Original Article

ASSESSMENT OF URINE IODINE IN SCHOOL CHILDREN FROM URBAN AND RURAL AREAS OF TEHRAN IN 2001

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ABSTRACT

Introduction: Following the national survey for Iodine Deficiency Disorder (IDD) in 1989 which manifested endemic goiter in Iran, the iodination program was implemented. By 1998, Iran has managed to become an IDD-free country. This study is a part of continuous assessment to monitor the effectiveness of this program.

Methods: The prevalence of iodine deficiency was studied by assessment of urine iodine concentration among a random sample of schoolchildren, in the South Tehran. The extent of salt iodination in the public was assessed meanwhile.

Results: Most cases (52.19%) showed a urine iodine concentration between 10-30 µg/dl. As well, 5.85% of pupils had mild iodine deficiency according to world standards, 1.45% of pupils showed moderate and none had severe IDD. Examination of consumed salt in public areas showed 98.8% iodination.

Conclusion: Total mean iodine excretion was obviously above the state survey in 1996. The risk of exceeding the allowed limits (<30 µg/dl) should be attentively studied.

KEY WORDS: Iodine Deficiency, Urine Iodine, Iran

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INTRODUCTION

Thyroid hormone plays a major role in regulating the metabolism of most cells, the growth and development, especially in infants and children. Normal level of TSH secretion and an adequate, but not excessive supply of iodine are indispensable for normal thyroid hormone formation. Iodine insufficiency disturbs thyroid function and depending on the duration and severity of the deficiency, a range of complications and changes take place within the body, which is addressed by the term "Iodine Deficiency Disorders" (IDD)[1].

Our present knowledge indicates that the complications of iodine deficiency goes far beyond the thyroid enlargement and will cause many health (and medical) problems. Today, we have no doubt that iodine deficiency consequences are considerable obstacles towards the development of societies –due to its devastating effects on brain development and cognitive function. (Note that IDD is the first preventable cause of mental retardation and diminished IQ)[1]. According to the WHO reports, more than 800 million individuals in the world are suffering from IDD. The Islamic Republic

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of Iran began to study the prevalence of goiter and other Iodine Deficiency Disorders in 80's and conducted a national IDD survey in 1989 that clearly manifested hyper endemic and endemic goiter in almost all regions of the country[2].

After implementation of iodination program and commitment to the fulfillment of 10 programmatic indicators set by WHO/UNICEF/ICCIDD[3], the Islamic Republic of Iran has managed to attain IDD control and was considered as an IDD free country by showing more than 95% of household consumed adequately iodized salt by late 1998. The health administrators carry out regular survey in different provinces to monitor the whole process[4].

The most sensitive method for evaluation of IDD control program is the determination of urinary iodine excretion[1,5]. This is due to the effective clearance of this element by the kidneys regardless of other confounding factors.

In recent studies Tehran was amongst the provinces with the median urinary iodine between 20-29 µg/dl and 2.0% of the children were reported to demonstrate severe iodine deficiency[4].

It is important to note that disastrous complications of IDD such as low learning capability and diminished functionality due to brain development and cognitive function disturbances may present a major problem in succeeding generations and different aspects of progress of a country. Also, it is so important that these problems are incurable but easily preventable[1].

As Iran is situated in a goiter-prone area and the prevention is one of the priorities of health system, international guidelines of WHO were applied to launch national IDD control programs[4,6].

Iodination of salt could be most effective if subsequently monitored with regular assessment. There are two widely used methods for assessment of magnitude of IDD in a population; determining goiter prevalence, and urine iodine excretion. The latter, is a useful indicator of consumed iodine because of nearly exclusive clearance of the element by the kidneys. Therefore, measurement of urinary iodine is a good indicator of dietary intake[1].

It is not practical to gather a 24 hour sample, therefore for evaluation surveys, it is recommended to get a random sample. Study of all age groups is practically not easy yet as regards the susceptibility of the children to the complications, they are studied as representatives of the society showing the iodine sufficiency/deficiency status[1].

