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Effect of individual and socio-economic risk factors on the incidence of thyroid carcinoma in Olsztyn province

Wpływ osobniczych i socjoekonomicznych czynników ryzyka na zapadalność na nowotwory złośliwe tarczycy w województwie olsztyńskim

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Abstract

Introduction: The aim of this study was an investigation into the individual and socio-economic risk factors of the incidence of thyroid carcinoma.
Material and methods: Our study was into risk factors affecting the incidence of thyroid carcinoma conducted in patients included in a register of thyroid carcinoma. For that purpose, a questionnaire was prepared which covered personal information, medical history and socio-economic factors. A statistical analysis was conducted.
Results: The register comprised 297 patients (89% female) with thyroid carcinoma and 589 healthy subjects. Age group distribution was similar for both groups. The largest group was aged 50–54. The number of children born to women with carcinoma and women in the control group did not differ significantly. 10% of the women with carcinoma had used contraception. Patients were most frequently born in Olsztyn province, an area of relative iodine deficiency. 9.72% had suffered from thyroid disease in childhood. 32.41% had a family history of thyroid disease. Mothers of patients most frequently also came from regions of similar iodine level. The fathers most frequently came from Warsaw province (17.08%). The origin of the remainder was the same as of the mothers. 36% of patients had elementary, 14% vocational, 38% secondary and 13% higher education. Logistic regression showed that the risk of carcinoma increased 0.98 times in each person younger by a year. Individuals with body mass lower had 0.98 times greater risk of the disease by each kilogram.
Conclusions: The risk factors for the incidence of thyroid carcinoma: **f**emale sex, age at onset, **l**ow body mass
(Pol J Endocrinol 2010; 61 (5): 671–682)

Key words: *thyroid carcinoma, individual and socio-economic risk factors*

Streszczenie

Wstęp: Celem pracy było zbadanie osobniczych i socjoekonomicznych czynników ryzyka zapadalności na raka tarczycy.
Materiał i metody: Badanie przeprowadzono wśród chorych objętych rejestrem raka tarczycy na podstawie przygotowanej ankiety. Ankieta zawierała: informacje osobnicze, historię medyczną oraz czynniki socjoekonomiczne. Uzyskane dane poddano analizie statystycznej.
Wyniki: Rejestrem objęto 297 chorych (89% kobiet) i 589 zdrowych ochotników dobranych odpowiednio pod względem wieku i miejsca zamieszkania. Najczęstszą grupę stanowili chorzy w wieku 50–54, z dominującą grupą kobiet. Kobiety chore na raka tarczycy rodziły tak samo często, jak kobiety z grupy kontrolnej; 10% stosowało leki antykoncepcyjne. Większość chorych urodziło się w województwie olsztyńskim (obszar umiarkowanego niedoboru jodu). U 9,72% w dzieciństwie rozpoznano chorobę tarczycy. Rodzinne obciążenie chorobami tarczycy miało 32,41%. Wykształceniem podstawowym legitymowało się 36%, 14% zawodowym, 38% średnim i 13% wyższym. Na podstawie modelu regresji logistycznej wykazano, że ryzyko raka tarczycy wzrastało 0,98-krotnie u każdej osoby młodszej o rok i 0,98-krotnie z masą ciała niższą o 1 kg.
Wnioski: Czynniki ryzyka zapadalności na raka tarczycy to: płeć żeńska, wiek rozpoznania raka tarczycy, niska masa ciała.
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Słowa kluczowe: *rak tarczycy, osobnicze i socjoekonomiczne czynniki ryzyka*

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Introduction

Thyroid carcinoma comprises as little as 1% of all neoplasms; however, they are the commonest form of endocrine gland cancer [1–5]. The growth of interest in this group of carcinomas in the 1990s was the consequence of advances in diagnostics, especially ultrasonographic thyroid examination, which contributed to a massive increase in random recognition of thyroid carcinoma ('incidentaloma'). Another factor that caused growth of interest in thyroid carcinoma was the Chernobyl accident in 1986. One of the elements in the radioactive downfall was radioactive iodine, which upon depositing in the thyroid gland brought about a considerable rise in the incidence of cancer. The evidence for this includes the observations of thyroid carcinoma in children made in Belarus four years after Chernobyl [6–8].

The aim of our study was to investigate individual and socio-economic risk factors in the incidence of thyroid carcinoma.

Material and methods

A prospective study on thyroid cancer was conducted in Olsztyn province from 1 January 1994 to 31 December 2003. Olsztyn province is in the north-east of Poland, with an area of 12,327 km^2 (3.9% of Poland's area). In 1994, its population was 769,200 and in 2002 it was 760,737, making up 2% of the whole Polish population. In 1994, 22 towns in the province were inhabited by 60% of the province's population [10–12].

The register of thyroid carcinoma included patients for the following criteria:

— disease onset between 1 January 1994 and 31 December 2003
— permanent residents of Olsztyn province, with respect to all age groups
— thyroid carcinoma was diagnosed on post-operational histopathological thyroid examination classified as ICD-9, ICD-10 at the Department of Pathomorphology of the District Specialistic Hospital in Olsztyn and verified at the Department of Pathomorphology of the Medical Academy in Warsaw or the Oncological Centre of Institute in Gliwice [13, 14].

The study was into factors affecting the incidence of thyroid carcinoma conducted among patients included in the standardised register. For that purpose, a questionnaire was prepared (Table I).

The questionnaire covered: personal information such as initials, sex, age, date and place of birth, with consideration of iodine level (iodine deficiency region: slight/moderate/serious); parents' place of birth (region of Poland along with iodine level, including the parts of Ukraine, Belarus and Lithuania which used to belong to Poland before World War II); positive family history of thyroid cancer of the first and second degree; in women the number of deliveries, contraception and hormonal replacement therapy. Socio-economic factors covered were: education level (in a four-point scale: elementary/vocational/secondary/higher) and place of residence (country, town). Anthropometrical parameters covered were: height (cm), body mass (kg) and body mass index (BMI kg/m^2), medical history: date of cancer being diagnosed, diagnostics and treatment methods.

