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ORIGINAL ARTICLE

# NUTRITIONAL KNOWLEDGE, DIET QUALITY AND BREAST OR LUNG CANCER RISK: A CASE-CONTROL STUDY OF ADULTS FROM WARMIA AND MAZURY REGION IN POLAND

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## ABSTRACT

**Background.** Knowledge on proper nutrition favours the creation of pro-healthy nutritional behaviours of people. Studies related to the nutritional knowledge of adults, diet quality and incidence of breast or lung cancers are limited.

**Objective.** Analysis of the relationship between the level of nutritional knowledge, diet quality and risk of breast cancer in women or lung cancer in men from the Warmia and Mazury region in Poland.

**Material and methods.** The study was carried out in 202 subjects aged 23-80 years, including 107 women (17 cases of breast cancer) and 95 men (54 cases of lung cancer) from the Warmia and Mazury region in Poland. Nutritional knowledge was evaluated with the Questionnaire of Eating Behaviours (QEB), including 25 statements. Based on the frequency of the consumption of 16 food items, two diet quality indices were created: the pro-Healthy-Diet-Index-8 (pHDI-8) and the non-Healthy-Diet-Index-8 (nHDI-8). The values of pHDI-8 and nHDI-8 were calculated on the basis of the sum of the daily frequency of consumption of the selected food items and expressed as times/day. The Odds Ratio (OR) of both breast cancer or lung cancer in relation to the level of nutritional knowledge was calculated based on a logistic regression analysis.

**Results.** The incidence of breast or lung cancer in the bottom, middle and upper tertile of nutritional knowledge was 57.6%, 32.6% and 15.8%, respectively. As nutritional knowledge grew in the subsequent tertiles, pHDI-8 was on the increase (2.63 vs. 3.78 vs. 4.22 times/day) and n-HDI-8 was on the decrease (1.32 vs. 1.21 vs. 0.94 times/day). In the upper tertile of nutritional knowledge, the Odds Ratio for the incidence of breast or lung cancers varied from 0.06 (95% CI: 0.02; 0.17; $p<0.05$, with adjustment for cancer type and age) to 0.17 (95% CI: 0.04; 0.69; $p<0.05$, with adjustment for age and sex) when compared to the bottom tertile (OR=1.00). In the middle tertile of nutritional knowledge, the Odds Ratio of both cancers varied from 0.27 (95% CI: 0.12; 0.62, $p<0.05$, with adjustment for cancer type and age) to 0.35 (95% CI: 0.18; 0.71, $p<0.05$, variables without adjustment) when compared to the bottom tertile.

**Conclusions.** A higher level of nutritional knowledge was associated with the higher quality of a pro-healthy diet and lower risk of breast cancer in women or lung cancer in men. In contrast, a lower level of nutritional knowledge was associated with a lower diet quality and a higher risk of both types of cancers.

**Key words:** *nutritional knowledge, diet quality, breast cancer, lung cancer*

## STRESZCZENIE

**Wprowadzenie.** Wiedza na temat prawidłowego żywienia sprzyja kształtowaniu prozdrowotnych zachowań żywieniowych ludzi. Badania dotyczące wiedzy żywieniowej osób dorosłych w powiązaniu z jakością diety oraz częstością występowania raka piersi lub płuc są ograniczone.

**Cel.** Analiza zależności między poziomem wiedzy żywieniowej, jakością diety i ryzykiem raka piersi u kobiet lub płuc u mężczyzn z regionu Warmii i Mazur w Polsce.

