

## PRACA ORYGINALNA

## Study of health risks in patients with type 2 diabetes by assessing their diet

Badanie zagrożeń zdrowia pacjentów z cukrzycą typu 2 za pomocą oceny ich sposobu żywienia

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## ABSTRACT

Treating diabetes is a complex process covering proper diet, regular and moderate physical activity and medication. The basis of diet planning is to determine the energy requirements, considering the age, sex, physical activity, physiological condition, concomitant diseases and body mass of the patient. The aim of the study was to evaluate the energy value of meals consumed by patients with type 2 diabetes considering their age, sex and body mass.

**MATERIAL AND METHODS**

The study was performed three times on 100 patients, including 52 men and 48 women. It consisted in a 24-hour diet recall and performing anthropometric measures. To evaluate the energy value of meals, the Dieta 2 computer program was used, whereas the Statistica 7.1 program was used for statistical analyses purposes.

**RESULTS**

Among the men and women of all the age groups, the daily energy requirements were lower comparing to the dietary recommendations. Moreover, the energy value of individual meals was lower in comparison to the recommendations, excluding dinner which for all the age and weight groups (excluding men aged 31–50 of 90–99kg body mass and women over 75 years of age of 60–69 kg body mass) provided more energy comparing to the recommended value. The energy value of individual meals consumed by the studied patients regardless of their age, weight and body mass was lower comparing to the dietary recommendations. An improper distribution of energy in daily rations and its inadequate division in meals was noted, regardless of the age and sex of the studied subjects.

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**CONCLUSIONS**

A 24-hour diet recall is an element enabling possible health risks assessment, including under-nutrition, overweight or obesity in patients with type 2 diabetes.

**KEY WORDS**

nutrition, energy, diabetes

**STRESZCZENIE**

Leczenie cukrzycy jest procesem kompleksowym i obejmuje stosowanie odpowiedniej diety, regularnej i umiarkowanej aktywności fizycznej oraz przyjmowanie leków. Podstawą planowania diety jest ustalenie zapotrzebowania energetycznego, które powinno uwzględniać wiek, płeć, aktywność fizyczną, stan fizjologiczny, współistnienie chorób oraz masę ciała pacjenta. Celem pracy była ocena wartości energetycznej posiłków spożywanych przez pacjentów z cukrzycą typu 2, z uwzględnieniem ich płci, wieku i masy ciała.

**MATERIAŁ I METODY**

Badanie zostało przeprowadzone trzykrotnie. Uczestniczyło w nim 100 pacjentów, w tym 52 mężczyzn i 48 kobiet. Składały się na nie 24-godzinny wywiad żywieniowy oraz pomiary antropometryczne. Do oceny wartości energetycznej posiłków posłużono się programem komputerowym Dieta 2, do analiz statystycznych wykorzystano program Statistica 7.1.

**WYNIKI**

Dla mężczyzn i kobiet we wszystkich grupach wiekowych dobowy podaż energii była niższa od wskazywanej w zaleceniach żywieniowych. Także wartość energetyczna poszczególnych posiłków była niższa od zalecanej, z wyjątkiem posiłku obiadowego, który we wszystkich grupach wiekowych i wagowych (poza mężczyznami w wieku 31–50 lat i masie ciała 90–99 kg oraz kobietami powyżej 75 lat i masie ciała 60–69 kg) dostarczał więcej energii od ilości rekomendowanej. Wartość energetyczna poszczególnych posiłków spożywanych przez badanych pacjentów niezależnie od ich płci, wieku i masy ciała była niższa od zaleceń żywieniowych. Stwierdzono nieprawidłowy rozkład energii zawartej w dziennej racji pokarmowej i podział jej na posiłki, niezależnie od płci i wieku badanych osób.

**WNIOSEK**

24-godzinny wywiad żywieniowy jest elementem umożliwiającym ocenę możliwości wystąpienia zagrożeń zdrowia, w tym niedożywienia, nadwagi lub otyłości, u pacjentów z cukrzycą typu 2.

