Rocz Panstw Zakl Hig 2017;68(4):365-373

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ORIGINAL ARTICLE

COMPARISON OF NUTRITIONAL VALUE OF "FRUIT AND VEGETABLES" AND "WESTERN" DIETARY PATTERNS IDENTIFIED IN A GROUP OF CANCER PATIENTS

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ABSTRACT

Background. Dietary patterns (DPs) are defined as the amounts, types and combinations of various food products in habitual diets and the frequency of their consumption. Dietary pattern analysis is usually performed in order to assess the combined effect of consumed food products on health.

Objective. The aim of the study was to assess and compare the nutritional value of dietary patterns identified in a group of patients staying on the oncological ward.

Material and methods. The study group consisted of 100 patients (51 women and 49 men) aged 19-83 years. Dietary intake was assessed using a food frequency questionnaire (FFQ) validated for the population of Lower Silesian Voivodeship.

Results. Factor analysis identified two main dietary patterns explaining 25.6% of variance. The "fruit and vegetables" DP consisted of vegetables, fruits, juices, unrefined grains and nuts, seeds and raisins. Instead, the "Western" DP was characterized by the consumption of high-fat and processed meat and poultry, fried fish, refined grains, honey and sugar, fats, sweets, beverages and chips. While higher scores for "fruit and vegetables" pattern were associated with increased intake of dietary fiber, antioxidant vitamins, folic acid and decreased glycemic load per 1000 kcal and sodium intake, for "Western" pattern observed relationships were opposite. Women were more likely to have higher factor scores for "fruit and vegetables" DP and lower factor scores for "Western" DP than men.

Conclusions. Dietary patterns identified in the study group differed in terms of nutritional value, in spite of similar macronutrient content in the diet. "Western" DP was characterized by lower nutritional value than "fruit and vegetables" dietary pattern.

Key words: *dietary patterns, factor analysis, fruit and vegetables, Western diet, cancer, glycemic load*

STRESZCZENIE

Wprowadzenie. Wzory żywienia (*ang. dietary patterns*) definiowane są jako ilości, rodzaje i kombinacje produktów spożywczych i napojów zawartych w całodziennej diecie oraz częstotliwość, z jaką są one zwyczajowo spożywane. Analiza wzorów żywienia jest stosowana w celu określenia synergistycznego efektu oddziaływania różnorodnych składowych diety na zdrowie.

Cel. Celem pracy było porównanie wzorów żywienia wyodrębnionych w grupie pacjentów przebywających na oddziale onkologicznym.

Materiał i metody. Grupa badana liczyła 100 pacjentów (51 kobiet i 49 mężczyzn) w wieku 19-83 lata. Sposób żywienia oceniono na podstawie kwestionariusza częstotliwości spożycia żywności (FFQ) walidowanego dla populacji dolnośląskiej.

Wyniki: Za pomocą analizy czynnikowej wyodrębniono dwa główne wzory żywienia wyjaśniające łącznie 25,6% wariancji. Wzór „owocowo-warzywny" charakteryzował się wysokim spożyciem warzyw, owoców, soków, nierafinowanych produktów zbożowych, orzechów i nasion, a wzór „zachodni" - tłustego i przetworzonego mięsa i drobiu, smażonych ryb, rafinowanych produktów zbożowych, miodu i cukru, tłuszczów, słodyczy, słodzonych napojów i frytek. Wysokie wartości czynnikowe wzoru „owocowo-warzywnego" były związane ze zwiększoną zawartością w diecie błonnika pokarmowego, witamin antyoksydacyjnych i kwasu foliowego, niższą zawartością sodu oraz niższym ładunkiem glikemicznym w przeliczeniu na 1000 kcal diety. Dla wzoru „zachodniego" zaobserwowane zależności były odwrotne. W grupie kobiet

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uczestniczących w badaniu wykazano wyższe wartości czynnikowe wzoru „owocowo-warzywnego" i niższe wartości czynnikowe wzoru „zachodniego" niż w grupie mężczyzn.
Wnioski. Wzory żywienia wyodrębnione w badanej grupie chorych znacznie różniły się od siebie wartością odżywczą pomimo podobnej zawartości makroskładników diety. Wzór „zachodni" charakteryzował się niższą wartością odżywczą diety, niż wzór „owocowo-warzywny".

