

THE INFLUENCE OF NUTRITION AND LIFESTYLES ON BONE HEALTH IN PATIENTS WITH SCHIZOPHRENIA AND DEPRESSION

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UTICAJ ISHRANE I ŽIVOTNIH STILOVA NA ZDRAVLJE KOSTIJU KOD PACIJENATA SA SHIZOFRENIJOM I DEPRESIJOM

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ABSTRACT

Objective. The aim of this paper is to investigate the influence of nutrition and pattern behaviors on bone health in people with mental health disorders.

Methods. A cross-sectional study has been conducted at the Clinic for Psychiatry of the Clinical Center of Kragujevac and at the Department of Neuropsychiatry of the Specialist-Consultative Service of Health Care Center Kragujevac. The survey included 46 patients from the age of 22 to 81, both genders, with schizophrenia as a diagnosis for mental disorders and depression determined by a psychiatrist. Quantitative testing of calcium, magnesium, phosphorus, sodium and potassium has been performed by standard biochemical methods. Vitamin D has been determined by high performance/pressure liquid chromatography i.e. by a liquid chromatography under high pressure.

Results. In the whole group of patients tested, 58.7% of patients were physically active and the patients with schizophrenia ($p = 0.026$) were less physically active. Out of the total number, 67% of patients eat irregularly and this habit is more present in patients with schizophrenia ($p = 0.003$). In terms of the presence of certain nutrients, fish is more represented in the nutrition of people suffering from depression. Three patients (6.5%) reported osteoporosis in their medical history, one of whom had a spontaneous fracture. In the anamneses (6.5%) of the patients stated that their parents had had spontaneous bone fractures. Low values of 25 (OH) D in the serum were present in both study groups.

Conclusion. Unhealthy lifestyles, low level of Vitamin D found in people who have mental health disorders represent risk factors for the reduced bone mass. The results of our research indicate the need for timely identification of potential risk factors and improvement of prevention in order to raise awareness of the importance of healthy lifestyles and behavior modification.

Key words: mental disorders; risk factors; lifestyle; bone diseases, metabolic; vitamin D

SAŽETAK

Cilj. Cilj rada bilo je ispitivanje uticaja ishrane i obrazaca ponašanja na zdravlje kostiju kod osoba s poremećajima mentalnog zdravlja.

Metode. Studija preseka sprovedena je u Klinici za psihijatriju Kliničkog centra Kragujevac i Odeljenju neuropsihijatrije Specijalističko-konsultativne službe Doma zdravlja Kragujevac. Anketnim istraživanjem je obuhvaćeno 46 pacijenata uzrasta od 22 do 81 godine, oba pola, sa dijagnozom mentalnog poremećaja shizofrenije i depresije, utvrđenih od strane psihijatra. Vršeno je kvantitativno ispitivanje kalcijuma, magnezijuma, fosfora, natrijuma i kalijuma standardnim biohemijskim metodama. Vitamin D određivan je high performance / pressure liquid chromatography, tj. tečnom hromatografijom pod visokim pritiskom.

Rezultati. U celoj grupi ispitanika fizički je aktivno 58,7% ispitanika, a fizički su neaktivniji ispitanici oboleli od shizofrenije ($p = 0,026$). Od ukupnog broja, 67% ispitanika se neredovno hrani, a ova navika je prisutnija kod ispitanika obolelih od shizofrenije ($p = 0,003$). Po zastupljenosti pojedinih namirnica, u ishrani obolelih od depresije zastupljenija je riba. Tri ispitanika (6,5%) navode osteoporozu u svojoj istoriji bolesti od čega je jedan imao spontanu frakturu. U anamnezi je 6,5% ispitanika navelo da su im roditelji imali spontane frakture kostiju. Kod obe ispitivane grupe prisutne su niske vrednosti 25(OH)D u serumu.

