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COMPLIANCE OF HOSPITALIZED SCHIZOPHRENIC PATIENTS TO A 3-MONTH NUTRITION INTERVENTION PROGRAM FOR THE TREATMENT OF METABOLIC SYNDROME

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Abstract

Metabolic syndrome is a complex clinical entity that requires multiple treatment approaches. Numerous studies have shown that schizophrenic patients have inadequate dietary habits, which is a risk factor for metabolic syndrome development.

This study aimed to evaluate the compliance of hospitalized schizophrenic patients to a 3-month nutrition intervention program for the treatment of metabolic syndrome. The study sample consisted of 67 hospitalized schizophrenic patients with metabolic syndrome (aged 18 - 67), randomly allocated to the intervention group (Dietary approaches to stop hypertension - DASH diet with reduced calorie intake by 400 kcal/day, when compared to standard hospital diet, together with four nutrition lectures aimed to improve dietary habits; n = 33) or the control group (regular hospital diet that provided 2,200 - 2,400 kcal/day, together with the same nutrition educational program as for the intervention group; n = 34). During the intervention, dietary intake (food provided by the hospital and individually purchased) was assessed using three 24-hour dietary recalls. The computer software Program Prehrane 5.0 was used for the calculation of energy and nutrient intakes. Data analysis was performed using the statistical software Statistica v. 6.1. The data were analyzed using descriptive statistics. Difference in means was tested using t test.

Energy intake, together with the intake of total fat, saturated fatty acids, and sodium (all $p < 0.001$) was significantly higher, while the intake of fibre ($p=0.010$) was significantly lower in the intervention group, when compared to the prescribed DASH diet. Similarly, in the control group, the intake of energy, total fat, and saturated fatty acids (all $p < 0.001$) was significantly higher, and the intake of fiber ($p = 0.037$), iron ($p = 0.022$), and folic acid ($p = 0.014$) was significantly lower, when compared to the standard hospital diet. When comparing the two groups, the intervention group had significantly lower intake of energy, total fat, saturated fatty acids, trans fatty acids, cholesterol, and sodium (all $p < 0.001$), with significantly higher intake of fiber, potassium, magnesium (all $p < 0.001$), and many other micronutrients.

The results have revealed certain irregularities in complying with the respective intervention program and elucidated a need for further studies that would focus on identifying and correcting factors which lead to nonadherence.

***Key words**: Compliance, Nutrition, Schizophrenia, Metabolic syndrome.*

1. Introduction

The metabolic syndrome is a complex clinical entity that includes abdominal obesity, decreased value of high-density lipoprotein cholesterol, elevated triglycerides, increased blood pressure and hyperglycaemia [1], and is a crucial risk factor for the development of the two leading causes of death, cardiovascular disease and type 2 diabetes mellitus [2]. During the last three decades, there has been a constant increase in the metabolic syndrome prevalence [3], and therefore it has become one of the major public health concerns worldwide [4]. According to the results of numerous studies, schizophrenic patients are at a higher risk for developing metabolic syndrome, with the estimated prevalence being 1.5 - 2 times higher than in the general population [5, 6].

Although the exact pathogenesis of metabolic syndrome has not yet been fully understood, it is known to be influenced by multiple factors, including inadequate dietary habits [7]. Inadequate dietary habits

have often been associated with patients suffering from schizophrenia. Recently published research by Aguiar-Bloemer *et al.*, [8], revealed certain irregularities in eating patterns of schizophrenic patients. Given their results, the respondents were prone to intake of food rich in carbohydrates and fat. Similar results to those of Aguiar-Bloemer were also provided by some of the previously conducted research [9, 10]. Furthermore, one study from Iran [11], has reported that individuals with schizophrenia tend to consume food with high amounts of hydrogenated fats, as well as full-fat cream, and carbonated soft drinks, more often than those without mental disorder.

Due to its complexity, the metabolic syndrome requires multiple, interdisciplinary treatment approaches [12]. The clinical management of the syndrome remains complicated because no adequate method for its treatment has yet been established [13]. Nevertheless, the important approach in the treatment of metabolic syndrome belongs to lifestyle modifications, including dietary changes strategies. According to Donato, [14], this type of therapy is beneficial because of the possible moderate reductions in all of the metabolic risk factors. Even though it is known that adequate nutritional therapy could improve metabolic syndrome parameters, the results of the research conducted on schizophrenic patients rarely showed clinical significance [15]. It is believed that a key reason for not achieving the expected benefits of dietary interventions lies in the patients' non-compliance, commonly known as non-adherence [16]. Up until now, several non-compliance risk factors have been identified [17], as well as intervention characteristics that could improve compliance, including controlled environment such as clinics, and face-to-face information transfer [18].