Słowa kluczowe: *wzory żywienia, analiza czynnikowa, owoce i warzywa, dieta zachodnia, choroba nowotworowa, ładunek glikemiczny*

INTRODUCTION

Environmental factors including improper diet are one of the most important causes of non-communicable diseases: cardiovascular diseases, cancer, chronic respiratory diseases and diabetes [20]. The list of selected food products that are usually considered as the most unhealthy comprises refined starchy foods, red and processed meat, sweetened drinks, fast foods, salty and energy-dense foods [24].

Nonetheless, the consumption of individual food products may be sometimes insufficient to provide significant effect on health outcomes and various combinations of nutrients may influence one's condition in different ways. However, some food groups are often consumed together by the same persons and those relationships are used to determine the dietary patterns (DPs). Dietary patterns are defined as the quantities, variety, proportions, combinations, as well as the frequency of consumption of diverse food products and beverages. DPs may depend on a variety of environmental, socio-cultural and economic factors, that is why they may vary in different populations [23].

In opinion of the United States Department of Agriculture and United States Department of Health and Human Services [30], it is recommended to follow a "healthy eating pattern", explained as a combination of healthy food products and drinks consumed every day. It includes a variety of vegetables, fruits, whole grains, low fat dairy, plant oils and protein foods, such as seafood, lean meat and poultry, eggs, legumes, nuts, seeds and soy products. "Healthy" DP and similar to it "prudent" or "fruit and vegetables" DPs were found to decrease the risk of various diseases, including cancer [5], heart diseases [15], and diabetes [1].

A good example of unhealthy dietary pattern is "Western" pattern, typically characterized by high intake of processed food, sweets, refined grains and fast foods. In contrast to a "healthy" DP, "Western" or similar to it "unhealthy" or "processed" DPs were associated with an increased risk of development and recurrence of various diseases [1, 5, 15, 21].

Up to now, conducted studies were focused mainly on the composition of derived dietary patterns and their association with the development of various diseases. Less attention was paid to the differences in the content of selected nutrients in analyzed diets depending on their dietary pattern scores.

The aim of the presented study was therefore to assess and compare the nutritional value of dietary patterns identified in the group of patients staying on the oncological ward.

MATERIALS AND METHODS

The study group included 100 cancer patients (51 women and 49 men) from the Department of Clinical Oncology. The study was performed in the years 2014-2015 in Lower Silesian Voivodeship in Poland. The average age of participants was 60.5 ± 11.2 years (range 19-83). The average BMI (body mass index) was 26.6 ± 5.2 kg/m^2 in the group of women and 27.7 ± 4.9 kg/m^2 in the group of men. Participants were diagnosed mainly with colorectal (n=39) and breast (n=23), but also with lymphoma, bladder, ovary, prostate, kidney, pancreas, liver, lung, urinary tract or testicle cancer (n=38). The average age of breast cancer patients was 57.1 ± 9.7 years, colorectal cancer patients - 61.5 ± 8.7 years, while other patients - 61.3 ± 14.1 years. The average BMI of breast cancer patients was 26.6 ± 4.5 kg/m^2, colorectal cancer patients - 27.3 ± 5.6 kg/m^2 and other patients - 27.3 ± 4.9 kg/m^2.

Dietary intake was assessed using the data from the Food Frequency Questionnaire (FFQ), created for Prospective Urban and Rural Epidemiological Study (PURE Poland Study) and validated for the population of Lower Silesian Voivodeship aged 35-70 years [7]. The FFQ comprises 8 food groups (milk and dairy products, fruits, vegetables, meat and eggs, cereal products, mixed dishes, beverages and snacks) and overall it includes 154 food products. Dietary interview included one year period before the study.