**SŁOWA KLUCZOWE**

odżywianie, wartość energetyczna, cukrzyca

**INTRODUCTION**

Nutrition plays a major role in diseases such as type 2 diabetes, obesity, hypertension, hyperlipidemia and cardiovascular diseases [1,2,3]. Patients with diabetes constitute a significant

percentage of patients treated by general practitioners and specialists in many fields, including among others cardiology, nephrology, neurology, surgery, ophthalmology and cardiac surgery [4,5,6]. The treatment of diabetes is a complex process covering proper diet, regular and moderate physical activity and medication. The treatment should be accompanied

by widely understood education, including dietary habits [7,8]. Diet is connected with the necessity to follow certain rules aiming at well-being and a proper blood glucose level as well as preventing late diabetic complications [2]. A patient with diabetes may consume the same products as a healthy person, however, he or she should watch not to exceed the quantities and proportions adjusted to his or her limited metabolic capabilities [9]. When drawing up a diet for patients with diabetes, one should consider its energy value, composition and proper distribution of meals during the day. The individual preferences of a patient should also be considered. The planned diet should meet the quantitative and qualitative demands of the organism. It should consist of products of both animal and plant origin and contain all the necessary nutrients. The frequency and regularity of meals is of significance since it provides the opportunity to obtain a metabolic balance [1,10]. Determining the energy requirements, considering the age, sex, physical activity, physiological condition, concomitant diseases and body mass of the patient is the basis for any diet planning [11,12]. The recommendations specified below should be followed when determining the energy requirements:

- 1) recumbent patients should receive 20–25 kcal/kg due body mass/day,
- 2) walking patients performing no physical activity should receive 25–30 kcal/kg due body mass/day,
- 3) patients performing light work should receive 30–35 kcal/kg due body mass/day
- 4) patients performing heavy work – 40 kcal/kg due body mass/day [7].

With regard to the recommendations above, periodical control of the nutritional regime of patients with diabetes, including both the energy and nutrition value of consumed meals, seems to be necessary.

Due to the significance of the nutritional regime in treating type 2 diabetes, studies aiming at evaluating the energy value of meals consumed by the examined patients, considering their sex, age and body mass, were performed.

#### MATERIAL AND METHODS

The study was performed on 100 patients with type 2 diabetes, including 52 men and 48 women, who visited the Diabetes Clinic in

Bytom in May, 2011. They were all walking patients performing no physical activity. Participation in the study was of a voluntary nature and the participants were informed about the purpose thereof. The study consisted of two phases; diet recall concerning the nutrition method within 24 hours preceding the examination and performing anthropometric measurements (height and body mass) which were then used to calculate the body mass index (BMI). Diet recalls with the patients were performed three times during two working days and a holiday.

For the needs of the performed analyses, the patients were divided into 4 age groups: 31–50 years (22 patients, including 12 women and 10 men), 51–65 years (31 patients, including 15 women and 16 men), 66–75 years (28 patients, including 11 women and 17 men), over 75 years (19 patients, including 10 women and 9 men) and 3 weight groups for women: 60–69 kg (7 patients), 70–79 kg (33 patients) and 80–89 kg (8 patients) and 3 weight groups for men: 70–79 kg (9 patients), 80–89 kg (32 patients) and 90–99 kg (11 patients).

To assess the energy value, the Dieta 2 computer program was used, a database of which contained information included in tables of the composition and nutritional value of products and meals. For the purposes of statistical analysis, the Statistica 7.1 program was used. The main energy value and standard deviation were calculated and the obtained results were compared to the normative value by means of a t-test for a single sample. Comparisons between the individual groups (age and weight group) were performed by means of two-factor variance analysis.

In all the tables, the uniform method of determining significant differences between the individual groups studied was adopted. The values marked with letters are of significant difference between each other. Small letters (a, b) mean significant differences ( $p \leq 0.05$ ), whereas capital letters (A, B) mean highly significant differences ( $p \leq 0.01$ ).

