Iodine Nutrition Status in Pregnant Women in Mexico


Background: Iodine nutrition during pregnancy has become an important public health concern because of the deleterious impact of iodine deficiency on brain development during fetal and early postnatal life. Iodine nutrition status can be assessed in a population by the median urinary iodine concentration (UIC). World Health Organization, the United Nations Children’s Fund, and the International Council for Iodine Deficiency Disorders have established that a median of UIC between 150 and 249 μg/L in pregnant women indicates an adequate iodine intake. The aim of this study was to assess iodine nutrition status in Mexican pregnant women.

Methods: Two hundred ninety-four pregnant women receiving prenatal care in the Public Medical Units of the State Ministry of Health for each pregnancy trimester (first, n = 60; second, n = 103; and third, n = 131) in Querétaro, Mexico, were enrolled to assess UIC by the Sandell-Kholtoff method.

Results: The median of UIC was 273, 285, and 231 μg/L in the first, second, and third trimesters of gestation, respectively. Globally, the median (range) of UIC was 260 (5–1320) μg/L, and the percentage of samples with UIC below 150 μg/L was 28%. There was no significant difference between the UIC of women using iodine-containing multivitamins compared with those who reported the consumption of noniodized multivitamins (p > 0.05). In addition, we found no difference between the UIC of women using iodized table salt compared with those who employed noniodized table salt, with those who did not know whether their table salt was iodized (p > 0.05).

Conclusions: Based on the median UIC, iodine intake in Querétaro, Mexico, is slightly above requirements during the first two trimesters, and adequate in the third trimester. The wide Mexican universal iodized salt program seems to supply adequate dietary iodine to pregnant women without health insurance in this region. However, regular monitoring of iodine status is recommended during pregnancy throughout Mexico.

Introduction

In recent years, iodine nutrition during pregnancy and lactation have become important public health concerns because of the deleterious impact of iodine deficiency on brain development during fetal and early postnatal life (1–3). Iodine is an essential micronutrient constituent of thyroid hormones (TH) that participates in neurogenesis, neuronal migration, myelination, synaptic transmission, and brain plasticity (2,3). Severe iodine deficiency during pregnancy causes hypothyroxinemia, which may lead to irreversible brain damage, mental retardation, and neurologic defects in the fetus (2,3). On the other hand, it is uncertain as to whether moderate and mild iodine deficiency affect motor and cognitive functions (4). Gestation is accompanied by significant physiological adjustments in both TH and iodine metabolism that increase iodine requirements (4,5). Maternal T4 synthesis is increased ~50% to maintain the euthyroidal state in the mother and to transfer a small amount of TH to the fetus. This increase in TH is explained by two major reasons (5). These are an increase in thyroxine binding globulin due to estrogen stimulation, which decreases free TH and stimulates pituitary-thyroid axis, and thyrotropin receptor stimulation by human chorionic gonadotropin. In addition, in later gestation, iodine is transferred to the fetus for TH synthesis, and there seems to be an increase in iodine glomerular filtration rate during gestation; although this observation is still under discussion (4,5). On this basis, the World Health Organization, the United Nations Children’s Fund, and the International Council for Iodine Deficiency Disorders (WHO/UNICEF/ICCIDD) have set the recommended daily iodine intake in adult men and women at 150 μg and in pregnant women at 250 μg (6). On the other hand, the most useful indicator to evaluate iodine nutrition in a population is the assessment of the median of
urinary iodine concentration (UIC), and it was established that in pregnant women a median UIC between 150 and 249 μg/L indicates an adequate iodine intake (6).

In recent years, several countries have evaluated iodine nutrition in pregnant women by using the UIC (7–13). It has also been shown that in some countries, although iodine intake is sufficient in school-age children, there is iodine deficiency in pregnant women (8,9). This finding justifies the need for a continuous monitoring of iodine nutrition in these two vulnerable populations. One of the most cost-effective actions to guarantee an adequate iodine intake is universal salt iodization (USI), and special attention should be paid to the correct application of this kind of program (6). In Mexico, there are no recent data regarding UIC in children and pregnant women, but there is a wide USI program (14). It was estimated that in 2009, 81% of all marketed salt in Mexico contained an adequate iodine concentration (20–40 ppm), and 94% contained ≥15 ppm of iodine (14). This is the minimum quantity recommended by international organizations (6). However, the quality of the salt was not homogenous throughout the country. There were places where only 25% of the salt samples had ≥15 ppm of iodine (15). This could contribute to insufficient iodine intake, and to a heterogeneous iodine nutrition status. Considering the WHO/UNICEF/ICCIDD recommendation for a periodic surveillance of the iodine nutrition status in vulnerable populations, in the current study, we analyzed the iodine nutrition of pregnant women in the municipality of Queretaro, Mexico.

