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THE PREVALENCE OF IODINE DEFICIENCY IN THE STUDENTS OF AGES 12-14 YEARS OLD IN KHORRAMABAD CITY BASED ON URINARY IODINE IN 2016

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ABSTRACT

Because of importance of the disease, the World Health Organization (WHO) has offered general plans to reduce the level of the disease through continuous measurement of iodine or goiter. This study has been conducted with the aim of controlling the iodine deficiency level among high school students of Khorramabad in 2016. 500 students in grade 1 of high school with mean age range of 13.70±0.79 year old and mean weight of 54.14±9.10kg were studied. The median of urinary iodine excretion in these students was obtained to 53.20µg/l with 0.54% with the limit of urinary iodine in range of 50-99µg/l. Analysis of the effect of studies variables on urinary iodine level showed that gender could be an effective factor on urinary iodine level and girls with 56% showed mild iodine deficiency compared to boys with 54%. The results showed that age is an effective factor in the level of iodine excretion in urine. Also, the iodine excretion level in 13-year old students (46%) was higher than students of age 12 (20%) and age 14 (34%). The iodine level showed no significant differences in ages of 13 and 14 ($p>0.05$). Moreover, the results obtained from this study show that the urinary iodine level is under effect of weight and students with mean weight of 50-59kg (37%) were the most people in limit of mild iodine deficiency. After this limit, the students with weight in range of 40-49kg (34%) and students below 40kg (11%) possessed rank 3. 56% of students were not suffering from goiter; 24% of them suffer from grade 1 goiter and 18% suffer from grade 2 goiter. The mean urinary creatinine in girls was equal to 0.13±0.92mg/dl and was equal to 0.96±0.17mg/dl in boys. Median of urinary creatinine was equal to 0.83mg/dl and people with mild iodine deficiency (50-99µg/l) to 277 people (54%) had 0.88mg/dl creatinine. The creatinine excretion was increased with increase in iodine deficiency.

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Introduction

The Congenital hypothyroidism disease is a treatable status of thyroid hormone deficiency, which could cause acute disabilities of physical growth and severe mental retardation od child in case that is not diagnosed on-time or is treated inadequately. Till before beginning of screening process, early diagnosis of the disease used to be done with delay because of few symptoms in early days of childbirth and this could lead to severe disorders of physical growth and loss of intelligence quotient to different degrees in the patients [1].

The level of prevalence of the disease at the world is 1person per 3000 or 4000 live childbirth and the disease has highest prevalence in Asian countries and it is 2-3 times in Iran more than other countries because of high prevalence of family marriages and genetic problems in infants [2]. Various reports have been provided since the time of implementation of the

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plan in Iran (2005) in cities such as Tehran [3], Fars [4], Isfahan [5], Tabriz [6] respectively 1 per 914, 1465, 342 and 666. The said cases have been higher than the global average level. Normal thyroid gland contains 10mg iodine and is mainly in protein-binding form. The least daily need to iodine is about 100µg, which is equal to its renal excretion. Iodine deficiency could lead to disorder in hormone synthesis and Thyroid-Stimulating Hormone (TSH) and as a result, stimulation of the secretion and enlargement of the thyroid and goiter [7].

Epidemiologic analysis of goiter as one of the main indices of iodine deficiency was taken for the first time in Iran in 1969 by the Nutrition Institute [8]. The obtained results showed that iodine deficiency was prevalent in majority of cities and villages of Alborz and Zagros Mountains. After a 15-year interval, the Department of Endocrine Disease Research of Shahid Beheshti University of Medical Sciences and the Institute of Nutrition Sciences and Food Technology conducted further studies among the students of Shahryar [9], East of Tehran [10] and the villages of Northwest of Tehran with severe iodine deficiency [11, 12] The report of these studies could make the disorders caused by iodine deficiency be recognized as one of the health priorities in Iran and caused also establishment of State Committee on Combating Iodine Deficiency. The committee conducted the rapid analysis of goiter in 1989 in all provinces of Iran [12] and the strategy of producing and distributing iodized salt was selected as the main strategy of combating the disorders caused by iodine deficiency and came into force [13]. As a result of enforcing the production of iodized salt in 1994, iodine consumption was increased by households The last investigations show that 93% of rural people and 97% of people in urban areas use iodized salt ([14]. Problems caused by iodine deficiency include Endemic Goiter, Thyroid Hypothyroidism, Cretinism and Maternal Anomalies, which could be generally recognized as iodine deficiency disorders. Undesirable effect of iodine deficiency could be observed in fetal life and during the lifetime. Iodine is one of the most important and preventable factors causing disorder in mental evolution. Elimination of iodine deficiency disorders is one of the most underlying health and social goals [15].

