Endokrynologia Polska/Polish Journal of Endocrinology
Tom/Volume 61; Numer/Number 6/2010
ISSN 0423–104X

Iodine status of pregnant women from central Poland ten years after introduction of iodine prophylaxis programme

Zaopatrzenie w jod kobiet ciężarnych w centralnej Polsce po upływie 10 lat od wprowadzenia profilaktyki jodowej

Małgorzata Gietka-Czernel[1], Marzena Dębska[2], Piotr Kretowicz[2], Helena Jastrzębska[1], Agnieszka Kondracka[3], Hana Snochowska[1], Mariusz Ołtarzewski[4]

[1]*Endocrinology Department of Medical Centre of Postgraduate Education, Warszawa, Poland*
[2]*Obsterical and Gynecology Department of Medical Centre of Postgraduate Education, Warszawa, Poland*
[3]*Internal Diseases and Endocrinology Department, Warsaw University, Poland*
[4]*Institute of Mother's and Child's Health, Warszawa, Poland*

Abstract

Introduction: Until 1997, Poland was one of the European countries suffering from mild/moderate iodine deficiency. In 1997, a national iodine prophylaxis programme was implemented based on mandatory iodisation of household salt with 30 ± 10 mg KI/kg salt, obligatory iodisation of neonatal formula with 10 μg KI/100 mL and voluntary supplementation of pregnant and breast-feeding women with additional 100–150 μg of iodine.
Our aim in this study was to evaluate the iodine status of pregnant women ten years after iodine prophylaxis was introduced.
Material and methods: A cross-sectional study was undertaken in 100 healthy pregnant women between the fifth and the 38th week of gestation with normal thyroid function, singleton pregnancy, normal course of gestation, without drugs known to influence thyroid function except iodine. Serum TSH, fT_4, fT_3, thyroglobulin (TG), anti-peroxidase antibodies (TPO-Ab), anti-thyroglobulin antibodies (TG-Ab) and urinary iodine concentration (UIC) were determined. Thyroid volume and structure were evaluated by ultrasonography.
Results: Fifty nine per cent of studied pregnant women had a diet rich with iodine carriers and 35% obtained iodine supplements. Twenty eight per cent appeared to have a goitre: 11 diffuse and 17 a nodular one, median goitre volume was 18.7 mL (range 6.8–29.0 mL). Median UIC was 112.6 μg/L (range 36.3–290.3 μg/L), only 28% of women had UIC ≥ 150 μg/L. Median UIC was significantly higher in the group receiving iodine supplements than in the group without iodine supplements: 146.9 μg/L *v.* 97.3 μg/L respectively, $p < 0.001$. Serum TSH, fT_3 and fT_3/fT_4 molar ratio increased significantly during pregnancy while fT_4 declined. Median serum TG was normal: 18.3 ng/mL (range 0.4–300.0 ng/mL) and did not differ between trimesters. Neonatal TSH performed on the third day of life as a neonatal screening test for hypothyroidism was normal in each case: median value was 1.49 mIU/L (range 0.01–7.2 mIU/L). Less than 3% (2 out of 68) of results were > 5 mIU/L.
Conclusion: Iodine supplements with 150 μg of iodine should be prescribed for each healthy pregnant woman according to the assumptions of Polish iodine prophylaxis programme to obtain adequate iodine supply. **(Pol J Endocrinol 2010; 61 (6): 646–651)**

