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Change of the Nutritional Habits and Anthropometric Measurements of Type 2 Diabetic Patients – Advantages of the Nutritional Education Carried Out

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A – research concept and design; **B** – collection and/or assembly of data; **C** – data analysis and interpretation; **D** – writing the article; **E** – critical revision of the article; **F** – final approval of article; **G** – other

Abstract

Background. Diabetes is one of many diseases in which prevention and treatment are essentially based on proper nutrition. Nutritional education should be a constant, integral and indispensable part of the therapeutic procedure in diabetes.
Objectives. The aim of the study was an estimation of the nutritional habits of patients with type 2 diabetes before and after individual nutritional education and the answers to the question what influence this education had on the change of nutritional habits and the change of the anthropometric measurements of the patients.
Material and Methods. 148 patients of diabetes outpatient clinics participated in our study, which contained, among others, anthropometric measurements and carrying out a questionnaire that tested dietary habits. An individual nutrition plan was established and the individual dietary education of the patients was carried out on the basis of the gathered data. The nutritional habits and the anthropometric measurements were verified again three months after the education.
Results. The analysis of the results received revealed an occurrence of the differences between the incidence of proper nutritional habits and middle-values of body weight and waist size in the period before and after education. Before the education, an enormous amount of improper nutritional habits were found and the values of body weight and waist size were higher, while after the education the improvement of habits and a reduction in body weight and waist size were observed.
Conclusions. The results of our study carried out before the education revealed the occurrence of many unfavorable nutritional habits. As a result of the education, nutritional habits improved, which were simultaneously reflected in an improvement of the anthropometric parameters. The results of the studies carried out proved the efficiency and profitable influence of dietary education on changes to the nutritional habits of respondents (**Adv Clin Exp Med 2014, 23, 4, 589–598**).

Key words: diabetes, nutritional habits, anthropometric measurements, nutritional education.

Diabetes, as a syndrome of metabolic disorders of the body, is one of many diseases in which prevention and treatment are essentially based on proper nutrition. Constantly increased blood glucose level is the characteristic feature of the illness. This condition may cause the destruction of many organs and systems, may be the cause of disability and leads to a reduction in lifespan. People suffering from diabetes make up a considerable percentage of the patients treated both by general practitioners and by specialist clinics such as cardiology, nephrology, ophthalmology and surgical [1–3].

In spite of the supreme development of medical science, there is still an increasing number of new cases of diabetes observed that may be called an epidemic. It constitutes one of the most important problems of public health [3, 4]. WHO expectations from 2004 showed an increase of the

frequency of diabetes occurrence from 171 m in 2000 to 366 m in 2030 [5]. According to data from the International Diabetes Federation (IDF), 246 m people suffer from diabetes worldwide nowadays [6]. This means that 7 m new cases appear each year [7] and, according to some evaluations, the number may reach 439 m in 2030 [8]. Simultaneously, the quoted treatises point out that the incidence of diabetes will concern older people to a higher degree in advanced countries and middle-aged people in developing countries [7].

According to IDF data, there are more than 2.6 m people suffering from diabetes in Poland [9]. In the opinion of the Polish Diabetes Association (PDA), the occurrence of diabetes in Poland has increased from 6.3% in the 70's of the 20th century to about 9.3% of the population nowadays [10], and the further increase of the percentage to 11% is predicted by 2025 [9]. It is also alarming that diabetes remains undiagnosed in about 30–40% of cases [10].

Diabetes treatment is a complex process, it includes insulin therapy or taking chemicals orally, proper nutrition and regular physical activity. Moreover, the widely understood education including both individual and group nutritional education should be a constant, integral and indispensable part of the therapeutic procedure in diabetes. The aim of nutritional education should be to make it possible for patients to use the therapeutic strategy without assistance and to modify their lifestyle so that it complies with the use of proper nutritional recommendations and increase of physical activity [11].

Numerous scientific reports show the influence of education on the improvement of nutritional habits [12, 13] and an increase of the nutritional knowledge level [14, 15] which is evident in the improvement of clinical results such as a decrease of glucose and HbA1c level [16–18] and lipids concentration [12, 19].