The frequency of consumption was recorded in nine categories (0-1/month, 1-3/month, 1/week, 2-4/week, 5-6/week, 1/day, 2-3/day, 4-5/day, >6/day) and the portion sizes were calculated based on the „Album of photographs of food products and dishes" [29]. The average content of each nutrient in analyzed diets was afterwards determined using database of the Food and Nutrition Institute [19]. Dietary glycemic load (GL) was calculated as a sum of GLs of each food. Glycemic load for individual food product was calculated based on glycemic index (GI) and content of available carbohydrates. GI values of individual foods were taken from international databases [11, 22], whereas GL of traditional Polish dishes was calculated based on their composition [19].

In order to assess the dietary patterns in the study group, food items from the FFQ were classified into 21 groups: dairy (except high-fat cheese), high-fat cheese, fats, fruits, cooked vegetables, raw vegetables, eggs, chips, potatoes, high-fat or processed meat or poultry or fried fish, unprocessed low-fat meat or poultry or fish, refined grains, unrefined grains, traditional polish mixed dishes, soups, juices, beverages, alcohol, nuts, seeds and raisins, honey and sugar and sweets. Dietary patterns were identified a posteriori based on the data from the factor analysis (principal axis factoring, PAF) with varimax rotation [17]. This method was chosen due to the lack of normal distribution of variables in the study group. The number of dietary patterns was determined according to the Scree plot for eigen values of factors. Values of factor loadings higher than 0.4 were accepted as the cut-off point. For each pattern, patients were divided into three groups (tertiles), based on the factor scores of their diet.

Bioimpedance analysis (BIA) was performed using Tanita BC 418-MA analyzer in order to measure the body composition. BMI values were determined, and used to classify the patients as normal weight (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2) and obese (above 30.0 kg/m^2). Body fat percentage considered as normal depended on age and varied between 21% and 36% for women and between 8% and 25% for men. Visceral adipose tissue level lower than 13 was classified as normal [26].

Results of the study were analyzed using Statistica 12.0 PL software. A *Shapiro-Wilk* test was used to assess the normality of the data. Statistical analyses were performed using the *Kruskal-Wallis* test, *Mann-Whitney* U test and *Chi*^{2} test. Correlation between variables was assessed using Spearman's correlation analysis. Spearman's correlation coefficient higher than 0.6 were considered as strong correlation. The level of statistical significance for all analyses was set at α=0.05.

The study was approved by the Bioethics Committee of Medical University of Wroclaw (No. KB-362/2014).

RESULTS

Two principal dietary patterns were identified in presented study. Together, they explained 25.6% of variance. The factor loadings of food products for each dietary pattern are presented in Table 1.

First DP was characterized by high loadings for raw vegetables (0.87), cooked vegetables (0.67), fruits (0.65), juices (0.52), unrefined grains (0.42) and nuts, seeds and raisins (0.42). It explained 14.1% of variance. Due to its composition, it was called "fruit and vegetables" dietary pattern.

Table 1. The values of factor loadings for particular food groups

Group of products	"Fruit and vegetable" dietary pattern	"Western" dietary pattern
Raw vegetables	**0.87**	0.01
Cooked vegetables	**0.67**	-0.09
Fruits	**0.65**	0.07
Juices	**0.52**	-0.02
Unrefined grains	**0.42**	-0.30
Nuts, seeds and raisins	**0.42**	-0.18
Traditional polish mixed dishes	0.37	0.19
Dairy (except high-fat cheese)	0.32	-0.08
Soups	0.23	0.12
Unprocessed low-fat meat and poultry and fish	0.21	0.12
Eggs	0.15	0.09
High-fat and processed meat and poultry; fried fish	0.07	**0.69**
Refined grains	0.03	**0.67**
Honey and sugar	0.12	**0.52**
Fat spreads	0.29	**0.52**
Sweets	0.06	**0.51**
Beverages	-0.02	**0.50**
Chips	0.00	**0.47**
High-fat cheese	0.27	0.28
Potatoes	-0.04	0.25
Alcohol	-0.03	0.09

Second DP was associated with high loadings for high-fat and processed meat and poultry and fried fish (0.69), refined grains (0.67), honey and sugar (0.52), fats (0.52), sweets (0.51), beverages (0.50) and chips (0.47). It explained 11.5% of variance and it was called "Western" dietary pattern.