The control group consisted of 589 healthy subjects selected based on age and place of residence who consented to take part in the study (Table II). Statistical analysis was done using Statistica 7PL software. Logistic analysis for change odds ratio was applied to analyse the effect of risk factors on cancer at 95% CI. The

Table I. *Characteristics of patients with thyroid cancer who responded*

Tabela I. *Charakterystyka badanej grupy chorych na raka tarczycy objętych badaniami ankietowymi*

Characteristics of patients with thyroid cancer	n (%)
Number of patients with thyroid cancer registered	462 (100.00)
Number of patients with thyroid cancer who died	77 (16.66)
Patients responded	
Personally	139 (30.08)
By mail	151 (32.68)
By phone	4 (0.86)
From members of family	3 (0.64)
Total	297 (64.28)

Table II. *Characteristics of members of control group who responded*

Tabela II. *Charakterystyka osób z grupy kontrolnej objętych badaniami ankietowymi*

		Control group n=589	
Age (years)	Sex	n (%)	Average age (years) ± SD
0–18	Girls	7 (58.33)	16.71 ± 1.38
	Boys	5 (41.67)	13.80 ± 2.17
> 18	Women	507 (87.87)	50.92 ± 13.01
	Men	70 (12.13)	46.33 ± 13.71
0–85+	Women	514 (87.27)	50.46 ± 13.52
	Men	75 (12.73)	44.16 ± 15.56
Total		589 (100.00)	49.66 ± 13.46

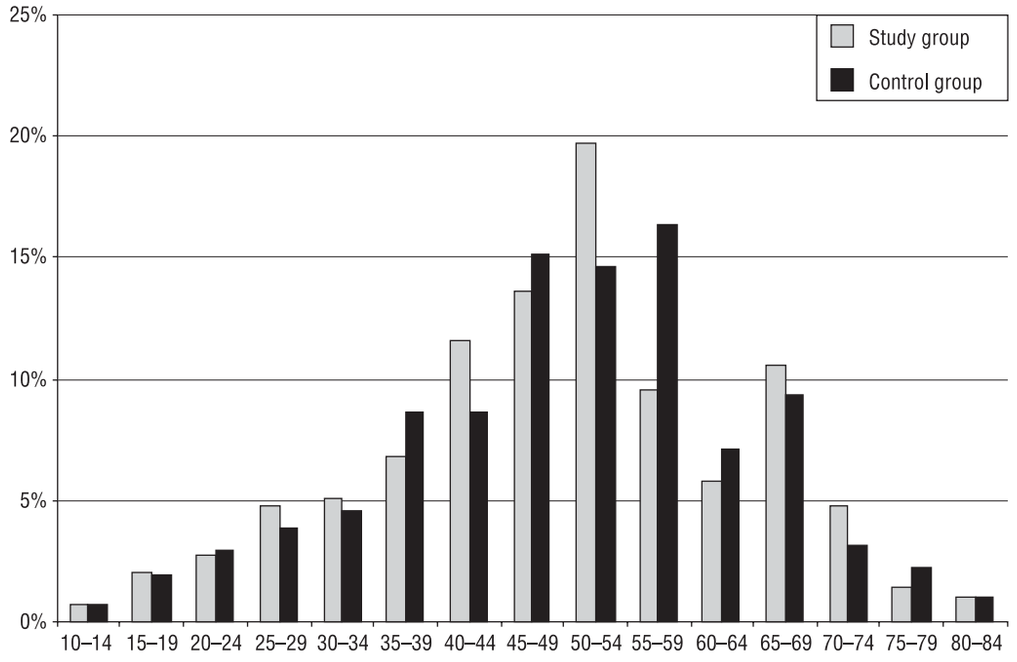


Figure 1. *Age characteristics of study group who responded*

Rycina 1. *Charakterystyka badanych grup objętych badaniami ankietowymi z uwzględnieniem wieku*

hypotheses about a relation (or lack of relation) between variables in the nominal or ordinal scale was verified using Pearson test and Highest Credibility test. Poisson distribution was used for analysis of disease incidence.

Results

Between 1994 and 2003, 297 patients completed the 'Questionnaire on thyroid carcinoma', as did 589 healthy subjects from the control group. Age group distribution was similar for patients with carcinoma and healthy subjects. The largest group was that of patients aged 50–54 (Fig. 1). Women were predominant (Fig. 2). Figure 3 illustrates that the number of children born to women with thyroid carcinoma and those from the control group did not differ significantly. Figure 4 shows that 10% of the women with carcinoma and 11% of the healthy ones used contraception, with no statistical differences between groups. Patients with thyroid carcinoma and those from the control group were most frequently born in Olsztyn province, which indicates that they originated from an area of relative iodine deficiency (Table III). The place of birth of all study subjects is graphically presented in Figure 5. 9.72% of patients with thyroid carcinoma and 7.41% of control patients suffered from thyroid disease in childhood: the groups did not differ statistically (Fig. 6). No statistically significant differences were found in the family history of thyroid diseases (32.41% of the sufferers from cancer *v.* 30.22% of the control group) (Fig. 7).