The aim of the study was the estimation of the nutritional habits of the tested group of patients with type 2 diabetes before and after carrying out individual nutritional education and answering the question how such education influences the change of nutritional habits in our country's conditions.

Material and Methods

The study comprised the patients from two diabetic outpatients clinics from Sosnowiec in Poland. 148 persons participated in the first part of the study (including 93 women and 55 men) whereas 122 (75 women and 47 men), from among the 148 taking part in the first stage, participated in the second. The average age of the participants was 61 ± 9.1.

In the first part of the study, 148 patients were subjected to several stages which included anthropometric measurements, blood pressure measurement, biochemical tests, carrying out a questionnaire, testing nutritional habits and individual nutritional education conducted in the form of direct conversation with a dietician.

The results of the anthropometric measurements (height, body mass and waist size) were used to calculate the body mass index (BMI) and to estimate the fat tissue distribution. The biochemical tests included glucose level, HbA_{1c} and lipids parameters evaluation.

The questionnaire consisted of 21 questions including 6 referring to the social status of the respondents, duration of the illness and form of treatment and 15 questions concerning the number of meals eaten, frequency of the chosen groups of groceries taken in and type of products consumed.

An individual nutrition plan, in accordance with the Polish Diabetic Association [11] and directives of the National Food and Nutrition Institute [20], was established for each patient based on the results of the anthropometric measurements and biochemical tests, after carrying out the survey and estimating the nutritional habits. In the process of the education, accessible didactic means were used in the form of tables of composition and the nutritive values of groceries and meals, a products and meals photo album and plastic models of groceries. Particular note was taken of the elimination of the nutritional mistakes observed during the earlier studies. Regular meals of the proper size and quality, taking into consideration products with a low glycemic index, in everyday nutrition were recommended. Moreover, the technologies were introduced for preparing meals minimizing the loss of vitamins and mineral ingredients and reducing the fat content. All patients were acquainted with the rules of menu planning and equipped with educational materials.

122 of those patients had anthropometric measurements done again, which were used for body mass index (BMI) evaluation and estimated fat tissue distribution, for the second part of the study that took place three months after the end of the first one. Moreover, the nutritional habits test was given to the patients again.

The last stage of the study was the statistical analysis of the results received. The StatSoft, Inc. STATISTICA version 8.0 program was used to carry out the analysis www.statsoft.com. The nutritional habits of the subjects were estimated pursuant to the analysis of the frequency of the answers given to particular questions included in the questionnaire (the number of answers proving the proper nutritional habits divided by the number of all questions in the survey). The estimation of the differences between the frequency of answers testifying to proper nutritional habits and differences in

the population of the respondents in body mass, waist circumference and BMI before and after the education was carried out, was done using the Wilcoxon pair sequence test. The effect of the education on the change of nutritional habits in the population of the respondents was analyzed by the test of correlation between the statistical feature "Education (before, after)" and the questions included in the survey, using the χ^2 test, correspondence analysis, V Cramér's test, and rang γ correlation coefficient. χ^2 McNemar's test was used to estimate the effect realized of the educational program on the number of people among whom an improvement of the nutritional habits was observed in the general population of the patients. The significance level $\alpha = 0.05$ was adopted for all statistic analyses.

Results

Sociological Characteristics of the Tested Group

Table 1 shows the sociological characteristics of the tested group, taking their gender into account.

Clinical Characteristics of the Tested Group

Table 2 shows the clinical characteristics of the tested group. Among all the tested patients, the largest percentage consisted of obese people (65.9%), including both men (69.6%) and women (63.4%). The patients with regular body mass constituted only 5.1% of all those tested. The analysis of the waist circumference measurements revealed that people taking part in the research were characterized by considerable abdominal obesity (86.9%). There were more women (94.7%) than men (74.5%) in this group.

A desirable blood pressure level for diabetic patients was observed in 77% of the tested, regular glucose level in 18.2% and a desired level of HbA_{1c} in 54.6%. The desirable value of lipid parameters for diabetic patients, referring to triglycerides concentration, was observed among 42.5%, total cholesterol concentration among 20.3%, HDL cholesterol level among 51.6% and LDL cholesterol level among 72%.