#### RESULTS

The subjects suffered from overweight (72 patients, including 35 women and 37 men), in rare cases obesity (23 patients, including 10 women and 13 men), whereas correct body

mass was determined in 5 patients (3 women and 2 men).

In the men of all the age groups, the daily energy demand was lower comparing to the dietary recommendations. The highest energy value was noted in the group of men aged 51–65 of 90–99 kg body mass. Furthermore, the energy value of the individual meals was lower comparing to the recommendations, excluding dinner which for all the age and weight groups (excluding men aged 31–50 of 90–99 kg body mass) the energy requirements were higher comparing to the adopted standards.

In the women of all the age groups, the daily energy requirements were lower comparing to the dietary recommendations. The highest energy value was stated in the group of women aged 31–50 of a 80–89 kg body mass. Furthermore, the energy value of the individual meals was lower comparing to the recommendations, excluding dinner which for all the age and weight groups (excluding women above 75 of 60–69 kg body mass) the energy requirements were higher comparing to the adopted standards.

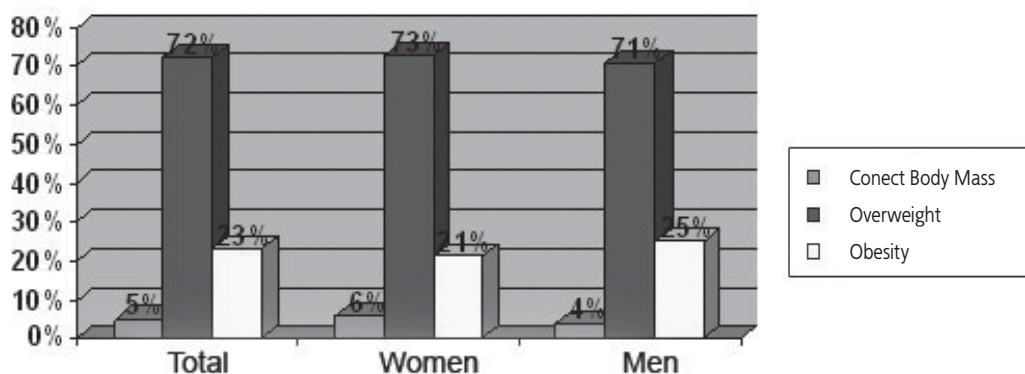


Fig. 1. BMI of examined persons.

Ryc. 1. Badane osoby wg wskaźnika BMI.

Table I. Percentage of energy in men's and women's meals (average values)

Tabela I. Procentowy rozkład kaloryczności posiłków mężczyzn i kobiet (wartości średnie)

Meal	Recommended energy value (%)	Percentage of energy in meals' age groups							
		31–50 year-olds		51–65 year-olds		66–75 year-olds		> 75 year-olds	
		men	women	men	women	men	women	men	women
Breakfast	20	13	18	16	19	17	21	20	19
Breakfast II	15	9	11	7	9	7	7	8	10
Dinner	30	27	40	31	36	35	39	36	33
Afternoon snack	15	3	7	4	10	2	9	8	9
Supper	20	14	27	15	28	17	31	19	20

An improper distribution of energy in meals was noted, regardless of the age and sex of the studied subjects.

SPOSÓB ŻYWIENIA PACJENTÓW Z CUKRZYCĄ

**Table II.** Realization of standard for energy (kcal) and its content in men's meals, in relation to weight  
**Tabela II.** Realizacja norm na energię (kcal) i jej zawartość w posiłkach mężczyzn, z uwzględnieniem masy ciała

