruits and vegetables (2.4±2.8). The total average dietary iodine intake (122.2±80.6 μg/d) for the entire sample was lower than that recommended by WHO.

Table 1 Characteristics and iodine intake of study sample (n=802)

Parameter	Mean ± SD	Min, Max
Age (year)	27.4±6.6	18, 45
Family number	4.9±2.4	1,14
Weight (kg)	61.9±13.7	31,116
Height (cm)	158.4±6.2	120,189
BMI (kg/m^2)	24.6±5.3	12.1,47.7
Intake of iodine from yoghurt (mcg/d)	27.5±27.5	10.7,300
Intake of iodine from milk (mcg/d)	36.4±36.5	8.6,300
Intake of iodine from white fish (mcg/d)	18.8±33.9	14.1,594
Intake of iodine from red fish (mcg/d)	15.2±23.7	7.1,250
Intake of iodine from bread (mcg/d)	5.6±4.5	0.7,30
Intake of iodine from shrimps and oyster (mcg/d)	9.9±22.7	5,210
Intake of iodine from egg (mcg/d)	10.2±10.1	3.4,144
Intake of iodine from meat and chicken (mcg/d)	7.7±6.3	1.4,60

Intake of iodine from cheese and cheddar (mcg/d)	7.8±7.3	1.7,72
Intake of iodine from apple juice (mcg/d)	2.9±4.8	1,42
Intake of iodine from fruits and vegetables (mcg/d)	2.4±2.8	0.4,18
Intake of iodine from nuts (mcg/d)	9.2± 13	4,150
Total intake of iodine (mcg/d)	122.2±80.6	13.3,708.3

Table 2 shows the sociodemographic characteristics of the study sample. From the total sample, 91.9% were Jordanians, and 62% had a family size of <= 5 members. The majority of the samples were unemployed (74.3%), urban residents (97.8%), nonsmokers (94.3%), and those not using supplements containing iodine (84.3%), and married (68%). Three hundred fifty-two (43.9%) participants were pregnant, and most were in their third trimester (40.1%). Obesity and overweight were found in 13.7% and 28.4%, respectively. A middle income (US$701–US$2,000 per month) was found in 71.2% of the sample. Those with a university education represented 74.9% of the total selected group.

Table 2 Sociodemographic characteristics and average iodine intake (Mean±SD) of study sample

Parameter	Frequency (%)	Average iodine intake (mcg/d)	P-value
Nationality (n=802) Jordanian Not Jordanian	 737 (91.9) 65 (8.1)	 120.8±78.7 137.7±99.1	0.184
Family size (n=802) <= 5 members >= 6 members	 497 (62) 305 (38)	 115.2±67.6 126.5±87.4	**0.041**
Employment (n=802) Yes No	 206 (25.7) 596 (74.3)	 131.5±85.1 118.9±78.8	0.064
Residence (n=802) Urban Rural	 784 (97.8) 18 (2.2)	 121.8±80.8 140.3±72.1	0.296
Smoking (n=802) Yes No	 46 (5.7) 756 (94.3)	 98.4±47.3 123.6±81.9	**0.001**
Secondhand smoker (n=802) Yes No	 252 (31.4) 550 (68.6)	 116.1±86.3 124.9±77.8	0.165
Using iodine-containing supplements (n=802) Yes No	 126 (15.7) 676 (84.3)	 123.2±74.7 121.9±81.7	0.871
Marital status (n=802) Single Marriage Divorced	 242 (30.2) 545 (68) 15 (1.8)	 110.6 ±76.2 126.5±79.8 150.2±144.8	0.15
Marriage status (n=802) Pregnant Neither pregnant nor lactating Lactating Not marriage (single or	 352 (43.9) 137 (17.1) 56 (7.0) 257 (32.0)	 99±65.6 114.3±65.7 130.5±69.7 113±81.8	**0.018**

divorced)			
Pregnant trimester (n=352) First Second Third	 80 (22.7) 131 (37.2) 141 (40.1)	 137.8±108.6 122±76.1 130.5±79	0.412
BMI groups (n=802) Underweight Normal Overweight Obese	 84 (10.5) 380 (47.4) 228 (28.4) 110 (13.7)	 111±57.3 121±78.6 127±80.6 132.4±98.5	0.38
Family income (n=802) < 700 US dollar 701-1500 US dollar 1501-2000 US dollar > 2001 US dollar	 146 (18.2) 363 (45.3) 208 (25.9) 85 (10.6)	 125.8±95.5 120.7±76.4 121.8±81.9 123.2±66.6	0.931
Education (n=802) Read and write/Primary Intermediate/Secondary University	 98 (12.3) 103 (12.8) 601 (74.9)	 124.4±90.6 117.7±80.8 124.3±79.1	0.753