Many studies conducted on schizophrenic patients have been mainly focused on the determination and estimation of non-compliance to psychopharmacological therapy, and to the best of our knowledge no studies on non-compliance to dietary recommendations have been published so far. As already stated by Khan *et al.*, [16], that it is important to notice that non-compliance in general, which includes non-compliance to dietary intervention strategies as well, may invalidate the effects of even high-quality treatment plan. Therefore, it would be interesting to evaluate the compliance of hospitalized schizophrenic patients to a 3-month nutrition intervention program for the treatment of metabolic syndrome, taking into consideration the fact that the intervention was conducted in controlled environment, and that all information and instructions were given face-to-face.

This study aimed to evaluate the compliance of hospitalized schizophrenic patients to a 3-month nutrition intervention program for the treatment of metabolic syndrome,and the results of this paper confirm that non-compliance to dietary treatment is a major problem among schizophrenic patients, and highlight a need for the urgent identification of factors that could help improve compliance.

2. Materials and Methods

A 3-month randomized controlled trial was designed to primarily examine the impact of Dietary Approaches to Stop Hypertension (DASH) diet and nutrition educational program on metabolic syndrome parameters in hospitalized schizophrenic patients (the data not shown in the present study). The study was conducted in Psychiatric Hospital Ugljan.

All hospitalized patients, both genders, were eligible to enter the study if they met certain inclusion criteria, such as being diagnosed with schizophrenia (F20) according to the World Health Organization's 10th Revision of the International Classification of Diseases (ICD-10), being between the age of 18 and 67, have been taking antipsychotic medications for at least 6 months prior to the study enrollment, and being in the stable phase of schizophrenia (defined by the fact that antipsychotic therapy has not changed significantly in the past month). Eligible patients also had to have the diagnosis of metabolic syndrome according to the Joint Interim Statement definition [19]. Hospitalized patients older than 67, and without the diagnosis of schizophrenia and metabolic syndrome were not included in the study. Moreover, patients that were considered ineligible to participate in the study were: those who followed one of the specific hospital diets that do not allow the consumption of one or more specific food items, food groups and/or nutrients, those who were under pharmacological therapy for the reduction of body weight, or those who had experienced a significant body weight loss in the past three months. Patients were excluded from the study: if they or their legal guardians refused to give a written informed consent, if they made a personal request during the intervention period, if their psychotic symptoms aggravated, or if they experienced a new illness that either could have an interfering effect or make them unable to fully participate in the study, if their pharmacological therapy significantly changed during the intervention period, if they showed cognitive impairments that could make them unable to fully participate in the study, if they began to follow a specific hospital diet mentioned previously, or if they have been discharged from the hospital before the completion of the study.

All patients participated on a voluntary basis, and have provided a written informed consent before the enrollment in the study. For those participants deprived of legal capacity, written informed consent was provided by both the participants and their legal guardians. Before signing written informed consent, the aims of

the study and all of the study procedures have been explained by the researcher. The Ethics Committee of the Psychiatric Hospital Ugljan (approval number: 01-552/01-16) and the Central Ethics Committee of the Medical School, University of Zagreb (approval number: 380-59-10106-17-100/56) approved the study. Study was conducted in accordance with the Declaration of Helsinki principles.

A total of 79 hospitalized schizophrenic patients met the inclusion criteria and were therefore deemed eligible to enter the study. Participants were randomly assigned to the intervention group (IG) or the control group (CG). From initially enrolled study participants, 11 of them (13.9%) were excluded due to hospital discharge during the intervention phase (4 participants - 10.5% from the IG, and 7 participants - 17.1% from the CG), and one participant from the IG - 2.6% has died before the end of the study. The final sample consisted of 67 participants (33 in the IG, and 34 in the CG). The mean age of the final sample was 52 ± 8.5 years, with the majority of the participants being male (57 participants; 85.1%).

The IG followed the DASH diet [20], with reduced caloric intake by 400 kcal/day, when compared to standard hospital diet. Moderate energy reduction has been chosen in order to prevent possible mental and emotional deteriorations. The most important daily nutrient goals of the DASH diet that were included are: total energy intake of 1,900 kcal, total fat 27%, saturated fatty acids 6%, protein 18%, carbohydrates 55%, cholesterol 150 mg, sodium 2,300 mg, potassium 4,700 mg, calcium 1,250 mg, magnesium 500 mg, and fiber 30 g. The CG continued to follow a standard hospital diet (regular diet without restrictions). According to the legal regulations in Croatia, the standard hospital diet should meet the following criteria: total daily energy intake of 2,200 - 2,400 kcal, total fat 25 - 35%, protein 10 - 20%, carbohydrates 50 - 60%, and the recommended dietary allowances for micronutrients [21]. Simultaneously, both the IG and the CG participated in a nutrition educational program which consisted of four nutrition lectures aimed to improve dietary habits. The lectures were of an interactive character and have covered the following themes: 1 - My Plate dietary guidelines; 2 - Basic principles of balanced diet; 3 - Understanding food nutrition labels; 4 - Nutritional recommendations for hypertension, elevated blood lipids, and diabetes. After the whole lecture cycle ended, participants have been given brochures with the most important take-home messages.