Meal	Age	Weight					
		70-79 kg		80-89 kg		90-99 kg	
		standard (kcal)	obtained results	standard (kcal)	obtained results	standard (kcal)	obtained results
Whole day	31-50	2350	1616.7 (101.8)	2450 <sup>A</sup>	1529.8 <sup>B</sup> (133.8)	2650 <sup>A</sup>	1438.8 <sup>B</sup> (51.6)
	51-65	2150 <sup>A</sup>	1421.1 <sup>B</sup> (239.3)	2200 <sup>A</sup>	1377.1 <sup>B</sup> (138.1)	2400 <sup>A</sup>	1831.9 <sup>B</sup> (466.7)
	66-75	1950 <sup>A</sup>	1513.6 <sup>B</sup> (147.9)	2100 <sup>A</sup>	1410.1 <sup>B</sup> (92.6)	2150	1735.5 (375.8)
	> 75	1850	1790.8 (273.2)	1950 <sup>A</sup>	1732.2 <sup>B</sup> (75.3)	2000	1481.7 (280.1)
I breakfast	31-50	470	400.7 (66.9)	490	358.3 (141.4)	530 <sup>A</sup>	288.0 <sup>B</sup> (71.7)
	51-65	430	295.2 (103.2)	440 <sup>A</sup>	299.2 <sup>B</sup> (93.8)	480	470.9 (117.5)
	66-75	390	388.2 (56.0)	420	323.2 (98.4)	430	406.8 (132.9)
	> 75	370	392.0 (176.3)	390	367.6 (61.1)	400 <sup>A</sup>	312.4 <sup>B</sup> (29.6)
II breakfast	31-50	352 <sup>A</sup>	0.0 <sup>B</sup> (0.0)	368	247.8 (98.0)	398 <sup>A</sup>	184.0 <sup>B</sup> (87.3)
	51-65	323 <sup>A</sup>	118.0 <sup>B</sup> (30.7)	330 <sup>A</sup>	115.9 <sup>B</sup> (113.1)	360	196.9 (170.2)
	66-75	293 <sup>A</sup>	112.5 <sup>B</sup> (140.1)	315 <sup>A</sup>	163.3 <sup>B</sup> (137.5)	323 <sup>A</sup>	156.3 <sup>B</sup> (59.9)
	> 75	278	253.3 (62.7)	293	241.7 (130.1)	300 <sup>A</sup>	87.0 <sup>B</sup> (119.0)
Dinner	31-50	705	794.0 (71.2)	735	698.0 (95.2)	795 <sup>A</sup>	569.7 <sup>B</sup> (66.5)
	51-65	645	702.2 (82.5)	660 <sup>A</sup>	626.1 <sup>B</sup> (122.8)	720	791.5 (239.1)
	66-75	585	710.3 (142.5)	630 <sup>A</sup>	554.3 <sup>B</sup> (67.8)	645	856.9 (218.9)
	> 75	555	795.8 (139.8)	585	688.4 (113.2)	600	646.9 (204.2)
Afternoon snack	31-50	352 <sup>A</sup>	0.0 <sup>B</sup> (0.0)	368 <sup>A</sup>	58.0 <sup>B</sup> (50.3)	398 <sup>A</sup>	101.5 <sup>B</sup> (24.1)
	51-65	323 <sup>A</sup>	82.9 <sup>B</sup> (76.2)	330 <sup>A</sup>	46.9 <sup>B</sup> (61.1)	360 <sup>A</sup>	136.3 <sup>B</sup> (88.7)
	66-75	293 <sup>A</sup>	51.7 <sup>B</sup> (57.3)	315 <sup>A</sup>	70.9 <sup>B</sup> (72.9)	323 <sup>A</sup>	69.8 <sup>B</sup> (70.5)
	> 75	278	141.0 (29.0)	293 <sup>A</sup>	104.7 <sup>B</sup> (85.9)	300	119.3 (110.8)
Supper	31-50	470	457.8 (87.0)	490	295.6 (147.2)	530 <sup>A</sup>	363.7 <sup>B</sup> (56.2)
	51-65	430	327.6 (133.3)	440	344.7 (120.6)	480 <sup>A</sup>	356.5 <sup>B</sup> (110.7)
	66-75	390	342.2 (56.0)	420	400.8 (76.7)	430	375.4 (64.3)
	> 75	370	290.8 (50.7)	390	442.2 (67.1)	400	344.8 (29.0)

A, B – significantly important differences between the examined parameter and the standard (p<0,01); a, b – mean significant differences between the examined parameter (p<0,05) and the standard.