Materials and Methods

Setting and subjects

This study was performed in the municipality of Queretaro, which is one of the most populated municipalities in the country with important industrial and commercial activity (16). The municipality of Queretaro is located at the center of the country (20°30’–20°56’ N, 100°17’–100°36’ W), at a distance of 221 km northwest from Mexico City. According to the 2010 national census, the municipality of Queretaro has 801,883 inhabitants (1,174.5 inhabitants per km²) representing 43.9% of the total population of the State (16).

In 2008, the municipality of Queretaro registered 22,324 births, and 43.5% of these were attended by the Ministry of Health of Mexico (Secretaría de Salud, SSA), 41.0% were attended by the Mexican Institute of Social Security, and 13.6% were attended by private medical clinics (17). The SSA provides public health care to the population without health insurance. The SSA in conjunction with the Ministry of Health of the State of Queretaro (Secretaría de Salud del Estado de Queretaro, SESEQ) maintains 23 Public Medical Units, providing both primary and antenatal care.

The population included in this cross-sectional study consisted of 294 consecutive healthy pregnant women who received antenatal care in 23 Public Medical Units of the SSA/SESEQ, of which 60 attended during the first trimester of gestation, 103 in the second trimester, and 131 in the third trimester. All women with a previous history of thyroid disease or medications affecting thyroidal status, including systemic illnesses, were excluded from the study. Once enrolled, the women completed a questionnaire. This included demographic data, age, gestational age (based on the date of the last menstrual period and corroborated by the Medical Unit records), smoking habits, consumption of iodized salt, intake of multivitamins, exposure to contrast media or other iodine-containing drugs or products such as amiodarone, vaginal douches, antiseptic skin cleaners, or fruit and vegetable disinfectants. Special diet consumption such as Japanese food with iodine-rich content was also registered. Data were collected from April 2009 to July 2010.

This study was approved by the Bioethical Committee of the School of Medicine of the Autonomous University of Queretaro. All participants did so voluntarily by signing a written informed consent. In the case of pregnant women <18 years of age, written consent was obtained from at least one parent or guardian.

Urinary iodine concentration

Spot urine samples were obtained from pregnant women into a 40 mL plastic urine sample container labeled with their identification code. Samples were immediately placed in polyethylene tubes and stored at −20°C until analysis. Urine samples were exclusively employed for UIC determination, and urine test strips were not employed to avoid iodine contamination (18). The UIC determinations were performed by the Sandell-Kolthoff method after sample digestion with ammonium persulfate, according to Pino and colleagues (19). Intra- and interassay coefficients of variation were 5.9% and 7.8%; respectively. The UIC was expressed as micrograms per liter (μg/L).

The iodine nutrition status in pregnant women was determined according to the recommended WHO/UNICEF/ICCIDD criteria (6). Insufficient iodine intake was defined as UIC <150 μg/L; adequate intake of iodine as UIC 150–249; iodine intake above the requirements as UIC 250–499; and excessive intake of iodine as UIC >500 μg/L.

Statistical analysis

We used Microsoft Excel 2007 (Microsoft Corporation, Redmond, WA), SPSS 16.0 (SPSS Inc., Chicago, IL) and GraphPad Prism 5 (GraphPad Software, Inc., La Jolla, CA) to perform statistical analyses. Values shown are means ± standard deviation, or in case of UIC data that are not normally distributed, correspond to medians and ranges. The nonparametric tests, Mann–Withney and Kruskal–Wallis, were used for comparisons of unpaired groups of UIC. Multiple regression analysis was performed with continuous variables (UIC, age, and gestational age), and logistic regression analysis was performed with UIC as a dependent variable (more than and less than 150 μg/L), and iodine sources, age, and gestational age as independent variables. p-values <0.05 were considered statistically significant.

Results

The age, gestational age, and the median of UIC by trimesters are shown in Table 1. The UIC in the first, second, and third trimesters of gestation was 273, 285, and 231 μg/L, respectively. According to the median of UIC, iodine intake in the first and second trimesters of gestation was above the requirements, and during the third trimester of gestation, it was adequate. On the other hand, when the median of UIC between each trimester was compared, there were no significant differences (p>0.05). In the 294 pregnant women
studied, the median of UIC was 260 µg/L, with a range of 5–1320 µg/L, and the percentages of samples with a UIC below 150 and 50 µg/L were 28% and 6.8%, respectively.

