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Iodine deficiency in pregnant women residing in an area with adequate iodine intake

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Abstract

Objective: To prevent iodine deficiency disorders, the World Health Organization, United Nations Children's Fund, and International Council for the Control of Iodine Deficiency Disorders established that for a given population median urinary iodine concentrations (UIC) must be 100–199 μg/L in clinically healthy subjects and 150–249 μg/L in clinically healthy pregnant women. We evaluated whether in the urban area of Rome, Italy, where a salt iodination program (30 mg/kg) was introduced since 2005, an increased demand of iodine during pregnancy is guaranteed.

Methods: During 2006, 51 pregnant women at first trimester of a physiologic gestation were consecutively enrolled on presentation to evaluate UIC in morning spot urine samples. As controls, 100 age-matched clinically healthy non-pregnant women were evaluated.

Results: The median UICs were 182 μg/L (range 85–340 μg/L) and 74 μg/L (range 17–243 μg/L), respectively, in the control and pregnant groups. This difference was highly significant ($P < 0.001$). In particular, the UIC was found to be lower than adequate in 4% of control women compared with 92% of pregnant women. This difference of occurrences was highly significant ($P < 0.001$).

Conclusion: This observational study demonstrated that, despite the adequate supplementation of iodine intake, most pregnant women appear not to be protected against iodine deficiency. If confirmed in larger case studies, this finding claims the attention of relevant professionals to monitor iodine nutrition during gestation, assuming that ordinary supplementation of iodine intake seems to be sufficient only in non-gestational conditions.

Keywords: Iodine supplementation; Iodine deficiency disorders; Thyroid hormones; Pregnancy

Introduction

During pregnancy the thyroxine (T_4) requirement is increased by approximately 50%, mainly due to the estrogen-induced rise of thyroxine-binding globulin and to increased peripheral T_4 metabolism due to T_4 placental deiodination [1]. The appropriate maternal T_4 levels at the onset of pregnancy is important, because during the first trimester of gestation the only source of fetal plasma T_4 is represented by the small placental transfer of maternal T_4 [2].

Iodine is an essential micronutrient required for thyroid hormone biosynthesis, and the dietary intake recommended by the World Health Organization (WHO), United Nations Children's Fund (UNICEF), and International Council for the Control of Iodine Deficiency Disorders (ICCIDD) is 150 μg/d for adults [3–5]. It must be increased during gestation to 200–300 μg/d to sustain the augmented maternal T_4 requirement and fetal thyroid function and to compensate for the enhanced urinary iodide excretion [3,5–7]. Urinary iodine concentration (UIC) is an accurate indicator of iodine intake because 90% of ingested iodine is excreted in 24-h urine [7]. To prevent iodine deficiency disorders, the WHO/UNICEF/ICCIDD established

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for a given population that median UICs must be 100–199 μg/L in clinically healthy subjects and 150–249 μg/L in clinically healthy pregnant women [2–5,8–12]. These disorders include inadequate development and maturation of the fetal brain, which is the major preventable cause of mental defects. The severity can vary from mild intellectual blunting to frank cretinism [9]. In addition, iodine deficiency during pregnancy is responsible for maternal and fetal goiter, miscarriages, stillbirths, reduced fetal growth, neonatal hypothyroidisms, and damaged reproduction in adult life [8,9,13]. Despite several programs of iodine prophylaxis actuated in many countries, different surveys have shown that iodine deficiency remains a significant public health problem in several areas. Studies from different European and Asian countries, still affected by moderate to mild iodine deficiency, have shown that the thyroid gland increases its volume during gestation and pregnant women are at risk of iodine deficiency disorders [14,15]. Furthermore, some studies have shown that, even in areas with adequate iodide intake, a significant proportion of pregnant women have UICs below the recommended levels [3,4,13,16,17]. This raises the issue of whether iodine supplementation should be generalized in pregnant women, as recommended for the United States and Canada by the Public Health Committee of the American Thyroid Association [4,6].

