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## Dietary patterns as risk factors of differentiated thyroid carcinoma

### Sposób odżywiania jako czynnik ryzyka zróżnicowanego raka tarczycy

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- A** Study Design
- B** Data Collection
- C** Statistical Analysis
- D** Data Interpretation
- E** Manuscript Preparation
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#### Material/Methods:

#### Summary

Nutritional factors are known to be important in the development of different metabolic diseases. The history of nodular or diffuse goiter is closely related to risk of thyroid carcinoma. On account of the function of the thyroid gland, many studies focus on iodine intake.

The aim of the study was to assess whether dietary patterns could be risk factors of differentiated thyroid carcinoma.

The case-control study was based on a questionnaire, which included information about dietary patterns and was carried out on 284 patients comprising 30 males (mean age 58.4±13.7 years), and 254 females (mean age 52.1±13.8 years), as well as 345 randomly selected controls: 58 males (mean age 60.2±12 years) and 287 females (mean age 53.4±14.3 years) randomly selected from the Population Register and adjusted by age and gender to the group of TC. The main groups of nutritional products, i.e. starchy foods, meat, dairy products, vegetables, fruits, and beverages, were analyzed.

#### Results:

Consumption of vegetables, fruits, saltwater fish and cottage cheese was significantly lower in patients with differentiated thyroid carcinoma than in controls, quite the contrary to starchy foods, especially white bread.

#### Conclusions:

Dietary patterns appear to modify the risk of thyroid carcinoma. A diet rich in vegetables and fruit, as well as saltwater fish (a source of iodine) and low-fat meat, could be an important protective factor.

#### Key words:

**thyroid carcinoma • dietary pattern • risk factors • vegetable • coffee**

#### Streszczenie

Czynniki żywieniowe odgrywają ważną rolę w rozwoju różnych chorób metabolicznych. Wywiad w kierunku wola guzkowego lub wola mięszonego jest ściśle związany ze zwiększonym ryzykiem rozwoju zróżnicowanego raka tarczycy (ZRT). Wielu autorów koncentruje swoją uwagę na roli spożycia jodu w funkcjonowaniu tarczycy i miejscu niedoboru tego pierwiastka w patogenezie chorób tarczycy.

Celem badania była ocena czy sposób odżywiania może wpływać na zwiększenie ryzyka ZRT.

**Materiały/Metody:** Badaniem case-control opartym na ankiecie zawierającej informacje na temat sposobu odżywiania objęto 284 chorych: 30 mężczyzn (średnia wieku  $58,4 \pm 13,7$  lat i 254 kobiet (średnia wieku  $52,1 \pm 13,8$  lat) oraz 345 osób grupy kontrolnej: 58 mężczyzn (średnia wieku  $60,2 \pm 12$  lat) i 287 kobiet (średnia wieku  $53,4 \pm 14,3$  lat) losowo wybranych z Rejestru Ludności, w odpowiednim do osób z grupy badanej wieku i płci. Analizowano spożycie głównych grup produktów spożywczych: produktów mącznych, mięsa, nabiału, warzyw, owoców i napojów.

**Wyniki:** W grupie chorych z ZRT obserwowano niższe spożycie warzyw, owoców, ryb morskich, twarogu niż w grupie kontrolnej, natomiast odpowiednio wyższe było spożycie białego pieczywa i ryżu.

**Wnioski:** Sposób odżywiania może wpływać modulująco na ryzyko rozwoju ZRT. Dieta bogata w warzywa, owoce, ryby morskie będące istotnym źródłem jodu oraz mięso o niskiej zawartości tłuszczów nasyconych może pełnić rolę ochronną.

**Słowa kluczowe:** rak tarczycy • sposób odżywiania • czynniki ryzyka • warzywa • kawa

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## INTRODUCTION

Nutritional factors are known to be important in the development of different metabolic diseases. The history of nodular or diffuse goiter is closely related to the risk of thyroid carcinoma (TC). Therefore, researchers of thyroid gland function focus on iodine intake. In Europe a high incidence of thyroid carcinoma is described in iodine deficient areas [8,16]. Moreover, introduction of iodine prophylaxis shifts the incidence toward the less aggressive papillary type [18,23]. However, dietary factors other than iodine deficiency play a role in the genesis of endemic goiter [7,15]. Some population-based studies have shown that the relation between iodine intake and thyroid function is not linear, and both iodine deficiency and iodine excess may interfere with the synthesis of thyroid hormones and cause goiter [5]

### Aim of the study

The aim of the study was to assess whether dietary patterns could be a risk factor of differentiated thyroid carcinoma (DTC).

## MATERIALS AND METHODS

The case-control study was based on a questionnaire, which included information about dietary patterns with the following groups of commonly consumed products: starchy foods, vegetables and fruits, dairy products, meat, fish, fats and beverages. It was carried out on 284 patients diagnosed as having TC, and 345 controls in 1996–1998. All of them were inhabitants of a southern Poland district defined as an iodine-deficient area. Fifty questions about food aimed to obtain an average frequency of consumption, given standard portion sizes. The time to which the dietary habits were referred was ten years before diagnosis of DTC and in controls ten years before questionnaire completion.