Key words: *pregnancy, iodine supply, gointer prevalance*

Streszczenie

Wstęp: Do 1997 roku Polska należała do grupy krajów europejskich o umiarkowanym/łagodnym niedoborze jodu. W 1997 roku wprowadzono narodowy program profilaktyki jodowej, polegający na obowiązkowym jodowaniu soli kuchennej przeznaczonej do użytku domowego w ilości 30 ± 10 mg KI/kg soli, obligatoryjnym jodowaniu odżywek dla niemowląt w ilości 10 μg KI/100 ml i nieobowiązkowej suplementacji kobiet ciężarnych i karmiących o dodatkowe 100–150 μg jodu dziennie.
Celem podjętej pracy była ocena zaopatrzenia w jod kobiet ciężarnych po upływie 10 lat od wprowadzenia profilaktyki jodowej.
Materiał i metody: Przeprowadzono badanie przekrojowe w grupie 100 zdrowych kobiet ciężarnych z terenu województwa mazowieckiego, będących w 5.–38. tygodniu ciąży. Kryterium włączenia były: prawidłowa czynność tarczycy, prawidłowy przebieg ciąży, ciąża pojedyncza, nie przyjmowanie leków wpływających na tarczycę, z wyjątkiem suplementów jodu. Badano stężenie TSH, fT_4, fT_3, tyreoglobuliny (TG), przeciwciał antyperoksydazowych (TPO-Ab) i antytyreoglobulinowych (Tg-Ab) w surowicy oraz stężenie jodu w dobowym moczu. Objętość i morfologię tarczycy oceniano ultrasonograficznie.
Wyniki: Jedynie 58% ciężarnych spożywało dietę bogatą w nośniki jodu, a 35% otrzymywało suplementy jodowe. U 28% badanych stwierdzano wole: w 11% przypadków miąższowe, w 17% guzowate. Mediana objętości wola wynosiła 18,7 ml (zakres 6,8–29,0 ml). Mediana stężenia jodu w moczu była 112,6 μg/l (zakres 36,3–290,3 μg/l); jedynie u 28% badanych joduria wynosiła ≥ 150 μg/l. Mediana jodurii była znamiennie wyższa w grupie przyjmującej suplementy jodowe niż w grupie nie otrzymującej takich suplementów:

Małgorzata Gietka-Czernel MD, Endocrinology Department of Medical Centre of Postgraduate Education, Warszawa, Cegłowska St. 80, 01–809 Warszawa, tel.: +48 22 569 05 09; fax: +48 22 834 31 31, e-mail: malgietka@vp.pl

146 μg/l *v.* 97,3 μg/l, p < 0,001. Stężenie TSH, fT_3 i stosunek molarny fT_3/fT_4 wzrastały znamiennie w czasie trwania ciąży, podczas gdy stężenie fT_4 malało. Mediana TG była prawidłowa: 18,3 ng/ml (zakres 0,4–300,0 ng/ml) i nie różniła się istotnie pomiędzy trymestrami. Noworodkowe TSH oceniane w trzeciej dobie życia w ramach skriningu niedoczynności tarczycy było w każdym przypadku prawidłowe: mediana wynosiła 1,49 mjm./l (zakres 0,01–7,2 mjm./l) i tylko 2,9% wyników było powyżej 5 mjm./l.
Wniosek: Celem zapewnienia dostatecznej podaży jodu w okresie ciąży, każdej zdrowej kobiecie ciężarnej należy zalecać przyjmowanie 150 μg jodu dziennie, zgodnie z założeniami polskiej profilaktyki jodowej. **(Endokrynol Pol 2010; 61 (6): 646–651)**

Słowa kluczowe: *ciąża, podaż jodu, występowanie*

This study was supported by a grant from the Scientific Committee of the Medical Centre of Postgraduate Education 501-2-1-07-02/07.

Introduction

Maternal iodine deficiency (ID) during pregnancy and lactation is a well recognised, and preventable, cause of brain damage in the foetus and infant [1–5]. The degree of neurodevelopmental impairment depends on the severity of ID. In areas of severe ID (< 20 μg/day) 5–15% of the population suffers endemic cretinism and the general IQ of the population is 13.5 points lower than in iodine-sufficient areas [6, 7]. In mild-moderate ID countries in Europe, lower psychomotor development in early infancy, as well as lower learning capacity and high prevalence of attention deficit hyperactivity disorder (ADHD) in schoolchildren, have been noted [8–11]. Because the iodine status of pregnant and breast-feeding women has an extremely important impact on the health of their progeny, how to ensure adequate iodine supply in this particular group has occupied the attention of clinicians, professional organisations and governments [12–16]. A recent World Health Organisation (WHO) Technical Consultant Group recommended an increase in the iodine intake for pregnant and lactating women to c.250 μg/day (200–300 μg/day) and pointed out that UIC of 150–250 μg/L indicated adequate iodine supply in pregnant women.

The aim of our study was to determine the iodine status of pregnant women living in central Poland ten years after the introduction of a national iodine prophylaxis programme.

Material and methods

One hundred and two healthy pregnant women, inhabitants of the Warsaw region, attending the prenatal care unit at Bielański Hospital between January 2007 and November 2008, were recruited to the study. Exclusion criteria were: previous or current history of thyroid disease; multiple pregnancy; pathological course of gestation; drugs known to influence thyroid gland except iodine supplements. The participants were between the fifth and 38th week of gestation, mean age ± ± SD 31 ± 4.39 years, range 23–43. Forty six (45%) were first time mothers and 54 (55%) had already had children. Information about dietary habits, vitamin and mineral supplementation was obtained from each subject.