Zaključak. Nezdravi stilovi života te nizak nivo vitamina D kod osoba s poremećajima mentalnog zdravlja predstavljaju faktore rizika za smanjenje koštane mase. Rezultati našeg istraživanja ukazuju na potrebu pravovremenog uočavanja potencijalnih faktora rizika i poboljšanja prevencije radi podizanja svesti o značaju zdravih stilova života i modifikaciji ponašanja.

Cljučne reči: mentalni poremećaji; faktori rizika; životni stil; bolesti kostiju, metaboličke; vitamin D

INTRODUCTION

According to the World Health Organization data, mental health disorders are among the top ten causes of disability in the world, both in developed and undeveloped countries (1). Mostly due to the chronic nature of depression, alcohol, drug use and schizophrenia, about 14% of global disease predisposition is attributed to psychiatric disorders (2). Mental disorders are significantly associated with poor quality of life as well as with a higher risk of developing chronic diseases. The association between depression and the development of chronic diseases can partly be explained by common risk factors (3,4). People who are depressed often sleep less, are less physically active, eat less, smoke more and consume alcohol and other psychoactive substances more often than those who are not depressed (5,6). In this context, research shows that there is a connection between osteoporosis and different psychiatric disorders (depression, bipolar disorder, schizophrenia, and Alzheimer's disease) (7). Several studies have shown that the main depressive disorder is connected with lower mineral density of bones and that people with lower bone mineral density with depression have an increased risk of fractures (8,9).

Osteoporosis has been determined as "a systemic skeletal disease characterized by low bone density and micro-architectural decay of bone tissue with a consequent increase in bone fragility and susceptibility to fracture." Risk factors for the occurrence of osteoporosis include those that cannot be changed significantly during life, such as age, gender, genetic predisposition, a positive family history of fractures, and long-term use of corticosteroids. Lifestyles are of great importance as they can be influenced on during life and as they significantly contribute to bone demineralization such as poor nutrition, lack of physical activity, smoking, excessive use of alcohol or caffeine, insufficient exposure to sun, low calcium intake and low levels of vitamin D and vitamin K (10).

The aim of this study was to examine the influence of nutrition and behavioral patterns on bone health in people with mental health disorders.

PATIENTS AND METHODS

The cross-sectional study has been conducted at the Clinic for Psychiatry of the Clinical Center of Kragujevac and at the Department of Neuropsychiatry of the Specialist-Consultative Service of Health Care Center Kragujevac. The research has been approved by the Board of Ethics of Clinical Center Kragujevac and the Board of Ethics of Health Center Kragujevac. Each patient has given his/her consent to voluntary participate

in the study. Our previous research provided the basis for sample size calculation data about the proposed significance between groups, difference of 25(OH) serum concentrations and their variability (11). By using appropriate software (www.gpower.hhu.de), with $\alpha = 0.05$, study power of 0.8 and other necessary inputs as well as the corrective increase for presumed non-parametric data distribution we have estimated total study sample of at least 50 people, 25 in each group. We finally included a total of 46 adult patients of both genders (outpatient and inpatient treatments) from the age of 22 to 81, who were allocated to two groups: 26 patients with schizophrenia taking antipsychotic medication and 20 with depression taking antidepressant medication, determined by the psychiatrist. The patients had only one diagnosis from the group of psychotic disorders (World Health Organization International Classification of Diseases, version 10, codes F20 and F32).

The semi-structured questionnaire for the assessment of vitamin D status was designed based on the previous studies in the field and the study was conducted within the same geographical area (11,12). Other data were extracted from the patients' medical files. The blood samples were obtained from May to June 2016 which is a season with adequate and approximately the same sunshine exposure. The serums were sent to the hospital laboratory where the vitamin D (in 25(OH)D form), calcium, phosphorus, magnesium, sodium and potassium concentrations were determined by using "Cobas e601" analyzer (*Roche Diagnostics*, Mannheim, Germany) and "Beckman Coulter AU 680" biochemical analyzers, as appropriate. Vitamin D measurements were performed by using the manufacturer's reagent testing kit (electrochemilu-minescence binding assay), providing regular internal and external controls according to the laboratory quality assurance procedures.