In the third tertile (T3) of the "fruit and vegetables" DP, in comparison with the first tertile (T1), there was a significantly higher percentage of women (63.6% vs. 39.4%). In contrast, in T3 of the "Western" DP, compared to T1, there was a significantly lower percentage of women (27.3% vs. 69.7%). No statistically significant difference between the upper and the bottom tertile was found with reference to BMI, body fat percentage, visceral adipose tissue level and abdominal obesity.

Table 2 presents the average energy intake and selected nutrients content in analyzed diets divided into tertiles of "fruit and vegetables" dietary pattern score. Compared to subjects in T1 of "fruit and vegetables" dietary pattern score, subjects in T3 had significantly higher energy intake, total dietary glycemic load, percentage of saturated fatty acids (SFA) and content of dietary fiber, vitamin E, folic acid and vitamin C per 1000 kcal. Inversely, they had significantly lower glycemic load per 1000 kcal and sodium content in the diet.

Table 2. Comparison of daily energy intake and nutrients content in the diets of the study group, classified into tertiles of "fruit and vegetables" dietary pattern score

Variable	T1 (n=33)	T2 (n=34)	T3 (n=33)	p
Energy [kcal]	2330.5 ± 810.6	2769.2 ± 792.1	3427.3 ± 1141.4	0.0001
Protein [% of energy]	15.7 ± 3.3	15.5 ± 3.0	14.6 ± 2.3	NS
Carbohydrates [% of energy]	43.3 ± 6.4	44.1 ± 6.0	42.2 ± 5.9	NS
Glycemic load [g]	141.5 ± 55.9	168.3 ± 53.3	187.9 ± 67.8	0.0125
Glycemic load [g/1000 kcal]	60.1 ± 9.5	60.6 ± 9.0	54.8 ± 8.8	0.0088
Dietary fiber [g/1000 kcal]	9.9 ± 2.6	11.6 ± 3.5	12.8 ± 3.0	0.0009
Sucrose [g/1000 kcal]	25.9 ± 12.5	27.9 ± 11.5	25.7 ± 11.0	NS
Fats [% of energy]	39.7 ± 6.3	39.5 ± 6.6	42.6 ± 5.6	NS
SFA [% of energy]	16.4 ± 3.1	16.2 ± 3.7	18.9 ± 3.9	0.0112
MUFA [% of energy]	15.0 ± 3.4	14.6 ± 3.2	14.8 ± 2.4	NS
PUFA [% of energy]	5.5 ± 1.4	5.9 ± 2.6	6.0 ± 1.9	NS
n6/n3 ratio	7.0 ± 1.7	7.4 ± 3.3	7.3 ± 2.4	NS
Vitamin A [µg/1000 kcal]	704.2 ± 237.0	810.0 ± 232.7	921.0 ± 410.7	NS
Retinol [µg/1000 kcal]	335.1 ± 132.4	375.3 ± 149.6	355.5 ± 144.3	NS
B-carotene [µg/1000 kcal]	2207.7 ± 1049.3	2601.3 ± 1187.0	3386.8 ± 2198.9	NS
Vitamin D [µg/1000 kcal]	1.2 ± 0.4	1.2 ± 0.4	1.1 ± 0.4	NS
Vitamin E [mg/1000 kcal]	5.5 ± 1.5	6.0 ± 1.9	6.7 ± 1.7	0.0058
Vitamin B_1 [mg/1000 kcal]	0.6 ± 0.1	0.6 ± 0.1	0.6 ± 0.1	NS
Vitamin B_2 [mg/1000 kcal]	0.9 ± 0.3	0.9 ± 0.2	0.9 ± 0.2	NS
Niacin [mg/1000 kcal]	9.6 ± 2.9	10.0 ± 3.5	8.4 ± 1.6	NS
Vitamin B_6 [mg/1000 kcal]	1.0 ± 0.2	1.0 ± 0.2	1.0 ± 0.2	NS
Folic acid [µg/1000 kcal]	136.5 ± 34.5	148.5 ± 33.6	176.4 ± 49.0	0.0012
Vitamin B_{12} [µg/1000 kcal]	2.1 ± 0.8	2.0 ± 0.8	1.9 ± 0.6	NS
Vitamin C [mg/1000 kcal]	65.0 ± 31.9	70.6 ± 24.3	108.5 ± 49.1	< 0.0001
Sodium [mg/1000 kcal]	1117.1 ±262.8	1159.6 ± 361.7	921.9 ± 217.2	0.0016
Potassium [mg/1000 kcal]	1779.2 ± 382.5	1802.6 ± 341.3	1897.5 ± 372.6	NS
Calcium [mg/1000 kcal]	458.4 ± 217.2	420.8 ± 140.5	457.0 ± 157.9	NS
Phosphorus [mg/1000 kcal]	679.7 ± 160.7	673.5 ± 118.9	669.7 ± 132.3	NS
Magnesium [mg/1000 kcal]	163.4 ± 37.2	169.8 ± 34.9	175.4 ± 42.8	NS
Iron [mg/1000 kcal]	5.58 ± 1.3	6.0 ± 1.0	6.1 ± 1.2	NS
Zinc [mg/1000 kcal]	5.2 ± 1.3	5.2 ± 0.8	5.0 ± 0.8	NS

