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ORIGINAL ARTICLES. PHYSICAL THERAPY

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## Obesity and depression: the course of depressive disorders depending on the body mass index, the role of physical activity and cognitive-behavioral therapy for their correction

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### Abstract

**Purpose:** to establish the relationship between the severity of the course of depressive disorders and body mass index in patients with non-alcoholic fatty liver disease on the background of abdominal obesity, the role of physical activity and cognitive-behavioral therapy for their correction.

**Materials and methods.** 272 people (136 women and 136 men) were examined. The patients were divided into two clinical groups: 1st group – 90 people with non-alcoholic fatty liver disease and overweight (average body mass index = $27.5 \pm 1.31$  kg/m<sup>2</sup>), who followed only dietary recommendations and a complex physical exercises; 2nd group - 92 people with non-alcoholic fatty liver disease and abdominal obesity of the 1st degree (average body mass index = $31.74 \pm 1.03$  kg/m<sup>2</sup>), who additional underwent a 6-month course of cognitive-behavioral therapy. The control group consisted of 90 people with normal body weight (average body mass index = $22.41 \pm 1.43$  kg/m<sup>2</sup>). The Beck scale was used to assess the presence of depression.

**Results.** Depression in patients of the 1st and 2nd groups was registered in 2.3 times ( $\chi^2=28.105$ ,  $p=4.762e-10<0.05$ ) and 2.6 times more often ( $\chi^2=12.019$ ,  $p=0.007<0.05$ ), than in the control group. Mild depressive disorders in 1.9 times ( $D=0.304$ ,  $p=0.032<0.005$ ) more often recorded in young women (up to 45 years old). Patients of the 2nd group, who additionally received a course of CBT, recorded a decrease in the number of depressive disorders of moderate severity by 3.33 times ( $D=0.1837$ ,  $p=0.0133$ ), compared to the patients of the 1st group.

**Conclusions.** Gender-age characteristics and weight affect the severity of depressive disorders in obese patients. To reduce the number of depressive disorders and optimize body mass index, it is mandatory to use combined treatment in the form of aerobic exercises and cognitive-behavioral training.

**Key words:** obesity, cognitive-behavioral therapy, depression, non-alcoholic fatty liver disease



## Анотація

**Людмила Кіро, Максим Зак, Олег Чернишов, Мзія Свєрдлова. Ожиріння та депресія: перебіг депресивних розладів в залежності від індексу маси тіла, роль фізичної активності та когнітивно-повідінкової терапії для їх корекції**

**Мета:** встановити залежність між тяжкістю перебігу депресивних розладів та індексом маси тіла у пацієнтів з неалкогольної жирової хворобою печінки на фоні абдомінального ожиріння, роль фізичної активності та курсу когнітивно-повідінкової терапії для їх корекції.

**Матеріали та методи.** Обстежено 272 особи (136 жінок та 136 чоловіків). Пацієнти були розподілені на дві клінічні групи: 1 група – 90 осіб хворих на неалкогольної жирової хворобою печінки та надлишковою масою тіла (середній індекс маси тіла  $=27,5 \pm 1,31$  кг/м<sup>2</sup>), які дотримувались лише дієтичних рекомендацій та комплексу фізичних навантажень; 2 група - 92 особи з неалкогольної жирової хворобою печінки та абдомінальним ожирінням 1 ступеня (середній індекс маси тіла  $=31,74 \pm 1,03$  кг/м<sup>2</sup>), які додатково пройшли 6 місячний курс когнітивно-повідінкової терапії. Контрольну групу склали 90 осіб з нормальною масою тіла (середній індекс маси тіла  $=22,41 \pm 1,43$  кг/м<sup>2</sup>). Для оцінки наявності депресії використовували шкалу Бека.