Using the data of such a survey, health administrative would estimate the severity of the problem, if any, and the efficiency of any iodine-control program, therefore to act accordingly. Anyhow, high prevalence of goiter and low concentrations of urine iodine show that IDD emerges as a health problem.

Monitoring and regular evaluation of this program's effect in every aspect is essential to the success and any negligence would put the efforts all in vein. Proper monitoring is performed in every province and any considerable abnormal change of iodine index should be immediately reported to the authorities. In Iran, it is now eleven years since iodized salt production was initiated and it is six years from its mandatory consumption by the household throughout the country[5,6].

We have studied the prevalence of iodine deficiency by assessment of urine iodine among schoolchildren living in the south region of Tehran, a district in which health care is provided and supervised by Tehran University of Medical Sciences and Health Services.

SUBJECTS AND METHODS

It is a cross-sectional study designed to assess the urinary iodine concentration in schoolchildren of 8-10 years of age.

After defining the schools in the area and determining the rural to urban ratios sampling was performed. According to this proportion, samples were obtained from urban and rural regions. Calculating girls to boys ratio in each set, sample size of each sex was determined. By the means of the randomized numbers' chart, sampling was performed considering the

size and the total number of pupils (randomized sampling).

A team was sent to the schools in order to obtain urine specimen from the specified students. The samples were delivered to the laboratory on the same day.

In the lab, the color change of ammonium sulfate with another substance (arsenic acid) is accelerated by iodine as catalyzing agent. The speed of the change in color depends on the iodine concentration. Measurement of the color intensity and the iodine content, comparing to a standard solution with known iodine content was performed with colorimeter.

The data was recorded in blank tables, Excel and Epi-info softwares were employed for analyzing the results. Mean, median, variance, standard deviation, and other parameters were calculated and different charts were drawn accordingly, all were handed in to the health authorities to make use of them in practice.

RESULTS

Two hundred five children were selected for assessment of urine iodine content from three districts in Tehran; District 11 (south Tehran), Eslamshahr, and Shahr Ray; among them were 107 boys and 98 girls.

Figure-1 illustrates the urinary iodine excretion in schoolchildren of the three districts under the supervision of Tehran University of Medical Sciences. The results were categorized into these groups (Figure 1). The number of the cases in each group was calculated. It is evident that most cases (56 pupils) had a urine iodine concentration between 10-20 µg / dl with a prevalence of 27% and the smallest number of samples had shown 0-5 µg / dl of urine iodine (moderate to severe iodine deficiency) with only 3 pupils (1.5%). As well, 12 children (5.85%) had 5-10 µg / dl urine iodine, which is considered as mild iodine deficiency.

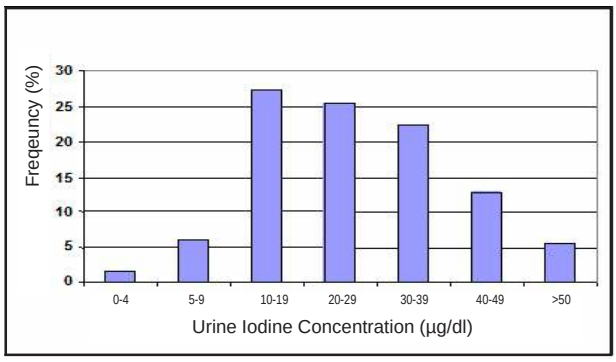

Figure-1: The prevalence of different levels of urine iodine concentration

Figure-2 shows gender distribution of urinary iodine concentration in the three districts. Girls had shown a 31.63% of prevalence in 10-20 µg / dl range, while the 30-40 µg / dl was the span with highest prevalence among the boys (27.1%).

Paying attention to the iodine deficiency limit (0-10 µg / dl); 8.4% of the boys and 6.12% of girls had low urine iodine content.

In the south area of Tehran (District 11), 120 children were studied; 63 boys and 57 girls, in Eslamshahr 39 samples were obtained, 20 from the boys and 19 from the girls, while in Shahr Rey the total sample size was 46 with 24 and 22 boys and girls, respectively.