During the intervention, dietary intake was assessed using three non-consecutive 24-hour dietary recalls (two week days and one weekend day). Participants were asked to report detailed information about all foods and beverages consumed during the previous day, regardless of whether it was provided by the hospital or individually purchased. All 24-hour dietary recalls were administered by the researcher. The computer software Program Prehrane 5.0 (IG PROG, Rijeka, Croatia) was used for the calculation of energy and nutrient intakes. Moreover, prior and after the intervention, participants self-reported all the foods individually purchased in the last month period. Obtained data were used to estimate the additional average daily intake of nutrients that form the mandatory nutrition declaration [22] using the computer software Program Prehrane 5.0.

Data analysis was performed using the statistical software Statistica v. 6.1. (StatSoft Inc., Tulsa, OK, USA). For describing the sample, descriptive statistics (arithmetic mean ± standard deviation, 95% confidence interval, and percentage) were used. Difference in means of the studied parameters was tested using t test. The threshold of significance was $p < 0.05$.

3. Results and Discussion

In the present study we have compared the prescribed energy and nutrient intake of the DASH diet with the real energy and nutrient intake of the IG obtained by 24-hour dietary recalls analysis. The results are shown in Table 1.

According to the results, the real intake of energy and observed nutrients in the IG deviated from the prescribed nutritional values of the DASH diet. Regarding energy and macronutrients, the biggest difference was seen in the total daily energy intake, total carbohydrate content, and the content of total fat and saturated fatty acids (SFA), with the intakes in the IG being significantly higher (all $p < 0.001$) compared to intakes prescribed by the DASH diet. On the other hand, protein intake was significantly lower ($p = 0.038$) in the IG, when compared to the DASH diet. When looking at the percentages of energy derived from macronutrients, the diet of the participants in the IG was characterized by significantly higher percentage of energy from carbohydrates ($p = 0.001$), significantly lower percentage of energy from protein ($p < 0.001$), and with no significant difference in the percentage of energy derived from fat ($p = 0.238$) when compared to the prescribed DASH diet. Furthermore, the intake of fiber was significantly lower in the IG ($p = 0.010$) when compared to the DASH diet. For the majority of studied micronutrients there was no statistically significant difference between real and prescribed intake, with the exception of significantly higher intake of sodium ($p < 0.001$), calcium ($p < 0.001$), cooper ($p = 0.001$), and niacin ($p = 0.002$), and significantly lower intake of beta-carotene ($p = 0.008$) in the IG.

We have also compared the prescribed energy and nutrient intake of the standard hospital diet with the real energy and nutrient intake of the CG calculated using three 24-hour dietary recalls from each participant (Table 2).

Table 1. The comparison of energy and nutrient intakes between DASH diet and 24-hour dietary recalls of the IG