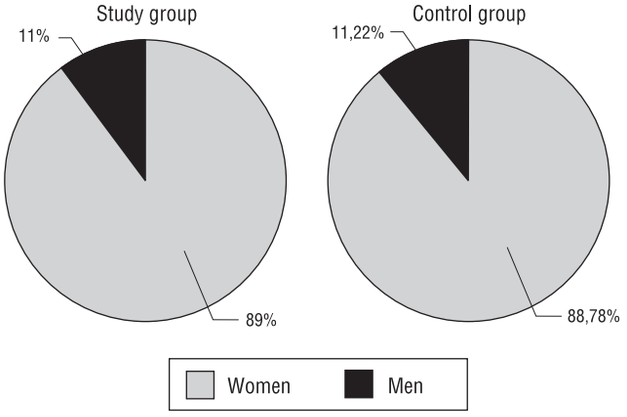


Figure 2. *Sex characteristics of study group who responded*

Rycina 2. *Charakterystyka badanych grup objętych badaniami ankietowymi z uwzględnieniem płci*

Mothers of patients with thyroid carcinoma and of healthy subjects most frequently came from regions of similar iodine levels (Table IV). The data is graphically presented in Figure 8. The fathers in both groups also most frequently came from Warsaw province (17.08% and 18.84%, respectively). The origin of the remaining ones was the same as of the mothers (what is now Lithuania and Olsztyn province); in general, most men were born in areas of moderate iodine deficiency (Table V, Fig. 9).

Within the group of patients with carcinoma, 108 (36%) had elementary education, 41 (14%) had voca-

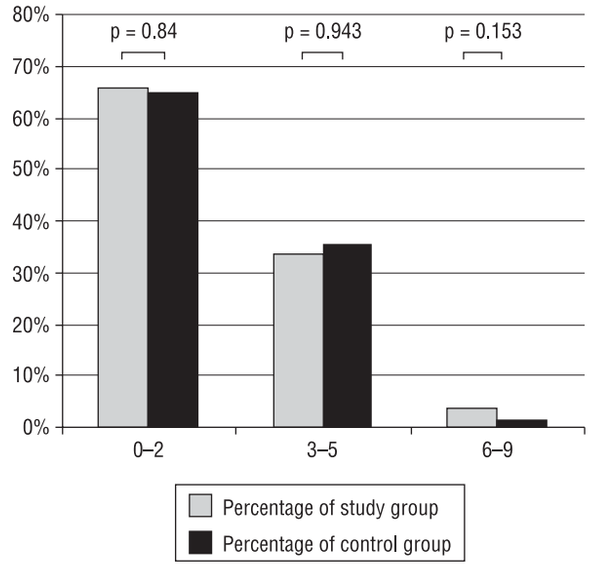


Figure 3. *Number of children: study group v. control group*

Rycina 3. *Liczba odbytych porodów w badanej grupie kobiet chorych na raka tarczycy i grupie kontrolnej*

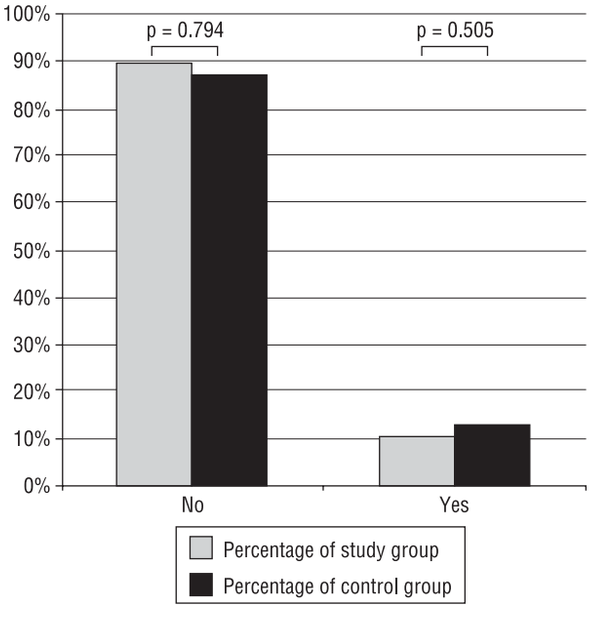


Figure 4. *Contraception: study group v. control group*

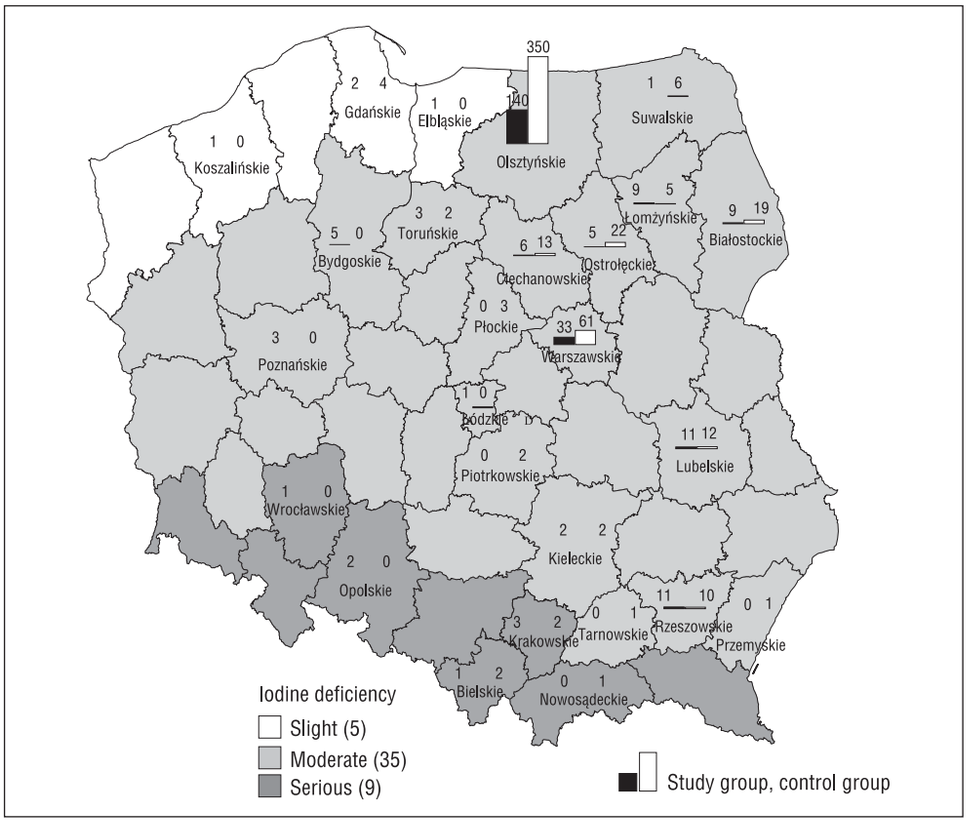
Rycina 4. *Częstość stosowania antykoncepcji w badanej grupie kobiet chorych na raka tarczycy i grupie kontrolnej*