Although iodine deficiency has been controlled in Iran since 1996 and Iran has been announced as a country free from iodine deficiency since 2000 on behalf of WHO [16], iodine deficiency could be never eradicated and it may be returned and the most important method to monitor that could be ensuring of sufficiency iodine content in iodized salt and its consumption by households and determination of urinary iodine excretion level [17, 18]. The relationship between prevalence of goiter and low iodine intake has been well proved. The deficiency could be compensated usually with more activity of the gland and more production of hormone. The increased activity could cause compensatory hypertrophy and hyperplasia of the thyroid gland (Goiter). In mild iodine deficiency, goiter could be created just under conditions of increased physiologic need like rapid growth age (adolescence) and pregnancy [19, 20].

In the regions with average iodine deficiency, goiter in primary school students may be treated automatically and it may be relapsed in pregnancy or during breastfeed time. The frequency above 5% of children of age 6-12 could refer to the endemic goiter and the frequency below 0.01% refers to sporadic goiter [20]. The present study has been designed to evaluate the status of iodine deficiency disorders in KHoramabad City and comparing the findings with results of other relevant studies and analysis of the effect of state plan on controlling iodine deficiency disorders to overcome the problem.

Methods and materials

This study is a descriptive cross-sectional research conducted in 2016 in Khorramabad schools. The sample individuals were selected from male and female students of age 12-14 and the sampling was done using cluster sampling method. To this end, 3 Educational Districts were considered as 3 areas and some schools were selected from each area and some classes were also selected from each school and all students in these classes were studied as sample.

To achieve confidence level of 95% and accuracy of 10%; 500 urinary samples were taken. In this study, 10cc urine of studied individuals of both genders was taken regardless of their thyroid status and randomly. This is because; measurement of urinary iodine in 500 people randomly could show clear status of iodine intake in the region. The urine samples were collected in closed plastic containers and were immediately sent to the laboratory (Research Center of Lorestan University of Medical Sciences) and was maintained there under temperature of 4ºC till the time of examinations.

The chemicals used to measure iodine included Ammonium persulfate, arsenic oxide, sulfuric acid, ammonium ceric and potassium iodide and deionized water purchased from Merck Company, Germany.

The urinary iodine excretion concentration (ULE) was measured using acid digestion method [21]. In this method, the urine sample was incubated for 60min under temperature of 100ºC with ammonium persulfate and then, the released iodine was reacted in the Sandal-Koltov reaction with ceric ammonium and the declined yellow color in wavelength of 420nm was measured using spectrophotometer, PERKIN-ELEMER 550 SE Model.

Moreover, to make the iodine level real and to adjust urinary iodine level, the urinary creatinine concentration was also measured at the same time using Gaffa method and by auto-analyzer BT-3000 device. In this method, Pars Azmoon Kits (Iran) are used with the picrate alkaline solution and a red-colored complex us created and the adsorption is measured using photometry method in wavelength of 485nm.

To estimate the goiter prevalence, the goiter clinical examinations (enlargement of thyroid gland) in students were done by the specialists using touching method and using the following standard method. The recommended criteria by WHO, UNICEF and ICCIDD were taken. In the Goat's Touch Experiment or clinical examination, the patients were examined in a place with enough light in the position that neck is turned to right and a little backward. The thyroid area was observed from both front

and side angles of neck and any kind of Bumps, Surgery Oscars, Enlarged veins, Redness or adhesion, and changes in the thyroid area skin were considered. After the initial examinations, the patients were asked to drink a glass of water or eat something. Through this, the bump of thyroid area could be displaced, since the larynx curtain covers the thyroid gland and the thyroid bump is displaced through eating something.

To compare the mean value of excreted iodine between two genders and among different districts, Mann Whitney and Kruskal-Wallis tests were used and to measure the goiter level, Chi-squared (x2) test was used. To make decision on significance of evaluated correlations, the level of $p<0.05$ is considered as judgment criterion.