The vitamin D status types were defined as: deficiency (< 20 ng/mL), insufficiency (20-29.9 ng/mL) and sufficiency (> 30 ng/mL) (13). Determining the electrolytes from the serum is based on well-known facts on direct and indirect links with their metabolism, both mutually and with vitamin D homeostasis (14,15).

The statistical analyses of collected data included testing of sample distribution for normality (Normal Q-Q Plot, Histogram, Kolmogorov-Smirnov test, Shapiro-Wilk test), the measures of descriptive statistics as well as Wilcoxon rank sum test, Pearson χ^2 test and Fisher exact test for analyzing the differences between study groups. The level of probability for statistical significance was established at $p < 0.05$. Data processing and analysis were done in the statistical program R - version 3.1.1 (2014-07-10).

RESULTS

Out of a total of 46 patients in the group of patients diagnosed with schizophrenia, 14 (53.8%) patients are female and 12 (46.2%) are male. Nevertheless, the group of patients with depression consists of 16 (80%) females and 4 (20%) males. Demographic variables in patients are presented in detail in Table 1.

By using the t-test, it has been found that there is no statistically relevant distinction when it comes to the age ($p = 0.505$). The majority of patients (75%) live in an urban environment, irrespective of residence the largest number stated that they lived in poor circumstances (76%). In regard to the level of education, more than half of the patients completed high school, a quarter of them had elementary or incomplete elementary education, while the smallest number of patients had a college or university degree (15%).

By examining the lifestyle and eating habits it was shown that smokers make up 60.8% of the total number of patients, with a higher number of smokers in the group of patients with schizophrenia (69.2%) compared to the group of patients treated for depression (50%). The patients with schizophrenia smoke twice as many

cigarettes per day as the patients with depression ($p = 0.003$) 41.3% of patients stated that they consumed coffee intensively, and in this case patients with schizophrenia with a share of (50%) were predominant compared to 30% of the patients with depression.

In the whole group of patients, 58.7% of patients were physically active. However, only (2.1%) patients did a specific type of physical activity. The patients who suffered from schizophrenia were physically more inactive, which was supported by the fact that there was a statistically relevant distinction between these two groups of patients when it came to sedentary lifestyle ($p = 0.026$) (Table 2).

When asked about proper nutrition (which includes 3 main meals, 2 snacks and daily intake of fruits and vegetables), even 67% patients said that they did not apply these principles of nutrition. There was a statistically significant difference ($p = 0.003$) between the groups of patients in terms of irregular nutrition, which was more present in patients with schizophrenia. Regarding the presence of certain foods in nutrition (meat, fish, eggs, dairy products), a statistically significant difference referred to the number of patients from the group with depression who consumed fish compared to patients with

Table 1. Sociodemographic characteristics of patients

Variable	Total (46)	Patients with schizophrenia (n = 26)	Patients with depression (n = 20)	Statistics
Male	16 (34.8)	12 (46.2)	4 (20.0)	p = 0.117
Female	30 (65.2)	14 (53.8)	16 (80.0)	
Age (years)*	51.28 (12.42)	50.4 (11.9)	52.5 (13.3)	p = 0.505
Urban area	34 (74.9)	21 (80.8)	13 (65.0)	p = 0.227
Rural area	12 (26.1)	5 (19.2)	7 (35.0)	
Good living conditions	11 (23.9)	6 (23.1)	5 (25.0)	p = 0.063
College or university education	7 (15.2)	3 (11.5)	4 (20.0)	p = 0.557
Body mass index (kg/m ²)* ¹	25.16 (3.88)	25.3 (4.3)	25 (3.5)	p = 1

The numbers indicate frequency (percentage); 1 average value (standard deviation); * > 2 categories