**Результати.** Депресія у хворих 1-ї та 2-ї груп реєструвалася в 2,3 рази ( $\chi^2=28,105$ ,  $p=4,762e-10 < 0,05$ ) та в 2,6 рази частіше ( $\chi^2=12,019$ ,  $p=0,007 < 0,05$ ), ніж у контрольній групі. Депресивні розлади легкого ступеня в 1,9 рази ( $D=0,304$ ,  $p=0,032 < 0,005$ ) частіше зафіксовані у жінок молодого віку (до 45 років). У пацієнтів 2-ї групи, які додатково отримували курс когнітивно-повідінкової терапії, зафіксовано зменшення кількості депресивних розладів середньої тяжкості в 3,33 рази ( $D=0,1837$ ,  $p=0,0133$ ), в порівнянні з пацієнтами 1-ї групи.

**Висновки.** Гендерно-вікові особливості та вага впливають на тяжкість перебігу депресивних розладів у пацієнтів з ожирінням. Для зменшення кількості депресивних розладів та оптимізації індексу маси тіла обов'язковим є застосування комбінованого лікування у вигляді аеробних фізичних навантажень та когнітивно-поведінкових тренінгів.

**Ключові слова:** ожиріння, когнітивно-повідінкова терапія, депресія, неалкогольна жирова хвороба печінки

## Аннотация

**Людмила Киро, Максим Зак, Олег Чернышов, Мзия Свєрдлова. Ожирение и депрессия: течение депресивных расстройств в зависимости от индекса массы тела, роль физической активности и когнитивно-поведенческой терапии для их коррекции**

**Цель:** установить зависимость между тяжестью течения депрессивных расстройств и индексом массы тела у пациентов с неалкогольной жировой болезнью печени на фоне абдоминального ожирения, роли физической активности и курса когнитивно-поведенческой терапии для их коррекции.

**Материалы и методы.** Обследовано 272 человека (136 женщин и 136 мужчин). Пациенты были распределены на две клинические группы: 1 группа – 90 человек больных неалкогольной жировой болезнью печени с избыточной массой тела (средний  $=27,5 \pm 1,31$  кг/м<sup>2</sup>), которые придерживались только диетических рекомендаций и комплекса физических нагрузок; 2 группа - 92 человека из неалкогольной жировой болезнью печени с абдоминальным ожирением 1 степени (средний индекс массы тела  $=31,74 \pm 1,03$  кг/м<sup>2</sup>), которые дополнительно прошли 6 месячный курс когнитивно-поведенческой терапии. Контрольную группу составили 90 человек с нормальной массой тела (средний индекс массы тела  $=22,41 \pm 1,43$  кг/м<sup>2</sup>). Для оценки наличия депрессии использовали шкалу Бека.

**Результаты.** Депрессия у больных 1-й и 2-й групп регистрировалась в 2,3 раза ( $\chi^2=28,105$ ,  $p=4,762e-10 < 0,05$ ) и в 2,6 раза чаще ( $\chi^2=12,019$ ,  $p=0,007 < 0,05$ ), чем в контрольной группе. Депрессивные расстройства легкой степени в 1,9 раза ( $D=0,304$ ,  $p=0,032 < 0,005$ ) чаще зафиксированы у женщин молодого возраста (до 45 лет). У пациентов 2-й группы, дополнительно получавших курс когнитивно-поведенческой терапии, зафиксировано уменьшение количества депрессивных расстройств средней тяжести в 3,33 раза ( $D=0,1837$ ,  $p=0,0133$ ), по сравнению с пациентами 1-й группы.

**Выводы.** Гендерно-возрастные особенности и вес влияют на тяжесть течения депрессивных расстройств у пациентов с ожирением. Для уменьшения количества депрессивных расстройств и оптимизации индекса массы тела обязательно применение комбинированного лечения в виде аэробных физических нагрузок и когнитивно-поведенческих тренировок.

**Ключевые слова:** ожирение, когнитивно поведенческая терапия, депрессия, неалкогольная жировая болезнь печени



## Introduction

Physical inactivity was identified as the fourth leading risk factor in global mortality estimates (responsible for 6% of deaths worldwide). The three leading factors are high blood pressure (13%), tobacco use (9%) and high blood glucose (6%) [1-2]. Overweight and obesity are responsible for 5% of global mortality. Levels of physical inactivity are increasing in many countries with significant consequences for the overall health of people in the world and cause the prevalence of NCDs such as cardiovascular disease, diabetes and cancer due to their risk factors, which include high blood pressure, high blood sugar of blood and excess weight [3-4]. Physical inactivity is estimated to be the main cause of approximately 21% to 25% of breast and colon cancers, 27% of diabetes and approximately 30% of coronary heart disease. In addition, NCDs now account for about half of all disease cases worldwide. According to current estimates, 6 out of every 10 deaths are deaths from non-communicable diseases [5-6].