Variables	DASH diet M ± SD (95% CI)	IG 24-hour dietary recalls (n = 33) M ± SD (95% CI)	% of the prescribed quantity	P value
Energy (kcal/day)	1928.16 ± 41.17 (1919.64 - 1936.69)	2185.34 ± 417.84 (2102.01 - 2268.68)	113.34	< 0.001
Total carbohydrates (g/day)	283.77 ± 21.89 (279.24 - 288.31)	332.81 ± 67.11 (319.42 - 346.19)	117.28	< 0.001
Total carbohydrates (% E)	55.66 ± 1.81 (55.29 - 56.04)	57.13 ± 3.74 (56.39 - 57.88)	102.64	0.001
Total protein (g/day)	94.51 ± 8.40 (92.77 - 96.25)	98.17 ± 14.7 (95.24 - 101.10)	103.87	0.038
Total protein (% E)	19.44 ± 1.72 (19.08 - 19.79)	18.21 ± 2.5 (17.71 - 18.71)	93.67	< 0.001
Total fat (g/day)	52.42 ± 3.7 (51.66 - 53.19)	58.77 ± 16.79 (55.42 - 62.12)	112.11	< 0.001
Total fat (% E)	24.50 ± 1.68 (24.15 - 24.85)	24.03 ± 3.44 (23.34 - 24.72)	98.08	0.238
SFA (g/day)	12.50 ± 1.84 (12.11 - 12.88)	15.88 ± 6.89 (14.50 - 17.25)	127.04	< 0.001
SFA (% E)	5.83 ± 0.82 (5.66 - 6.00)	6.37 ± 1.76 (6.02 - 6.72)	109.26	0.008
MUFA (g/day)	17.64 ± 2.63 (17.10 - 18.19)	16.82 ± 4.03 (16.02 - 17.63)	95.35	0.101
PUFA (g/day)	16.51 ± 2.85 (15.92 - 17.10)	16.11 ± 3.51 (15.41 - 16.81)	97.58	0.396
TFA (g/day)	0.32 ± 0.21 (0.28 - 0.36)	0.33 ± 0.22 (0.28 - 0.37)	103.13	0.831
Cholesterol (mg/day)	111.8 ± 24.33 (106.77 - 116.84)	111.57 ± 54.26 (100.74 - 122.39)	99.79	0.969
Fiber (g/day)	31.04 ± 3.14 (30.39 - 31.69)	29.48 ± 4.89 (28.50 - 30.45)	94.94	0.010
Sodium (mg/day)	2170.05 ± 147.62 (2139.48 - 2200.63)	2614.21 ± 875.73 (2439.55 - 2788.87)	120.44	< 0.001
Potassium (mg/day)	4769.30 ± 298.94 (4707.4 - 4831.21)	4793.59 ± 659.08 (4662.14 - 4925.04)	100.51	0.746
Calcium (mg/day)	1262.59 ± 187.74 (1223.71 - 1301.47)	1408.78 ± 350.1 (1338.95 - 1478.6)	111.58	< 0.001
Magnesium (mg/day)	501.05 ± 65.19 (487.55 - 514.56)	523.6 ± 86.33 (506.38 - 540.81)	104.50	0.044
Phosphorus (mg/day)	1575.36 ± 237.31 (1526.21 - 1624.51)	1564.68 ± 282.95 (1508.24 - 1621.11)	99.32	0.779
Iron (mg/day)	14.59 ± 1.56 (14.27 - 14.92)	15.07 ± 2.37 (14.6 - 15.54)	103.29	0.105
Copper (mg/day)	1.68 ± 0.23 (1.63 - 1.73)	1.83 ± 0.35 (1.76 - 1.9)	108.93	0.001
Zinc (mg/day)	12.26 ± 2.07 (11.83 - 12.69)	12.34 ± 2.53 (11.83 - 12.84)	100.65	0.825
Manganese (mg/day)	6.93 ± 1.05 (6.71 - 7.15)	6.88 ± 1.30 (6.62 - 7.14)	99.28	0.797
Selenium (µg/day)	55.47 ± 12.69 (52.85 - 58.10)	55.16 ± 15.56 (52.06 - 58.27)	99.44	0.881
Iodine (µg/day)	79.76 ± 22.81 (75.04 - 84.48)	80.53 ± 25.58 (75.42 - 85.63)	100.97	0.828
Retinol (µg/day)	223.71 ± 125.39 (197.74 - 249.67)	225.98 ± 141.84 (197.69 - 254.27)	101.01	0.907
Beta-carotene (µg/day)	5344.83 ± 4723.20 (4366.69 - 6322.98)	3723.69 ± 3543.56 (3016.94 - 4430.44)	69.67	0.008
Vitamin D (µg/day)	1.63 ± 0.59 (1.51 - 1.75)	1.56 ± 0.99 (1.36 - 1.75)	95.71	0.552
Vitamin E (mg/day)	107.54 ± 285.7 (48.38 - 166.71)	95.6 ± 265.24 (42.7 - 148.5)	88.89	0.765
Vitamin K (µg/day)	525.59 ± 565.39 (408.5 - 642.67)	451.18 ± 569.29 (337.63 - 564.72)	85.84	0.366
Thiamine (mg/day)	2.06 ± 0.42 (1.98 - 2.15)	2.01 ± 0.47 (1.91 - 2.1)	97.57	0.381
Riboflavin (mg/day)	1.45 ± 0.26 (1.4 - 1.51)	1.48 ± 0.45 (1.39 - 1.57)	102.07	0.567
Niacin (mg/day)	23.12 ± 2.04 (22.70 - 23.55)	24.84 ± 4.94 (23.85 - 25.82)	107.44	0.002
Pantothenic acid (mg/day)	5.90 ± 0.84 (5.72 - 6.07)	5.89 ± 1.59 (5.57 - 6.21)	99.83	0.975
Pyridoxine (mg/day)	2.66 ± 0.35 (2.59 - 2.73)	2.63 ± 0.54 (2.53 - 2.74)	98.87	0.655
Folic acid (µg/day)	429.29 ± 91.46 (410.35 - 448.23)	430.76 ± 130.08 (404.82 - 456.71)	100.34	0.929
Cobalamin (µg/day)	2.96 ± 1.06 (2.74 - 3.18)	2.82 ± 1.39 (2.54 - 3.1)	95.27	0.449
Vitamin C (mg/day)	239.36 ± 113.67 (215.82 - 262.90)	209.49 ± 121.20 (185.31 - 233.66)	87.52	0.081

Legend: DASH - Dietary Approaches to Stop Hypertension; IG - intervention group; M ± SD (95% CI) - mean ± standard deviation (95% confidence interval); n - number of participants; % E - percentage of energy; SFA - saturated fatty acids; MUFA - monounsaturated fatty acids; PUFA - polyunsaturated fatty acids; TFA - trans fatty acids. Statistically significant: $p < 0.05$.