P-values were determined by Mann-Whitney test and Kruskal-Wallis test for 2 and ≥3 groups, respectively.
Bold P-values denote statistical significance at the p < 0.05 level.

The average iodine intake for different sociodemographic characteristics was found in Table 2. However, no significant difference (p>0.05) was observed for average iodine intake regarding nationality, employment, residence, secondhand smoke, use of iodine supplements, marital status, pregnancy trimester, BMI groups, income, and education. On the other hand, a family of five or fewer had significantly (P=0.041) lower average iodine intake than larger families. Additionally, smokers had significantly (P=0.001) lower average iodine intake than nonsmokers. Pregnant women showed the lowest iodine intake and a significant difference (P=0.018) than other groups.

Multivariable logistic regression results adjusted for age were shown in Table 3. Pregnant women were approximately three times (OR= 3.067, 95% CI= 1.588-5.924, P= 0.001) more likely to have suboptimal iodine adequacy compared with unmarried women. Smoking was also another risk factor for suboptimal iodine intake (OR= 1.66, 95% CI= 1.055-5.493, P= 0.02). However, family size did not have a significant effect on suboptimal iodine adequacy.

Table 3 Significant socioeconomic factors as predictors for suboptimal iodine adequacy

Predictor	OR (95% CI)	P-value
Marriage status Pregnant Marriage but neither pregnant nor lactating Lactating Not marriage	 3.067 (1.588-5.924) 1.068 (051-2.236) 1.425 (0.522-3.893) 1	 **0.001** 0.861 0.49
Smoking Yes No	 1.66 (1.055-5.493) 1	 **0.02**
Family size <= 5 members >= 6 members	 1.175 (0.725-1.175) 1	 0.513

The reference group is the normal iodine adequacy. Multivariable logistic regression adjusted for age.
Bold P-values denote statistical significance at the p < 0.05 level.

4. DISCUSSION

This study aimed to measure the daily consumption of dietary iodine in females of childbearing age in the Amman region and determine the relationship of iodine intake with sociodemographic characteristics. Optimum iodine adequacy was detected in only 9.6% of participants, and pregnant women and smokers were more likely to have iodine inadequacy. It is noteworthy to mention that suboptimal iodine intake during pregnancy may be associated with adverse health effects for pregnant women and in children at age three. These adverse effects are language delay, externalizing and internalizing behavior problems, and reduced fine motor skills (Abel et al., 2017). Historically, there has been a lack of interest in research that determines the iodine nutrition status of women in Jordan. A recent systematic review conducted by Mohammadi et al. (2018) found that data on Jordan concerning iodine intake were rare, and only two observational studies have been conducted to study iodine intake in schoolchildren. Yet no such data for women are available. Therefore, this research could have a major impact on literature that concerns data related to this issue.

In this study, the highest average dietary iodine intake was found to be through drinking milk, and the lowest was observed from intake of fruits and vegetables. A study in Australian women identified that dairy products were the most significant contributor to total iodine intake (57%–62%), followed by fortified bread and cereals (19%–21%), with minor contributions from fish and seafood (3%–8%) (Charlton et al., 2016). Another U.K. study found that milk and eggs were the best iodine-rich foods for pregnant and nonpregnant women (Fuge & Johnson, 2015). In the United States, they found that the major driving forces for improving urine iodine concentration among females of childbearing age were dairy products and dietary supplements with iodine, and they recommended an increase in the consumption of dairy products to achieve the adequate iodine intake (Arsenault et al., 2017).

