Journal of Nutrition and Food Security
Shahid Sadoughi University of Medical Sciences
School of Public Health
Department of Nutrition
Nutrition & Food Security Research Center

eISSN: 2476-7425 pISSN: 2476-7417 JNFS 2017; 2(3): 195-200 Website: jnfs.ssu.ac.ir

Urine Iodine Status of 8-10-Year Old School Children in Yazd Province during Ten Years (2007-2016)

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ARTICLE INFO

ORIGINAL ARTICLE

Article history:
Received: 15 Oct 2016
Revised: 15 Nov 2016
Accepted: 28 Dec 2016

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ABSTRACT

Background: Iodine is an essential element for growth and development and its inadequate intake leads to insufficient production of thyroid hormone. In developed countries iodine deficiency (ID) is one of the reformable factors. So, this study determined urinary iodine (UI) status of 8-10-year old school children in Yazd province during 2007 to 2016. **Methods:** This cross-sectional and descriptive study was conducted on 2236 students who were randomly selected from urban and rural regions with equal proportion of gender. Questionnaires were administered to gather the required descriptive data and then morning samples of urine were collected. Iodine concentration was determined with titration and acidic digestion. Data were analyzed through SPSS software**.** **Results:** During the study period, the percentage of students with UI of lower than 2 µg/dL, was zero and only 2.37 % of them had a UI level in the range of 2-4.90 µg/dL. Median of UI was 18.40 ± 7.70 µg/dL level of UI in normal range showed noticeable increase from 2013 to 2016. Level of normal UI in ten years was 79.02%. **Conclusions:** According to the results of this study, Yazd province was considered "IDD free" similar to some other provinces. Also, level of UI more than 30 µg/dL was decreased. It is clear that this approaches need continuous evaluation such as annual evaluation of UI in 8-10 years old students at province level and every five years evaluation at national level.

Keywords: *Students; Urinary iodine; Iodine deficiency disorder (IDD); Yazd*

Introduction

Iodine is one of the essential nutrients for natural growth and development. Human body includes 15 to 20 µg of iodine, 70 to 80% of which is accumulated in the thyroid gland. Inadequate intake of iodine leads to inadequate production of thyroid hormones and hypothyroidism. Iodine deficiency (ID) is one of the reformable factors in

This paper should be cited as: Naghiaee Y, Lotfi MH, Mozaffari-Khosravi H, Hajimirzadeh M, Amini F, Pirmadah F. ***Urine Iodine Status of 8-10-Year Old School Children in Yazd Province during Ten Years (2007-2016).*** *Journal of Nutrition and Food Security (JNFS)*, 2017; 2 (3): 195-200.

[DOR: 20.1001.1.24767417.2017.2.3.1.9]

advanced countries and has disadvantages for child growth. Severe deficiency of iodine in pregnancy causes cretinism and increase of fetal or neonatal mortality. However, mild deficiency causes increase of thyroid size and learning disorders in children (Danijela *et al.*, 2009). Related studies suggested that ID causes up to 13.5 decrease of score in intelligence quotient (IQ) (Pineda-Lucatero *et al.*, 2008, Santiago-Fernandez *et al.*, 2004). Marginal deficiency may lead to learning difficulties in advanced countries (Moleti *et al.*, 2016).

Many of countries used salt fortification or other iodine-food products to decrease iodine deficiency disorders (IDD). In 2007 about 31.5% (264 millions of people) of school children were iodine deficient (with iodine intake of below100 µg/dL) that showed 5% decrease in comparison with 2003. From 2003 to 2013 the total number of countries with adequate iodine intake has increased from 67 to 111 (Pedersen *et al.*, 1993, Qian *et al.*, 2005). Despite this progress, ID is one of the most common causes of thyroid disease. In Europe, incidence of ID decreased 30% from 2003 to 2010, however, 44% of school children were reported to still have insufficient intake of iodine (Liesenkötter *et al.*, 1991).

The best method for assessment of nutritional iodine intake is urine iodine assessment, thyroid size, TSH scale, and serum thyroglobulin. The later methods reflect iodine status in past months or years whereas urinary iodine (UI) indicates the current iodine intake and is the common method for school children assessment (Andersson *et al.*, 2005, ICCIDD, 2001, WHO, 2007). On the basis of urinary iodine assessment, mean scores of 100-299 µg/dL are acceptable (Pearce *et al.*, 2013). A study conducted in 2013 showed that 30 countries were iodine deficient, 9 countries had middle deficiency, Twenty one countries were mild deficient, and there were no countries with sever deficiency. In this study, Iran had adequate iodine intake (Pearce *et al.*, 2013) and the East Mediterranean office of world health organization introduced Iran as" IDD free" in 2000. Thereafter, in order to retain this index, national surveys were conducted about goiter incidences, level of iodine in edible salt, and 8-10 year-old students' urinary iodine. This study however was conducted to determine the urine iodine in elementary students of Yazd province during 2007 to 2016 years; it also aimed to investigate the relationship of urine iodine with some demographic factors.