Two women were finally excluded from the study: one was found to have subclinical hypothyroidism, and the other was mildly thyrotoxic in the course of multinodular goitre.

The study was cross-sectional. Blood samples were taken from each participant by standard puncture of a cubital vein. Quantitative analyses of TSH, free T_3 (fT_3), free T_4 (fT_4), thyroglobulin (TG), thyroid-peroxidase antibodies (TPO-Ab) and thyroglobulin antibodies (TG-Ab) were performed by chemiluminescent immunoassays (EURO/DPC, UK) using an Immulite 2000 automatic analyser. Normal ranges for analytical data were: TSH 0.4–4.0 μIU/mL, fT_4 10.4–24.4 pmol/L, fT_3 1.8–4.2 pg/mL, TG 1.6–59.9 ng/mL, TPO-Ab < 35 IU/mL, TG-Ab < 40 IU/mL. Urine samples from 24 hour collection were delivered by 72 participants; urinary iodine concentration was measured by the catalytic arsenium-cerium method based on the Sandell-Kolthoff reaction [17]. Ultrasonographic assessment of the thyroid gland was made in each case using a Medison S.A. –9900 Prime scanner with linear transducer 5–12 MHz. Subjects with thyroid nodules underwent fine-needle aspiration biopsy (FNAB) according to the recommendations of the Polish Group for Endocrine Tumours [18]. Neonates' TSH was examined as part of the neonatal screening protocol. The procedure was based on determination of TSH in dried blood spots obtained by heel puncture three days after birth. Results above 15 mIU/L were indicative of hypothyroidism.

All statistical analyses were performed using Statistica 7.0 software. Usual statistics: mean, standard deviation and median have been used to describe the data. Distributions of variables were tested according to Kolmogorov-Smirnov and Lilliefors tests. The distributions of fT_3, fT_4, UIC and thyroid volume were log-normal. TSH presented gamma distribution and distribution of TG was exponential. In the analysis of TG and TSH one-parametric transformation of Box-Cox was applied to obtain normal distribution. Data was analysed by one-way and two-way ANOVA with NIR *post hoc* test for comparison between trimesters. Mann-Whitney and Kruskal-Wallis tests were used to analyse non-normally distributed unpaired data. Correlations were measured with the Spearman rank correlation coefficients. P < 0.05 was considered significant.

Table I. *Dietary habits, supplementation with vitamins/minerals and iodine in 100 pregnant women*
Tabela I. *Nawyki żywieniowe i suplementacja witaminowo-mineralna w grupie 100 kobiet ciężarnych*

Pregnancy trimester	Diet rich with iodine		Vitamin/minerals supplementation		Vitamin/minerals and iodine supplementation	
	n	%	n	%	n	%
1st n = 32	17	53	8	25	10	31
2nd n = 36	19	53	11	31	14	39
3rd n = 32	23	72	16	50	11	34
All n = 100	59	59	35	35	35	35

The study was approved by the Ethical Committee of the Medical Centre of Postgraduate Education and informed consent was obtained from all participants.

Results

One hundred healthy euthyroid pregnant women were finally enrolled on the study. Of them, 18 appeared to be positive for thyroid antibodies: 13 for TPO-Ab, nine for TG-Ab (four for both of them).

Twenty eight subjects were diagnosed by ultrasonography as having a goitre: 11 had a diffuse goitre and the other 17 a nodular one. The median volume of goitre was 18.7 mL, (range 8.4-29.0 mL, mean ± SD 19.7 ± ± 5.1). Age, parity, presence of thyroid antibodies and UIC did not influence thyroid volume. In 15 women, FNAB was undertaken and the cytological results of 18 nodules were obtained: all were benign.

The dietary habits and supplementation with vitamins and minerals in the study group are set out in Table I: only 35% of pregnant women received iodine supplements. The amount of iodine in the supplements was 150 μg per tablet (the usual amount of iodine in supplements prepared for pregnant women).

Median UIC in the whole group was 112.6 μg/L (range 36.3–290.3 μg/L, mean ± SD 123.9 ± 58.9 μg/L) and there were no statistical differences in UIC between trimesters (Table II). Forty two per cent of the studied pregnant women had UIC < 100 μg/L, while only 28% had values within the recommended range ≥ 150 μg/L (Table III). In the group receiving iodine supplements, median UIC was significantly higher than in the group without iodine supplements: 146.9 μg/L *v.* 97.3 μg/L respectively, $p < 0.001$.

