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Nutrition

Development of thyroid dysfunction among women with excessive iodine intake – A 3-year follow-up

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ABSTRACT

Objectives: Thyroid dysfunction can be a result of excessive iodine intake, which may have adverse health consequences, particularly for women in fertile age. In 2010, we conducted a cross-sectional study among lactating women with excessive iodine intake in the Saharawi refugee camps in Algeria and found a high prevalence of thyroid dysfunction. Three years later, we conducted a follow-up study to monitor the iodine situation and explore whether thyroid dysfunction still was highly prevalent when the women no longer were post-partum. None of the women were treated for hyper- or hypothyroidism between baseline and follow-up.
Methods: In 2013, we were able to recapture 78 of the 111 women from the baseline. Thyroid hormones and antibodies were measured in serum and thyroid size was assessed by palpation. Urinary iodine concentration (UIC) and drinking water iodine concentration were measured.
Results: The overall prevalence of thyroid dysfunction and/or positive antibodies was 34.3% and was not significantly changed from baseline. Of the non-pregnant women we reexamined, 17 had hypo- or hyperthyroidism in 2010; among these, 12 women still had abnormal thyroid function at follow-up. In addition, we found 9 new cases with marginally abnormal thyroid function. Women with thyroid dysfunction and/or positive antibodies had significantly higher BMI and thyroglobulin than women with normal thyroid function. We also found that women with high breast milk iodine concentration (BMIC) at baseline had more thyroid dysfunction at follow-up than the women with lower BMIC at baseline.
Conclusions: At follow-up, the prevalence of thyroid dysfunction was still high and had not changed during the 3 years between studies and from a postpartum period. The women still had a high iodine intake indicated by high UIC. Breast milk iodine concentration from baseline predicted thyroid dysfunction at follow-up.

Introduction

Iodine is essential for the maintenance of a normal thyroid function [1]. Quite small differences in iodine status may be associated with different levels of thyroid diseases [2,3]. Iodine status and thyroid function may be of particular concern for women in fertile age, since this may affect child growth and development [4]. In 2010, a cross-sectional study was conducted to investigate thyroid function among breastfeeding women with children 0–6 months of age, living in areas of high iodine exposure. Elevated thyrotropin (TSH) indicating hypo function, was found in 18.9% of the women. Low TSH indicating hyper function, was found in 8.1%. Of the women with biochemical thyroid dysfunction, 40% had positive thyroid antibodies, while 6.3% had positive antibodies with normal thyroid function [5]. The women in the baseline study had all recently given birth and some of them might have had postpartum thyroid dysfunction. Three years later, in 2013, we did a follow-up study

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with the purpose to explore whether or not the prevalence of thyroid dysfunction in the untreated women remained high beyond the postpartum period. We also wanted to monitor the iodine situation in the refugee camps by measuring the iodine content in urine and water.

The main objective of this paper was to monitor the iodine situation in the camps and explore whether or not thyroid dysfunction remained high when the women were no longer postpartum. Further we wanted to explore the thyroid function after 3 years in women with pathological thyroid tests at baseline.

Sample

In 2010, a cross-sectional baseline survey was performed in four Saharawi refugee camps in the Algerian desert. Lactating women with children from 0 to 6 months of age were the target group. In total, 111 women were included in this study [5]. In 2013, a new study was conducted from April to July to monitor the iodine situation and thyroid function. Follow-up of the 111 women from 2010 was a part of a larger iodine project in which the main objective was to explore the hormonal and developmental consequences of excessive iodine among women and children. Of the 111 women from baseline, we identified 93 at follow-up; 6 of these had moved, 4 were travelling for a longer period of time, 2 did not want to participate, and 3 were excluded because they did not wish to give blood samples. This left us with a follow-up sample of 78 women.

Materials and methods

Spot urine samples were collected from all participants and stored at −20 °C until analyzed. Six samples of public water were randomly collected from the water source in each camp ($n = 24$). Analyses of the iodine concentration in urine and water were performed by means of manual acid digestion, followed by the Sandel–Kolthoff reaction recorded spectrophotometically [6] at La Paz University Hospital Foundation for Biomedical Research.

Blood samples were drawn in plastic clot activator gel tubes (BD Vacutainer SST II, Oxford, UK) and kept at 5 °C until centrifuged and separated from the blood pellet within 2 h after extraction. Serum samples were stored in transfer tubes and kept frozen at −20 °C until analyzed. Serum thyrotropin (TSH), free thyroxine (fT_4), free triiodide (fT_3), antibodies to thyroid peroxidase (TPOAb) and thyroglobulin (TgAb) and thyroglobulin (Tg) were analyzed on Modul E, Roche at the La Paz University Hospital Foundation for Biomedical Research in Spain. Analysis methods for serum at baseline have been previously described [5].