Table III. *Place of birth: study group vs. control group*

Tabela III. *Miejsce urodzenia badanej grupy chorych na raka tarczycy i grupy kontrolnej*

Place of birth	Study group n (%)	Control group n (%)
Białostockie	9 (3.06)	19 (3.22)
Bielskie	1 (0.34)	2 (0.33)
Bydgoskie	5 (1.70)	
Ciechanowskie	6 (2.04)	13 (2.20)
Elbląskie	1 (0.34)	
Gdańskie	2 (0.68)	4 (0.67)
Katowickie		
Kieleckie	2 (0.68)	2 (0.33)
Koszalińskie	1 (0.34)	
Krakowskie	3 (1.02)	2 (0.33)
Lubelskie	11 (3.74)	12 (2.03)
Łomżyńskie	9 (3.06)	5 (0.85)
Łódzkie	1 (0.34)	9 (1.52)
Nowosądeckie		1 (0.16)
Olsztyńskie	140 (47.61)	350 (59.42)
Opolskie	2 (0.68)	
Ostrołęckie	5 (1.70)	22 (3.73)
Piotrkowskie		2 (0.33)
Płockie		3 (0.51)
Poznańskie	3 (1.02)	
Przemyskie		1 (0.16)
Rzeszowskie	11 (3.74)	10 (1.69)
Suwalskie	1 (0.34)	6 (1.01)
Tarnowskie		1 (0.16)
Toruńskie	3 (1.02)	2 (0.33)
Warszawskie	33 (11.22)	61 (10.35)
Wrocławskie	1 (0.34)	
Zamojskie		
Belarus	5 (1.70)	12 (2.03)
France		
Lithuania	33 (11.22)	44 (7.47)
Latvia		
Russia	1 (0.34)	
Siberia		
Ukraine	5 (1.70)	6 (1.01)
USA		
Unknown		
Total	294 (100)	589 (100)

tional, 113 (38%) had secondary and 38 (13%) had gone throughhigher education. The same was true of the control group (Fig. 10). No significant differences were found concerning the place of residence (75.54% and 77.25%, respectively) (Fig. 11). Based on analysis with logistic regression method it was shown that the risk of thyroid carcinoma increased 0.98 times (CI 0.97–0.99) in each person younger by a year. Individuals with lower body mass had 0.98 times (CI 0.96–0.99) greater risk of developing the disease by each kilogram (Table VI). No significant relationships were found for the remaining risk factors such as family history of thyroid disease, ei-



Place of birth beyond Poland (not marked on the map)	Study group n (%)	Control group n (%)
Belarus	5 (1.70)	12 (2.03)
France	0 (0.00)	0 (0.00)
Lithuania	33 (12.22)	44 (7.47)
Latvia	0 (0.00)	0 (0.00)
Russia	1 (0.34)	0 (0.00)
Siberia	0 (0.00)	0 (0.00)
Ukraine	5 (1.70)	6 (1.01)
USA	0 (0.00)	0 (0.00)
Total	64 (21.77)	62 (10.52)

Figure 5. *Place of birth: study group v. control group*

Rycina 5. *Miejsce urodzenia badanej grupy chorych na raka tarczycy i grupy kontrolnej*

ther among patients or their families, the number of children they had, the age at delivery, or contraception used.

Discussion

Individual risk factors

Age of patients

No cases of thyroid carcinoma were registered in the youngest groups aged 0–9; in older groups, i.e. 10–19, there were 15 cases (7 girls and 8 boys). Our observations confirmed the results of other studies which have shown that thyroid carcinoma occurs in children and youths very rarely [5, 19, 20]. From the data analysis with logistic regression method it followed that each individual younger by a year had a 0.98 times higher risk (95% CI 0.97–0.99) of developing this kind of cancer.

The low incidence of cancer among children and youths in the studied province can be accounted for by a considerably lower dose of radiation in Poland than experienced in Ukraine and Belarus on the one hand, and by the effectively carried out iodine prophylactic action during the post-Chernobyl period on the other [21, 22]. Most probably for that reason, the cases of thyroid carcinoma were most frequently registered be-

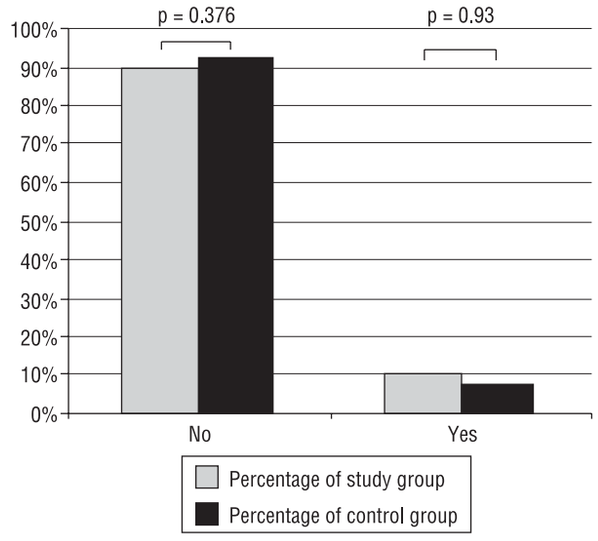


Figure 6. *Subjects with thyroid diseases history:study group v. control group*

Rycina 6. *Wywiady chorób tarczycy w badanej grupie chorych na raka tarczycy i grupie kontrolnej*