Patients: 30 males (mean age  $58.4 \pm 13.7$  years), and 254 females (mean age  $52.1 \pm 13.8$  years). Cases were included in the Regional Register of Thyroid Cancer after pathological diagnosis of DTC.

Controls: 58 males (mean age  $60.2 \pm 12$  years) and 287 females (mean age  $53.4 \pm 14.3$  years) randomly selected from the Population Register and adjusted by age and gender to the group of TC.

The main groups of nutritional products were analyzed: starchy foods, meat, dairy products, vegetables, fruit, and beverages.

The frequency of food and beverage consumption was analyzed as an estimated number of portions per month. Statistical analysis was conducted using the statistical package Statistica 8.0 PL.

ANOVA was applied and Student's t-test was used to determine significant differences between group means, where  $p < 0.05$  was considered significant.

## RESULTS

There was a higher, but not statistically significant consumption of fiber-rich starchy foods in the control group, i.e. wholegrain bread, grits, and composed with other nutritional products such as dumplings and pasta. In contrast, white bread and rice were more often present in the diet of DTC patients (Table 1).

All groups of vegetables and some groups of fruits were more often consumed by healthy people. Statistical significance was reached for vegetable products rich in antioxidants, vitamins and fiber (Table 2).



Table 1. Consumption of starchy foods in patients and controls

Product	DTC patients portion $\pm$ SD	Controls portion $\pm$ SD	P
White bread	30.47 $\pm$ 18.33	27.93 $\pm$ 16.09	0.0561
Wholegrain bread	32.50 $\pm$ 43.26	34.67 $\pm$ 34.67	0.4245
Grits	5.11 $\pm$ 6.44	5.63 $\pm$ 6.20	0.1882
White rice	6.16 $\pm$ 7.98	5.96 $\pm$ 4.66	0.3767
Dumplings	3.59 $\pm$ 4.47	4.11 $\pm$ 8.47	0.2140
Pasta	7.26 $\pm$ 5.79	8.63 $\pm$ 10.13	0.0448

Table 2. Consumption of vegetables and fruits in patients and controls

Product	DTC patients portion $\pm$ SD	Controls portion $\pm$ SD	P
Tomato	14.09 $\pm$ 12.89	14.14 $\pm$ 15.35	0.4866
Lettuce	1.14 $\pm$ 2.94	2.27 $\pm$ 5.20	0.0030
Cabbage	5.60 $\pm$ 4.77	6.67 $\pm$ 7.06	0.0333
Cauliflower	0.68 $\pm$ 1.05	1.16 $\pm$ 2.48	0.0056
Green pea	0.81 $\pm$ 1.52	1.24 $\pm$ 2.50	0.0151
Bean	2.36 $\pm$ 1.95	3.33 $\pm$ 5.64	0.1353
Radish	0.50 $\pm$ 1.30	1.15 $\pm$ 3.14	0.0031
Carrot	5.10 $\pm$ 4.90	5.85 $\pm$ 5.26	0.0563
Beetroot	4.10 $\pm$ 3.59	5.17 $\pm$ 5.03	0.0082
Potato	32.22 $\pm$ 32.73	32.44 $\pm$ 33.94	0.4729
Vegetable soup	4.96 $\pm$ 4.18	6.64 $\pm$ 9.73	0.0116
Citrus fruit	7.46 $\pm$ 11.31	11.30 $\pm$ 14.21	0.0009
Apple	33.58 $\pm$ 34.87	38.01 $\pm$ 63.70	0.3861
Pear	0.34 $\pm$ 1.05	0.94 $\pm$ 3.10	0.0044
Plum	1.48 $\pm$ 6.68	1.24 $\pm$ 3.14	0.3479

There was a higher consumption of poultry, ham, fish, cheese, cottage cheese and margarine in the control group. Animal products rich in saturated fatty acids such as pork and cream were more often components of DTC patients' diets (Table 3).

The consumption of juices, coffee and chocolate was higher in the control group. Differences for coffee met statistical significance (Table 4).