**Materiał i metody.** Badania przeprowadzono wśród 202 osób w wieku 23-80 lat, w tym u 107 kobiet (17 przypadków raka piersi) i 95 mężczyzn (54 przypadki raka płuc) z regionu Warmii i Mazur. Wiedzę żywieniową respondentów oceniono za pomocą zestawu 25 stwierdzeń na temat żywności i żywienia z kwestionariusza o akronimie QEB. Na podstawie częstości spożycia 16 grup żywności utworzono dwa indeksy jakości diety: Indeks Prozdrowotnej Diety (pHDI-8) i Indeks Niezdrowej Diety (nHDI-8). Indeksy pHDI-8 i nHDI-8 obliczono przez sumowanie dziennej częstości spożycia odpowiednich grup

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żywności i wyrażono jako krotność/dzień. Za pomocą regresji logistycznej obliczono iloraz szans (OR) wystąpienia raka piersi lub płuc w relacji do poziomu wiedzy żywieniowej.
**Wyniki.** Występowanie raka piersi lub płuc w dolnym, środkowym i górnym tercylu wiedzy żywieniowej wynosiło odpowiednio 57,6%, 32,6% i 15,8%. Wraz ze wzrostem wiedzy żywieniowej w kolejnych tercylach rósł wskaźnik pHDI-8 (2,63 vs 3,78 vs 4,22 krotność/dzień) oraz malał wskaźnik n-HDI-8 (1,32 vs 1,21 vs 0,94 krotność/dzień). W górnym tercylu wiedzy żywieniowej iloraz szans wystąpienia raka piersi lub płuc wynosił od 0,06 (95% CI: 0,02; 0,17; p<0,05, z adjustacją na rodzaj raka i wiek) do 0,17 (95% CI: 0,04; 0,69; p<0,05, z adjustacją na wiek i płeć) w porównaniu z dolnym tercylem (OR=1,00). W środkowym tercylu wiedzy żywieniowej ryzyko obu raków wynosiło od 0,27 (95% CI: 0,12; 0,62, p<0,05, z adjustacją na rodzaj raka i wiek) do 0,35 (95% CI: 0,18; 0,71 p<0,05, zmienne nieadjustowane) w porównaniu z dolnym tercylem.
**Wnioski.** Większy poziom wiedzy żywieniowej był związany z lepszą jakością prozdrowotną diety i mniejszym ryzykiem wystąpienia raka piersi u kobiet lub płuc u mężczyzn. Z kolei mniejszy poziom wiedzy żywieniowej był związany z gorszą jakością diety i większym ryzykiem wystąpienia obu raków.

**Słowa kluczowe:** *wiedza żywieniowa, jakość diety, rak piersi, rak płuc*

## INTRODUCTION

On average, 38 million people die due to chronic non communicable diseases all around the world. Most deaths are caused by: cardiovascular diseases (17.5 million), cancers (8.2 million), respiratory diseases (4 million) and diabetes (1.5 million) [25]. In the Polish population, the most prevalent types of cancer are: in men – lung cancer (20%), prostate cancer (14%) and colon cancer (12%), and in women – breast cancer (20%), colon cancer (10%) and lung cancer (9%) [14].

The aetiology of breast and lung cancer is not yet completely known in spite of many studies [2, 10]. Therefore, the identification of risk factors becomes particularly important. Reduction of the incidence of breast or lung cancer is feasible mainly due to the avoidance of modifiable risk factors. An expert report, which was published by the World Cancer Research Fund (WCRF) and American Institute for Cancer Research (AICR) [24] in 2007, identified foods which can be associated with the risk of development of breast or lung cancer. The relationship, however, has not yet been confirmed and requires further studies.

The primary condition for the success of a nutritional policy is an increase in the public awareness of the relationship between nutrition and health. Nutritional education increases the level of knowledge of society and enables a conscious selection of food [3]. This favours the creation of desirable, pro-healthy views, attitudes and nutritional human behaviour [11]. There are limited studies on the relationship between the level of adult nutritional knowledge, diet quality and incidence of breast or lung cancer. No relevant studies have been performed in the northern and eastern region of Poland.

The aim of the study was evaluation of the relationship between the level of nutritional knowledge, diet quality and risk of breast cancer in women or lung cancer in men from the Warmia and Mazury region.