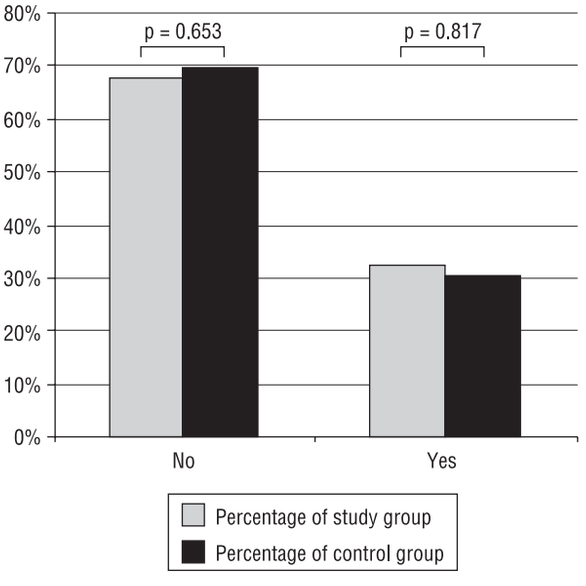


Figure 7. *Subjects with thyroid diseases 1st degree family history:study group v. control group*

Rycina 7. *Wywiady chorób tarczycy w rodzinie w badanej grupie chorych na raka tarczycy i grupie kontrolnej*

tween the ages of 30 and 50 and this age group made a significant risk factor for thyroid cancer.

Sex of patients

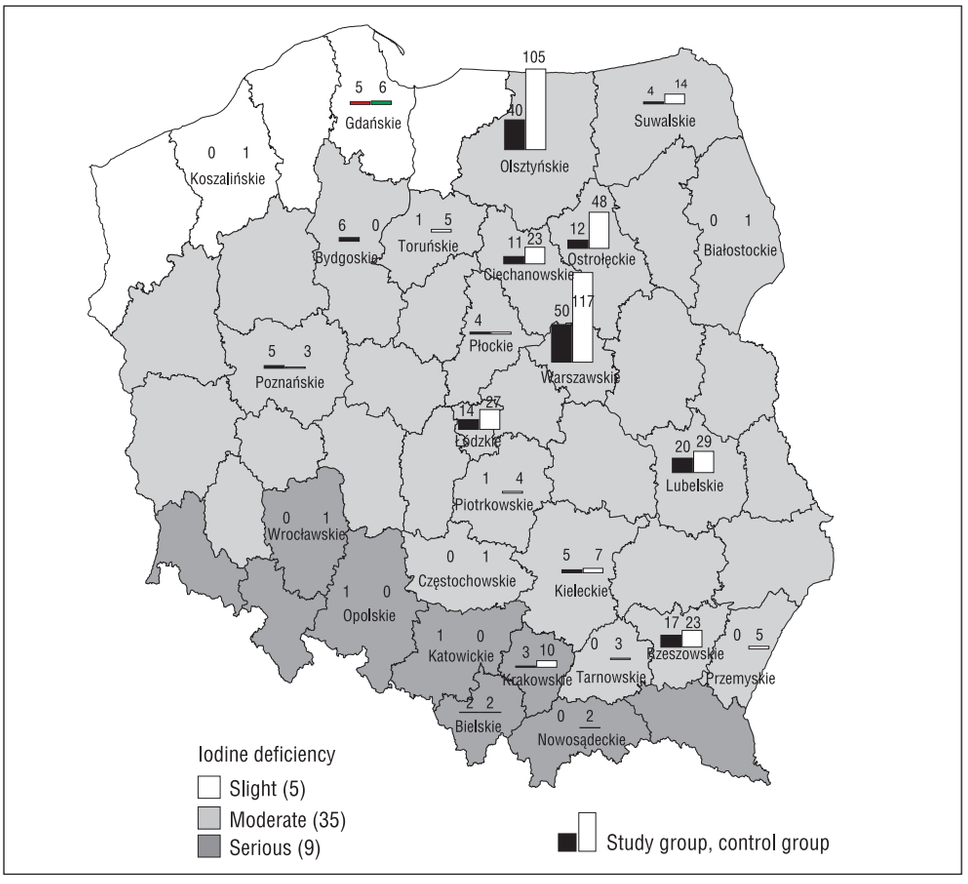
The data from Olsztyn province showed that the high incidence of thyroid carcinoma, with a significant rising trend over the 10 years, concerned mainly women, and the women to men ratio was 5.8:1. The results of our study agree with most data from Poland and elsewhere [20, 22, 24–28].

It is generally thought that the main reasons for the elevated incidence of thyroid carcinoma in women are hormonal factors, mainly oestrogens, which

Table IV. *Place of mother's birth: study group v. control group*

Tabela IV. *Miejsce urodzenia matek badanej grupy chorych na raka tarczycy i grupy kontrolnej*

Place of mother's birth	Study group N (%)	Control group n (%)
Białostockie		1 (0.17)
Bielskie	2 (0.68)	2 (0.33)
Bydgoskie	6 (2.04)	
Ciechanowskie	11 (3.74)	23 (3.90)
Częstochowskie		1 (0.17)
Elbląskie		
Gdańskie	5 (1.70)	6 (1.01)
Katowickie	1 (0.34)	
Kieleckie	5 (1.70)	7 (1.18)
Koszalińskie		1 (0.17)
Krakowskie	3 (1.02)	10 (1.69)
Lubelskie	20 (6.80)	29 (4.92)
Łomżyńskie		
Łódzkie	14 (4.76)	27 (4.58)
Nowosądeckie		2 (0.33)
Olsztyńskie	40 (13.60)	105 (17.82)
Opolskie	1 (0.34)	
Ostrołęckie	12 (4.08)	48 (8.14)
Piotrkowskie	1 (0.34)	4 (0.67)
Płockie	4 (1.36)	4 (0.67)
Poznańskie	5 (1.70)	3 (0.51)
Przemyskie		5 (0.85)
Rzeszowskie	17 (5.78)	23 (3.90)
Suwalskie	4 (1.36)	14 (2.37)
Tarnowskie		3 (0.51)
Toruńskie	1 (0.34)	5 (0.85)
Warszawskie	50 (17.00)	117 (19.86)
Wrocławskie		1 (0.17)
Belarus	27 (9.18)	56 (9.51)
France		
Lithuania	47 (15.98)	72 (12.22)
Latvia		1 (0.17)
Russia	2 (0.68)	1 (0.17)
Siberia		
Ukraine	12 (4.08)	16 (2.71)
USA		1 (0.17)
Unknown	4 (1.36)	3 (0.51)
Total	294 (100)	589 (100)