Table 1. Sociological characteristics, duration of the illness and form of treatment of the tested group

Criterion	Women		Men		Both	
	n	%	n	%	n	%
Gender	75	61.5	47	38.5	122	100
Age:						
49 and under	5	6.7	7	14.9	12	9.8
50–59	20	26.7	16	34	36	29.5
60–69	35	46.7	15	31.9	50	41.1
70 and over	15	20	9	19.1	24	19.6
Education:						
primary	19	25.3	9	19.1	28	23
professional	28	39.3	26	55.3	54	44
secondary	26	34.7	9	19.1	35	28.5
higher	2	2.7	3	6.4	5	4.5
Occupational activity:						
employed	7	9.3	12	25.5	19	15.5
unemployed	68	90.7	35	74.5	103	84.5
Duration of the disease:						
less than 5 years	48	63.9	36	76.6	84	68.9
5–10 years	11	14.7	7	14.9	18	14.6
11–20 years	14	18.7	3	6.4	17	14
more than 20 years	2	2.7	1	2.1	3	2.5
Form of treatment: (possibility of choosing more than 1 answer):						
diet	74	98.7	46	97.9	120	98.4
pills	73	97.3	46	97.9	119	97.5
insulin	23	30.7	11	23.4	34	27.9

Table 2. Clinical characteristics of the group tested

	Women		Men		Both	
	n	%	n	%	n	%
Body mass /BMI:						
18.5–24.9*	4	5.6	2	4.3	6	5.1
25–29.9	23	31	12	26.1	35	29
≥ 30	48	63.4	33	69.6	81	65.9
Waist circumference:						
< 80 cm in women, < 94 cm in men*	2	2.7	3	6.4	5	4.1
80–88 cm in women, 94–102 cm in men	2	2.7	9	19.1	11	9
> 88 cm in women, > 102 cm in men	71	94.7	35	74.5	106	86.9
Blood pressure level:						
< 130/80*	59	78.7	35	74.5	94	77
≥ 130/80	16	21.3	12	25.5	28	23
Glucose level:						
< 100 mg/dL*	15	20.3	7	14.9	22	18.2
100–125 mg/dL	13	17.6	6	12.8	19	15.7
> 125mg/dL	47	62.2	34	72.3	81	66.1
HbA_{1c}:						
< 7.0%*	40	53	27	57	67	54.6
≥ 7.0%	35	47	20	43	55	45.4
Triglycerides:						
< 150 mg/dL*	33	44.5	19	40	52	42.5
≥ 150 mg/dL	42	55.5	28	60	70	57.5
Total cholesterol:						
< 175 mg/dL*	12	16.1	12	26.6	24	20.3
≥ 175 mg/dL	63	83.9	35	73.4	98	79.7
HDL:						
> 40 mg/dL in men, > 50 mg/dL in women*	45	61	18	38	63	51.6
≤ 40 mg/dL in men, ≤ 50 mg/dL in women	30	39	29	62	59	48.4
LDL:						
< 100 mg/dL*	49	65	39	82.5	88	72
≥ 100 mg/dL	26	35	8	17.5	34	28

* the desirable values for diabetic patients in accordance with Polish Diabetic Association's recommendations.

Analysis of the Nutritional Habits of the Tested Group

Table 3 shows the nutritional habits of the tested group before and after the conducted education.

Table 4 shows the correlation that has been ascertained in the tested group between nutritional habits before and after education.

A Comparison of the Frequency of Appearance of the Proper Nutritional Habits Before and After the Conducted Education

The statistic analysis of the results received showed the frequency of the differences between incidences of proper nutritional habits in the period before and after the education was carried out (*t*-test and the Wilcoxon test).