## MATERIAL AND METHODS

*Subjects*

The study was carried out from July 2013 to September 2014. The study in women was performed at the Hospital of the Ministry of Internal Affairs with Warmia and Mazury Oncology Centre in Olsztyn and the Centre for Prevention and Diagnostics of Breast Diseases in Olsztyn. The study in men was performed at the Independent Public Complex Tuberculosis and Lung Diseases in Olsztyn and in selected health clinics of the lung diseases diagnostics in the Warmia and Mazury region.

The inclusion criteria to the study were related to examinations which were performed within the last 6 months and which included: in women – an ultrasound (USG) and/or mammogram, in men – X-ray examination and/or computed tomography of the thorax and/or bronchoscopy. The exclusion criteria to the study were: (i) the coexistence of cancer(s) other than breast/lung cancer, (ii) nonmalignant cancers, (iii) age below 18 years, (iiii) place of residence outside the Warmia and Mazury region, (iiiii) pregnancy in women. Patients with positive biopsy results or/and of a histopathology were included into the "cancer" group, and with a confirmed negative result – to the "control" group.

Finally, the study was carried out in 202 subjects aged 23-80 years, including 107 women (17 cases of breast cancers) and 95 men (54 cases of lung cancer) from the Warmia and Mazury region of Poland. The characteristics of the study subjects are provided in Table 1. The study was approved by the Bioethics Committee of the Faculty of Medical Sciences, University of Warmia and Mazury in Olsztyn on 2 October 2013 (Resolution No. 29/2013). Written consent to participate in the study was required.

*Nutritional knowledge*

Data on nutritional knowledge was collected with the Questionnaire of Eating Behaviours (QEB), which

Table 1. Characteristics of the sample

| Characteristics | Total | | Control | | Cancer | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| *Total sample number* | 202 | 100 | 131 | 64.8 | 71 | 35.2 |
| *Sex* | | | | | | |
| Female | 107 | 52.5 | 90 | 68.7 | 17 | 23.9 |
| Male | 95 | 47.5 | 41 | 31.3 | 54 | 76.1 |
| *Size of place of residence* | | | | | | |
| Village | 53 | 26.2 | 25 | 19.1 | 28 | 39.4 |
| Town <20,000 | 35 | 17.3 | 19 | 14.5 | 16 | 22.6 |
| Town 20,000–100,000 | 50 | 24.8 | 35 | 26.7 | 15 | 21.1 |
| City >100,000 | 64 | 31.7 | 52 | 39.7 | 12 | 16.9 |
| *Education* | | | | | | |
| Primary or lower secondary school | 37 | 18.3 | 7 | 5.3 | 30 | 42.3 |
| Higher secondary school | 120 | 59.4 | 83 | 63.4 | 37 | 52.1 |
| High school | 45 | 22.3 | 41 | 31.3 | 4 | 5.6 |
| *Physical activity at work*[#] | | | | | | |
| Low | 43 | 21.3 | 32 | 24.4 | 11 | 15.5 |
| Average | 71 | 35.2 | 57 | 43.5 | 14 | 19.7 |
| Above average | 36 | 17.8 | 28 | 21.4 | 8 | 11.3 |
| Not employed | 52 | 25.7 | 14 | 10.7 | 38 | 53.5 |
| *Physical activity in leisure time*[‡] | | | | | | |
| Low | 47 | 23.3 | 27 | 20.6 | 20 | 28.2 |
| Average | 125 | 61.9 | 81 | 61.8 | 44 | 62.0 |
| Above average | 30 | 14.8 | 23 | 17.6 | 7 | 9.8 |

n – sample number, % – sample percentage, [#]Physical activity at work: "low" – more than 70% of working time spent sedentary, "average" – approx. 50% of working time spent sedentary and 50% of working time spent in an active manner, "above average" – approx. 70% of working time spent in an active manner or physical work related to great exertion, [‡]Physical activity in leisure time: "low" – sedentary for most of the time, watching TV, reading books, walking 1-2 hours per week, "average" – walking, bike riding, gymnastics, gardening, light physical activity performed 2-3 hours per week, "above average" – bike riding, jogging, gardening, sport activities involving physical exertion performed more than 3 hours weekly.