Serum TSH, fT_3 concentrations and fT_3/fT_4 molar ratio increased significantly during pregnancy, while serum fT_4 concentrations declined (Table II). Similar signs of thyroid stimulation were observed in the reference group of 88 subjects without thyroid antibodies: increase of serum fT_3, fT_3/fT_4 molar ratio and decrease of fT_4 (Table II). Median serum TSH in the reference group was significantly lower than in the antibody-positive group: 0.97 mIU/mL *v.* 1.5 mIU/mL respectively, $p < 0.0005$ (Table IV).

Serum TG was examined in subjects negative for TG-Ab; the median value in the whole group was 18.3 ng/mL (range 0.4–300 ng/mL, mean ± SD 27.7 ± 46.0 ng/mL) and it did not differ significantly between trimesters. Median serum TG was significantly higher in the group with goitre than in the group with normal thyroid: 25.9 ng/mL *v.* 15.3 ng/mL respectively, $p < 0.004$. In the whole studied group, there was a weak positive correlation between thyroid volume and serum TG concentration; $r = 0.29$, $p < 0.01$ and positive correlation between TSH and fT_3/fT_4 index; $r = 0.3$, $p < 0.002$.

The information about neonates' TSH was obtained in 68 cases. All the results were normal: median neonates' TSH was 1.49 mIU/mL (range 0.01–7.2 mIU/mL, mean ± SD 1.87 ± 1.58 mIU/mL). Two results (2.9%) were above 5 mIU/mL: 5.8 mIU/mL and 7.2 mIU/mL. The mother of the first of these two children was examined in the first trimester: her fT_4 was 18.3 pmol/L, TSH 1.2 mIU/mL, TG 14.9 ng/mL, thyroid ultrasound was normal, she was negative for thyroid antibodies, did not obtain iodine supplements and data concerning UIC was not obtained. In the second case, the mother was examined in the third trimester: her fT_4 was 12.0 pmol/L, TSH 1.7 mIU/mL, TG 25.1 ng/mL, thyroid antibodies were absent, UIC 196 μg/mL, she had a diffuse goitre measuring 25 mL and she obtained iodine supplements. The median TSH of neonates whose mothers obtained iodine supplements during pregnancy did not differ from those whose mothers were not supplemented (1.57 mIU/mL *v.* 1.33 mIU/mL respectively), p = NS.

Discussion

Poland is one of the European countries which has historically suffered from iodine deficiency. Iodine prophylaxis was first introduced in our country in 1935 but twice interrupted, first in the period 1939-47 because of

Table II. *Laboratory and sonographic data of 100 women according to trimesters of pregnancy and antibody status*

Tabela II. *Charakterystyka laboratoryjna i ultrasonograficzna 100 kobiet ciężarnych z uwzględnieniem kolejnych trymestrów ciąży i obecności przeciwciał tarczycowych*

Data	1st trimester		2nd trimester		3rd trimester		ANOVA
	Mean ± SD	Median	mean ± SD	Median	Mean ± SD	Median	
All							
TSH [μIU/mL]	0.91 ± 0.56	0.85	1.27 ± 0.7	1.12	1.48 ± 0.99	1.17	$p < 0.004^{I}$
fT_4 [pmol/L]	16.0 ± 2.0	15.9	14.3 ± 1.7	14.0	13.6 ± 1.4	13.4	$p < 0.0000^{II}$
fT_3 [pg/mL]	3.4 ± 0.7	3.3	3.9 ± 0.7	3.8	4.0 ± 0.5	3.9	$p < 0.002^{III}$
fT_3/fT_4	0.33 ± 0.1	0.31	0.42 ± 0.1	0.41	0.45 ± 0.1	0.45	$p < 0.00001^{IV}$
TG [ng/mL]	33.7 ± 56.3	20.8	30.9 ± 53.4	21.3	17.9 ± 13.9	14.4	p = 0.2
Urine iodine [μg/L]	112.0 ± 60.2	100.8	137.3 ± 63.6	128.3	122.3 ± 52.3	109.8	p = 0.2
Thyroid volume [mL]	14.2 ± 4.1	13.9	14.4 ± 5.2	14.9	13.6 ± 5.4	12.2	p = 0.7
Ab negative							
TSH [μIU/mL]	0.86 ± 0.5	0.85	1.22 ± 0.7	1.1	1.09 ± 0.46	1.09	p = 0.06
fT_4 [pmol/L]	15.9 ± 2.0	15.6	14.2 ± 1.8	14.0	13.7 ± 1.6	13.8	$p < 0.0003^{V}$
fT_3 [pg/mL]	3.4 ± 0.6	3.5	3.9 ± 0.8	3.8	3.9 ± 0.5	3.9	$p < 0.001^{VI}$
fT_3/fT_4	0.32 ± 0.03	0.31	0.43 ± 0.06	0.39	0.45 ± 0.05	0.43	$p < 0.00001^{VII}$
TG [ng/mL]	35.7 ± 58.2	21.2	32.4 ± 55.0	21.9	15.8 ± 11.7	13.9	p = 0.07
Urine iodine [μg/L]	110.8 ± 53.9	109.3	124.8 ± 50.1	123.6	126.2 ± 48.8	112.9	p = 0.4
Thyroid volume [mL]	13.8 ± 3.8	13.4	14.5 ± 5.4	14.9	13.5 ± 5.5	12.1	p = 0.8