## DISCUSSION

Our study suggests that some dietary patterns are associated with the risk of differentiated DTC. High intake of fatty (pork, cream) and starchy foods (especially refined wheat and rice) was observed in patients more frequently than in controls. Consumption of ham and poultry, and fish (i.e. low fat products) was more often observed in healthy people. We

have shown an adverse relationship between DTC prevalence and consumption of iodine-rich foods such as saltwater fish and fish products. These data are similar to previous studies [10,11,12,26]. A diet rich in vegetables seems to play a protective role, which is in agreement with other authors' studies. Vegetables may affect the risk of thyroid cancer probably via several pathways: goitrogenic and anticarcinogenic effects of thiocyanates contained in cruciferous vegetables, or via antioxidative vitamins C and E and beta-carotene in these products [2,3,7]. The latter can explain the protective, anticarcinogenic role of fruit, especially rich in vitamin C citrus fruits. Cabbage is one of the most frequently consumed vegetables in Poland. Excessive intake of cruciferous vegetables has long been considered to be a risk factor for developing nodular goiter [9]. Some authors have demonstrated that consumption of cruciferous vegetables was related to a greater risk of developing TC, especially in a group of patients with mild iodine deficiency [1,20,24]. Our data

Table 3. Consumption of meat, fish, dairy products and fats (vegetable and animal) in patients and controls

Product	DTC patients portion $\pm$ SD	Controls portion $\pm$ SD	P
Veal	1.60 $\pm$ 3.31	1.65 $\pm$ 2.94	0.4282
Poultry	6.65 $\pm$ 4.48	7.50 $\pm$ 5.88	0.0481
Giblets	1.38 $\pm$ 3.45	1.64 $\pm$ 2.51	0.1734
Ham	13.22 $\pm$ 12.47	18.10 $\pm$ 14.35	0.0001
Sausage	10.75 $\pm$ 12.49	12.40 $\pm$ 14.87	0.1037
Pork	3.98 $\pm$ 4.93	3.62 $\pm$ 4.44	0.2048
Saltwater fish	3.09 $\pm$ 2.38	3.59 $\pm$ 3.11	0.0065
Freshwater fish	0.59 $\pm$ 3.14	0.47 $\pm$ 1.56	0.0303
Tinned fish	1.57 $\pm$ 1.85	1.95 $\pm$ 2.78	0.0502
Milk	22.93 $\pm$ 25.77	22.43 $\pm$ 24.01	0.4146
Yoghurt	8.77 $\pm$ 11.25	8.54 $\pm$ 12.83	0.4198
Buttermilk/kefir	5.81 $\pm$ 7.57	8.35 $\pm$ 24.56	0.0806
Cheese	12.97 $\pm$ 12.82	13.25 $\pm$ 18.45	0.4272
Cottage cheese	15.56 $\pm$ 12.44	20.57 $\pm$ 22.30	0.0023
Cream	14.45 $\pm$ 18.21	13.03 $\pm$ 12.06	0.1555
Eggs	10.46 $\pm$ 10.75	10.38 $\pm$ 9.94	0.4661
Butter	23.36 $\pm$ 20.36	23.77 $\pm$ 24.28	0.4397
Margarine	7.63 $\pm$ 12.20	12.20 $\pm$ 14.13	0.0348

Table 4. Consumption of beverages in patients and controls

Product	DTC patients portion $\pm$ SD	Controls portion $\pm$ SD	P
Water	4.11 $\pm$ 18.79	3.75 $\pm$ 16.61	0.4612
Mineral water	23.32 $\pm$ 28.79	19.89 $\pm$ 26.10	0.0894
Juices	10.21 $\pm$ 11.19	11.29 $\pm$ 13.04	0.1728
Tea	86.71 $\pm$ 70.53	85.91 $\pm$ 66.18	0.4501
Coffee	17.78 $\pm$ 13.63	22.56 $\pm$ 11.64	0.0353
Chocolate	2.33 $\pm$ 4.67	2.63 $\pm$ 4.27	0.3087
Beer	0.37 $\pm$ 2.33	0.51 $\pm$ 2.13	0.2499
Wine	0.36 $\pm$ 2.36	0.14 $\pm$ 0.35	0.2620
Alcohol	0.06 $\pm$ 0.29	0.07 $\pm$ 0.25	0.4084

suggest that lettuce, cabbage, cauliflower, radish as well as green pea and beetroot containing beta carotene can play a protective role. Similar findings have been made by other researchers, who have proved a decreased risk of TC for the highest level of cruciferous vegetable intake [4,12,14,22].

We were unable to show an association of egg and milk consumption with DTC. This seems to indicate that nutritional

deficiency in dairy products and eggs was not a risk factor for TC [1,19]. Regardless of the above, we have revealed that consumption of cottage cheese was significantly higher in healthy subjects.

An interesting finding is that patients with DTC drank less coffee than healthy controls. A similar observation has been obtained by other authors, who have shown that



drinking coffee could decrease the risk of certain carcinomas [17,21,25]. Cardenas et al. suggested that a coffee diterpene might have a protective role and therefore act as the anti-angiogenic factor of coffee [6].

It is possible that the overall impact of particular dietary components on thyroid gland carcinogenesis depends not only on iodine intake but on their interaction with other dietary components. Description of new functions of nutritional factors depending on environmental factors, climate, UV, and pollution probably could explain their role

in carcinogenesis. However, no one questions the importance of other, personal factors related to physiological aspects and the patient's lifestyle.

## CONCLUSIONS

Dietary patterns appear to modify the risk of DTC. A diet rich in vegetables and fruit, as well as saltwater fish (a source of iodine) and low-fat meat, could be important protective factors.

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