was developed by the Sections of Behavioural Conditions of Nutrition, Committee of Human Nutrition Science, Polish Academy of Sciences [22]. The Questionnaire included twenty-five statements related to nutritional knowledge. The reliability of all statements was confirmed with the Cronbach's alpha analysis. A respondent was provided with three options with regard to each statement on food and nutrition, and they included: "I agree", "I don't agree", "I have no opinion". Each correct answer was scored with 1, and a wrong answer and "I have no opinion" were scored with 0. The sum of points was calculated for each respondent (range: 0-25). Based on the sum, the respondents were divided into 3 tertiles of nutritional knowledge:

- bottom tertile <11 points,
- middle tertile from 11 to 15 points,
- upper tertile >15 points.

*Frequency of food consumption*

Frequency of food consumption was defined with the Questionnaire of Eating Behaviours. Respondents were asked to specify the habitual frequency of the consumption of 16 selected foods which were consumed on average within the last year. They were provided with 6 categories of the answer, which were converted into daily frequency (times/day): "never" (0), 1-3 times a month (0.06), once a week (0.14), several times a week (0.5), once a day (1), several times a day (2) [22]. Two diet quality indices were created by summing up the daily frequency of the consumption of the selected food items:

- pro-Healthy-Diet-Index-8 (pHDI-8; range: 0-16 times/day) – which included 8 food items: fruit, vegetables, wholemeal bread, fermented milk drinks (yoghurt, kefir, etc.), milk (including flavoured milk), cottage cheese (including cream cheese), fish or fish-based dishes, legumes-based dishes;
- non-Healthy-Diet-Index-8 (nHDI-8; range: 0-16 times/day) – which included 8 food items: sweets or confectionery, fried food, alcoholic beverages, sweetened carbonated drinks, canned: meat, fish and vegetables-meat, instant or ready-to-eat concentrated soups, fast food, energy drinks.

*Data analysis*

The normality of variables was verified with the *Kolmogorov-Smirnov* test. The means and standard deviations (SDs) were calculated for the frequency of consumption of each food item, as well as both diet quality indexis. All variables were logarithmically transformed

before the analysis was performed. The differences between the groups were verified with ANOVA. A logistic regression analysis was used. The Odds Ratio (OR) and 95% confidence interval (95% CI) were calculated. The significance of OR was verified with Wald's statistics. The reference group included subjects within the bottom tertile of nutritional knowledge (OR=1.00). The logistic regression analysis included the following confounders: age (a continuous variable), sex (a categorical variable), cancer type (a categorical variable). Five models were created: Model 1 – crude, without adjustment for confounding factors, Model 2 – variables adjusted for age, Model 3 – variables adjusted for age and sex, Model 4 – variables adjusted for cancer type, Model 5 – variables adjusted for cancer type and age.

For all tests, $p<0.05$ was considered as significant. The statistical analysis was performed with STATISTICA software (version 10.0 PL; StatSoft Inc., USA, Tulsa; StatSoft Polska, Kraków).

## RESULTS

The incidence of breast or lung cancers in the bottom, middle and upper tertiles of nutritional knowledge was 57.6%, 32.6% and 15.8%, respectively (Table 2).