Table 2. The comparison of energy and nutrient intakes between standard hospital diet and 24-hour dietary recalls of the CG

Variables	Standard hospital diet M ± SD (95% CI)	CG 24-hour dietary recalls (n = 34) M ± SD (95% CI)	% of the prescribed quantity	P value
Energy (kcal/day)	2335.14 ± 143.82 (2311.78 - 2358.5)	2568.02 ± 738.76 (2422.91 - 2713.13)	109.97	< 0.001
Total carbohydrates (g/day)	340.39 ± 28.25 (335.8 - 344.97)	368.7 ± 108.19 (347.45 - 389.95)	108.32	0.003
Total carbohydrates (% E)	54.84 ± 5.06 (54.02 - 55.66)	54.19 ± 7.07 (52.8 - 55.58)	98.81	0.396
Total protein (g/day)	98.38 ± 12.29 (96.38 - 100.37)	106.55 ± 31.5 (100.36 - 112.74)	108.30	0.005
Total protein (% E)	16.84 ± 1.97 (16.52 - 17.16)	16.84 ± 3.13 (16.23 - 17.46)	100.00	0.987
Total fat (g/day)	73.76 ± 14.57 (71.4 - 76.13)	84.81 ± 32.24 (78.48 - 91.15)	114.98	< 0.001
Total fat (% E)	28.3 ± 4.63 (27.55 - 29.06)	28.34 ± 6.26 (27.11 - 29.57)	100.14	0.955
SFA (g/day)	20.57 ± 6.61 (19.49 - 21.64)	25.19 ± 12.5 (22.74 - 27.65)	122.46	< 0.001
SFA (% E)	7.84 ± 2.29 (7.47 - 8.22)	8.59 ± 2.63 (8.07 - 9.11)	109.57	0.018
MUFA (g/day)	20.01 ± 6.36 (18.98 - 21.05)	18.57 ± 8.81 (16.84 - 20.3)	92.80	0.135
PUFA (g/day)	24.11 ± 4 (23.46 - 24.76)	19.8 ± 7.21 (18.38 - 21.22)	82.12	< 0.001
TFA (g/day)	0.65 ± 0.4 (0.58 - 0.71)	0.65 ± 0.47 (0.55 - 0.74)	100.00	0.968
Cholesterol (mg/day)	222.32 ± 153.9 (197.32 - 247.32)	194.6 ± 167.93 (161.61 - 227.58)	87.53	0.179
Fiber (g/day)	24.62 ± 5.29 (23.76 - 25.48)	22.73 ± 8.87 (20.99 - 24.47)	92.32	0.037
Sodium (mg/day)	3905.5 ± 568.47 (3813.16 - 3997.85)	4048.53 ± 1541.18 (3745.81 - 4351.25)	103.66	0.303
Potassium (mg/day)	3866.68 ± 687.42 (3755.01 - 3978.34)	3739.62 ± 1240.15 (3496.03 - 3983.21)	96.71	0.301
Calcium (mg/day)	1284.23 ± 367.61 (1224.51 - 1343.95)	1413.36 ± 580.96 (1299.25 - 1527.47)	110.06	0.032
Magnesium (mg/day)	359.39 ± 39.24 (353.01 - 365.76)	369.16 ± 113.12 (346.94 - 391.38)	102.72	0.333
Phosphorus (mg/day)	1357.39 ± 236.23 (1319.02 - 1395.77)	1349.61 ± 467.99 (1257.69 - 1441.53)	99.43	0.863
Iron (mg/day)	15.12 ± 2.39 (14.74 - 15.51)	14.03 ± 5 (13.05 - 15.01)	92.79	0.022
Copper (mg/day)	1.53 ± 0.31 (1.48 - 1.58)	1.49 ± 0.51 (1.39 - 1.59)	97.39	0.519
Zinc (mg/day)	11.99 ± 2.12 (11.65 - 12.34)	11.9 ± 3.99 (11.12 - 12.69)	100.00	0.818
Manganese (mg/day)	4.61 ± 0.89 (4.46 - 4.75)	4.30 ± 1.57 (4 - 4.61)	93.28	0.051
Selenium (µg/day)	68.71 ± 25.07 (64.64 - 72.78)	66.22 ± 29.95 (60.34 - 72.1)	96.38	0.478
Iodine (µg/day)	91.38 ± 33.73 (85.9 - 96.86)	90.52 ± 47.47 (81.2 - 99.84)	99.06	0.867
Retinol (µg/day)	209.97 ± 188.66 (179.32 - 240.61)	181.94 ± 155.13 (151.47 - 212.41)	86.65	0.217
Beta-carotene (µg/day)	4710.56 ± 3767.47 (4098.55 - 5322.57)	4172.23 ± 3653.38 (3454.64 - 4889.82)	88.57	0.262
Vitamin D (µg/day)	2.01 ± 0.93 (1.86 - 2.16)	4.46 ± 27.2 (-0.89 - 9.80)	221.89	0.275
Vitamin E (mg/day)	16 ± 3.92 (15.36 - 16.64)	49.26 ± 274.35 (-4.63 - 103.15)	307.88	0.141
Vitamin K (µg/day)	407.3 ± 624.81 (305.8 - 508.8)	345.12 ± 591.77 (228.88 - 461.35)	84.73	0.430
Thiamine (mg/day)	2.31 ± 0.42 (2.24 - 2.38)	2.21 ± 0.79 (2.06 - 2.37)	95.67	0.234
Riboflavin (mg/day)	1.28 ± 0.37 (1.22 - 1.34)	1.29 ± 0.56 (1.18 - 1.4)	100.78	0.802
Niacin (mg/day)	23.08 ± 4.44 (22.36 - 23.8)	24.92 ± 8.62 (23.23 - 26.62)	107.97	0.028
Pantothenic acid (mg/day)	5.59 ± 1.01 (5.42 - 5.75)	5.80 ± 2.29 (5.35 - 6.25)	103.76	0.328
Pyridoxine (mg/day)	3.43 ± 0.82 (3.29 - 3.56)	3.11 ± 1.11 (2.89 - 3.33)	90.67	0.010
Folic acid (µg/day)	603.95 ± 120.22 (584.42 - 623.47)	555.32 ± 191.14 (517.78 - 592.87)	91.95	0.014
Cobalamin (µg/day)	4.13 ± 1.98 (3.81 - 4.45)	3.60 ± 2.4 (3.13 - 4.08)	87.17	0.061
Vitamin C (mg/day)	190.76 ± 119.72 (171.32 - 210.21)	169.76 ± 129.64 (144.30 - 195.23)	88.99	0.189