Results

In table 1, the descriptive indices are presented for variables of gender, age, height, weight and living place.

Table 1. Descriptive indices

Variable	Number	Mean±SD
Age (year)	500	13.70±0.79
Weight (kg)	500	54.14±9.10
Height (cm)	500	157.4±8.10

According to table 2, the median of urinary iodine excretion was obtained to 53.20µg/l. The iodine level among 3 selected limits for urinary iodine showed significant difference ($p>0.05$). The majority of students (n=277) were in limit of urinary iodine of 50-99µg/l.

Table 2. Measurement of the mean iodine level in Khoramabad studenys (µg/l)

Mean / Urinary iodine limit	Mean and SD	Number	Median
<20	7.29±0.70[a]	101	53.30
20-49	36.90±11.09[b]	122	
50-99	73.14±16.08[c]	277	

Dissimilar letters refer to significant difference at the level of 0.05 ($p<0.05$)

Analysis of studied variables in iodine level of Khoramabad students

The results obtained from this study showed that majority of girls (n=146) and majority of boys (n=131) were in urinary iodine limit of 50-99µg/l (table 3). On the other hand, significance of x2 Pearson to 0.433 showed that the two variables of gender and urinary iodine are not independent from each other. It means that gender could affect urinary iodine level.

Table 3. The effect of gender on urinary iodine level of Khoramabad students

urinary iodine (µg/l) / gender	>20	20-49	50-99	Total
Female	55	57	146	258
Male	46	65	131	242

According to table 4, females showed significantly higher iodine level than males.

Table 4. Comparing urinary iodine between male and female students of Khorramabad

Variable			Number	Mean±SD
Iodine	Gender	Female	258	52.28±5.77 a
		Male	242	49.61±4.81 b

Dissimilar letters refer to significant difference at the level of 0.05 ($p>0.05$)

The effect of age on urinary iodine level of students showed that majority of 13-year old students was in iodine limit of 50-99µg/l (table 5). Moreover, two variables of age and urinary iodine were not independent from each other ($x2=0.022$); it means that age could affect urinary iodine level.

Table 5. The effect of age on urinary iodine level of Khoramabad students

Urinary iodine (µg/l) / Age (year)	<20	20-49	50-99	Total
12	28	30	42	100
13	47	54	129	230
14	26	38	106	170
Total	101	122	277	500

The iodine level showed no significant differences between ages 13 and 14; although both age ranges showed significant difference with students of age 12 ($p<0.05$) (table 6).

Table 6. The effect of age on iodine level of students

age (year) / parameter	12	13	14
iodine (µg/l)	44.46±3.26 a	50.70±2.97 b	55.22±3.26 b

Dissimilar letters refer to significant difference at the level of 0.05 ($p>0.05$)

According to the results in table 7, majority of students of Khoramabad were in weight range of 50-59kg and according to significance level of Pearson chi-squared value (0.00), weight could affect urinary iodine level.

Table 7. Effect of weight on urinary iodine level of Khoramabad students

Urinary iodine (µg/l) / Weight (kg)	<20	20-49	50-99	Total
<40	16	24	33	73
40-49	17	30	96	143
50-59	40	38	104	182
60-69	22	17	20	59
70	6	13	24	43
Total	101	122	277	500

Mean value of urinary iodine level in these studies showed that the iodine level in students with weights of >40, 40-49, 50-59 and >70 showed no significant difference (table 8).

Table 8. Mean urinary iodine in Khoramabad students with different weights

Weight (kg) / Parameter	>40	40-49	50-59	60-69	>70
Iodine (µg/l)	46.52±7.33 ab	58.67±5.33 b	50.75±4.25 b	36.72±4.85 a	53.66±4.38 b

Analysis of the effect of goiter grade on urinary iodine level of Khoramabad students

In table 9, the effect of goiter grade on urinary iodine level of studied students is presented. According to the results obtained from this table, majority of students in this city were not suffering from goiter. Only 94 students were suffering from grade 2 goiter. The output of Chi-squared test was obtained to 0.046, which confirms that two variables of goiter grade and urinary iodine were not independent from each other and the grade of goiter could affect urinary iodine level.