Place of birth beyond Poland (not marked on the map)	Study group n (%)	Control group n (%)
Belarus	27 (9.18)	56 (9.51)
France	0 (0.00)	0 (0.00)
Lithuania	47 (15.98)	72 (12.22)
Latvia	0 (0.00)	1 (0.17)
Russia	2 (0.68)	1 (0.17)
Siberia	0 (0.00)	0 (0.00)
Ukraine	12 (1.36)	16 (2.71)
USA	0 (0.00)	1 (0.17)
Total	88 (29.93)	147 (24.95)

Figure 8. *Place of mother's birth: study group v. control group*
Rycina 8. *Miejsce urodzenia matek badanej grupy chorych na raka tarczycy i grupy kontrolnej*

probably affect carcinogenesis. Oestrogens, endogenous and exogenous, (hormonal contraception and HRT), may stimulate TSH production and, in consequence, cause thyroid hyperplasia and increase the risk of cancer [29, 30].

Numerous studies on the effect of the number of past pregnancies, or age at first conception, or number of consecutive pregnancies, on the development of thyroid carcinoma provide some contradictory results [31–38]. A few studies have reported that women who had experienced several pregnancies were exposed to the development of thyroid carcinoma much more often, especially as a result of radiation [39, 40]. Also in Poland, based on the observation of the population of Krakow, it has been found that women with more than one child have a greater risk of thyroid carcinoma [41]. We found that neither the number of past pregnancies, nor the mother's age at first giving birth, nor consecutive children, was related to an increased risk of cancer.

Table V. *Place of father's birth: study group v. control group*
Tabela V. *Miejsce urodzenia ojców badanej grupy chorych na raka tarczycy i grupy kontrolnej*

Place of father's birth	Study group n (%)	Control group n (%)
Białostockie	11 (3.74)	48 (8.14)
Bielskie	1 (0.34)	2 (0.33)
Bydgoskie	5 (1.70)	
Ciechanowskie	12 (4.08)	18 (3.05)
Częstochowskie		1 (0.16)
Elbląskie		
Gdańskie	6 (2.04)	8 (1.35)
Katowickie	1 (0.34)	
Kieleckie	3 (1.02)	9 (1.52)
Koszalińskie		
Krakowskie	3 (1.02)	10 (1.69)
Lubelskie	21 (7.14)	31 (5.26)
Łomżyńskie	11 (3.72)	22 (3.73)
Łódzkie	5 (1.70)	10 (1.69)
Nowosądeckie		3 (0.51)
Olsztyńskie	43 (14.62)	100 (16.97)
Opolskie		
Ostrołęckie	11 (3.74)	44 (7.47)
Piotrkowskie	1 (0.34)	5 (0.85)
Płockie	3 (1.02)	3 (0.51)
Poznańskie	3 (1.02)	10 (1.69)
Przemyskie		6 (1.01)
Rzeszowskie	21 (7.14)	29 (4.92)
Suwalskie	2 (0.68)	12 (2.03)
Tarnowskie		1 (0.16)
Toruńskie	1 (0.34)	5 (0.85)
Warszawskie	52 (17.68)	111 (18.84)
Wrocławskie	1 (0.34)	
Belarus	10 (3.40)	8 (1.35)
France		1 (0.16)
Lithuania	45 (15.31)	68 (11.54)
Latvia		1 (0.16)
Russia	1 (0.34)	1 (0.16)
Siberia		
Ukraine	13 (4.42)	18 (3.05)
USA		
Unknown	8 (2.72)	5 (0.85)
Total	294 (100)	589 (100)

The study did not reveal a significant relationship between oestrogens used in contraception or HRT and the incidence of thyroid carcinoma; however, the conclusions from the study may not be unequivocal, as the patients from Olsztyn province, of either the carcinoma or the control group, rarely used hormonal contraception or replacement therapy.