Table 2. Lifestyle of patients

Variable	Total (46)	Patients with schizophrenia (n = 26)	Patients with depression (n = 20)	Statistics
Smoking	28 (60.9)	18 (69.2)	10 (50.0)	p = 0.404
Daily number of cigarettes	22.19 (15.41)	28.94 (15.52)	11.4 (6.96)	p = 0.003
Coffee intensively	19 (41.3)	13 (50.0)	6 (30.0)	p = 0.412
Physical activity	27 (58.7)	13 (50.0)	14 (70.0)	p = 0.172
Exercises	1 (2.1)	0 (0)	1 (5.0)	p = 0.434
Sedentary lifestyle	29 (63)	20 (76.9)	9 (45.0)	p = 0.026
Exposure to sun (>5 minutes in the last week)	18 (39.1)	16 (61.5)	2 (10.0)	p = 0.000
Long time in the open	14 (30.4)	5 (19.2)	9 (45.0)	p = 0.059
Use of sun lotion	8 (17.4)	1 (3.9)	7 (35.0)	p = 0.014

The numbers indicate frequency (percentage); 1 average value (standard deviation);

schizophrenia. This difference between these groups was found also when it comes to meat types ($p = 0.020$) and the frequency of meat consumption (Table 3).

The 18 patients had an associated chronic disease, which made 39% of the total number of patients, while this was the case in 60% of the patients from the group with depression ($p=0.010$). Three patients (6.5%) reported osteoporosis in their medical history, one of whom had a spontaneous fracture, while 3 patients (6.5%) stated in their anamneses that their parents had had spontaneous bone fractures. Low serum values of 25(OH)D were found in both groups, while there was no statistically relevant distinction in sera concentrations of calcium, phosphorus and magnesium between the study groups (Table 4).

DISCUSSION

Bone is a dynamic tissue, the formation and resorption of bones are dynamically and closely connected and these

processes take place continuously throughout the life. Bone mineral density (BMD) depends on the balance of these two processes. Many conditions, medications, and lifestyles are connected with reduced bone mass and an increased risk of fractures. At each life phase, adequate intake of main nutrients, such as calcium, vitamin D and protein, contributes to bone health and thus reduces predisposition to osteoporosis and fractures (10).

Poor and irregular diet is very common in patients with psychiatric disorders. More than half of the participants in this study, stated that they had irregular meals and inadequate intake of fruits and vegetables. There is a statistically relevant distinction between patients ($p = 0.003$) when it comes to irregular nutrition in favor of the patients with schizophrenia. In terms of the presence of certain foods in the nutrition (meat, fish, eggs, dairy products), statistically significant differences were shown when it comes to consuming fish.

Table 3. Characteristics of patients' nutrition

Variable	Total (46)	Patients with schizophrenia (n = 26)	Patients with depression (n = 20)	Statistics
Irregular nutrition	31 (67.4)	22 (84.6)	9 (45.0)	$p = 0.003$
Meat consumption	42 (91.3)	22 (84.6)	20 (100)	$p = 0.121$
How often meat ¹	3.31 (1.65)	2.77 (1.41)	3.9 (1.71)	$p = 0.034$
Fish consumption	30 (65.2)	13 (50.0)	17 (85.0)	$p = 0.027$
Egg consumption	39 (84.7)	24 (92.3)	15 (75.0)	$p = 0.212$
Dairy products consumption	44 (95.6)	25 (96.15)	19(95.0)	$p = 0.212$
Bread consumption (g/daily) ¹	306 (167.19)	341.7 (158.6)	258.3 (170.8)	$p = 0.728$

The numbers indicate frequency (percentage); 1 average value (standard deviation);