For TSH, fT_4, fT_3, TPOAb, and TgAb reference ranges were established at Oslo University Hospital and for TSH reference ranges from the Norwegian HUNT study were used [7] were used. For Tg, references from Elecsys E170 Roche Diagnostics were used [8]. Reference values used are shown in Table 1. Overt hypothyroidism was defined as TSH >3.5 mIU/L and fT_4 <9 pmol/L, or TSH >10 mIU/L and fT_4 below the first quartile of fT_4 (<12 pmol/L). Subclinical hypothyroidism was defined at a TSH level of >3.5 and <10 mIU/L with fT_4 within the reference range (9–21 pmol/L). Overt hyperthyroidism was defined as TSH <0.5 mIU/L and fT_4 and/or fT_3 higher than the upper reference range. Subclinical hyperthyroidism was defined as TSH <0.5 mIU/L and both fT_4 and fT_3 within the reference values. Positive antibodies were defined by TPOAb levels >50 kU/L and/or TgAb levels >100 kU/L.

Table 1
Reference ranges used for thyroid tests.

Blood constitutes	Reference levels[a]
TSH	0.5–3.5 mIU/L
fT_4	9.0–21.0 pmol/L
fT_3	2.7–6.3 pmol/L
TgAb	<100 kU/L
TPOAb	<50 kU/L
Tg	<78 μg/L

[a] For TSH published by Bjoro et al. [7].

Table 2
Background characteristics and iodine status among the women at baseline and follow-up[a].

Characteristics	Baseline ($n = 111$)	Follow-up ($n = 78$)
Age (years)	31.4 ± 5.9	34.7 ± 5.9
No. of children	3.1 ± 1.9	3.6 ± 1.9
Height (cm)	156.5 ± 5.4	156.6 ± 6.0
Weight (kg)	65.9 ± 11.7	69.8 ± 12.2
BMI (kg/m^2)[*]	26.9 ± 4.6	28.2 ± 4.8
<18.5	3 [2.7]	1 [1.5]
18.5–24.9	33 [29.7]	19 [28.4]
25.0–29.9	48 [43.2]	23 [34.3]
≥30	27 [24.3]	24 [35.8]
Iodine status		
UIC (μg/L)	350 (208–533)	617 (249–1046)
BMIC (μg/L)	479 (330–702)	–
Enlarged thyroid gland (%)[b,*]	–	21 [31.3]
Water iodine (μg/L)[c]	102 (80–255)	58 (29–172)

[a] Values are presented as mean ± SD, median (IQR), and n [%].
[b] Measured by palpation [9].
[c] Samples taken from main water sources in each camp, $n = 6$ from each camp, total $n = 24$.
[*] For BMI and enlarged thyroid gland $n = 67$, 11 were excluded because of pregnancy. Mean BMI for all women were 28.5 ± 5.0.

Body weight was measured using a UNICEF digital platform scale (SECA 890, Hamburg, Germany), and height was measured to the nearest 0.1 cm using a portable UNICEF length board. The WHO body mass index (BMI) (kg/m^2) was used to classify underweight, normal weight, overweight, and obese, defined by BMI < 18.5 kg/m^2, BMI = 18.5–24.9 kg/m^2, BMI = 25.0–29.9 kg/m^2, and BMI = 30 kg/m, respectively. Thyroid size was measured by medical doctors in the respective camps, using palpation. The WHO classification of goiter by palpation was used to determine the size [9]. The participants answered a pre-coded questionnaire concerning age, marital status, and childbirths.

Ethics approval for the baseline and the follow-up has been given by the Regional Committees for Medical and Health Research Ethics in Norway and by the Saharawi Ministry of Public Health. Informed consent was obtained from all participants.

Statistics

Data were entered and analyzed using SPSS version 21 (SPSS Inc., Chicago). Normally distributed data were expressed as mean (±SD). Variables that did not adhere to a normal distribution were expressed as median and interquartile range (IQR). We used chi-square tests to compare the proportions with thyroid dysfunction between baseline and follow-up. Differences in characteristics between women with and without thyroid dysfunction were estimated using the Student's t-test for normally distributed data, the Mann–Whitney U test for skewed data, and the chi-square test for categorical data. Significance was given at $p < 0.05$.

Results

Sample characteristics and iodine status among the women are presented in Table 2. In the follow-up study, the mean age was 34.7 years, mean BMI was 28.2 kg/m^2, and 70.1% of the women were overweight or obese. BMI was significantly higher at follow-up ($p = 0.025$) than at baseline, where the increase was mostly seen