As nutritional knowledge grew in their consecutive tertiles, pHDI-8 significantly increased (2.63 vs. 3.78 vs. 4.22 times/day, respectively) (Table 2). In the upper tertile of nutritional knowledge, in comparison to the middle or bottom tertile, a significantly higher frequency of consumption of fruit (0.95 vs. 0.88 vs. 0.64 times/day; respectively; p=0.004), vegetables (1.05 vs. 0.81 vs. 0.53 times/day, respectively; p<0.001), wholemeal bread (0.63 vs. 0.49 vs. 0.36 times/day, respectively; p=0.015) was found. In the upper tertile vs. bottom tertile of nutritional knowledge, a significantly more frequent consumption of fermented milk drinks (0.58 vs. 0.27 times/day, respectively; p<0.001) and cottage cheese (0.32 vs. 0.19, respectively; p=0.001) was found. With an increase of nutritional knowledge, in their consecutive tertiles, a significant decrease of nHDI-8 (1.32 vs. 1.21 vs. 0.94 times/day, respectively) was found (Table 2). In the upper tertile of nutritional knowledge, in comparison to the middle tertile or bottom tertile, a significantly less frequent consumption of sweetened carbonated drinks (0.04 vs. 0.11 vs. 0.15 times/day, respectively; p=0.003), canned: meat, fish or vegetables-meat (0.05 vs. 0.07 vs. 0.10 times/day, respectively; p<0.001), instant or ready-to-eat concentrated soups (0.03 vs. 0.07 vs. 0.07 times/day, respectively; p=0.049) and fast food (0.02 vs. 0.03 vs. 0.03 times/day, respectively; p=0.036) was found. In the upper tertile vs. bottom tertile of nutritional knowledge, a significantly less frequent consumption of alcoholic beverages (0.07 vs. 0.16; p=0.021) and energy drinks (0.00 vs. 0.01; p=0.010) was shown.

Table 2. Frequency of the consumption of selected foods (times/day) in relation to nutritional knowledge

| Food items | Total | Nutritional knowledge | | | p |
|---|---|---|---|---|---|
| | | Bottom tertile | Middle tertile | Upper tertile | |
| Percentage of cancer cases (%) | 35.2 | 57.6$^{b}$ | 32.6$^{c}$ | 15.8$^{bc}$ | <0.001 |
| **pro-Healthy Diet Index – pHDI-8**$^{\#}$ | 3.57±1.91 | 2.63$^{ab}$±1.45 | 3.78$^{a}$±1.85 | 4.22$^{b}$±2.09 | <0.001 |
| Fruit | 0.83±0.60 | 0.64$^{ab}$±0.54 | 0.88$^{a}$±0.57 | 0.95$^{b}$±0.65 | 0.004 |
| Vegetables | 0.80±0.53 | 0.53$^{ab}$±0.36 | 0.81$^{ac}$±0.50 | 1.05$^{bc}$±0.62 | <0.001 |
| Wholemeal bread | 0.49±0.61 | 0.36$^{b}$±0.57 | 0.49±0.62 | 0.63$^{b}$±0.63 | 0.015 |
| Fermented milk drinks | 0.45±0.50 | 0.27$^{ab}$±0.30 | 0.49$^{a}$±0.53 | 0.58$^{b}$±0.58 | NS |
| Milk | 0.45±0.49 | 0.43±0.50 | 0.49±0.46 | 0.43±0.51 | NS |
| Cottage cheese | 0.30±0.36 | 0.19$^{ab}$±0.22 | 0.36$^{a}$±0.41 | 0.32$^{b}$±0.36 | NS |
| Fish or fish-based dishes | 0.15±0.17 | 0.12±0.12 | 0.17±0.18 | 0.17±0.19 | NS |
| Legumes-based dishes | 0.09±0.13 | 0.08±0.14 | 0.10±0.12 | 0.08±0.12 | NS |
| **non-Healthy Diet Index – nHDI-8**$^{\#}$ | 1.17±0.79 | 1.32$^{b}$±0.93 | 1.21$^{c}$±0.72 | 0.94$^{bc}$±0.70 | 0.028 |
| Sweets or confectionery | 0.46±0.50 | 0.50±0.51 | 0.50±0.53 | 0.37±0.41 | NS |
| Fried food | 0.32±0.25 | 0.30±0.24 | 0.31±0.23 | 0.35±0.30 | NS |
| Alcoholic beverages | 0.11±0.20 | 0.16$^{b}$±0.27 | 0.11±0.18 | 0.07$^{b}$±0.11 | NS |
| Sweetened carbonated drinks | 0.10±0.23 | 0.15$^{b}$±0.30 | 0.11$^{c}$±0.21 | 0.04$^{bc}$±0.15 | 0.003 |
| Canned: meat, fish or vegetable-meat | 0.07±0.11 | 0.10$^{b}$±0.12 | 0.07±0.11 | 0.05$^{b}$±0.11 | <0.001 |
| Instant or ready-to-eat concentrated soups | 0.06±0.15 | 0.07±0.16 | 0.07±0.18 | 0.03±0.10 | 0.049 |
| Fast foods | 0.03±0.03 | 0.03±0.04 | 0.03±0.03 | 0.02±0.03 | 0.036 |
| Energy drinks | 0.01±0.02 | 0.01$^{b}$±0.02 | 0.01$^{c}$±0.02 | 0.00$^{bc}$±0.01 | NS |