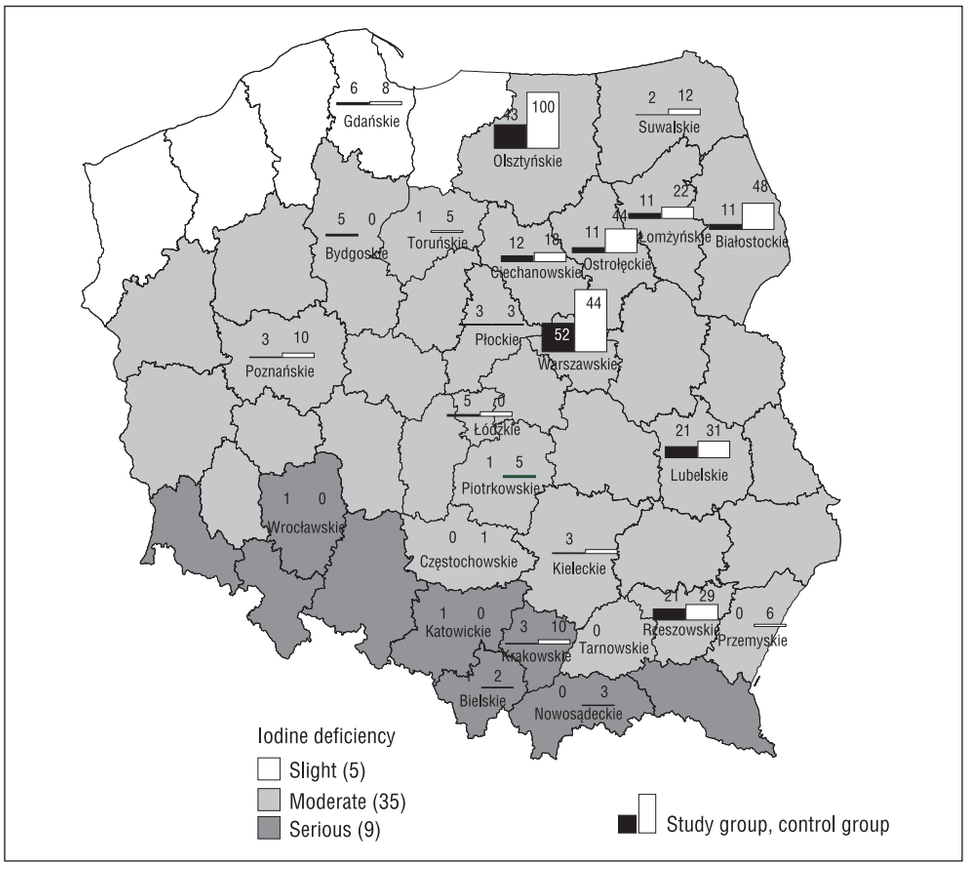
In urban areas in the south of Poland, it has been observed that thyroid carcinoma occurs more often in women using contraception [41]. Also, La Veccia in his meta-analysis of 13 studies, observed a slight increase in thyroid carcinoma incidence in women who had previously used hormonal contraception, although he did not find a relationship between the age of its first use or using it before giving birth to the first child [31, 42, 43]. Like us, other researchers have not confirmed a relation between contraception used and an increase in thyroid carcinoma [34,38,44]. In turn, Sakoda observed a decreased thyroid carcinoma risk in women using contraception [34, 45].

Body mass of patients

The effect of anthropometric indicators (height, body mass) on thyroid carcinoma was assessed in a meta-analysis of 12 studies made by Dal Maso et al.; a moderate effect of body height and mass on thyroid carcinoma was observed [46]. In Poland, in the Krakow population, thyroid carcinoma occurred significantly more often in obese men; but no such observations were made for women [41]. Our study showed, using the logistic regression model, that a higher risk of thyroid cancer was run by individuals with lower body mass. The risk decreased 0.98 fold (95% CI 0.96–0.99) with each extra kilogram of body mass.

Family history of thyroid diseases

Numerous papers have stressed that there is a relationship between previous nodular goitre and later occurrence of thyroid carcinoma [36, 38, 47–52]. The debate as to whether the increase in thyroid cancer in patients with nodular goitre is only the natural consequence of thyroid carcinoma growth, or if the increase is related to advanced techniques and more precise diagnostics, continues. Some authors have suggested that the observed growth in thyroid carcinoma incidence is the effect of advances in medicine and better access to specialists [53–55]. In the presented material, 9% of patients with cancer had a positive family history of thyroid disease in childhood, and 80% had nodular goitre, Hashimoto's thyroiditis or Graves' (also known as Basedow's) disease prior to diagnosis of thyroid cancer. Following recognition of nodular goitre, more than 80% of patients were referred for surgery within two years. In patients with thyroid carcinoma with a large goitre, one of the actual reasons for late diagnosis was the difficulty of accessing specialists. Hence, the suggestion that the development of specialist medical care could cause 'overdiagnosing' of carcinoma seems groundless. In such cases, early surgical treatment of thyroid carcino-



Place of birth beyond Poland (not marked on the map)	Study group n (%)	Control group n (%)
Belarus	10 (3.40)	8 (1.35)
France	0 (0.00)	1 (0.16)
Lithuania	45 (15.31)	68 (11.54)
Latvia	0 (0.00)	1 (0.16)
Russia	1 (0.34)	0 (0.00)
Siberia	0 (0.00)	1 (0.16)
Ukraine	13 (4.42)	18 (3.05)
USA	0 (0.00)	0 (0.00)
Total	69 (23.47)	97 (16.46)

Figure 9. *Place of father's birth: study group v. control group*

Rycina 9. *Miejsce urodzenia ojców badanej grupy chorych na raka tarczycy i grupy kontrolnej*

ma, when the neoplasm lesion was small and there were no metastases, permits effective therapy.

In our study, as many as 30% of the patients had a positive thyroid family history. There is extensive data indicating that positive family history of nodular goitre was one of the factors which might affect the development of thyroid carcinoma [47, 56–60]. On the other hand, it should be pointed out that individuals from families with a positive history of nodular goitre were more interested in diagnosing this condition; they were more willing to agree to strumectomy, which is able to diagnose thyroid carcinoma in stadium T1. Yet, our study did not confirm univocally unequivocally that positive family history in patients and in their families was a significant risk factor for development of thyroid carcinoma.