Table 3. The nutritional habits of the tested group before and after education

Nutritional habits	Before education		After education		Statistical analysis – relations
	n = 122	%	n = 122	%	
1. Number of daily eaten meals:					
a) ≤ 3	41	33.6	0	0	χ^2 Pearson's = 52.01
b) 4	36	29.5	69	56.6	$p < 10^{-5}$;
c) ≥ 5	45	36.9	53	43.4	V Cramér's = 0.46
2. Regularity of eaten meals:					
a) yes	54	44.3	90	73.8	χ^2 Pearson's = 32.2
b) no	20	16.4	32	26.2	$p < 10^{-5}$;
c) differently	48	39.3	0	0	V Cramér's = 0.36
3. The frequency of eating whole-wheat bread:					
a) daily	57	46.7	96	78.7	χ^2 Pearson's = 52.3
b) several times a week	20	16.4	25	20.5	$p < 10^{-5}$;
c) several times a month	34	27.9	1	0.8	V Cramér's = 0.46
d) occasionally	11	9	0	0	
4. The frequency of milk intake:					
a) every day	24	19.7	5	4.1	χ^2 Pearson's = 51.5
b) several times a week	32	26.2	8	6.5	$p < 10^{-5}$;
c) several times a month	2	1.6	20	16.4	V Cramér's = 0.46
d) occasionally	30	24.6	64	52.5	
e) never	34	27.9	25	20.5	
5. The frequency of cottage cheese consumption:					
a) every day	10	8.2	32	26.2	χ^2 Pearson's = 43.5
b) several times a week	67	54.9	82	67.2	$p < 10^{-5}$;
c) several times a month	19	15.6	8	6.6	V Cramér's = 0.42
d) occasionally	21	17.2	0	0	
e) never	5	4.1	0	0	
6. The frequency of meat and/or processed pork intake:					
a) every day	101	82.8	113	92.6	χ^2 Pearson's = 5.47
b) several times a week	19	15.6	7	5.7	$p < 0.019$;
c) several times a month	0	0	2	1.7	V Cramér's = 0.15
d) occasionally	2	1.6	0	0	
e) never	0	0	0	0	
7. The frequency of fish intake:					
a) every day	2	1.6	4	3.3	χ^2 Pearson's = 28.0
b) several times a week	24	19.7	57	43.5	$p < 10^{-5}$;
c) several times a month	70	57.4	53	43.4	V Cramér's = 0.34
d) occasionally	26	21.3	8	6.5	
e) never	0	0	0	0	
8. The frequency of fruit intake:					
a) every day	93	76.2	103	84.5	
b) several times a week	26	21.3	17	13.9	
c) several times a month	2	1.7	1	0.8	
d) occasionally	1	0.8	1	0.8	
e) never	0	0	0	0	
9. The amount of fruit eaten per day:					
a) less than 200 g	5	4.3	28	22.9	χ^2 Pearson's = 80.6
b) 200–300 g	16	12.6	51	41.8	$p < 10^{-5}$;
c) 300–500 g	59	48.3	37	30.3	V Cramér's = 0.58
d) 500 g and more	42	34.6	6	5	

Table 3. The nutritional habits of the tested group before and after education (cd.)

Nutritional habits	Before education		After education		Statistical analysis – relations
	n = 122	%	n = 122	%	
11. The frequency of potatoes consumption:					
a) every day	50	41	14	11.5	χ^2 Pearson's = 58.4
b) several times a week	69	56.6	62	50.8	$p < 10^{-5}$;
c) several times a month	2	1.6	35	28.7	V Cramér's = 0.49
d) occasionally	1	0.8	11	9	
e) never	0	0	0	0	
12. Sweetening beverages:					
a) yes	44	36.1	2	1.6	χ^2 Pearson's = 47.3
b) no	73	59.8	117	95.9	$p < 10^{-5}$;
c) occasionally	5	4.1	3	2.5	V Cramér's = 0.44
13. The frequency of sweets consumption:					
a) every day	15	12.3	1	0.8	χ^2 Pearson's = 42.0
b) several times a week	29	23.8	3	2.5	$p < 10^{-5}$;
c) several times a month	18	14.8	22	18	V Cramér's = 0.42
d) occasionally	43	35.2	83	68	
e) never	14	11.5	7	5.8	
f) in case of hypoglycemia	3	2.5	6	4.9	
14. Drinking alcohol:					
a) yes	10	8.2	2	1.7	χ^2 Pearson's = 29.5
b) no	78	63.9	113	92.6	$p < 10^{-5}$;
c) occasionally	34	27.9	7	5.7	V Cramér's = 0,35
15. Paying attention to sugar content in food:					
a) yes	47	38.5	108	88.6	χ^2 Pearson's = 65.8
b) no	66	54.1	7	5.7	$p < 10^{-5}$;
c) occasionally	9	7.4	7	5.7	V Cramér's = 0.52