Over the last few decades, the problem of depressive disorders and obesity has become particularly acute for the global health care system. In the process of implementing the project "European study of the epidemiology of mental disorders" almost 13% of respondents found signs of psychotic depression in a certain period of their lives and 4% - in the last 12 months. The total number of people with psychotic depression in Europe in 2020 reached 21 million [7]. Researchers have found that increasing the body mass index for every 4.7 kg increases the risk of depression by 18% [8]. It has also been found that people who suffer from childhood obesity are more prone to depression than those who acquire it in adulthood [9]. Depressive disorders, as well as obesity, significantly affect physical, mental and social functioning and increase the risk of premature death. Depression makes it difficult to meet basic human needs and negatively affects their daily life activities, leading to a significant reduction in quality of life [10]. According to epidemiological studies, depression causes a number of social dysfunctions that are more severe than the effects of chronic somatic diseases such as angina, arthritis, bronchial asthma and diabetes [11]. According to some experts, depressive disorders should be considered one of the most important factors of socio-economic problems arising from health disorders [12]. According to

WHO forecasts, by 2025, depressive disorders will occupy the second place after cardiovascular disease in the world as a factor of disability [13]. This assumption, made in the mid-90s of the last century, is quite justified: in some Western European countries, ten years later, depression becomes not the second but the first factor in the loss of full years of life [14]. The social significance of depression is due not only to the negative impact of depressive disorders on the quality of life of patients themselves. Helping patients with depression involves significant costs for their treatment and social security [15].

The interest in studying the features of depressive disorders in patients with non-alcoholic liver disease on the background of abdominal obesity is associated with an unfavourable epidemiological situation, severe medical and social consequences of this comorbid pathology. Physical activity and cognitive-behavioral therapy are the priority direction of non-pharmacological correction of the above disorders.

**Purpose:** to establish the relationship between the severity of the course of depressive disorders and body mass index in patients with non-alcoholic fatty liver disease (NAFLD) on the background of abdominal obesity, the role of physical activity and cognitive-behavioral therapy (CBT) for their correction.

## Materials and methods

### Participants

On the basis of the University Clinic of the Black Sea National University named after Petro Mohyla and the polyclinic of the State Institution "Territorial Medical Association of the Ministry of Internal Affairs of Ukraine in Mykolaiv region" 272 people (136 women and 136 men) were examined. The age of women ranged from 19 to 60 years (mean age was  $41.5 \pm 11.2$  years), the age of men - from 22 to 60 years (mean age -  $42.3 \pm 12.3$  years). All patients were divided into two clinical groups: 1st group - 90 people (45 women and 45 men) patients with NAFLD and overweight with average  $BMI = 27.5 \pm 1.31$  kg/m<sup>2</sup>, who followed only dietary recommendations and a complex physical exertion; 2 group - 92 people with NAFLD (46 women and 46 men) with abdominal obesity of the 1st degree (average  $BMI = 31.74 \pm 1.03$  kg/m<sup>2</sup>), who underwent



a 6-month course of CBT, diet therapy, and physical exercises. The control group consisted of 90 people (45 women and 45 men) with normal body weight (average body mass index= $22.41 \pm 1.43$  kg/m<sup>2</sup>).

### Procedure

General clinical examination of patients included: determination of height and body weight, calculation of body mass index; extinction of the circular waist and hips; study of body proportions; assessment of the presence of striae and study of sexual development; extinction of blood pressure; general blood and urine tests; determination of fasting blood glucose followed by an oral glucose tolerance test; blood lipid spectrum; detailed collection of family history. Additional examination: laboratory study of thyroid hormones, electrocardiography (ECG), in case of persistent increase in blood pressure - echocardiography (ECG).