Legend: CG - control group; M ± SD (95% CI) - mean ± standard deviation (95% confidence interval); n - number of participants; % E - percentage of energy; SFA - saturated fatty acids; MUFA - monounsaturated fatty acids; PUFA - polyunsaturated fatty acids; TFA - trans fatty acids. Statistically significant: $p < 0.05$.

Similar to comparison of the DASH diet and IG intakes, the results have shown significantly higher total daily energy intake ($p < 0.001$), along with significantly higher intake of total carbohydrates ($p = 0.003$), total fat ($p < 0.001$), and SFA ($p < 0.001$) in the CG when compared to the standard hospital diet. Among the participants in the CG, significantly higher total protein content ($p = 0.005$) than prescribed has also been recorded. Regarding the percentages of energy from macronutrients, there were no statistically significant differences in the percentages of energy from carbohydrates ($p = 0.396$), protein ($p = 0.987$), and fat ($p = 0.955$) between the CG and the standard hospital diet, but with significantly higher percentage of energy from SFA ($p = 0.018$) in the CG. Additionally, the intake of fiber was significantly lower in the CG ($p = 0.037$) when compared to the amount of fiber present in the standard hospital diet. As for the micronutrients, significantly higher intake of calcium ($p = 0.032$) and niacin ($p = 0.028$) along with significantly lower intake of iron ($p = 0.022$), pyridoxine ($p = 0.010$), and folic acid ($p = 0.014$) were observed in the CG when compared to the quantities in the standard hospital diet. For other assessed nutrients there were no significant differences between real and prescribed intake.

According to the aforementioned, our results speak in favor of the body of evidence about poor dietary habits of individuals with schizophrenia, mostly regarding the patients' tendency to consume more carbohydrates and fats, especially SFA, and less fiber than recommended. The participants were also prone to higher total caloric intake than arranged by the DASH diet or the standard hospital diet. Brown, [9], found that diet of schizophrenic patients was higher in fat and lower in fiber when compared to the diet of the general population. Similar was observed by Strassnig *et al.*, [23], who found that schizophrenic patients have significantly higher intake of total energy, carbohydrates, and fats compared to the general population. Furthermore, McCreadie *et al.*, [24], examined dietary intake of 30 schizophrenic patients and have found higher intake of SFA than recommended. Moreover, in individuals with serious mental disorders, including schizophrenia, the very nature of the disease may affect their motivation to ameliorate their lifestyle [25], which is certainly one of the potential reasons for the observed non-compliance.