Figure-3 illustrates the urine iodine excretion according to the categories specified beforehand and presents a comparison among the

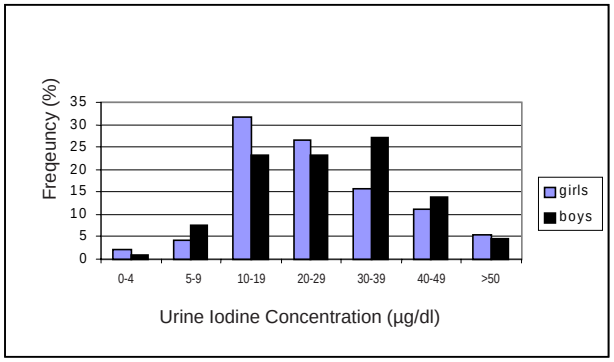

Figure-2: Gender distribution of different levels of urine iodine concentration

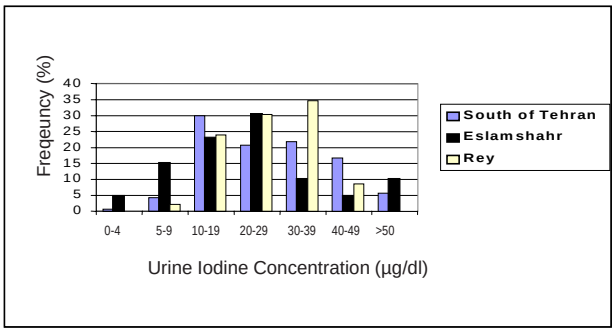

Figure-3: Frequency of different levels of urine iodine among three districts

three districts. In south of Tehran, 30% of schoolchildren had a urine iodine content between 10 to 20 µg/dl (the most common range) and only 0.83% had 0-5 µg/dl. In Eslamshahr, the highest proportion (30.76%) was shown to have 20-30 µg/dl urine iodine and 5.12% had 0-5 µg/dl (least frequent limit).

Among the pupils who reside in Ray area, the highest proportion was 30-40 µg/dl with 34.78% of children and the smallest percentage was detected in 0-5 µg/dl with actually no case (0%).

Figure-4 shows the urine iodine in South [area] of Tehran in two sexes separately. As the observer can see, the majority of both sexes were placed in 10-20 µg/dl group; 26.98% for the boys and 33.33% for girls. None of the boys was shown to have a very low excretion (0-5 µg/dl) while 1.75% of girls were detected to have this low amount of iodine content in the urine.

Figure-5 shows gender distribution of urine iodine concentration in Eslamshahr is illustrated in this figure. 25% (the majority) of boys had 5-10 µg/dl (mild iodine deficiency) and the most frequent content among girls was detected to be 20-30 µg/dl (47.36%). Approximately same number of both sexes had urine iodine concentration less than 5 µg/dl.

Figure-6 shows the same chart was drawn for Rey area. Most frequent amount in boys was 30-40 µg/dl (41.66%) and 20-30 µg/dl in girls (36.36%). None of the pupils had urine iodine concentration less than 5 µg/dl.

Figure-7 shows the latest WHO standards which were utilized to demonstrate the whole samples' iodine status. According to these criteria there was no case of severe iodine deficiency (0-2 µg/dl). Moderate iodine deficiency (2-5 µg/dl) was found in 1.45%, mild (5-10 µg/