Materials and Methods

Design and participants of study: This cross-sectional descriptive study was conducted during 2007-2016 years. Participants of the study were 8-10 year-old elementary students (in the second, third, and fourth stages) of Yazd province. Schools were selected randomly according to the urban and rural population (38 urban and 10 rural schools; 24 girls' and 24 boys' schools). Among the students studying at the second to fourth stages, 5 students were selected randomly from each class list through the probability proportionate to size (PPS) method. Consequently, a total number of 2236 students were selected in two gender groups of equal sizes (WHO, 2007).

Measurements: A questionnaire was completed on descriptive data. Samples were later carried to the professional health laboratory of Yazd health center and UI was measured by acidic digestion method.

UI according to previous studies is divided into three classes; UI less than10 µg/dL is considered as deficiency , UI in the range of 10-29.90 µg/dL as normal, and UI more than or equal to 30 µg/dL is considered as additional intake (Andersson *et al.*, 2005, Pearce *et al.*, 2013).

Ethical considerations: A written consent and permission was completed by parents to ensure security of data and sample collection.

Data analysis: Data were fed into the SPSS software (version 16) and then analyzed with descriptive methods of prevalence, percentages, median, mean, and standard deviation. In order to determine abnormality of urine iodine median as well as some demographic variables independent samples median-test was conducted. A p-value of less than 0.05 was defined as significant.

[DOR: 20.1001.1.24767417.2017.2.3.1.9]

Results

Total samples consisted of 2236 students; 82% from urban (1835 students) and 18% from rural areas (401 students). However, 51% of samples were boys (1151 students) and 49% were girls (1085 students). According to **Table 1**, the mean of UI in rural regions was more than that of urban regions (P = 0.03) and mean of UI in girls was significantly more than boys (P = 0.01).

The mean of IU in term of years are presented in **Table 2**. As it is observable, total median and mean of IU were 18.40 and 19.01 ± 7.77 µg/dL, respectively. The highest level of UI was 47 µg/dL for the year 2008 and the lowest level was 2.10 µg/dL for the year 2010.

Table 1. Mean of urinary iodine (µg/dL) in term of region and gender

Regions	n	Mean ± SD	P- value[a]
Urban	1835	18.82±7.67	0.03
Rural	401	19.87±8.15	
Boy	1151	18.54±7.69	0.01
Girl	1085	19.51±7.82	

[a]: Student *t*-test

Table 2. Mean of urinary iodine (µg/dL) in term of years.

Year	n	Mean ± SD	Max	Min	Median
2007	220	15.70 ± 5.86	26.00	4.00	15.80
2008	211	22.12 ± 11.36	47.00	5.70	20.00
2009	220	16.54 ± 6.55	34.00	3.40	17.50
2010	216	18.45 ± 10.36	41.90	2.10	17.85
2011	219	18.81 ± 8.32	32.00	3.50	17.70
2012	221	17.18 ± 7.80	34.00	3.60	16.40
2013	215	20.46 ± 6.31	33.60	5.30	19.20
2014	233	20.36 ± 6.18	34.10	6.60	19.40
2015	239	20.31 ± 5.36	31.20	8.70	19.60
2016	242	20.04 ± 5.40	35.10	8.80	19.30
Total	2236	19.01 ± 7.77	47.00	2.10	18.40

Table 3, shows frequency distribution of UI classifications during ten years. Totally, the percentages of students with UI of less than 20 µg/dL and in the range of 20-40.9 µg/dL were 0% and 2.37 %, respectively. Based on the information of this table, the major portion of participants are placed within the normal UI range of 100-290.9 so that from 2014 onwards, more than 90% of individuals were within this range of UI.

Table 4 shows the mean and median of UI in different cities of Yazd province during ten years. The highest mean was for Ashkezar (21.60 ± 8.29 µg/dL) while the lowest one was for Bafgh (16.51 ± 8.10 µg/dL). Moreover, a significant difference was observed between cities (P < 0.001).

[DOR: 20.1001.1.24767417.2017.2.3.1.9]

Table 3. Frequency distribution of urinary iodine classifications (µg/dL) in term of years (2007-2016)

Year	n	Urinary iodine classifications									
		‹20		20-49.9		50-99.9		100-299.9		≥300	
		%	n	%	n	%	n	%	n	%	n
2007	220	0.00	0	3.18	7	15.00	33	81.81	180	0.00	0
2008	211	0.00	0	0.00	0	15.63	33	56.87	120	27.48	58
2009	220	0.00	0	3.18	7	14.09	31	77.72	171	5.00	11
2010	216	0.00	0	12.50	27	13.42	29	57.40	124	16.66	36
2011	219	0.00	0	2.73	6	14.15	31	72.14	158	10.95	24
2012	221	0.00	0	2.71	6	18.55	41	70.58	156	8.14	18
2013	215	0.00	0	0.00	0	1.86	4	87.90	189	10.23	22
2014	233	0.00	0	0.00	0	0.42	1	90.12	210	9.44	22
2015	239	0.00	0	0.00	0	0.41	1	94.97	227	4.60	11
2016	242	0.00	0	0.00	0	0.41	1	95.86	232	3.71	9
Total	2236	0.00	0	2.37	53	9.16	205	79.02	1767	9.43	211