The assessment of a patient with NAFLD necessarily included: exclusion of alcohol consumption  $\geq 30$  g/day in the case of a man and  $\geq 20$  g/day in the case of a woman; individual and family history of diabetes mellitus, hypertension and cardiovascular diseases were analysed in detail, BMI, waist circumference, body weight changes were calculated; laboratory-confirmed negative results for markers of HBV and HCV infection; exclusion of the use of steatogenic drugs; slight or moderate increase in the activity of ALT and AST (AST/ALT  $< 1$ ) and GGT ( $\approx 50\%$  of cases), fasting blood glucose, HbA1c, PGTT (possibly fasting insulin and HOMA-IR test); general blood test; concentration of total cholesterol, HDL, triglycerides and uric acid in plasma; ultrasound data (increased echogenicity (steatosis) of the liver, rarely hepatomegaly; in cirrhosis symptoms of portal hypertension). Given the technical difficulties in the presence of obesity, mainly due to the inability to visualize minor steatosis ( $< 20\%$  of liver weight), inability of sonographic examination to differentiate simple steatosis NASP from NASH), patients in group 2 with abdominal obesity were recommended MRI, which assesses minor steatosis (5-10% of hepatocytes).

The patients' diet was moderate and balanced in the content of fats (25–30%), proteins (15–20%) and carbohydrates (55–60%); the frequency of eating 4–5 times a day, without big breaks, the nutritional value of snacks did not exceed 200 kcal, the daily energy calorie content of food 1000-1500 kcal. The daily diet contained at least 400–500 g of protein

products (meat, fish, cheese), dishes from vegetables and leafy greens (cabbage), radishes, cucumbers, zucchini, raw, boiled or baked tomatoes, as well as dishes from potatoes, beets, carrots (no more than 200 g/day). Once a week, patients did unloading days. The unloading days are divided into protein (cheese, milk, meat, fish), carbohydrate (sugar, potato, apple, cucumber, etc.), fat (cream) and combined days according to the chemical composition of the food products consumed. According to statistics, the most effective of the listed are cucumber, apple, meat, milk and cream unloading days. Significant positive results were observed when taking various medicinal plants (germinated grain, seeds, etc.). 2–4 centuries l. sprouted sunflower seeds, wheat grains, oats, rye, barley for breakfast is an excellent means of correcting metabolic processes, various pathologies and body weight. Products containing iodine were also used for the prevention and treatment of obesity: sea cabbage and other seaweed; fruits of chokeberry, mountain ash, cranberry; beet roots, all varieties of cabbage, salads, etc.

One of the main indicators of a person's health and the achievement of an optimal body mass index is the patient's aerobic productivity - the maximum amount of oxygen she can consume in one minute. Glucose, glycogen, free fatty acids, glycerol, and nitrogen-free amino acid residues are broken down in the cleansing processes that ensure resynthesis of ATP (cleansing phosphorylation). The final products of aerobic processes are carbon and water, which are easily excreted from the body. A prerequisite for aerobic processes is a sufficient supply of O<sub>2</sub> to the cells. The more intensive the activity of the cells, the more it is necessary to spend and resynthesize ATP, the greater the need for oxygen.

The training plan for the patients consisted of four levels. The program of the first level of load was designed for 3-4 months. Its goal is to prepare for continuous running for 20 minutes. Training according to this program involved alternating slow running with walking, the duration of classes - from 15 to 35 minutes. At this stage, the running speed did not increase, but the walking speed gradually increased. The main task of training for the II load level is to prepare for continuous running for 35 minutes. The program was designed for those patients who have mastered the I level of exercise, as well as beginners who can run for 15 minutes at a slow pace without stress. At this level of load, only running was provided. The III load level program is aimed at the further development of the body's