Table 9. Measurement of the effect of goiter grade on the urinary iodine level of Khoramabad students

Urinary iodine (µg/l) / Goiter grade	<20	20-49	50-99	Total
Grade 0	65	73	145	283
Grade 1	26	25	72	123

Grade 2	10	24	60	94
Total	101	122	277	500

Comparing the mean ratio of creatinine and iodine/creatinine in Khoramabad students
According to table 10, majority of students (n=122) in limit of 20-49µg/l urinary iodine has 0.98mg/dl creatinine.

Table 10. Comparing mean ratio of creatinine in Khoramabad students

Parameter / Urinary iodine limit (µg/l)	Creatinine (mg/dl)		
20>	101	1.06±0.69	0.83
20-49	122	0.98±0.55	
50-99	277	0.88±0.58	

The mean iodine/creatinine ration in each limit of urinary iodine level is presented in table 11. Majority of students (n=122) in limit of 20-49µg/l urinary iodine had mean iodine/creatinine level of 6.59 (µg/mg).

Table 11. Comparing mean iodine/creatinine ratio in Khoramabad students

Parameter / Urinary iodine limit (µg/l)	Creatinine (mg/dl)		
20>	101	1.37±0.22	5.78
20-49	122	6.59±0.95	
50-99	277	18.43±3.47	

According to the results obtained from this study, living place, height, family background of goiter disease could affect urinary iodine level of students.

Discussion

Iodine deficiency disorder is a general problem in field of health in the areas with iodine deficiency in drinking water, soil and food. The deficiency could affect thyroid function [22, 23]. Because of the importance of the disease, the World Health Organization (WHO) has offered general plans to reduce the level of the disease through continuous measurement of iodine or goiter [24, 25]. This study has been conducted with the aim of controlling the iodine deficiency level among high school students of Khorramabad in 2016.

This study has been conducted with the participation of 500 students in grade 1 of high school (table 1) with mean age range of 13.70±0.79 years and mean weight of 54.14±9.10kg. The median of urinary iodine excretion in these students was obtained to 53.20µg/l and mean urinary iodine excretion was obtained to 52.25 in females and to 49.61±4.81µg/l in males. Majority of students to 0.54% had urinary iodine limit of 50-99µg/l (table 2). After this group, students with iodine level of 20-49µg/l to 245 and students with iodine level of <20µg/l possessed the next position (22%). When more than 20% of samples in same region have urinary iodine below 50µg/l, this could show iodine deficiency in the population [26].

In the study conducted by [27] in Khoramabad as similar area with this the studied area, the median of urinary iodine excretion was obtained to 17.1 and its mean value was obtained to 18.98µg/dl, which was significantly higher than the value obtained in this study. Moreover, according to the urinary iodine concentration, 6.8% of students were suffering from mild iodine deficiency (>20) and 11.3% of them were suffering from intermediate iodine deficiency, which could show reduced level of iodine deficiency over the years compared to the present study.

[28] have reported the rate of goiter to 16.8% and have also reported the median of urinary iodine to 115µg/l in students of a school in Peru, which was higher than the value obtained from this study.

Moulopoulos et al (24) have claimed that the excretive iodine of 15.1µg/l shows daily intake of 200µg iodine, which could meet the need of thyroid gland to iodine and could pave the way for production of thyroid hormones. According to this value, it could be mentioned that Khoramabad students in this study are in good status in terms of required iodine level by thyroid hormones.

[29] have mentioned that mean urinary iodine in 500 students in Urmia was equal to 14.6µg/dl and 22.8% of students were suffering from iodine deficiency (below 10µg/dl), which was higher than the value obtained in the present study for the khormaabad Students.

Investigation of the effect of studies variables on urinary iodine level showed that gender could be an effective factor in (table 4) urinary iodine level and girls with 56% suffer from mild iodine deficiency compared to boys with 54%. On the other hand, the number of girls with severe iodine deficiency was 21% compared to boys to 19%. The result is not in consistence with findings of [27] in field of the relationship between goiter prevalence and gender, since the results have reported lack of correlation between the two parameters.