Table 4. Median and mean of urinary iodine (µg/dL) in cities of Yazd province during ten years (2007-2016)

City	n	Median	Mean ± SD
Abarkoh	164	21.00	20.75 ± 6.73
Ardakan	186	17.00	17.11 ± 7.94
Ashkezar	128	21.00	21.60 ± 8.29
Bafgh	175	16.00	16.51 ± 8.10
Taft	99	19.20	20.08 ± 6.71
khatam	130	19.60	20.09 ± 8.36
Mehriz	163	20.00	21.09 ± 8.49
Maybod	236	17.50	17.28 ± 7.48
Yazd	955	18.30	19.01 ± 7.43
Total	2236	18.40	19.01 ± 7.77

Discussion

In this study iodine intakes of 8-10 year-old students were assessed on the basis of UI. Many previous studies have used students' UI to assess nutritional iodine, thus this method is considered as a highly reliable method (Andersson *et al.*, 2005, ICCIDD, 2001, Pardede *et al.*, 1998).

Median of UI and percentage of students with UI less than 50 µg/dL during ten years were 18.40 ± 7.70 µg/dL and 2.37%, respectively. According to the world standards (Pearce *et al.*, 2013, WHO, 2007), the median of UI higher than 10 µg/dL and a percentage of up to 20% of students with UI less than 50 µg/dL are acceptable. Then, student's iodine intake in Yazd province is adequate by ten years (2007-2016). However, in this study mean of UI was in normal range through all years (the lowest was 15.70 ± 5.80 µg/dL in 2007 year and the highest was 22.12 ± 11.36 µg/dL in 2008). In a study carried out by Mozaffari-Khosravi et al. , in Yazd city the mean of UI was 25.80 ± 12.20 µg/dL (Mozaffari-Khosravi *et al.*, 2004). Also, Sheikholeslam et al. conducted a study in Qom province and reported that the median of UI was 15.20 µg/dL (Sheikholeslam *et al.*, 2007) .

In **Table 2**, UI less than 20 µg/dL was zero and 2.37% of students were in 20-49.9 µg/dL range. In Mozaffari-Khosravi et al., study, 10% of samples were lower than the 10 µg/dL level of UI (Mozaffari-Khosravi *et al.*, 2005). In Sheikholeslam

[DOR: 20.1001.1.24767417.2017.2.3.1.9]

et al., study, 8.10% of samples were less than 50 µg/dL but no case of UI less than 20 µg/dL was observed (Sheikholeslam *et al.*, 2007). However, the trend of acceptable UI concentration (100-299.9 µg/dL) has been ascending except the 2007 and 2009 years. Thus, this divergence in contents could be due to laboratory errors.

Similar results were observed in studies of Rasmussen LB et al., in Denmark (Rasmussen *et al.*, 2002), Garcia-Solis et al., in Mexico (García-Solís *et al.*, 2013), Zhonghualiu in China (Ren and Yu, 2013), Caldwell et al., in USA (Caldwell *et al.*, 2011), Delshad et al., in Iran, Qazvin and Kermanshah (Delshad *et al.*, 2011a, Delshad *et al.*, 2012, Delshad *et al.*, 2011b, Delshad *et al.*, 2010), Rostami et al., in Urumia (Rostami *et al.*, 2012), and Sanjari et al., in Kerman (Sanjari *et al.*, 2011). Trend of UI concentration more than or equal to 300 µg/dL was descending (from 27.40% in 2008 to 3.70% in 2016 year) which is in consistency with the acceptable UI concentration. In Mozaffari-Khosravi et al., 40.70% of samples were ≥ 300 µg/dL (Mozaffari-Khosravi *et al.*, 2004).

The current study showed a significant difference between mean of UI in urban and rural regions and gender. In Mozaffari-Khosravi's study a significant difference was found between girls and boys (Mozaffari-Khosravi *et al.*, 2004). In Shaikholeslam's study the differences between boys and girls as well as urban and rural areas were not significant (Sheikholeslam *et al.*, 2007).This study also showed that mean of UI among cities of Yazd province was significantly different, which is similar to Mozaffari-Khosravi et al., study on goiter and UI prevalence during ten years (P = 0.02) (Mozaffari-Khosravi *et al.*, 2005). It seems that some factors, such as distance to the center of province, neighboring with other provinces, scattering of rural regions, and demography have important roles.

Conclusions

Findings of the current study showed that median of acceptable UI had an ascending trend and according to decrease of UI percentage of less than 100 µg/dL, Yazd province can be placed at "IDD free" status. However, the level of UI more than or equal to 300 µg/dL had remarkable decrease. It is clear that this approaches need continuous annual evaluation of UI in 8-10 years old students in province level and every five years evaluation in national level.

Acknowledgments

The authors thank with coworkers in cities health centers of Shahid Sadoughi University of Medical Sciences, especially nutritional experts and managers of schools.

Authors' contributions

Naghiaee Y wrote and Mozaffari-Khosravi H draft of the paper; Lotfi MH conducted research; Hajimirzadeh M, Amini F and Pirmadah F analyzed data; All authors read and approved the final manuscript.

Conflicts of interest

There is not.

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