

## Education Achievements and Goiter Size Ten Years After Iodized Salt Consuming

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### ABSTRACT

**Background:** Approximately 2.2 billion (2200 million) of the world population are living in the area with Iodine deficiency (ID), most of them in the developing countries. In IRAN about 2 million are exposed to Iodine deficiency. Most of the complications of ID are not curable, especially brain damage. On the other hand, adding iodine to daily salt is a suitable program for decreasing iodine deficiency. This has been the main aim of IDD National committee since 1986. This study is a before-after preventive trial, and was conducted to determine the effect of iodized salt in preventing the disorders of Iodine deficiency.

**Methods:** This study was a preventive field trial in 2 stages before and after prevention. Since 1995, Iodized salt has been distributed in Tabas in Yazd province. Sample of 2,150 students aged 6-18 years were chosen by stratified cluster random sampling method from 24 schools, 12 schools from rural and 12 from urban areas. Goiter frequency and educational status were determined using WHO criteria and mean scored, respectively.

**Results:** Prevalence of goiter has decreased from 34 to 25 percent after 10 years ( $P < 0.001$ ). The prevalence in urban areas has decreased from 35.8 to 23.5 percent and in rural from 35.6 to 28.5 percent ( $P = 0.02$ ). Prevalence of Goiter has changed from 32.8 to 20 percent and from 39.5 to 31.5 in boys and girls, respectively ( $P < 0.001$ ). There was a statistically significant relation between educational status and goiter frequency before and after prevention ( $P = 0.01$ ). There was also a statistically significant relation between educational status in 2 stages, before and after intervention ( $P < 0.001$ ).

**Conclusions:** Although, there are some confounding variables, such as: educational resources development, improved educational methods, and enhanced family emphasis on extracurricular education, increased frequency of students in higher education after intervention shows the iodine effects on mental function.

**Keywords:** Educational status, goiter, iodine deficiency, prevention

### INTRODUCTION

Approximately 2.2 billion of the world population is living in the areas with iodine deficiency. Most of them are residing

in the developing countries. Of these, 30-70% have goiter, as well as cretinism.<sup>[1]</sup> In Iran, up to 20 millions people has been exposed to iodine deficiency.<sup>[2]</sup> Two decades ago, the I.R. Iran was among the countries most severely affected by iodine deficiency, but during the last two decades has made much progress in the development of universal salt iodization strategies.<sup>[1]</sup>

Effects of iodine deficiency, termed iodine deficiency disorders (IDD), include endemic goiter, hypothyroidism, cretinism, decreased fertility rate, increased infant mortality and mental retardation. The most important complication of iodine deficiency is brain development disorders.<sup>[3]</sup> Some side effects of iodine deficiency are not curable. Adding iodine by simple methods, can prevent all complications. Therefore, health care policy makers and international organizations have perceived the importance of this program, which can lead to decreased the iodine deficiency.<sup>[1,4]</sup>

Several methods can be used for preventing iodine deficiency such as: Oral (or depot injections) oil based iodine, direct addition of iodine into the drinking water, iodizing flour and bread or daily salt. Iodizing the daily using salt is the oldest and the most cost-effective method in this regard. However, this method has many logistic problems which can be very troublesome.<sup>[5]</sup> Iodine is a trace element and as the time passes, the iodine content of the iodized salt would decreased depending on the humidity, exposure to light, and ambient temperature. This shows the importance of keeping the iodized salt in proper conditions from the production to consumption. Adding iodine to daily salt is a suitable way. This has been the main aim of IDD national committee since 1986 (1373).<sup>[2]</sup> When the iodine supplemental program is running, periodical evaluation must be done. By this way, the biological effects of program are reexamined. WHO emphasizes on the program monitoring and evaluating.

There are many countries that have had success at the beginning of the program implementation, but due to lack of continuous evaluations have failed.<sup>[1,3,6]</sup> This study is a before-after preventive trial and was conducted to determine the effect of iodized salt in preventing complications of iodine deficiency

## METHODS

The study is a preventive field trial. It has done in two stages: Before and after prevention, in 1995

iodized salt distributed in Tabas (a city located in the southern part of the Khorasan province). A sample included 2,150 students aged 6-18 years were chosen by stratified cluster random sampling method. The subjects were chosen randomly from 24 schools, 12 of them were located in the rural area and the other 12 in the urban area. For each grade (elementary school and high school) and sex (boy and girl) 2 schools were chosen. After sampling, the goiter severity and school performance of the cases were evaluated. For goiter severity, WHO staging was used. For school performance the average scores of the previous year and the first and second semesters of the outgoing educational year were evaluated (except for the first elementary school year for which we used the average of the pooled first and second semesters scores). The school performance was stratified as poor (0-11), average (12-14), good (15-17), and excellent (18-20).