The results obtained from this study showed that age could be an effective factor in urinary iodine excretion and the iodine excretion level in students of age 13 (46%) is higher than students of age 12 (20%0 and 14 (34%). Moreover, according to table 6, there was no significant difference between ages 13 and 14 in terms of iodine level ($p>0.05$). The result is not in consistence with findings of similar studies in this region, so that no correlation was obtained in similar studies between age and urinary iodine level [27]. In the study conducted by [30] on goiter prevalence monitoring and urinary iodine level in students of [30], they claimed that the prevalence of goiter could be increased with ageing and this finding is in consistence with results obtained from this study.

Moreover, the results obtained from this study showed that the urinary iodine level is under effect of weight and students with mean weight of 50-59kg (37%) are the most people in limit of iodine deficiency. After this limit, it is turn to students with weight of 40-49kg (34%) and students below 40kg (11%) in rank 3. Moreover, the results of table 8 showed that the highest urinary iodine level in students in weight range of 40-49kg was measured to 58.67±5.33µg/l.

The most important problem with iodine deficiency is creating goiter, which is in fact created by enlarged thyroid gland [31]. Out of 500 students studies here, 283 students (56%) were not suffering from grade 1 goiter and 18% were suffering from grade 2 goiter. In 1989, in regions such as Samiram, 89.5% of studied people were suffering from goiter [32]. Comparing these results with the results obtained from this study could show positive effects of the iodine deficiency combat plans in Iran. According to table 9, the goiter grade could affect urinary iodine level [33]. Moreover, salt iodine intake could not control goiter by itself and this may be one reason for the disease in students despite to wide distribution of iodine in Iran [34]. Various studies have shown that factor such as iron, selenium and vitamin deficiency could be factor affecting goiter [35, 34, 36].

In the study conducted by [27] on iodine deficiency and goiter prevalence in Khoramabad among students of age 6-10 years old, 43% of studied students were suffering from goiter and among them, 56% were suffering from grade 1 goiter and 44% were suffering from grade 2 goiter. Compared to values obtained from this study, it could be mentioned that the percent of goiter among Khoramabad students has been decreased over the years. [37] have reported the goiter level of 15.8% in students of age 6-12 and the value was obtained after 60 years of using iodized salt. [30] reported the overall goiter prevalence in [30] to 29.1% (relatively high) and mentioned that overall goiter prevalence showed chronic iodine deficiency and the correlation between urinary iodine level and goiter in this study is also in consistence with the said findings.

The common criteria for evaluation of iodine intake status, in addition to urinary iodine excretion, could be iodine to creatinine ratio. The concentration of this material in different people is depended on diet, ageing and physical activity [38]. Mean value of urinary creatinine in females was obtained to 0.13±0.92mg/dl and was obtained to 0.96±0.17mg/dl in males. The study conducted by [39] showed that with the beginning of maturity age in males, the iodine intake could lead to production of thyroid stimulating hormone. As a result, the thyroid hormones of troxin and triiodothyronine are created in blood circulation in response to increased level of energy and physical growth, which could explain the high creatinine level in females compared to males.

The median of urinary creatinine was obtained to 0.83mg/dl and people with mild iodine deficiency (50-99µg/l) (n=277) to 54% had 0.88mg/dl creatinine. The creatinine excretion level was also increased with increased iodine deficiency (table 10). And this showed interdependence of iodine level, goiter grade and creatinine to iodine ratio. In the study conducted by [29], the iodine excretion level and the iodine to creatinine ratio showed significant difference between students without goiter and students with goiter.

In the study conducted by [29], the mean urinary creatinine in all students of Urmia was obtained to 1.36mg/dl, which is higher than the value obtained from this study. Moreover, the iodine/creatinine ratio was obtained to 15.67µg/mg in the said study. At the present study, the maximum iodine/creatinine ratio was obtained to 18.43µg/mg and in range of 50-99µg.l (table 11). In the findings of [29] in Shiraz on female students, the iodine/creatinine ratio was obtained to 15.67µg/mg, which was lower than the value obtained in this study.

Conclusion

Iodine deficiency and relevant disorder is existed all around the world, especially in many regions of Iran like Khoramabad. It seems that it has local aspect in these regions. Over the years, increased consumption of iodized salt and increased awareness and knowledge of people has led to reduced level of the diseases compared to last years. However, according to the findings of this study, iodine deficiency and goiter disease are still existed in wide range in Khoramabad city in Iran and this needs more considerations and continuous monitoring.

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