Abstract

Background To measure the iodine nutritional status of island adults in Zhoushan, China.

Methods A comparison study was carried out in eight villages. These were selected from iodized salt and non-iodized salt districts of Zhoushan island by random sampling. The Mann–Whitney test was used to compare the urinary iodine concentration and dietary iodine intake between the two districts.

Results The median of urinary iodine concentration in the non-iodized salt group was 90 μg/l, which was lower than 194 μg/l in the iodized salt group (u = 14.673; p < 0.000), whereas the median of daily dietary iodine intake in the two groups was 128 and 147 μg, respectively (u = 1.847; p = 0.065). There was no significant correlation between dietary iodine intake and urinary iodine concentration (p = 0.095).

Conclusions Salt iodization is necessary. Special characteristics of the island diet should also be considered.

Keywords: salt iodization; nutritional status

Introduction

Iodization of salt is generally considered a first-line public health measure for preventing and controlling endemic goitre induced by iodine deficiency. The aim of this study was to compare iodine status between an iodized salt group and a non-iodized salt group.

Methods and results

A study was carried out in eight villages, which were selected by random sampling from Dinghai (iodized salt) district and Daishan (non-iodized salt) district of Zhoushan Island. Dinghai and Daishan districts have similar socioeconomic status. Daishan people use non-iodized salt because there are a lot of peasants who make a living on the sea salt, and sell it to the neighbouring areas. Dinghai people use iodized salt since iodization of table salt was carried out in 1995 in Zhejiang province. Target adults in each village were investigated by the method of rapid epidemiology assessment with a food-intake frequency questionnaire. The quantity and frequency of food that was consumed during the previous year was used to estimate iodine intake. The size of the thyroid gland of each adult was palpated and was graded according to the criteria of WHO/UNICEF/ICCIDD. A urine sample (~5 ml) was obtained from each participant during the interview. Iodine concentration in urine was measured by manual acid digestion and spectrophotometric detection of iodine by ceric ammonium reduction in the Sandell-Kolthoff reaction. Data processing and statistical analysis were carried out using Epiinfo6.04 and SPSS10.0 for Windows. The Mann–Whitney test was used to compare the urinary iodine concentration and dietary iodine intake of the iodized salt group and non-iodized salt group. The Spearman correlation was used to examine the correlation between urinary iodine concentration and dietary iodine intake in the two groups, respectively.

One thousand and fifty-three subjects were investigated: 516 (male 255, female 261) from the iodized salt group and 537 (male 264, female 273) from the non-iodized salt group. One thousand and forty-two samples of urine were obtained giving a response rate of 98.96 per cent (iodized salt group 507 (male 249, female 258), non-iodized salt group 535 (male 263, female 272)). The Table shows the median, 25th and 75th percentiles of the urinary iodine concentration and dietary iodine intake in the two groups, stratified by age. The median of urinary iodine concentration in the non-iodized salt group was 90 μg/l, which was lower than the 194 μg/l in the iodized salt group (u = 14.673; p < 0.000), whereas the median of daily dietary iodine intake in the two groups was 128 and 147 μg/l, respectively: this difference is not significant (u = 1.847; p = 0.065). There was no significant correlation of daily dietary iodine intake with urinary iodine concentration (r = 0.052; p = 0.095). The iodized salt group had an elevated urinary iodine concentration compared with the non-iodized salt group (p < 0.01), while there was no significant difference in dietary iodine intake between the two groups (p > 0.05) when it was stratified by age. The per cent of urinary iodine concentration below 100 μg/l was 57.2 per cent in the non-iodized salt group, and the per cent of urinary iodine...
concentration above 200 μg/l was 47.1 per cent in the iodized salt group.

According to the criteria of WHO/UNICEF/ICCIDD, 513, 2 and 1 of 516 subjects from the iodized salt group were palpated and graded as degree 0, 1, 2, respectively; and 537 subjects from the non-iodized salt group were palpated and graded as degree 0. The prevalence rate of both districts did not reach the criteria of the iodine deficiency disorders districts.