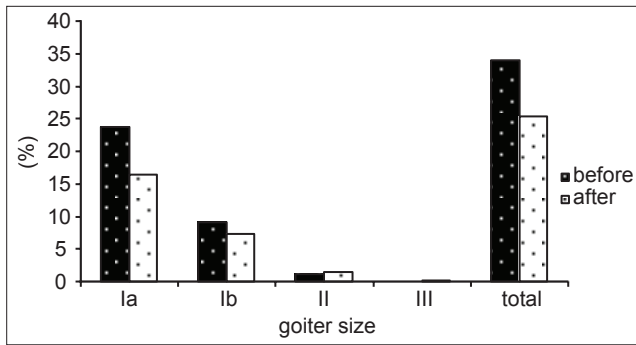
Ten years after intervention, (iodized salt distribution for preventing iodine deficiency) in 2002, students with the previous mentioned criteria (at the same places, schools, grades and sexes) were examined again. In both stages, examinations were done by the same person.

## RESULTS

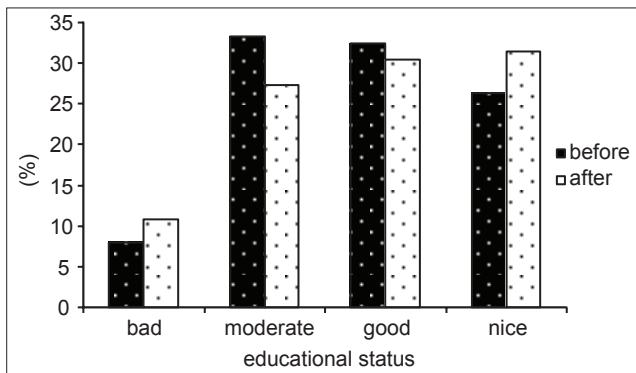
Figure 1 shows that during seven years the prevalence of the goiter has decreased from 34% to 25.3%, which was statistically significant ( $P < 0.001$ ). Considering the clinical grading, goiter has also decreased significantly ( $P < 0.001$ ). In spite of overall decrease in prevalence, the grade II goiter frequency has increased from 1.2% to 1.5%. Also, grade III goiter has increased from zero to 0.1%.

As shown in [Table 1], the prevalence in urban area has decreased from 35.8% to 23.5% ( $P < 0.001$ ). Also, in rural area prevalence has shown a reduction from 33.6% to 28.5% ( $P = 0.02$ ). This prevalence in boys changed from 32.8% to 20% and in the girls from 39.5% to 31.5% ( $P < 0.001$ ).

Educational performance is shown in Figure 2. As shown in this figure, poor educational performance has changed from 7.9% to 10.8%, moderate from 33.3% to 27.3%, good from 32.5% to 30.4% and excellent from 26.3 to 31.5%. There was a statistical significant relation between educational status and goiter frequency before



**Figure 1:** Goiter frequency before and after intervention



**Figure 2:** Educational performance before and after intervention

and after intervention ( $P = 0.01$ ). Also there was a statistical significant relation between education status in the two stages, before and after intervention ( $P < 0.001$ ).

## DISCUSSION AND CONCLUSION

For preventing complications due to iodine deficiency, enough iodine must be delivered to the community. For this purpose, many methods has proposed and implemented in many areas.<sup>[3]</sup> Iodine can be introduced to the body directly or indirectly (plants and animals that are used by humans).<sup>[1,3]</sup>

Consumption of iodine or thyroid hormone in long term has had definitive effect in reducing complications of iodine deficiency such as endemic goiter. For many years, iodized salts as a simple and effective method has been used. This method compensates the body needs for iodine. Iodized salt is added to daily foods.<sup>[1,6]</sup> Most countries have begun iodized salt consuming for many years. This program has had considerable results in reducing goiter and delaying endemic cretinism for those countries.<sup>[7-11]</sup>