T1, T2, T3 – tertiles of dietary pattern score; p - statistical significance; NS - no statistically significant differences between tertiles; SFA - saturated fatty acids; MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids

The average energy intake and selected nutrients content in analyzed diets divided into tertiles of "Western" DP score are presented in Table 3. Subjects in T3, in comparison with T1, had significantly higher energy intake, glycemic load, sucrose content per 1000 kcal and percentage of monounsaturated fatty acids (MUFA). At the same time, they had significantly lower dietary fiber, vitamin A, β-carotene, vitamin E, vitamin B_1, vitamin B_2, niacin, vitamin B_6, folic acid, vitamin C, potassium, calcium, phosphorus, magnesium, iron and zinc content per 1000 kcal.

Table 4 shows the *Spearman's* correlations between daily energy intake and nutrients content in the diets and dietary pattern scores. There was a significant positive correlation between "fruit and vegetables" dietary pattern score and energy intake, total dietary glycemic load, percentage of energy from total fats and SFA as well as dietary fiber, vitamin A, β-carotene, vitamin E, folic acid, vitamin C and iron content per 1000 kcal. Statistically significant negative correlation was found between "fruit and vegetables" dietary pattern score and glycemic load per 1000 kcal and sodium content

Table 3. Comparison of daily energy intake and nutrients content in the diets of the study group, classified into tertiles of "Western" dietary pattern score