**DISCUSSION**

For many years, the dietary treatment of patients with diabetes has been the only form of therapy. Also at present, the dietary treatment of diabetes plays a significant role and as patients fail to follow the dietary recommendations, despite intensive forms of insulin therapy and taking the latest generation of diabetes medication, they do not achieve the set goal of metabolic balance in diabetes.

The diet recalls performed in patients showed numerous mistakes. The subjects consumed between three and five meals a day, where the percentage distribution of meals' energy value was in most cases improper. Incorrectness referred to the second breakfast and afternoon snack. These meals were frequently omitted or consisted of a piece fruit or a serving of yoghurt and thus provided insufficient energy. The opposite situation referred to dinner, which was in turn too abundant and provided a surplus of energy. In the studies performed

**Table III.** Realization of standard for energy (kcal) and its content in women's meals, in relation to weight  
**Tabela II.** Realizacja norm na energię (kcal) i jej zawartość w posiłkach kobiet, z uwzględnieniem masy ciała

Meal	Age	Weight					
		60–69 kg		70–79 kg		80–89 kg	
		standard (kcal)	obtained results	standard (kcal)	obtained results	standard (kcal)	obtained results
Whole day	31–50	1850 <sup>a</sup>	1436.1 <sup>b</sup> (225.0)	1950 <sup>a</sup>	1544.5 <sup>b</sup> (223.5)	2100 <sup>a</sup>	1570.9 <sup>b</sup> (75.9)
	51–65	1750	1513.0 (99.6)	1850 <sup>a</sup>	1358.9 <sup>b</sup> (212.8)	2000 <sup>a</sup>	1557.7 <sup>b</sup> (174.7)
	66–75	1700 <sup>a</sup>	1521.5 <sup>b</sup> (10.1)	1750	1569.3 (308.8)	1900 <sup>a</sup>	1351 <sup>b</sup> (151.4)
	> 75	1650	1403.0 (0.0)	1700 <sup>a</sup>	1452.3 <sup>b</sup> (179.1)	1850 <sup>a</sup>	1434.4 <sup>b</sup> (124.7)
I breakfast	31–50	370 <sup>a</sup>	256.1 <sup>b</sup> (41.6)	390	420.0 (71.9)	420 <sup>a</sup>	297.7 <sup>b</sup> (49.2)
	51–65	350 <sup>a</sup>	227.6 <sup>b</sup> (41.3)	370 <sup>a</sup>	282.7 <sup>b</sup> (64.9)	400	333.2 (100.9)
	66–75	340	283.0 (11.3)	350	325.4 (143.6)	380 <sup>a</sup>	274.0 <sup>b</sup> (63.8)
	> 75	330	210.3 (0.0)	340	329.2 (63.5)	370 <sup>a</sup>	284.3 <sup>b</sup> (39.7)
II breakfast	31–50	278 <sup>a</sup>	159.0 <sup>b</sup> (72.0)	293 <sup>a</sup>	121.7 <sup>b</sup> (47.9)	315 <sup>a</sup>	129.4 <sup>b</sup> (82.6)
	51–65	263 <sup>a</sup>	157.1 <sup>b</sup> (7.7)	278 <sup>a</sup>	83.1 <sup>b</sup> (62.1)	300 <sup>a</sup>	95.9 <sup>b</sup> (94.4)
	66–75	255 <sup>a</sup>	77.5 <sup>b</sup> (26.2)	263 <sup>a</sup>	93.0 <sup>b</sup> (20.8)	287 <sup>a</sup>	86.2 <sup>b</sup> (68.0)
	> 75	248	308.0 (0.0)	255 <sup>a</sup>	85.9 <sup>b</sup> (72.0)	278 <sup>a</sup>	124.2 <sup>b</sup> (109.0)
Dinner	31–50	555	764.5 (168.6)	585	626.5 (125.5)	630 <sup>b</sup>	748.2 <sup>a</sup> (27.1)
	51–65	525	660.6 (186.3)	555 <sup>b</sup>	666.0 <sup>a</sup> (81.5)	600	731.5 (171.6)
	66–75	510 <sup>b</sup>	726.0 <sup>a</sup> (17.0)	525 <sup>b</sup>	727.0 <sup>a</sup> (88.4)	570	633.3 (78.1)
	> 75	495	427.0 (0.0)	510 <sup>b</sup>	725.3 <sup>a</sup> (130.0)	555	606.2 (136.4)
Afternoon snack	31–50	278 <sup>a</sup>	113.8 <sup>b</sup> (98.3)	293 <sup>a</sup>	80.2 <sup>b</sup> (79.4)	315 <sup>a</sup>	100.7 <sup>b</sup> (107.0)
	51–65	263 <sup>a</sup>	77.3 <sup>b</sup> (73.8)	278 <sup>a</sup>	86.8 <sup>b</sup> (79.5)	300 <sup>a</sup>	129.7 <sup>b</sup> (22.6)
	66–75	255 <sup>a</sup>	145.0 <sup>b</sup> (10.8)	263 <sup>a</sup>	127.8 <sup>b</sup> (33.2)	287 <sup>a</sup>	85.2 <sup>b</sup> (70.0)
	> 75	248	161.0 (0.0)	255 <sup>a</sup>	129.8 <sup>b</sup> (35.7)	278 <sup>a</sup>	111.0 <sup>b</sup> (88.2)
Supper	31–50	370 <sup>a</sup>	241.2 <sup>b</sup> (55.4)	390 <sup>a</sup>	317.5 <sup>b</sup> (48.8)	420	338.3 (60.4)
	51–65	350	298.2 (81.0)	370 <sup>a</sup>	289.5 <sup>b</sup> (73.1)	400	295.0 (118.9)
	66–75	340	300.3 (46.2)	350	346.4 (121.5)	380 <sup>a</sup>	263.5 <sup>b</sup> (113.3)
	> 75	330	157.7 (0.0)	340	295.4 (55.5)	370	367.7 (111.8)