Suboptimal iodine level in females of childbearing age is still a major global health concern. Iodine status in females of childbearing age can be dependent on many factors, including age, weight, gestational age, parity, family size, urban or rural residence, altitude, education level, income, employment status, active or passive smoking, exposure to radiation, use of supplements, use of thyroid medications, chronic disease(s), intake of iodized salt, goitrogens intake, or knowledge and awareness of foods with high iodine content (Kane et al., 2016; Henjum et al., 2018; Mohammadi et al., 2018; Azzeh & Refaat, 2020). An interesting study by Abel et al. (2017) included 33,047 Norwegian mothers who were not taking supplements containing iodine. It was found that only 4.3% of mothers consumed adequate iodine from food sources. Using a validated FFQ, sufficient daily iodine intake in pregnant women (>250 μg/d) was recorded in some countries, such as 10.9% in Spain (Rodriguez et al., 2013) and 21.7% in Norway (Brantsæter et al., 2013).

Findings have shown that the average iodine intake was affected significantly ($P<0.05$) by two sociodemographic characteristics in Amman: pregnancy and smoking. Pregnant women's risk of iodine deficiency was three times greater than that of nonpregnant women. This result could be related to the higher iodine requirements for pregnant women than nonpregnant women, assuming the dietary habits were still the same before and after pregnancy. Furthermore, iodine supplementation is not mandatory for pregnant women, which could significantly affect iodine status during pregnancy. Hynes et al. (2019) concluded that iodine nutrition, whether during pregnancy or not, deteriorated among women who did not consume supplements containing iodine, and they recommended iodine supplementation before and during pregnancy. Intriguingly, findings have shown that smoking could decrease the consumption of foods containing iodine. Suboptimal iodine intake was closely associated with smoking habits (Knudsen et al., 2002). It has been well established that smokers had different dietary habits than nonsmokers (Morabia & Wynder, 1990). As reported by Magetts and Jackson (1993), women who smoke in the United Kingdom tend to have a lower dietary intake of fried whitefish, white bread, whole milk, butter, meat products, potato chips, sugar, and peas, while nonsmoking women were more likely to consume brown bread, high-fiber dishes, fruits, and carrots. Another recent study (Zyriax et al., 2018) analyzed the differences in dietary habits between smokers and nonsmoking women from different European countries.

The previous study concluded that the intake of vegetable and fruit groups was significantly ($P<0.05$) higher in nonsmokers than smokers, while processed meat intake was significantly ($P<0.05$) higher in smokers than nonsmokers. Additionally, a nonsignificant higher intake of fish, dairy products, and fiber-rich dishes was observed in nonsmoking women compared to smokers. No available data are found on the effect smoking had on the dietary habits of pregnant women in Arabic-speaking regions; this is an area in need of further investigation. From the findings in this study, we can say that smoking could affect the intake of one or more food groups, which may reduce the intake of foods containing iodine and accordingly may decrease the iodine status in smokers. A study conducted by Henjum et al. (2018) confirmed the previous result that smoking increased the suboptimal iodine status in pregnant Norwegian women.

5. CONCLUSION

Study results concluded that optimum iodine adequacy was detected in only 9.6% of participants, and pregnant women and women smokers showed risk factors related to iodine inadequacy. The highest average dietary iodine intake was from milk and the lowest

from fruits and vegetables. The study results highlight the importance of increasing awareness in childbearing-age women about dietary iodine intake and iodine supplementation to overcome adverse health outcomes from suboptimal iodine intake.

Funding

This research received no external funding.

Conflict of interest

The author declares that he has no conflict of interest.

Informed consent

Written and oral informed consent was obtained from all individual participants included in the study.

Ethical approval for study protocol

The study was approved by the Medical Ethics Committee of the Royal Medical Services (ethical approval code: TF3-1-7290-2009).

Data and materials availability

All data associated with this study are present in the paper.