Furthermore, we have compared the real dietary intake of the IG and the CG (Table 3).

Regardless of any aforementioned deviations from the prescribed quantities detected in both groups, significantly lower total daily energy intake ($p < 0.001$), along with significantly lower intake of total carbohydrates ($p = 0.005$), fats ($p < 0.001$), and protein ($p = 0.017$), was detected in the IG, when compared to the CG. In regards to the percentages of energy derived

Table 3. The comparison of energy and nutrient intakes between the IG and the CG

Variables	% of the quantity in the IG (when compared to the CG)	P value
Energy (kcal/day)	85.1	< 0.001
Total carbohydrates (g/day)	90.27	0.005
Total carbohydrates (% E)	105.43	< 0.001
Total protein (g/day)	92.14	0.017
Total protein (% E)	108.14	0.001
Total fat (g/day)	69.3	< 0.001
Total fat (% E)	84.79	< 0.001
SFA (g/day)	63.04	< 0.001
SFA (% E)	74.16	< 0.001
MUFA (g/day)	90.58	0.073
PUFA (g/day)	81.36	< 0.001
TFA (g/day)	50.77	< 0.001
Cholesterol (mg/day)	57.33	< 0.001
Fiber (g/day)	129.65	< 0.001
Sodium (mg/day)	64.57	< 0.001
Potassium (mg/day)	128.18	< 0.001
Calcium (mg/day)	99.68	0.946
Magnesium (mg/day)	141.84	< 0.001
Phosphorus (mg/day)	115.94	< 0.001
Iron (mg/day)	107.41	0.063
Copper (mg/day)	122.82	< 0.001
Zinc (mg/day)	103.7	0.358
Manganese (mg/day)	160	< 0.001
Selenium (µg/day)	83.3	0.001
Iodine (µg/day)	88.96	0.066
Retinol (µg/day)	124.21	0.037
Beta-carotene (µg/day)	89.25	0,378
Vitamin D (µg/day)	34.98	0.290
Vitamin E (mg/day)	194.05	0.225
Vitamin K (µg/day)	130.73	0.197
Thiamine (mg/day)	90.95	0.025
Riboflavin (mg/day)	114.73	0.009
Niacin (mg/day)	99.68	0.931
Pantothenic acid (mg/day)	101.55	0.734
Pyridoxine (mg/day)	84.57	< 0.001
Folic acid (µg/day)	77.57	0.000
Cobalamin (µg/day)	78.33	0.005
Vitamin C (mg/day)	123.4	0.026

Legend: IG - intervention group; CG - control group; % E - percentage of energy; SFA - saturated fatty acids; MUFA - monounsaturated fatty acids; PUFA - polyunsaturated fatty acids; TFA - trans fatty acids. Statistically significant: $p < 0.05$.

from macronutrients, significantly higher percentage of energy from carbohydrates ($p < 0.001$) and protein ($p = 0.001$), but significantly lower percentage of energy from fat ($p < 0.001$) was detected in the IG. The biggest difference between the two groups was in the intake of SFA, trans-fatty acids, cholesterol, and sodium, with the intakes in the IG being significantly lower (all $p < 0.001$) than in the CG. Equally important, the intake of fiber ($p < 0.001$), potassium ($p < 0.001$), magnesium ($p < 0.001$), and some of the other assessed micronutrients was significantly higher in the IG compared to the CG. Therefore, the real dietary intake of the two groups, despite the deviations from the prescribed quantities, still differed in the following most important features of DASH eating plan: lower intake of total fat, SFA, cholesterol, and sodium, along with the higher intake of protein, fiber, potassium, and magnesium [26]. The intake of calcium, another major component of DASH diet, was above the prescribed quantity in the IG, but did not significantly differ from the CG intake. As per the above mentioned findings, we can expect at least some of the proved positive health effects of the DASH diet on metabolic syndrome and its parameters [27-29] in hospitalized schizophrenic patients during the 3-month intervention period.

Even though the present research was conducted in a controlled environment, we have ascertained that unrestrictive individual purchase of food could be a potential risk factor that could lead to non-compliance with the research. With the intention to reduce the effects of conceivable non-compliance factor, both the IG and the CG participated in a nutritional educational program where they received numerous dietary advices. To evaluate the impact of the program on participants' dietary habits, we have assessed the intake of all the foods individually purchased and consumed in addition to those provided as a part of the research. The most commonly purchased products among the participants were: carbonated soft drinks, bakery products, especially pastries, and confectionery products (the data not shown in the present study). It is well known that such products are considered part of unhealthy diet which is common in schizophrenic patients [11]. Additional energy intake and intake of selected nutrients of both the IG and the CG, assessed before and after the intervention period, are summarized in Table 4.