$^{\#}$ mean±standard deviation, p – significance level of ANOVA (after logarithmic data transformation before analysis), NS – insignificant differences, $^{aa, \ldots cc}$ – significant differences in pairs at p<0.05

Table 3. Odds Ratio and 95% Confidence Interval (95% CI) of the incidence of breast cancer in women or lung cancer in men in relation to nutritional knowledge

| | Odds Ratio (95% CI) | | |
|---|---|---|---|
| | Nutritional knowledge | | |
| | Bottom tertile | Middle tertile | Upper tertile |
| Model 1 | 1.00 | 0.35*(0.18;0.71) | 0.14*(0.06;0.34) |
| Model 2 | 1.00 | 0.30*(0.13;0.67) | 0.07*(0.02;0.22) |
| Model 3 | 1.00 | 0.62 (0.25;1.56) | 0.17*(0.04;0.69) |
| Model 4 | 1.00 | 0.32*(0.16;0.66) | 0.11*(0.05;0.29) |
| Model 5 | 1.00 | 0.27*(0.12;0.62) | 0.06*(0.02;0.17) |

Model 1 – variables without adjustment, Model 2 – variables adjusted for age, Model 3 – variables adjusted for age and sex, Model 4 – variables adjusted for cancer type, Model 5 – variables adjusted for cancer types and age, *significance level of the Wald test $p<0.05$

In the upper tertile of nutritional knowledge, the ORs of the incidence of breast cancer or lung cancer varied from 0.06 (95% CI: 0.02; 0.17; $p<0.05$, with adjustment for cancer type and age) to 0.17 (95% CI: 0.04; 0.69; $p<0.05$, with adjustment for age and sex) when compared to the bottom tertile (OR=1.00) (Table 3). In the middle tertile of nutritional knowledge, the ORs of the incidence of breast cancer or lung cancer varied from 0.27 (95% CI: 0.12; 0.62, $p<0.05$, with adjustment for cancer type and age) to 0.35 (95% CI: 0.18; 0.71, $p<0.05$, variables without adjustment) when compared to the bottom tertile.

## DISCUSSION

Results of our studies have shown an inverse relationship between the level of nutritional knowledge and the incidence of breast cancer in women or lung cancer in men. We also found an inverse relationship between the incidence of these cancers and the pro-healthy diet quality index, as well as many pro-healthy foods. There was also evidence of a positive relationship between the incidence of these cancers, a non-healthy diet index and many non-healthy food items.

The inverse relationship between the level of nutritional knowledge and risk of breast cancer in women or lung cancer in men in our studies can be explained with the relationship between nutritional knowledge and the diet quality. The author's study has shown that a higher level of nutritional knowledge was associated with a higher overall diet quality (measured as the diet quality index) and more frequent consumption of pro-healthy foods including: fruit, vegetables, wholemeal bread, fermented milk drinks, cottage cheese. These results are similar to those reported by other authors, which have shown the protective role of fruit and vegetables in the development of breast or lung cancer [9, 12, 23]. There are, however, studies on the risk of lung cancer which did not show any positive role of fruit and vegetables [26]. *Skuladottir* et al. [18] noticed a tendency for a lower risk of mortality among people who consumed more fruit and vegetables. This protective effect of fruit and vegetables can be contributed to their high content of bioactive compounds with a potential beneficial effect on health. Based on the results of many studies, experts of the WCRF/AICR report stated that fruit and also foods containing carotenoids probably decrease the risk of lung cancer [24]. Experts also stated that supplementation in smokers with beta-carotene taken as a single component is a well-recognized risk factor of lung cancer [24]. This report pointed out that there was no sufficient evidence showing the beneficial influence of the consumption of cereal products, dairy products, legumes, poultry and fish on the incidence of breast or lung cancer.