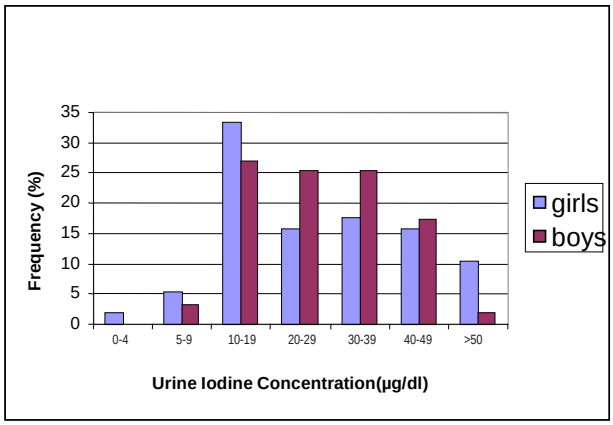

Figure-4: Gender distribution of urine iodine concentration in South Tehran

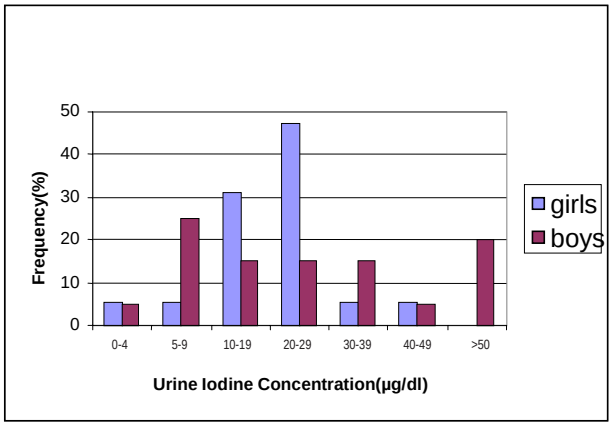

Figure-5: Gender distribution of urine iodine concentration in Eslamshahr

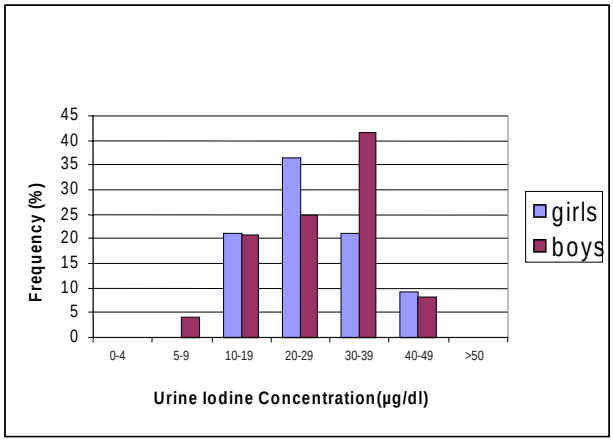

Figure-6: Gender distribution of urine iodine concentration in Ray

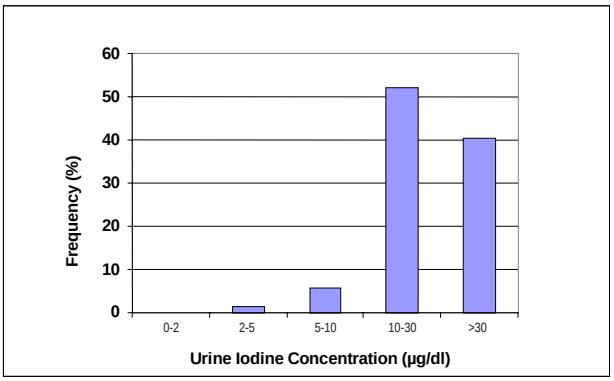

Figure-7: Urine iodine concentration according to WHO scales

dl) in 5.85% of pupils. In the 10-30 µg/dl limit, there were 52.19% of the study samples. And 40.48% of schoolchildren had >30 µg/dl urine iodine concentration.

Figure-8 illustrates the mean urine iodine in each and the whole three districts according to the gender. Mean iodine concentration in the whole area is 27.48 µg/dl in both sexes; 28.34 µg/dl in boys (a bit higher than girls) and 26.76 µg/dl in girls. In every district, the mean among the boys is higher than that of the girls, in Eslamshahr the difference is more prominent (5 µg/dl). The highest mean concentration belongs to South Tehran (28.75 µg/dl) and the lowest, to Eslamshahr (24.11 µg/dl).