In view of this, in the present observational study, we evaluated whether in the urban area of Rome (Italy), in which a salt iodination program (30 mg/kg) was introduced in 2005, the increased demand of iodine during pregnancy for preventing negative maternofetal effects of iodine deficiency is guaranteed.

Materials and methods

Subjects

During 2006, 51 clinically healthy pregnant women in their first gestational trimester (mean gestational age 9.3 ± 1.6 wk) were consecutively enrolled on presentation to evaluate UIC in morning spot urine samples. Only pregnant women with a normal pregnancy and no personal history of thyroid disease were included. As controls, 100 age-matched clinically healthy non-pregnant women were included in the study. Controls and pregnant women were resident in the urban area of Rome, Italy. The ages of the subjects ranged from 21 to 42 y, with mean ages of 32 and 30 y in pregnant and non-pregnant women, respectively. Body mass index was not different between the two groups, being 25.1 ± 3.0 kg/m^2 in non-pregnant controls and 25.8 ± 2.6 kg/m^2 in pregnant women. Parity in pregnant and control women did not differ significantly, with mean values of 0.8 ± 0.7 and 0.9 ± 0.8, respectively. All subjects included in the study claimed to use iodized salt liberally. However, none of the subjects studied were taking drugs or vitamins/mineral tablets containing an iodine supplement that could have affected UIC. Informed consent was obtained from each subject.

Urinary iodine measurement

Upon collection, morning urine samples were centrifuged at 1500 rpm for 10 min and supernatants stored at −20°C until analyzed. The UIC determinations were performed by the Sandell-Kolthoff method after sample digestion by the wet-ash method and expressed as micrograms per liter. Specificity of the assay was confirmed by the parallelism between the standard curve and that obtained with three different dilutions of a urine pool (data not shown). The recovery of the assay was 95.4 ± 2.4%. The intra- and interassay coefficients of variation were 8.4% (n = 10) and 11.0% (n = 10), respectively.

Statistical analysis

The UIC was expressed as micrograms per liter. The statistical significance of differences between group-related means was analyzed by the non-parametric Wilcoxon test. Additionally, the statistical analysis, by the chi-square test, was enlarged to the number of observations (occurrences) in which the UICs were found to be below the lowest limit for normalcy, i.e., 100 μg/L in non-gestational conditions and 150 μg/L during pregnancy, as established by the WHO/UNICEF/ICCIDD in their recommendations [4,5,11,12]. In both statistical contrasts, the differences were considered to be statistically significant if the pertaining P values were <0.05.

Results

In this study, we found that the median UIC in the control women was equal to 182 μg/L (range 85–340 μg/L), whereas than in pregnant women was equal to 74 μg/L (range 17–243 μg/L; Fig. 1). This difference was found to be highly statistically significant ($P < 0.001$) by the Wilcoxon test.

Furthermore, we detected that the occurrences of a lower UIC, with respect to the WHO/UNICEF/ICCIDD limits of normalcy, were substantially different, being equal to 4% in non-pregnant women and 92% in pregnant women. This difference was found to be highly statistically significant ($P < 0.001$) by the chi-square test.

Discussion

Because of the hormonal changes that affect thyroid function and the increased urinary iodide excretion during pregnancy, to prevent maternofetal disorders due to iodine deficiency the WHO/UNICEF/ICCIDD established that for