Variable	T1 (n=33)	T2 (n=33)	T3 (n=34)	p
Energy [kcal]	2054.9 ± 477.8	2744.0 ± 822.2	3699.9 ± 934.5	< 0.0001
Protein [% of energy]	15.9 ± 2.7	15.5 ± 3.5	14.4 ± 2.2	NS
Carbohydrates [% of energy]	43.6 ± 6.1	43.4 ± 6.7	42.7 ± 5.5	NS
Glycemic load [g]	114.5 ± 31.4	161.8 ± 47.8	219.8 ± 50.9	< 0.0001
Glycemic load [g/1000 kcal]	55.8 ± 9.4	59.4 ± 9.2	60.3 ± 9.2	NS
Dietary fiber [g/1000 kcal]	13.7 ± 3.4	11.9 ± 2.2	8.8 ± 1.9	< 0.0001
Sucrose [g/1000 kcal]	23.3 ± 8.5	24.2 ± 9.5	32.1 ± 14.1	0.0090
Fats [% of energy]	39.7 ± 6.5	40.0 ± 7.0	42.1 ± 5.2	NS
SFA [% of energy]	16.9 ± 4.1	16.9 ± 4.1	17.7 ± 3.1	NS
MUFA [% of energy]	13.7 ± 2.5	14.6 ± 3.3	16.0 ± 2.8	0.0036
PUFA [% of energy]	6.2 ± 2.8	5.7 ± 1.5	5.4 ± 1.5	NS
n6/n3 ratio	7.7 ± 3.4	7.2 ± 2.2	6.7 ± 1.9	NS
Vitamin A [µg/1000 kcal]	992.0 ± 391.7	802.9 ± 229.2	645.2 ± 186.5	< 0.0001
Retinol [µg/1000 kcal]	382.4 ± 186.0	359.7 ± 122.6	325.4 ± 102.9	NS
B-carotene [µg/1000 kcal]	3649.7 ± 2100.7	2653.6 ± 1181.3	1913.4 ± 845.8	< 0.0001
Vitamin D [µg/1000 kcal]	1.2 ± 0.4	1.2 ± 0.4	1.2 ± 0.3	NS
Vitamin E [mg/1000 kcal]	6.8 ± 2.2	6.1 ± 1.4	5.3 ± 1.2	0.0013
Vitamin B_1 [mg/1000 kcal]	0.6 ± 0.1	0.6 ± 0.1	0.6 ± 0.1	0.0260
Vitamin B_2 [mg/1000 kcal]	1.1 ± 0.3	0.9 ± 0.2	0.8 ± 0.2	0.0001
Niacin [mg/1000 kcal]	9.1 ± 2.2	10.5 ± 3.7	8.4 ± 2.1	0.0166
Vitamin B_6 [mg/1000 kcal]	1.1 ± 0.2	1.0 ± 0.2	0.8 ± 0.2	< 0.0001
Folic acid [µg/1000 kcal]	187.6 ± 45.5	153.1 ± 22.8	121.6 ± 27.0	< 0.0001
Vitamin B_{12} [µg/1000 kcal]	2.2 ± 0.9	2.0 ± 0.6	1.8 ± 0.5	NS
Vitamin C [mg/1000 kcal]	108.7 ± 50.9	79.9 ± 27.9	55.9 ± 18.7	< 0.0001
Sodium [mg/1000 kcal]	973.6 ± 267.3	1130.1 ± 368.2	1096.8 ± 248.2	NS
Potassium [mg/1000 kcal]	2100.6 ± 317.3	1860.3 ± 245.2	1526.8 ± 275.9	< 0.0001
Calcium [mg/1000 kcal]	530.5 ± 199.1	392.3 ± 127.6	413.5 ± 158.9	0.0072
Phosphorus [mg/1000 kcal]	758.6 ± 144.3	660.0 ± 116.1	606.3 ± 104.4	0.0002
Magnesium [mg/1000 kcal]	200.7 ± 38.4	169.4 ± 24.9	139.4 ± 21.6	< 0.0001
Iron [mg/1000 kcal]	6.7 ± 1.0	6.1 ± 1.1	5.0 ± 0.6	< 0.0001
Zinc [mg/1000 kcal]	5.6 ± 0.7	5.1 ± 1.2	4.7 ± 0.7	0.0001

T1, T2, T3 – tertiles of dietary pattern score; p - statistical significance; NS - no statistically significant differences between tertiles; SFA - saturated fatty acids; MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids

per 1000 kcal. "Western" DP was strongly positively correlated with energy intake and total glycemic load and strongly negatively correlated with dietary fiber, folic acid, potassium, magnesium and iron content per 1000 kcal. Moreover, significant positive correlation was observed between "Western" DP score and percentage of energy from MUFA and total glycemic load, sucrose and sodium content per 1000 kcal, while negative correlation was found for percentage of energy from protein and content of vitamin A, β-carotene, vitamin E, vitamin B_1, vitamin B_2, vitamin B_6, vitamin B_{12}, vitamin C, calcium, phosphorus and zinc per 1000 kcal.

DISCUSSION

According to current guidelines of World Cancer Research Fund and American Institute for Cancer Research [33], cancer survivors should follow the recommendations for cancer prevention: maintain a healthy weight, eat at least five portions of fruit and vegetables a day, limit red and processed meat and alcohol consumption, do not smoke and be physically active. Proper nutrition is thus an important part of cancer therapy, that may not only prevent the malnutrition, but also determine the effectiveness of the treatment.