REFERENCES AND NOTES

1. Abel M, Caspersen I, Meltzer H, Haugen M, Brandlistuen R, Aase H, et al. Suboptimal maternal iodine intake is associated with impaired child neurodevelopment at 3 years of age in the Norwegian mother and child cohort study. J Nutr. 2017;147(7):1314-1324.
2. Arsenault MA, Lee KW, Song WO. Dairy products and iodine-containing supplements use are positively associated with iodine. FASEB J. 2017;31: 446-447.
3. Azzeh FS, Refaat BR. Iodine deficiency among non-pregnant and pregnant women living in the Western region of Saudi Arabia. BMC Pregnancy Childb. 2020;20:370.
4. Brantsæter AL, Abel MH, Haugen M, Meltzer HM. Risk of suboptimal iodine intake in pregnant Norwegian women. Nutrients 2013;5:424–40.
5. Combet E, Lean ME. Validation of a short food frequency questionnaire specific for iodine in U.K. females of childbearing age. J Hum Nutr Diet. 2014;27(6):599-605.
6. Charlton, K., Probst, Y. and Kiene, G. Dietary iodine intake of the Australian population after introduction of a mandatory iodine fortification programme. Nutrients. 2016;8(11):701.
7. Fuge R, Johnson C. Iodine and human health, the role of environmental geochemistry and diet, a review. Appl Geochem. 2015;63:282-302.
8. Henjum S, Aakre I, Lilleengen A, Garnweidner-Holme L, Borthne S, Pajalic Z, et al. 2018. Suboptimal Iodine Status among Pregnant Women in the Oslo Area, Norway. Nutrients. 2018;10:280.
9. Hynes KL, Judy A. Seal, Petr Otahal, Wendy H. Oddy, John R. Burgess. Women remain at risk of iodine deficiency during pregnancy: The importance of iodine supplementation before conception and throughout gestation. Nutrients. 2019;11(1):172.
10. Kane SMO, Pourshahidi LK, Farren KM, Mulhern MS, Strain JJ, Yeates AJ. Iodine knowledge is positively associated with dietary iodine intake among women of childbearing age in the UK and Ireland. Br J Nutr. 2016;116:1728–1735.
11. Knudsen N, Bulow I, Laurberg P, Ovesen L, Perrild H, Jorgensen T. Associated of tobacco smoking with goiter in low iodine intake area. JAMA. 2002;162:439-443.
12. Magetts B, Jackson A. Interactions between people's diet and their smoking habits: the dietary and nutritional survey of British adults. BMJ. 1993;307(6916):1381–1384.
13. Mirmiran P, Golzarand M, Azizi F. Iron, iodine and vitamin A in the Middle East. Iran J Publ Heal. 2012;41:8–19.
14. Mohammadi M, Azizi F, Hedayati M. Iodine deficiency status in the WHO Eastern Mediterranean Region: a systematic review. Environ Geochem Health. 2018;40:87–97.
15. Morabia A, Wynder EL. Dietary habits of smokers, people who never smoked, and exsmokers. Am J Clin Nutr. 1990;52:933–7.
16. Rodriguez M, San Julián C, de Aguilar V. Iodine intake during pregnancy: Effects on thyroid function in mother and child. Endocrinol Nutr. 2013;60:352-357.
17. Schroeder AC, Privalsky ML. Thyroid hormones, T3 and T4, in the brain. Front. Endocrinol. (Lausanne). 2014;5:1–6.
18. Sheila SA. Iodine deficiency in pregnancy: The effect on neurodevelopment in the child. Nutrients. 2011;3:265–273.
19. WHO, UNICEF, ICCIDD. Assessment of the iodine deficiency disorders and monitoring their elimination. Geneva (Switzerland): World Health Organization; 2007. WHO/NHD/01.1. Available from: https://apps.who.int/iris/bitstream/handle/10665/43781/9789241595827_eng.pdf;jsessionid=F483733E42B93CAED51A142CAC4F6084?sequence=1. [Last accessed on 2019 Mar 12].
20. Zhao W, Li X, Xia X, Gao Z, Han C. Iodine nutrition during pregnancy: Past, present, and future. Biol Trace Elem Res. 2019; 188: 196–207.

21. Zimmermann MB, Andersson M. Assessment of iodine nutrition in populations: Past, present, and future. Nutr Rev. 2012; 70:553–570.
22. Zyriax B, Vettorazzi E, Hamuda A, Windler E. Interaction of smoking and dietary habits modifying the risk of coronary heart disease in women: results from a case–control study. Eur J Clin Nutr. 2018;72, 1673–1681.