Before the intervention, relatively high additional energy intake was observed in both groups. During the intervention this additional intake has decreased with a strong tendency towards statistical significance in the IG ($p = 0.058$) and without significant difference in the CG ($p = 0.836$). During the intervention, the intake of all other studied nutrients in the IG decreased, with significant decrease observed for total fat content ($p = 0.026$) and SFA ($p = 0.023$). For the CG, as well as for the comparison of the two groups, there were no significant differences before and after the intervention. Therefore, the focus during nutritional educations should be on the individual food purchase as it represents one of the critical compliance factors. Our results also suggest that nutrition counseling could have a positive effect

Table 4. The comparison of additional energy intakes and the intakes of selected nutrients in the IG and the CG, before and after the intervention

Variables	IG			CG			IG vs CG before interv.	IG vs CG after interv.
	Before interv. M ± SD (95% CI)	After interv. M ± SD (95% CI)	P value	Before interv. M ± SD (95% CI)	After interv. M ± SD (95% CI)	P value		
Energy (kcal/day)	540.11 ± 544.46 (347.05 - 733.17)	432.41 ± 474.96 (264.00 - 600.82)	0.058	433.28 ± 544.93 (243.14 - 623.42)	419.82 ± 578.91 (217.82 - 621.81)	0.836	0.425	0.923
Total fat (g/day)	15.36 ± 17.29 (9.23 - 21.49)	9.63 ± 12.98 (5.02 - 14.23)	0.026	11.79 ± 18.71 (5.26 -18.32)	13.66 ± 21.88 (6.03 - 21.29)	0.511	0.421	0.364
SFA (g/day)	7.19 ± 8.88 (4.04 - 10.34)	4.08 ± 5.31 (2.20 - 5.96)	0.023	5.21 ± 7.96 (2.43 - 7.99)	6.23 ± 10.89 (2.43 - 10.03)	0.542	0.340	0.311
Total carbohy. (g/day)	88.25 ± 92.18 (55.56 - 120.94)	71.76 ± 91.96 (45.15 - 104.37)	0.251	71.14 ± 91.53 (39.20 - 103.08)	61.54 ± 78.52 (34.14 - 88.94)	0.289	0.448	0.440
Sugars (g/day)	61.28 ± 69.62 (36.59 - 85.97)	58.40 ± 79.84 (30.08 - 86.71)	0.747	48.40 ± 73.80 (22.65 - 74.15)	37.89 ± 49.50 (20.62 - 55.16)	0.211	0.465	0.209
Total protein (g/day)	10.42 ± 13.24 (5.73 - 15.11)	7.66 ± 9.43 (4.31 - 11.01)	0.134	8.14 ± 13.16 (3.55 - 12.73)	10.15 ± 18.90 (3.55 - 16.75)	0.472	0.483	0.500
Salt (g/day)	1.34 ± 1.86 (0.68 - 2.00)	1.05 ± 1.48 (0.52 - 1.58)	0.177	1.24 ± 2.12 (0.50 - 1.98)	1.35 ± 2.35 (0.53 - 2.17)	0.473	0.828	0.543

Legend: IG - intervention group; CG - control group; M ± SD (95% CI) - mean ± standard deviation (95% confidence interval); SFA - saturated fatty acids. Statistically significant: $p < 0.05$.

on the improvement of dietary habits when combined with diet modifications. As stated in the review of Pearsall et al. [30], the evidence of the benefits of nutritional educational programs in schizophrenic patients are limited and not yet established. Two systematic reviews found that dietary advice led to improvement of eating patterns in general population [31, 32] which suggests that similar benefits could also be reached in schizophrenic patients [30].

The transparency of the obtained results as well as the established level of deviation from the recommended research plan could enhance and alter the interpretation of the primarily results of the present research. On the other hand, we have assessed the intake of foods individually purchased using self-reporting as a method. This could be seen as a limitation of the present study due to the fact that it could potentially lead to a recall bias and ultimately have an impact on results related to compliance evaluation.

4. Conclusions

- The present study revealed certain irregularities in regard to non-compliance with respective dietary intervention strategy, which consequently represents a major problem among hospitalized schizophrenic patients.

- There is an urgent need for further studies that would focus on identifying and correcting factors which lead to non-compliance with dietary interventions. We believe that the determination of these factors could improve schizophrenic patients' compliance during the intervention and thus result with preferred and expected outcomes.

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