**Table 1:** Frequency of goiter in Tabas before and after intervention

| Field       | Ia   | Ib   | II  | III | Total |
|-------------|------|------|-----|-----|-------|
| Urban       |      |      |     |     |       |
| Girl        |      |      |     |     |       |
| Before      | 23.2 | 11.9 | 2   | 0   | 37.1  |
| After       | 16.9 | 8.8  | 2.3 | 0.2 | 28.2  |
| Boy         |      |      |     |     |       |
| Before      | 25.1 | 9    | 0.3 | 0   | 34.4  |
| After       | 14.7 | 5.1  | 0.5 | 0   | 20.3  |
| Total       |      |      |     |     |       |
| Before      | 24.2 | 10.4 | 1.2 | 0   | 35.8  |
| After       | 15.6 | 6.6  | 1.2 | 0.1 | 23.5  |
| Rural       |      |      |     |     |       |
| Girl        |      |      |     |     |       |
| Before      | 23.8 | 11.2 | 1.2 | 0   | 36.2  |
| After       | 21   | 11.3 | 3.1 | 0.3 | 35.7  |
| Boy         |      |      |     |     |       |
| Before      | 22.1 | 7.2  | 1.2 | 0   | 30.5  |
| After       | 13.8 | 5.1  | 0.3 | 0   | 19.2  |
| Total       |      |      |     |     |       |
| Before      | 23   | 9.4  | 1.2 | 0   | 33.6  |
| After       | 17.9 | 8.6  | 1.9 | 0.1 | 28.5  |
| Urban+rural |      |      |     |     |       |
| Before      | 23.7 | 9.1  | 1.2 | 0   | 34    |
| After       | 16.4 | 7.3  | 1.5 | 0.1 | 25.3  |

In spite of this fact, many of developing countries have been unsuccessful in the iodized salt consuming. Therefore, they have not controlled endemic goiter. Over all, they have had problems (social, economic, local and geographic) in salts iodization.<sup>[1,7]</sup> For these reasons, international health organizations emphasizes on the evaluating of the implemented program effects. Because preventing iodine deficiency by iodized salts is vital.<sup>[1]</sup>

According to Azizi and colleagues, prevalence of goiter was decreased after seven years of salt iodination.<sup>[2]</sup> Wu and colleagues assessed six field controlled trials. These studies had compared iodized salt consuming with other iodine product and placebo. They found that iodized salt consuming reduced goiter considerably, with no significant complications due to of iodine consumption.<sup>[8]</sup>

Xie and colleagues evaluated the effectiveness of universal salt iodization for control of IDD. They found the goiter rate dropped and urinary iodine increased. They agreed that the management and supervision of salt market needs to be strengthened to

prevent non-iodized salt from reaching households, updating equipment and modifying technique are also necessary to ensure the quality of iodized salt.<sup>[9]</sup>

Selamat R and colleagues in a cross-sectional school-based survey assessed the status of national IDD prevention of Malaysia. Although endemic goiter was not present in Malaysia, almost half of the states still had large proportion of UI standard level and warranted immediate action. The findings suggested that there was a need for review on the current approach of national IDD prevention and control program.<sup>[10]</sup>

Golkowski and colleagues in a survey evaluated the adequacy of iodine prophylaxis in Poland. The Authors concluded that the iodine prophylaxis ensures efficiency, but slight changes in goiter prevalence in mild goiter endemic regions need further monitoring and considering other factors.<sup>[11]</sup>

Our study showed considerable reduction of goiter, from 34% to 25.3%. This reduction has been seen in similar studies.<sup>[12,13]</sup> In spite of this, after ten years of iodized salt consumption, 25% of people aged 6-18 years had iodine deficiency signs. These signs are seen in lower ages. Therefore, health system and other related system must evaluate iodized salt programs from point of quality, quantity, production, distribution and consuming.

During these seven years, grade II and III goiters have increased relatively. The rate of grade II and III goiters before intervention was 1.2% and 0%, respectively. But after intervention these rates increased to 1.5% and 1%. This increase was seen more in girls in puberty age to 18 years. According to these findings, it is necessary to evaluate the production and consumption of iodized salt.

Considering the educational performance, there was a significant relation between goiter frequency and educational performance before and after intervention. Although, there are some confounding variables, such as: Educational resources development, improved educational methods, and enhanced family emphasis on extracurricular education, increased frequency of student in higher education after intervention shows the iodine effects on mental function.<sup>[14-18]</sup>

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