Meyerhardt et al. [21] found that unhealthy diet, characterized by high intake of meat, fat, refined grains and dessert, was associated with higher risk of colon cancer recurrence and mortality among patients treated with surgery and chemotherapy. In that group of patients healthy diet is of special concern also due to the fact, that cancer survivors may be at increased risk of other non-communicable diseases, including diabetes and cardiovascular diseases. *Kroenke* et al. [18] observed that in group of women diagnosed with invasive breast cancer, higher intake of fruit, vegetables, whole grains and low-fat dairy was associated with significantly lower risk of death from all causes other than breast cancer.

In presented study, "fruit and vegetables" pattern consisted of products that are usually considered as healthy: fruits, vegetables, nuts and whole grains. It was associated with higher intake of dietary fiber, antioxidant vitamins and folate. These results are similar to the results obtained by other authors [14, 18, 27, 35]. Inadequate daily intake of dietary fiber may increase the risk of cancer and other non-communicable diseases, whereas higher dietary fiber intake was associated with a reduced risk of all-cause mortality [35].

Second DP identified in the conducted analysis was called „Western" due to its similarity to the diet typical for United States and Western countries. "Western" diet

Table 4. Correlation between daily energy intake and nutrients content in the diets and dietary pattern scores

Variable	R for "fruit and vegetable" dietary pattern	R for "Western" dietary pattern
Energy [kcal]	0.48 *	0.72 *
Protein [% of energy]	-0.17	-0.26 *
Carbohydrates [% of energy]	-0.07	-0.07
Glycemic load [g]	0.35 *	0.77 *
Glycemic load [g/1000 kcal]	-0.21 *	0.22 *
Dietary fiber [g/1000 kcal]	0.41 *	-0.68 *
Sucrose [g/1000 kcal]	-0.02	0.31 *
Fats [% of energy]	0.22 *	0.16
SFA [% of energy]	0.24 *	0.10
MUFA [% of energy]	0.03	0.37 *
PUFA [% of energy]	0.14	-0.15
n6/n3 ratio	0.05	-0.13
Vitamin A [µg/1000 kcal]	0.24 *	-0.53 *
Retinol [µg/1000 kcal]	0.06	-0.13
B-carotene [µg/1000 kcal]	0.28 *	-0.53 *
Vitamin D [µg/1000 kcal]	-0.12	0.05
Vitamin E [mg/1000 kcal]	0.36 *	-0.41 *
Vitamin B_1 [mg/1000 kcal]	0.04	-0.27 *
Vitamin B_2 [mg/1000 kcal]	0.00	-0.51 *
Niacin [mg/1000 kcal]	-0.14	-0.18
Vitamin B_6 [mg/1000 kcal]	0.09	-0.59 *
Folic acid [µg/1000 kcal]	0.39 *	-0.73 *
Vitamin B_{12} [µg/1000 kcal]	-0.16	-0.23 *
Vitamin C [mg/1000 kcal]	0.53 *	-0.57 *
Sodium [mg/1000 kcal]	-0.31 *	0.22 *
Potassium [mg/1000 kcal]	0.15	-0.74 *
Calcium [mg/1000 kcal]	-0.02	-0.31 *
Phosphorus [mg/1000 kcal]	-0.09	-0.49 *
Magnesium [mg/1000 kcal]	0.10	-0.78 *
Iron [mg/1000 kcal]	0.22 *	-0.73 *
Zinc [mg/1000 kcal]	-0.10	-0.50 *

R- *Spearman's* correlation coefficient; * – $p < 0.05$; SFA - saturated fatty acids;
MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids

contains a lot of products high in calories and low in nutrients, that is why its components belong to those usually considered as the most unhealthy [24]. For instance, high total red meat and processed meat intake was observed to increase the risk of all-cause and cancer mortality [32], while frequent consumption of sugar, sweets and sweetened beverages was associated with an increased risk of colorectal and breast cancer [3, 31].