Table 4. The correlation between the nutritional habits of the tested group before and after education

Nutritional habits	Statistical analysis – correlations
Number of meals eaten per day	$p < 10^{-6}$; $\gamma = 0.38$
Frequency of whole-wheat bread intake	$p < 10^{-6}$; $\gamma = 0.66$
Frequency of milk intake	$p < 2*10^{-5}$; $\gamma = -0.29$
Frequency of cottage cheese consumption	$p < 10^{-6}$; $\gamma = 0.68$
Frequency of meat and/or processed pork intake	$p < 5*10^{-4}$; $\gamma = 0.45$
Frequency of fish intake	$P < 10^{-6}$; $\gamma = 0.56$
Frequency of fruit intake	$p = 0.03$; $\gamma = 0.24$
Amount of fruit eaten	$p < 10^{-6}$; $\gamma = 0.93$
Frequency of vegetable intake	$p = 10^{-6}$; $\gamma = 0.79$
Frequency of sweets consumption	$p < 10^{-6}$; $\gamma = -0.62$

Depending on the number of the irregularities found in the estimated nutritional habits, the tested group was divided into three categories (levels) of nutritional habits: L – low level of habits (less than 40% of correct habits), M – median level of nutritional habits (40–70% of correct habits), H – high level of nutritional habits (more than 70% of correct habits).

The statistical relevance of dependence between variables was ascertained: education (before

and after) and the level of nutritional habits (L, M, H) for the accepted level of relevance α. The value of Pearson's $\chi^2 = 49.4$; $p < 10^{-5}$. V Cramér's = 0.45, which means a moderate strength of dependence between the analyzed statistical features in the test.

The results of the correspondence analysis shows that the period before education was connected with a low level of habits (large number of incorrect habits), whereas in the period after education the high level of habits (large number of correct habits) in the tested statistical community in general was ascertained. The median level of habits appears equally frequently before and after the education in the tested statistical population.

The correlation between variables: education (before and after) and level of nutritional habits (L, M, H) in the tested population ($p < 10^{-6}$) was ascertained. The power of dependence between the analyzed statistical features was high, $\gamma = 0.71$ in the test.

The results received show that the education carried out corresponds with the improvement of the nutritional habits in the tested population.

Using McNemar's χ^2 test, it was revealed that, as a result of the education, the number of people with a high nutritional habit level increased statistically significantly ($p < 10^{-4}$).

The Estimation of Body Mass, Waist Circumference and BMI Changes

The results of the tests and the analysis of the differences of arithmetic means for the tested features in the try-outs show that, for the random variables (body mass, waist circumference and BMI) in the tested populations after the education was carried out, a decrease of the mean values occurred.

The differences of arithmetic means for body mass, waist circumference and BMI before and after education in the tests respectively amounted to 2.6 ± 4.3 kg, 2.03 ± 3.8 cm and 0.9 ± 1.6 kg/m^2. The statistical values respectively amounted to $Z = 6.3$, $p < 10^{-6}$; $Z = 5.9$; $p < 10^{-6}$ and $Z = 5.9$, $p < 10^{-6}$ (Wilcoxon test).

The results received mean that the education carried out, and thus the improvement of nutritional habits, influences the body mass and waist circumference loss for persons in the tested population.

Discussion

The results of the research pursued among patients with type 2 diabetes before education show the occurrence of many unfavorable nutritional habits. The improvement of nutritional habits after the conducted education together with simultaneous body mass and waist circumference reduction was obvious.

In accordance with dietary recommendations, patients with type 2 diabetes should eat 4–5 meals per day. Regular arrangement of meals during the day and eating more frequently but in smaller amounts, agrees with better compensation of daily glucose concentration [11]. In our study, 66.4% of the patients before education and 100% after education ate the recommended 4–5 meals per day. In Batista's et al. study carried out in Vicosa in Brasil among female patients with newly-diagnosed diabetes, 54% of the tested answered that they ate 4–5 meals a day whereas 42% answered they ate 3 meals a day [21]. However, Hankó et al., testing the treatment and lifestyle of 142 Hungarian patients with type 2 diabetes, ascertained that almost half of the questioned (46.5%) ate less than 5 meals a day [22]. In Lim's et al. research, whose aim was the estimation of the influence of the individual dietary education carried out on the change of nutritional habits, showed that under its influence, the number of the meals consumed daily by the patients increased [19].