A,B – significantly important differences between the examined parameter and the standard ( $p < 0,01$ ); a, b – mean significant differences between the examined parameter ( $p < 0,05$ ) and the standard.

by Heropolitańska-Janik et al. [14] similar incorrectness was noted. The subjects also consumed their meals irregularly. The highest energy values were at dinner and supper, whereas breakfasts had an insufficient energy value in the daily ration. Identical nutritional errors were made by the population participating in the studies performed by Tokarz et al. [15] in selected Warsaw social associations. The obtained results showed that only 4.5%

studied subjects with type 2 diabetes failed to eat a second breakfast, whereas an afternoon snack was consumed by only 36.4%. In their own studies, the patients, apart from an improper scheduling of meals, failed to follow the recommended energy standards. In men and women, the daily energy requirements were lower comparing to the recommended standard. The exception was dinners which provided a surplus energy value comparing to



the recommendations. According to Buczek et al. [9] patients are unable to use the obtained knowledge in practice. In addition, following a diet requires a change in life-style of the patient which frequently relates to numerous sacrifices, limiting spontaneous behaviors and failures in following a diet.

According to the performed studies, the patients fail to follow their diet which enables a glucose metabolic balance. It should be assumed that the reason for that is the inability to prepare meals of a proper quality and quantity. The problems may be also caused by difficulties in adapting to new recommendations, poor nutritional habits and insufficient or improper nutritional knowledge.

## CONCLUSIONS

1. The energy value of meals in the daily ration of the studied group of patients with type 2 diabetes was lower comparing to the nutritional recommendations, regardless of age, sex and body mass.
2. Improper division of rations into individual meals regarding their energy value was stated, regardless of the age and sex of the subjects.
3. A 24-hour diet recall constitutes an element enabling the evaluation of possible risks to health, including undernutrition, overweight or obesity in patients with type 2 diabetes.

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