Family history of cancer

Several studies have pointed out the more frequent co-occurrence of thyroid carcinoma with mammary gland carcinoma in women [61]. One of the reasons for this was risk factors common for both cancers, such as

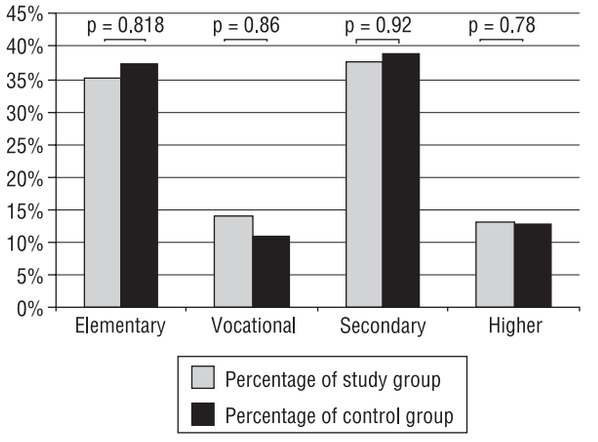


Figure 10. *Education: study group v. control group*

Rycina 10. *Poziom wykształcenia badanej grupy chorych na raka tarczycy i grupy kontrolnej*

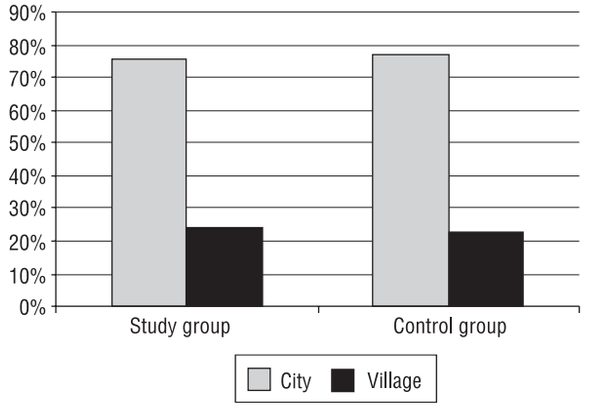


Figure 11. *Place of residence: study group v. control group*

Rycina 11. *Miejsce zamieszkania badanej grupy chorych na raka tarczycy i grupy kontrolnej*

Table VI. ***Thyroid carcinoma risk factors in study group for change odds ratio (OR)***

Tabela VI. ***Czynniki ryzyka zachorowania na raka tarczycy w badanej grupie chorych z określeniem ilorazu szans (OR) dla zmiany jednostkowej***

Risk factors	OR (95% CI)	p
Age onset of thyroid cancer	0.98 (0.97–0.99)	0.03
Body mass	0.98 (0.96–0.99)	0.00
Consumption of cruciferous vegetables	1.53 (1.19–1.96)	0.00
Cigarette smoking	0.54 (0.39–0.73)	0.00

family history of thyroid carcinoma, obesity and exposure to ionising radiation [61]. In the material, only two women with previously diagnosed mammary gland carcinoma developed thyroid carcinoma, while in another three the order was reversed. In one woman, following a diagnosis of thyroid cancer, kidney cancer was found. One man had chronic lymphatic leukaemia, another underwent radiotherapy of the chest due to immature cell dumbbell ganglioneuroma at the age of four (he developed thyroid carcinoma 17 years later). In view of the presented results, it is difficult to draw general conclusions on any relationships between thyroid cancer and cancer of other organs.

Birth place of patients

Researchers are not fully convinced as to whether being born in a region of iodine deficiency may affect the development of thyroid carcinoma. Judging from worldwide studies, living more than 20 years in an area of iodine deficiency might have a slight effect on the growth of thyroid cancer. The relationship is more strongly evident for follicular cancer, in elderly patients. Among women this relation is not clear [62]. In our material, most of both the patients with carcinoma and the control subjects were born in an area of moderate iodine deficiency, i.e. Olsztyn and Warsaw provinces or the present territory of Lithuania; only a few were born in the area of endemic thyroid goitre (Krakow province). Therefore, our observations do not allow us to make firm conclusions. Yet, considering patients' age and bearing in mind the fact that table salt iodisation was introduced in Poland in 1935, it can be stated with confidence that most of the oldest patients would have received iodine prophylaxis soon after they were born, although it was suspended in 1939 for the period of World War II and several years afterwards [63, 64]. This fact may be related to the increase in thyroid cancer incidence among the group of 60-year olds. Another significant problem requiring future study is the estimation of the effect of cessation of iodine prophylaxis in Poland in the 1980s and 1990s on the growth of thyroid carcinoma. In that period, the post-war generation of Poles entered their maturity.

In 1986, there appeared one more risk factor: radiation following the Chernobyl accident. The residents of our province were acutely exposed. In this situation, the examined population faced a combination of two most serious risk factors for thyroid cancer. The consequences lie still ahead of us.

Birth place of parents

While analysing the birthplaces of parents, we traced back the migration of population to the area of Olsztyn

province after the war. The place of birth of mothers and fathers of patients with carcinoma and control group subjects showed their similar origin from Warsaw and Olsztyn provinces and the present territory of Lithuania, areas of moderate iodine deficiency. There is no unequivocal evidence that moderate iodine deficiency there had any effect on the increase in thyroid carcinoma incidence.

Socio-economic factors

Patients' education level

Our results did not reveal any effect of education level on the occurrence of thyroid cancer. In the study group, 50% of patients had elementary education and 13% had higher education. Similar results were obtained in the control group and they reflect the general education level of the Polish population [12]. So far, there is no information available on the relationship between education level and risk of thyroid carcinoma. In New Caledonia, 75.8% of patients with thyroid cancer had low education level; in contrast, in Iribarren's study, higher education was a risk factor for thyroid cancer [38, 65].

Patients' place of residence

Studies conducted in Poland have shown that thyroid cancer develops most often in residents of towns [20, 21]. Our results seem to confirm this observation. This could be also due to the fact that urban dwellers have better access to specialists and diagnostic procedures, as well as better health education. On the other hand, it may follow from greater environmental pollution of the urban environment. There is no firm and clear evidence worldwide on the effect of residence place on the development of thyroid cancer. Romanian researchers found a greater incidence of thyroid carcinoma among the inhabitants of urban Cluj-Napoca area [66]; in Sweden, a greater carcinoma incidence was observed in towns, while that of follicular carcinoma in women, and of anaplastic carcinoma in both sexes, was greater in rural areas [62].

Conclusions

The risk factors for the incidence of thyroid carcinoma in the studied area were: female sex, age onset of thyroid cancer, low body mass of patients.

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