[I] 1st *v.* 2nd $p < 0.01$, 1st *v.* 3rd $p < 0.001$, 2nd *v.* 3rd $p = 0{,}3$, NIR test; [II] 1st *v.* 2nd $p < 0.0001$, 1st *v.* 2nd $p < 0.00001$, 2nd *v.* 3rd $p = 0.1$ NIR test; [III] 1st *v.* 2nd $p < 0.001$, 1st *v.* 3rd 0.0001, 2nd *v.* 3rd $p = 0.5$, NIR test; [IV] 1st *v.* 2nd $p < 0.00001$, 1st *v.* 3rd 0.00001, 2nd *v.* 3rd $p = 0.09$, NIR test; [V] 1st *v.* 2nd $p < 0.001$, 1st *v.* 3rd $p < 0.0001$, 2nd *v.* 3rd $p = 0.3$, NIR test; [VI] 1st *v.* 2nd $p < 0.002$, st *v.* 3rd $p < 0.001$, 2nd *v.* 3rd p-0.6, NIR test; [VII] 1st *v.* 2nd $p < 0.00001$, 1st *v.* 2nd $p < 0.00001$, 2nd *v.* 3rd $p = 0.08$, NIR test

Table III. *Median urine iodine concentration in 76 pregnant women*

Tabela III. *Mediana stężenia jodu w moczu w grupie 76 kobiet ciężarnych*

Urine iodine concentration μg/L										
< 50		50–99		100–149		150–250		251–300	
n	%	n	%	n	%	n	%	n	%
6	8	26	34	23	30	18	24	3	4

Table IV. *Data of 100 pregnant women stratified by antibody status*

Tabela IV. *Charakterystyka 100 kobiet ciężarnych z uwzględnieniem obecności przeciwciał tarczycowych*

	Ab negative (n = 82)		Ab positive (n = 18)		ANOVA
	Mean ± SD	Median (range)	Mean ± SD	Median (range)	
Age	30.9 ± 4.5	31 (23–43)	31.8 ± 4.0	32 (26–39)	p = 0.6
TSH [μIU/mL]	1.1 ± 0.6	0.9 (0.02–3.6)	1.9 ± 1.1	1.5 (0.5–4.4)	p < 0.0005
fT_4 [pmol/L]	14.6 ± 2.0	14.5 (9.6–21.4)	14.4 ± 1.5	13.8 (12.3–17.9)	p = 0.7
fT_3 [pg/mL]	3.7 ± 0.7	3.6 (2.2–5.7)	3.9 ± 0.7	3.9 (2.6–5.3)	p = 0.6
fT_3/fT_4	0.39 ± 0.1	0.38 (0.2–0.7)	0.41 ± 0.1	0.43 (0.3–0.6)	p = 0.8
TG [ng/mL]	28.6 ± 48.0	18.8 (0.9–300)	19.7 ± 18.0	14.7 (0.4–53.7)	p = 0.8
Urine iodine [μg/L]	120.2 ± 50.7	114.8 (36–245)	141.6 ± 86.6	102 (43–290)	p = 0.7
Thyroid volume	13.9 ± 4.9	13.2 (6.8–29)	14.2 ± 5.0	13.9 (7.2–24.7)	p = 0.8

the Second World War, and again from 1980 due to economic reasons. The results of the nationwide epidemiological survey conducted in 1992–1993 [19] and the European survey led in 1994–1995 [20] showed that more than 90% of Polish territory suffered from moderate ID with less than 10%, the area along the Baltic Sea, fulfilling the criteria of mild ID. Iodine prophylaxis based on iodisation of household salt was reestablished in 1986 as a voluntary model with 25 ± 10 mg KI/kg salt, and in 1997 as a mandatory model with 30 ± 10 mg KI/kg salt. The mandatory model also comprises obligatory iodisation of neonatal formula with 10 μg KI/ 100 mL. It strongly recommends voluntary supplementation of pregnant and breastfeeding women with an additional 100–150 μg of iodine daily given in tablets as potassium iodide or as a component of multivitamin/ /mineral pills.