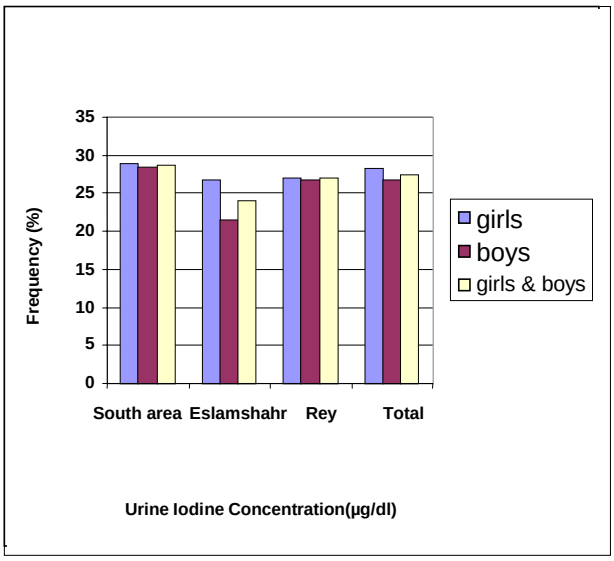

Figure-8: Mean urine iodine concentration according to gender

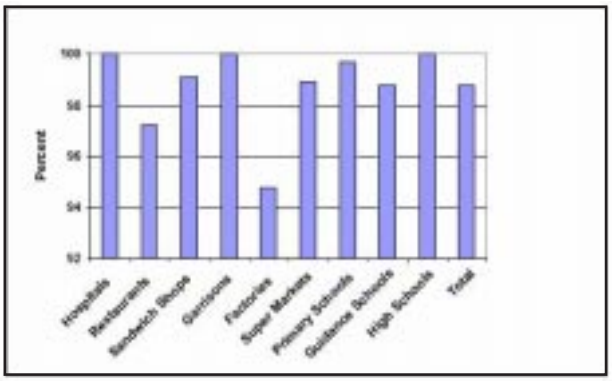

Figure-9: Percentage of Iodized Salt Consumed in Public Areas

Figure-9 demonstrates the percentage of iodized salt consumed in public areas, schools, and the retail sales. 98.8% of the salt examined was iodized. The highest rate belonged to high schools and garrisons (100%), the lowest, to the factories (94.8%).

CONCLUSION

If we compare figure-1 with the same chart of the 1996 survey[4], it is easily understood that the highest prevalence of iodine concentration is still between 10-20 µg/dl, but percentage of cases in 0-5 and 0-10 µg/dl (1.47% and 7.35% respectively) is decreased markedly. (Note that the rates suggested by WHO are <20% and <50% of samples, respectively).

Figure-2 shows that the boys' number is higher in 5-10 µg/dl limit (mild IDD), and the girls' is in 0-5 µg/dl (moderate to severe IDD); therefore, more careful study of possible causes is strongly recommended to prevent severe IDD. The same is true for figure-8. The figure of 1.6 µg/dl difference of the mean iodine concentration between boys and girls in the whole area needs special consideration to realize the factors contributing to higher urine iodine in boys.

Total mean iodine excretion (27.46 µg/dl) was obviously above the state survey in 1996 (20.5 µg/dl). Whereas the recommended value by WHO is 10-20 µg/dl, the risk of exceeding the allowed limits (<30 µg/dl) should be attentively studied.

As illustrated in Figure-7, there was no case of severe IDD -which is a good sign- but the rate of exceeding urine iodine excretion (40.48% more than 30 µg/dl) points out the possible risk of complications due to iodine overload.

If the amount of IDD in different districts is taken into consideration, as shown in Figure 3 it is assumed that mild to severe iodine deficiency is better under control in Rey. There exists no case of urine iodine higher than 50 µg/dl. Meanwhile, Eslamshahr had the lowest mean iodine concentration (24.11 µg/dl) and there were more than 20% of pupils in 0-10 µg/dl limit (most of them were boys), a fact

that needs careful investigation of the causes.

Figure-9 shows that 98.8% of the salt examined from the public area, retailers and schools in the three districts was iodized, which shows the WHO recommended goal (suggesting more than 90% of consuming salt should be iodized) is well achieved.

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