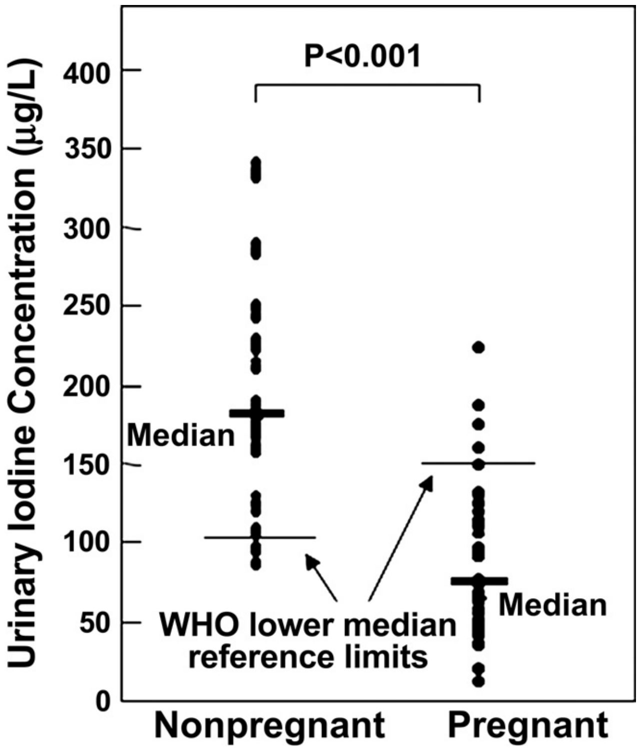

Fig. 1. Urinary iodine concentrations in 100 clinically healthy non-pregnant women and 51 clinically healthy pregnant women at the first trimester of a physiologic gestation were determined in morning spot urine samples. Differences between group-related means were highly statistically significant ($P < 0.001$) as analyzed by the non-parametric Wilcoxon test. Also highly statistically significant was the difference in the number of occurrences for values that were below the WHO, United Nations Children's Fund, and International Council for the Control of Iodine Deficiency Disorders lower median reference limits in each investigated group ($P < 0.001$) as analyzed by the chi-square test. WHO, World Health Organization.

a given population the median UIC for pregnant women must be 150–249 μg/L [11,12].

In the present observational study, performed in 2006, 1 y after the introduction of the salt iodination program in the urban area of Rome (Italy), we found that the recommended iodine excretion rate was detectable in 96% of non-pregnant women compared with 8% in pregnant women. This documented deficit implies that, even in urban areas with adequate iodine nutrition, mothers and their fetuses may be at risk of iodine deficiency disorders, including miscarriages, stillbirths, and inadequate development and maturation of the fetal brain.

In the United States and Switzerland, where iodine supplementation has been in place for several decades, increased urinary excretion during pregnancy and especially during the first trimester has been documented [4,18,19]. However, different studies performed in urban areas of China and Iran with adequate iodine intake in the general population and where iodine supplementation was initiated only a few years before the studies were done showed an unchanged or reduced UIC in pregnancy [16,17]. In particular, the study in Iran showed that half of the pregnancies had urinary iodine excretion below 200 μg/L, whereas in China the median iodine excretion in pregnancy was 50 μg/L lower than in non-pregnant women, despite adequate iodine intake in the general population [16,17]. This finding appears to be confirmed in the present observational study, where the salt iodination program was established the previous year. All of this suggests that in areas of moderate iodine deficiency, iodine prophylaxis, in the short period, is able to guarantee adequate iodine intake in the general population, but not in pregnancy when increased iodine intake is required.

A recent survey showed that even in the United States, where pregnant women have an adequate median UIC (173 μg/L), the lower 95% confidential interval showed an UIC below 150 μg/L [5,19]. Furthermore, a recent report from the Boston (Massachusetts) area showed that approximately half of pregnant women had UICs below 150 μg/L and 9% had values below 50 μg/L, with the latter being consistent with severe to moderate iodine deficiency [20]. These findings led the Public Health Committee of the American Thyroid Association to recommend a supplementation of 150 μg of iodine per day during pregnancy in the United States and Canada [4]. In addition, studies from the northeast of England and from Australia, in which the populations are assumed to be replete in iodine, demonstrated insufficient UICs in about 50% of pregnant women [21,22]. All together these findings suggest that Universal Salt Iodination programs may not be adequate for individual pregnant woman, especially in countries in which Universal Salt Iodination programs have been recently introduced or in conditions with unstable dietary iodine intake [18].

Conclusions

We demonstrated that in areas with recently established salt iodination programs, despite adequate iodine intake in non-pregnant women, the majority of pregnant women showed insufficient iodine intake. This indicates that relevant professionals should monitor iodine nutrition during gestation and the need of iodine supplementation in pregnancy.

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