Before implementation of the mandatory salt iodisation programme, the prevalence of goitre was 28-56% in schoolchildren aged 6–9 and 25% in adults [21–24]. In pregnant women, goitre in the third trimester reached 80% in some areas [25]. In 80–90% of pregnancies UIC was < 150 μg/L, mean 60 μg/L [26, 27]. The frequency of TSH > 15 mIU/L among neonates was 3.3% [28]. By 2003, goitre occurrence in schoolchildren had diminished to < 5%, meaning that endemic goitre had been eradicated and the prevalence of TSH > > 15 mIU/L in neonates declined to 0.55% [28–30]. In 2003, WHO, UNICEF and ICCIDD recognized Poland as a country of sufficient iodine supply [31]. However, observations of pregnant women since iodine prophylaxis introduction are still insufficient; it has been demonstrated that only 50% of subjects are supplemented with iodine and the prevalence of goitre declined only to 19% in some areas [32]. Our study showed that although the iodine status of pregnant women ten years after iodine prophylaxis introduction had improved greatly, it is still unsatisfactory. Median UIC was 112.6 μg/L but in only 28% of cases was within the recommended WHO level ≥ 150 μg/L. While 70% of women obtained multivitamin pills enriched with minerals, only half of them contained iodine. In the group of 35 women supplemented with iodine, median UIC was 146.9 μg/L, very close to the recommended value. In harness with insufficient UIC, our study noted signs of excessive thyroid stimulation, such as preferential T_3 secretion and increasing TSH concentration, which correlated positively to fT_3/ /fT_4 index. Because 18% of our study group demonstrated the presence of thyroid antibodies (higher than the 5–12% found in other studies) [2, 33], we analysed laboratory data separately in the group negative for TPO-Ab and TG-Ab to eliminate their possible influence on thyroid economy. The same tendency of preferential T_3 secretion was observed in this reference group, although serum TSH did not differ between trimesters ($p = 0.06$). The high prevalence of thyroid antibodies in our study can be attributed to the age of participants, mean 31 years, which is relatively advanced for pregnant women, but reflects the social reality for women living in a big city.

Serum TG, a very sensitive indicator of iodine insufficiency and excessive thyroid stimulation [34], did not differ between trimesters. Nevertheless, we found weak positive correlation between serum TG and thyroid volume.

The prevalence of goitre in the analysed group of pregnant women was 28%, one third of what it had been before the introduction of mandatory iodine prophylaxis, but still high. However, the median goitre volume was 18.7 mL and in most women it was not accompanied by any clinical symptoms. We could not demonstrate any association between thyroid volume and age, parity, presence of thyroid antibodies or UIC.

No case of neonatal TSH > 15 mIU/L was found, and only 2.9% of neonatal TSH results were above 5 mIU/L. According to the criteria for the absence of iodine deficiency, less than 3% of the neonatal TSH should be above 5 mIU/L. A percentage of between 3% and 19.9 % indicates mild iodine deficiency, 20–39.9% relates to moderate deficiency, and above 40% is severe iodine deficiency.

Our results clearly demonstrate that the assumptions of the Polish model of iodine prophylaxis are valid but they have not been fully realised. Educational efforts must be made among both pregnant women and obstetricians to encourage more iodine carriers in the diet and to prescribe iodine in the form of potassium iodine tablets or iodine-containing pre-natal multivitamin preparations, which are freely available. The problem of the infrequent use of iodine supplements by pregnant women in European countries has been reported previously: at present, only 13–50% of pregnant women in Europe receive iodine-enriched supplements [15, 16, 35].

The Polish iodine prophylaxis programme takes into account the WHO recommendations concerning limitations on salt intake. The Polish Council for Control of Iodine Deficiency Disorders (PCCIDD) prepares the protocol of iodisation cattle fodder so as to provide 100–150 μg of iodine for every litre of cows' milk. It is clear that economic conditions will be crucial in accomplishing this goal.

Conclusion

Supplements containing 150 μg of iodine should be prescribed for every healthy pregnant woman, and the as-

sumptions of the Polish iodine prophylaxis programme should be followed through to ensure adequate iodine supply.

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