Discussion

A recent report documented the effects of increased iodized salt intake on the incidence of thyroid disease.7 To meet iodine requirements, the current recommended daily iodine intakes are 150 μg for adults.8 In this study, the median of daily dietary iodine intake was 128 μg in the iodized salt group (excluding the iodine content from iodized salt), compared with 147 μg in the non-iodized salt group. Thus, on our evidence, neither of the two groups was reaching the suggested requirement. Although the local adults could eat seafood frequently, iodine intake remained low. Some measure of iodine supplement is still necessary in addition to the local people’s daily dietary iodine intake.

Daily salt intake is 10 g per person and in Zhoushan Island the iodine concentration in salt is 30 mg/kg. In the present situation, despite improvements in salt production and market technology, the quality of available salt is poor, or salt is incorrectly iodized, or salt that has been correctly iodized deteriorates due to excessive or long-term exposure to moisture, light, heat and contaminants. Under these circumstances, iodine losses could be 50 per cent or more from the moment salt is produced until it is actually consumed, so the daily iodine intake from salt is ~150 μg. Thus, the total intake of iodine was 128 + 150 = 278 μg, which exceeds the suggested standard.

The urinary iodine concentration is a good marker for dietary intake of iodine, as 80–95 per cent of daily iodine intake is excreted in the urine.1,9 Medians of urinary iodine concentration have been classified by WHO/UNICEF/ICCIDD 10 as follows:

1. <20 μg/l: insufficient, severe iodine deficiency;
2. 20–49 μg/l: insufficient, moderate iodine deficiency;
3. 50–99 μg/l: insufficient, mild iodine deficiency;
4. 100–199 μg/l: adequate, optional;
5. 200–299 μg/l: more than adequate;
6. >300 μg/l: risk of adverse health consequences (IIH, autoimmune thyroid diseases).

In the present study, the urinary iodine concentration of the iodized salt group was in the ideal range, but approaching its upper limit, while the concentration of the non-iodized salt group was still in the category iodine deficiency, but near to the low limit of the suggested range.

The question of side effects of high iodine intake was raised shortly after the introduction of iodine as the treatment for goitre. In this study, the per cent of urinary iodine concentration

### Table: Age-specific daily iodine intake and urinary iodine concentration (dietary iodine intake (μg/day)/urinary iodine concentration (μg/l)), Zhoushan, PR China, 2001

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>25th percentile</th>
<th>75th percentile</th>
<th>25th percentile</th>
<th>75th percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>20–29</td>
<td>48.3/183.9</td>
<td>127.8/102.9</td>
<td>48.3/183.9</td>
<td>127.8/102.9</td>
</tr>
<tr>
<td>30–39</td>
<td>58.3/185.6</td>
<td>76.3/183.5</td>
<td>58.3/185.6</td>
<td>76.3/183.5</td>
</tr>
<tr>
<td>40–49</td>
<td>68.3/186.6</td>
<td>102.3/185.3</td>
<td>68.3/186.6</td>
<td>102.3/185.3</td>
</tr>
<tr>
<td>50–59</td>
<td>78.3/187.6</td>
<td>127.8/187.5</td>
<td>78.3/187.6</td>
<td>127.8/187.5</td>
</tr>
<tr>
<td>Above 60</td>
<td>88.3/188.6</td>
<td>153.8/188.5</td>
<td>88.3/188.6</td>
<td>153.8/188.5</td>
</tr>
</tbody>
</table>

* Mann-Whitney U test.
† r*, the Spearman correlation coefficient of dietary iodine intake and urinary iodine concentration.
‡ p < 0.05.
above 200 μg/l was 47.1 per cent in the iodized salt group. Decreasing the concentration of iodine in salt should be considered. The key to solving the iodine nutritional problem in Zhoushan Island is by using iodized salt containing an appropriate iodine concentration that is lower than the present concentration.

In this study, the palpation results of goitre show that the prevalence rate did not reach the criteria of iodine deficiency disorders, and the non-iodized group have a lower prevalence rate. But the median of urinary iodine concentration was 90.4 μg/l, which is in the mild iodine deficient range according to the suggestion of the ICCIDD. Although this suggestion has its value, it cannot be used as an unchanged rule. It must be adjusted according to geographic and social conditions. It is important to evaluate the iodine nutritional situation not only according to the ICCIDD recommendation but also by the investigation of local people at a specified place and a specified time.

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References

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