Apart from the proper number of meals per day, it is very important that the consumption at regular hours correlated with the number of doses and pharmacodynamic features of insulin or oral hypoglycemic medicines and the character of physical exercise [11].

Our studies revealed that, as a result of the education carried out, the number of patients who eat regular meals increased (from 44.3% to 73.8%). In Tan's and Magarey's research, carried out in Malaysia among 126 adults with diabetes, nearly 80% of those questioned answered that they ate meals regularly. It is necessary to emphasize that the answers were given after giving the dietary advice to the patients [23].

Cereal products are the basic source of carbohydrates in the diet. When choosing them, patients with diabetes should take into consideration that they ought to contain large amounts of nutritive fiber in their composition and belong to the group of products with low glycemic index. Our studies showed that patients declared the everyday consumption of whole-wheat bread the most often, the percentage of these persons increased from 46.7% before to 78.8% after the education. Miller and et al., who estimated the changes in the nutritional habits of 103 patients suffering from type 2 diabetes, received similar results after the end of the education. It was ascertained that as a result of the conducted education, the frequency of white bread consumption evidently decreased

and the patient more frequently consumed wholewheat bread [24].

Milk and dairy products are the main source of protein and calcium, including the natural sugar lactose, which makes their consumption influence the increase of glucose blood concentration. Whereas our research showed that milk and cottage cheese consumption was insufficient and, after carrying out the education, in comparison to the previous period, additionally a decrease of the number of persons who drank milk everyday occurred (4.1% and 19.7%, respectively), whereas the number of persons eating cottage cheese every day increased (from 8.2% to 26.2%). Batistaet et al. ascertained that, from among 156 people tested, 61% consumed milk every day while 56% ate cottage cheese at least once a month [21]. Johansen and et al., who tested the changes of nutritional habits of 198 overweight Pakistani women living in Oslo endangered with diabetes, observed that after carrying out the dietary education, a decrease of particularly fat milk and yogurt consumption occurred [25].

Meat and fish are products which provide a large amount of protein but some of them contain a lot of fat and cholesterol as well. In our research, 82.8% of the patients before education and 92.6% after the education answered that they ate meat and its products every day. As a result of the education carried out the percentage of patients who ate fish several times a week increased as well from 19.7% to 43.5%. Other results in the range of frequency of meat consumption were received by Johansen et al., who tested the changes of dietary habits after introducing the Inna Diab-DEPLAN program. They revealed that, as a result of the education carried out, the intake of red meat decreased [25]. Whereas Batista et al., analyzing the results of the research in the matter of fish intake, ascertained that up to 74% of the tested patients ate fish every day [21].

The regular intake of green vegetables and fruit by the persons with diabetes influences the decrease of glycated hemoglobin [26]. In this respect, their daily consumption is recommended with every meal, best in the form of salads. It is worth paying attention to fruit intake for their easily digestible carbohydrates – glucose and fructose. Their consumption in larger amounts may cause an increase of blood glucose concentration.

The results of our research both before and after education showed that patients most often declared the daily consumption of vegetables and fruit and the number of these patients increased as a result of the education. Similar results were received by Johansen et al., who estimated the change of dietary habits of Pakistani women living in Oslo after introducing the Inna Diab-DEPLAN program, and ascertained that the daily intake of vegetable and fruit servings increased as a result [25]. Nelson et al., who tested the current state of knowledge of 717 war veterans from Washington suffering from diabetes, and simultaneously estimated their willingness to make the possible changes, ascertained that 14% of the questioned declared an intake of more than 5 servings of vegetables and fruits while up to 22% of the respondents answered that they did not eat fruit and vegetables every day. The intention to improve dietary habits regarding an increase in the frequency of fruit and vegetable intake up to 5 times a day was declared by up to 59% of the questioned [27]. In the research of Nelson et al., who tested the nutrition and the physical activity of 1480 adult Americans with type 2 diabetes applied to the 3rd National Health and Nutrition Examination Survey (NHANES III), revealed that 62% of all patients questioned answered that they ate less that 5 portions of vegetables and fruit per day [28]. Miller et al., estimating the changes in nutrition of adult Americans with type 2 diabetes, received other results [24]. They ascertained that both before and after the education, the test subjects ate the same number of fruits. Simultaneously in the same study, they proved that as a result of the conducted education, the test subjects decreased the consumption of potatoes. Such a decrease was ascertained in our research as well.