The author's study has shown that a lower level of nutritional knowledge was associated with a lower overall diet quality and more frequent consumption of non-healthy foods such as: alcoholic beverages, sweetened carbonated drinks, canned: meat, fish or vegetables-meat, instant or ready-to-eat concentrated soups, fast food and energy drinks. Our results are consistent with the results of *Taylor* et al. [20], who stated that consumption of processed meat increased the risk of development of breast cancer by 64%. In Spain, studies on lung cancer showed an inverse relationship between meat consumption and the risk of cancer [7]. In Uruguay, it was found out that consumption of spirits significantly increased the risk of lung adenocarcinoma [6]. International EPIC studies [21] did not show any significant relationship between alcohol consumption and the risk of breast cancer. The WCRF/AICR report [24] showed that consumption of alcohol is a factor which increases the risk of breast cancer, and in the case of lung cancer, there is no evidence of its negative influence. Our results have shown that consumption of sweetened carbonated drinks and fast food adversely affected the risk of both cancers. This is confirmed by epidemiological studies, which linked a low-sugar and low-fat diet with a lower incidence of cancer and an increased human lifespan, whereas an excess of calories increased the risk of cancer and shortened lifespan [13].

The author's study has shown a significant relationship between nutritional knowledge and the overall impact of pro-healthy and non-healthy food, which, as a consequence, affects the risk of breast cancer in women or lung cancer in men. The results of the author's studies are consistent with the results of studies on breast cancer in women from France. It was observed that an "Alcohol/Western" pattern was associated with a higher risk of breast cancer, and a "Healthy/Mediterranean" pattern was linked to a lower risk of cancer [4]. Similar results were obtained by *De Stefanii* et al. [5] in the context of the incidence of lung cancer in men from Uruguay. The "High meat" pattern increased the risk of lung cancer by three times, whereas the "Antioxidants" pattern reduced this risk.

The author's studies have confirmed that nutritional knowledge affected the incidence of breast cancer in women or lung cancer in men. The knowledge obtained in youth affects the behaviour and nutritional attitude of adults. Researchers share the view that prevention of cancer should start in schools [15]. Behaviour adopted in childhood appears to have a strong influence on adults' health-related activities [19]. It was reported that the nutritional education of adults resulted in their willingness to improve their nutritional pattern even after the first meeting [16], and as a consequence of nutritional intervention, elderly people increased consumption of fruit, vegetables and foods rich in calcium [1]. The results of the author's study have shown that nutritional knowledge had a great impact on food consumption and, as a result, on health. Many adults are aware of the relationship between nutrition and the risk of cancer. However, they often do not have knowledge on the diet quality, foods and their components and the increasing risk of disease [8]. There is evidence that nutritional education in women with breast cancer may be beneficial for health, as this can result in an increase in the consumption of fruits and vegetables and lead to a reduction in the consumption of meat [17].

## CONCLUSIONS

A higher level of nutritional knowledge was associated with a higher pro-healthy diet quality and lower risk of breast cancer in women or lung cancer in men. In contrast, a lower level of nutritional knowledge was associated with a lower diet quality and a higher risk of both types of cancers. It may be suggested that nutritional education focused on pro-healthy foods and knowledge on non-healthy foods may play an important role in prevention of both types of cancer.

**Conflict of interest**

*The authors declare no conflict of interest.*

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