In the herein study, "Western" DP was inversely associated with the intake of the majority of important health-promoting nutrients: dietary fiber, antioxidant vitamins, B vitamins and minerals. Also in other study, higher factor score of "Western" DP increased the number of nutrients with intakes not meeting recommended levels [28]. Inversely, "Western" DP was associated with excessive intake of sodium. Main dietary source of sodium is table salt, but it is also often added to processed foods: bread, cheese, hams and sausages, canned food and snacks. It certainly increases the risk of hypertension and cardiovascular diseases, but it was also associated with an increased risk of stomach cancer [25]. Lack of some substances in the daily food rations, as well as the excess of the others, affect the inflammatory changes, oxidative stress and immune response and thus may be the reason of chronic diseases typical for Western countries [10].

Stronger correlation was found between daily energy intake and "Western" DP than "fruit and vegetables" DP. Western diet is typically associated with excessive energy intake because of frequent consumption of high energy density foods [30]. Dietary glycemic load depends on the glycemic index of products, their type and the content of carbohydrates in the diet [11]. It is also associated with energy intake, that is why in the upper tertile of both DPs scores, in comparison with bottom tertile, GL was higher. However, GL adjusted for the energy intake was significantly lower in T3 of "fruit and vegetables" DP compared to T1, and negative correlation between this pattern score and GL per 1000 kcal was observed. The components of "fruit and vegetables" DP (unrefined grains, nuts, seeds, fruits and vegetables) have lower GL than components typical for "Western" DP: refined grains, sugar, sweets, and sweetened beverages.

In presented study, the intake of fatty acids according to the tertiles of both DP was rather unexpected and partially opposite to the results obtained by the other authors [12, 34]. Western diet is usually characterized by high intake of SFA, high n6/n3 ratio and relatively low intake of unsaturated fatty acids [30]. However, nuts and seeds, included in "fruit and vegetables" DP, have n6/n3 ratio that considerably exceeds the recommended norm. Moreover, typical fats for polish cuisine are lard, margarine and mayonnaise – sources of oleic acid (MUFA) and butter – source of saturated fatty acids [19]. The nutritional value of dishes prepared with these fats may be thus significantly changed.

Women participating in the herein study were more likely to have higher factor scores for "fruit and vegetables" dietary pattern and lower factor scores for "Western" dietary pattern than men. It indicates that compared to men, they chose recommended food products more often. Many studies showed that men had less healthy dietary habits than women – they consumed more red meat and alcohol and less fruits, vegetables and dairy [6, 16]. Overall, cancer survivors do not often follow the recommendations concerning healthy lifestyle - they have improper dietary habits, are overweight and have low physical activity rate [2, 4, 9].

However, dietary interventions focused on the improvement of fruit and vegetables intake and limitation of the red and processed meat consumption were successfully implemented in the group of colorectal and breast cancer patients [8, 13]. A nutritional counselling aimed at cancer survivors is thus possible and may ameliorate the diet quality as well as probably influence the cancer progression and overall survival.

Similar amounts of macronutrients in the diet are not the predictors of its general nutritional quality. Although no differences were observed in herein study between tertiles of DPs and percentage of energy from total fat, carbohydrates and protein, many significant differences in the intake of other nutrients were found. Interestingly, products with similar characteristics of using in the Polish daily diet (e.g. to make sandwich, to snack) were matched to different dietary patterns based on their nutritional value. The dietary intervention based on the replacement of refined grains with unrefined grains, beverages with juices or honey, sugar and sweets with fruits, nuts, seeds and raisins would thus remarkably change the content of vitamins and minerals in the daily food rations of patients.

CONCLUSIONS

Two main dietary patterns were identified in the group of patients staying on the oncological ward. Higher scores for "fruit and vegetables" DP were associated with an increased intake of dietary fiber, antioxidant vitamins and folic acid and decreased glycemic load per 1000 kcal and intake of sodium. Inversely, "Western" DP was negatively correlated with the majority of minerals, vitamins and dietary fiber. Moreover, "Western" dietary pattern was positively correlated with total glycemic load and glycemic load per 1000 kcal.

Identification of dietary patterns by using factor analysis demonstrated the differences in nutritional value between the combinations of products having similar functions in the diet.

Cancer patients should follow the healthy dietary pattern due to the higher intake of essential nutrients with proven health benefits.

Conflict of interest

The authors declare no conflict of interest.

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Received: 20.04.2017
Accepted: 14.07.2017