On the one hand, 69.4% of the participants reported consuming iodized salt, whereas 4.7% declared no consumption of iodized salt, and 25.8% reported that they did not know whether their salt was iodized. Twelve percent of subjects using iodized salt, and 25.8% reported that they did not know whether their salt was iodized. Twelve percent of subjects reported daily intake of vitamin and mineral supplements with at least 100 µg of iodine. The use of iodine-containing products (v. gr. vaginal douches, antiseptic skin cleaners, or fruit and vegetables disinfectants) or the consumption of iodine-rich foods such as seaweed, as well as smoking, was marginal, being < 0.5%. No subjects reported exposure to contrast media. We found no difference between the UIC of women using iodine-containing multivitamins and those who reported the consumption of noniodized multivitamins (p > 0.05). In addition, we found no difference between the UIC of women using iodized table salt and those who employed noniodized table salt, or those who did not know whether their table salt was iodized (p > 0.05). Finally, multivariate analyses were performed (multiple and logistic regressions) to identify significant predictors of UIC as iodine sources, age, and gestational age; the results were not significant.

### Discussion

We found that pregnant women without public health insurance in Queretaro, an urban and highly populated locality in Mexico, had an intake of iodine above requirements. This result is in agreement with the fact that only 5% of pregnant women declared not using iodized salt to cook, although a significant percentage of the subjects (25.8%) did not know whether their salt was iodized. This suggests a poor knowledge about the importance of iodine in human nutrition. In the current study, the iodine concentration in table salt samples was not determined. This is a limitation of the study. Other iodine sources such as multivitamin supplements with iodine were consumed only by 12% of pregnant women. These data suggest that iodized salt plays a central role in sustaining iodine nutrition in pregnant women in Queretaro, and this is in agreement with recent national reports of the USI program (14). However, a periodic surveillance of UIC is not performed in Mexico; the National Nutrition Survey in 1999 showed that the median UIC in nonpregnant women of 12–49 years of age was 281 µg/L (20). These data indicate an iodine intake above requirements. However, the only study to our knowledge conducted in Mexican pregnant women showed that, in three geographic regions in the state of Hidalgo (Pachuca, Ixmiquilpan, and Huejutla), the median UIC was 116, 124, and 109 µg/L, respectively (21). According to the current WHO/UNICEF/ICCIDD criteria, these values correspond to an insufficient iodine intake for pregnant women. The lack of relation between UIC and other variables (multivariate analyses) could be explained by other factors or sources not considered in this study, such as dietary habits or the intake of processed foods (11).

Our data contrast with several countries that analyzed iodine nutrition status in pregnant women. On one hand, it has been shown that not fully implemented USI programs fail to reach optimal iodine nutrition in gestation (v. gr. Bosnia and Herzegovina, India, Thailand) (7–9). On the other hand, countries such as Iran found that the USI strategy seems not to be enough to satisfy iodine requirements during the entire gestation period (10). In contrast, developed countries such as Switzerland and the United States reached overall optimal iodine nutrition without mandatory salt iodization; however, they established permanent monitoring iodine nutrition programs in their population, thus allowing the timely implementation of corrective actions (1,11,12). This continuous monitoring has recently revealed that some subgroups of pregnant women in the United States may be at risk of mild iodine deficiency (22), which further highlights the importance of a permanent surveillance program.

Even more, it is well established that the use of a median between 100 and 199 µg/L UIC in children of 6–12 years of age as an indicator of adequate iodine nutrition in a population is not useful to assume adequate iodine nutrition during gestation (6–12). WHO/UNICEF/ICCIDD has highlighted the importance of periodically monitoring iodine nutrition during gestation, and not only in school-age children (6). All these data underline the need of a new national survey of iodine nutrition in Mexico.

We noticed a slight nonsignificant trend toward a reduction of median UIC from the second to third trimester of gestation, together with an increase in the percentage of samples below 150 µg/L of UIC (Table 1). Other studies in countries such as Bosnia and Herzegovina, Iran and Thailand have shown a similar behavior in the median of UIC in the last two trimesters of gestation (7–9). This reduction of UIC during pregnancy is more clearly evident in places where iodine intake is borderline sufficient or frankly deficient (13). Stilwell et al. showed in Australian pregnant women a clear reduction in UIC through gestation, with 22.2% of samples below 50 µg/L.
l at the beginning of gestation, and 40% at the end (13). All these data suggest a depletion of maternal iodine stores due to maternal-fetal use, renal elimination, and/or inadequate dietary compensation (13).

Finally, due to the current global trend to reduce salt intake from 10 g/day per capita to <5 g/day to prevent heart disease and stroke (23), it is important to evaluate iodine nutrition status during pregnancy. Iodine intake in pregnancy should not be jeopardized due to a reduction in salt consumption. As an alternative, the iodine concentration of table salt should be increased or a regular iodine supplementation should be established for pregnant women. It was shown in one area that the restriction of iodine fortified salt during pregnancy was associated with insufficient UIC (7).

More comprehensive studies in children and pregnant women are needed throughout to address this issue and to sustain adequate iodine nutrition. These should identify salt consumption patterns, iodine in salt and other food supplies, and correlate these parameters with UIC data.

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Disclosure Statement

The authors declare that no competing financial interests exist.

References