In accordance with the standpoint of the Polish Diabetic Association, alcohol consumption by patients with type 2 diabetes is forbidden. Alcohol inhibits the release of glucose from the liver and, through this connection, it may favor the occurrence of hypoglycemia [11]. On the grounds of the results of our research, it was ascertained that most of the patients had not drunk any alcohol, and as a result of the education carried out, this number increased from 63.9% to 92.6%. In Batista's et al. research, 28% of the tested persons declared drinking alcohol, 71% of them answered that they had drunk at least once a week and 29% once a month [21]. In Magas' et al. study, whose aim was an estimation of the salubrious behavior of Croatian patients suffering from diabetes and comparison to the behavior of healthy persons, it was revealed that from among those ill with diabetes, 5.8% drank alcohol [29]. Eliat-Adar et al., who estimated the compliance with dietary recommendations of 1008 participants of the Strong Heart Study (SHS) and 373 participants of the National Health and Nutrition Survey (NHANES) with diabetes, ascertained that respectively 999 and 349 persons declared drinking alcohol [26].

The results of the studies carried out show that after education, a decrease occurred of the mean values of body mass of 2.6 ± 4.3 kg, waist circumference of 2.03 ± 3.8 cm and BMI of 0.9 ± 1.6 kg/m^2. Analyzing in detail the influence of the individual

education carried out on the change of anthropometric parameters of the tested persons, it can be ascertained that similar weight loss was observed by the authors of other research like Matvienko et al. [30], Lim et al. [19] in Korea and Deakin et al. [31] in Great Britain, among others. Matvienko et al., after 12 months since the author's program referring to the modification of nutritional habits was introduced, a loss of body weight of 6% in 56% of the tested persons was observed [30]. In Lim's et al**.** research, similarly to ours, a decrease of BMI was observed – on average from 24.4 to 23.7 [19]. In other studies where, as in our research, the effectiveness was estimated of the education carried out by a qualified dietician as one of the forms of type 2 diabetes prevention, after a yearlong period, weight loss of 4.2 ± 5.1 kg was observed. A body mass measurement carried out among the tested persons after two years showed that body mass remained lower (3.5 ± 5.5 kg) than in the days before education [32]

Kattlemann et al**.** [33], Metghalchi et al. [34] and Gurka et al. [35] also observed a slightly lesser although significant body mass loss and decrease of BMI. In Gurka's et al. studies, the authors observed the fact that the persons with less formal education had received better results of body mass reduction than those with higher education. Simultaneously the authors noticed the diminution of waist circumference [35].

Williamson et al**.** showed a mean loss of body mass of the tested persons that was larger than in our research; a body mass decrease of 8.2 kg was observed. Simultaneously, the authors of the study paid attention to the improvement of general fitness of the test subjects that carrying out the educational program had contributed to in a fundamental way in their opinion [36]. Torres et al., who in their research compared the efficiency of individual and group education carried out among the patients of a university hospital in Brazil, received interesting results. After three months since the education, a small increase in body mass was observed among the patients who had participated in the group education while, in the case of individual education, body mass decreased 2.7 kg [37].

The results of our research and many of the quoted studies confirm that the proper education of patients with diabetes may broaden their knowledge of the treatment [33, 38, 39] and of proper nutrition in diabetes [39]. This may have a reflection in the improvement of anthropometric measurements and biochemistry tests results, and the quality of life that follows, of the diabetic patients [19, 30, 40].

The results of our studies carried out among patients with type 2 diabetes before education revealed the occurrence of many unfavorable dietary habits. It was proved that, in the results of the education carried out, improvement occurred in that respect. The number of persons with a high level of good dietary habits statistically significantly increased, which reflected simultaneously in the improvement of anthropometric measurements. The results of the studies carried out proved the efficiency and profitable influence of dietary education on the change of the nutritional habits of the tested patients.

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