Table 4. Health characteristics of patients

Variable	Total (46)	Patients with schizophrenia (n = 26)	Patients with depression (n = 20)	Statistics
Associated disease	18 (39.1)	6 (23.1)	12 (60.0)	$p = 0.010$
Thyroid disease	1 (2.2)	0 (0)	1 (5.0)	$p = 0.434$
Osteoporosis	3 (6.52)	0 (0)	3 (15.0)	$p = 0.075$
Use of multivitamins	7 (15.2)	3 (11.54)	4 (20.0)	$p = 0.681$
Spontaneous bone fracture	1 (2.2)	0 (0)	1 (5.0)	$p = 0.434$
Spontaneous bone fracture with parents	3 (6.5)	2 (7.69)	1 (5.0)	$p = 1$
Serum 25(OH)D (ng/mL) ¹	12.7 (7.7, 9.5, 2.9, 35.9)	11.2 (8.0, 8.4, 2.9, 30.4)	13.07 (7.3, 11.4, 3.8, 35.9)	$p = 0.152$
Serum calcium (mmol/L) ²	2.39 (0.17)	2.40 (0.12)	2.38 (0.22)	$p = 0.559$
Serum magnesium (mmol/L) ²	0.78 (0.1)	0.79 (0.11)	0.76 (0.09)	$p = 0.420$
Serum phosphorous (mmol/L) ²	1.07 (0.25)	1.08 (0.25)	1.06 (0.25)	$p = 0.532$

The numbers indicate frequency (percentage); 1 average value (standard deviation, median, and minimum, maximum) and 2 average value (standard deviation);

Smoking represents an established predisposition factor to osteoporosis and fractures caused by osteoporosis. The mechanisms of nicotine effect include changes in the metabolism of calciotropic hormone, intestinal calcium absorption, regulation of sex hormones, adrenal hormone metabolism, and various activators of receptors (16). Smoking has also been known to be associated with lower levels of vitamin D (17). More than a half of them were active smokers, while this bad habit was more prevailing with the patients with schizophrenia compared to patients from the groups with depressive disorders, but without statistical relevance. The statistical relevance was shown in the number of cigarettes smoked per day, the patients with schizophrenia were predominant and on average they smoked more than one pack of cigarettes per day.

In promoting health and healthy lifestyles, physical activity has been given great importance. The World Health Organization recommends adults 30 minutes of moderate to intense physical activity at minimum, five days a week. Longitudinal studies have shown that regular physical activity, in addition to its beneficial effects on muscle mass, improves skeletal micro-architecture and increases BMD and consequently reduces the risk of fractures (18). In the whole group of patients, only one patient did the exercise as a specific type of physical activity. When asked whether they had spent most of the day inactive (lying down), more than half patients or answered in the affirmative way. The patients suffering of schizophrenia are more inactive physically which is supported by statistically relevant distinction between these two groups of patients when it comes to sedentary lifestyle, which in one part can be attributed to the use of antipsychotic drugs. The same can be explained by exposure to sun and being outdoors. More than two thirds of patients with schizophrenia spent less than five minutes in the sun in the previous week, and only every fifth spent prolonged time outdoors. Out of the total number of patients, only one has been on winter or summer vacation in the past six months, and only every sixth patient used sun lotion.

Genetic or invariant risk factors play a significant role in the getting osteoporosis. Three patients reported a positive family history for fractures while three subjects reported osteoporosis in their medical history, one of whom had a spontaneous fracture. All three subjects are from the group with depressive disorders.

Adequate intake of vitamin D and the minerals such as calcium, magnesium and phosphorus is necessary for normal bone metabolism. Magnesium is important for the preservation of the cardiovascular, skeletal and brain systems as well as for maintaining homeostasis. Vitamin D regulates the metabolism of calcium and, in part, phosphate, and there are feedback loops that affect the

function of bones, intestines and kidneys. Vitamin D deficiency indicates insufficient intake and / or synthesis, and it is associated with poor nutrition or insufficient exposure to sun, which is common in patients with psychiatric disorders (19).

The data indicated that both groups of patients had low levels of vitamin D. Studies have shown that calcium and vitamin D supplements have well-recognized benefits for improving bone health and reducing osteopenia (20). In our research, every sixth patient used vitamin supplements.

In conclusion, unhealthy lifestyles are present in people with mental health disorders. At the same time, they represent risk factors for reduced bone mass. The results of our research indicate the need for timely identification of potential risk factors and improvement of prevention in order to raise awareness of the importance of healthy lifestyles and behavior modification.

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ABBREVIATIONS

BMD - bone mineral density

HPLC - high performance/pressure liquid chromatography

CONFLICT OF INTEREST

All authors have no conflicts of interest.

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