aerobic capabilities. This program was performed by those patients who ran at a slow pace for 30-40 minutes without tension. This level of load was aimed at increasing the duration of running and speed. The speed gradually approached running 1 km in 5 minutes, and later - up to 12 km in 1 hour. The class took 40 to 60 minutes. For most patients, the III degree of load is the highest, so for those who mastered it, we recommended repeating exercises from 1 to 20 or from 10 to 20, but with a slightly increased speed. It was also recommended to increase the length of the runs without changing the speed. When performing the programs, patients should follow the general recommendations (a noticeable and sustainable result will be achieved only if you run regularly, often and a lot (30-40 minutes every day); you should start classes not with jogging, but with walking (at least 100 meters), gradually increasing the distance and speed of movement; train 3 times a week for 15-20 minutes at an average pace, alternating running and walking (run a circle, walk a circle); after 2 weeks, the load can be increased by reducing the number of walking circles, increasing the duration of each training, distance and frequency of classes per week (over time, one run should be 40-60 minutes); soon you will need a training program for running 3 km or more; clothes and shoes for training should be comfortable and convenient; you need to warm up before running for 10 minutes (the set of exercises included tilting the body and head,

squats, moving the hips in a circle, stretching the legs, 15 seconds for each muscle group); optimal it is physical activity in the fresh air; to exclude health risks, it is recommended to check your heart rate before and after training (after training, the rate should not exceed the norm by more than 70%, i.e. from the initial value recorded before the start of training); the heart rate should return to normal after half an hour after finishing the classes. Interval running is considered the most effective of all types of running (its essence is that fast movements for short distances alternate with slow ones for long distances). Regardless of the level of training, classes are held 4 times a week. If classes cause negative feelings, it is recommended to return to the previous level of exercise.

The first stage is accelerated walking. It starts with 300 - 500 meters and more, guided by the feeling of well-being. At the same time, the acceleration of the pulse should not exceed 50 percent of the initial (before walking). After a certain period of time, depending on the state of health and the degree of decrease in pulse response, the distance was extended by 250-500 m. The weekly cycle included four training sessions. The table below shows the full dosage of the load at each stage (Table 1). When performing aerobic exercise by patients, it was taken into account that a full or 75 percent recovery of the pulse to the initial data should occur 15-20 minutes after the end of the training.

Table 1

Dosage of aerobic load at each stage of training

Stage	Duration of the stage	Distance and nature of movement	Speed min./km	Pulse beats/min
I	2 weak	2000 m accelerated walking	10	84-90
II	8 weeks	from 600 m walking to 400 m running from 700 m walking to 800 m running	from 9.30 to 8.0	90-102
III	10 weeks	from 2000 m to 5000 m running	from 8 to 6	102-114
IV	4 weeks	from 5500 to 10000 m running	from 5.50 to 5	114-132



A modified Beck questionnaire was used to investigate the presence and severity of depressive disorders. Patients in all clinical groups were asked to answer 21 questions from Beck's survey, taking into account their well-being over the past 2 weeks. Each answer was evaluated from 0 points (in case of complaints) to 3 points (in the presence of a large number of patients). The obtained points were added and interpreted: 0-13 - situations of depression; 14-19 - mild depression; 20-28 - moderate depression; 29-63 - severe depression.

The diagnosis of depressive disorder was established in the presence of the following two symptoms: low mood for at least 2 weeks (more days, most of the time); loss of interest in life and habitual activities and feelings of satisfaction; decrease in energy and the expressed fatigue.

In addition, there must be at least one of the following symptoms: decrease in self-confidence; guilt or complete self-blame; suicidal thoughts or actions; decreased concentration or indecision; agitation or inhibition; sleep disorder; decreased appetite.

The diagnosis of mild depression is appropriate if a total of 5 symptoms and features of labour loss are noted. Moderate depression can be said to have 6 or more symptoms, which are accompanied by significant disability.

The study was conducted in accordance with the basic bioethical norms of the Helsinki Declaration of the World Medical Association "Ethical Principles of Medical Research Involving Humans as Research Subjects" (1964), with changes and additions to the General Declaration on Bioethics and Human Rights. United Nations (2005), Council of Europe Convention on Human Rights and Biomedicine (1997). All participants were informed about the goals, organization, methods of the study and signed an informed consent to participate in it. All measures are also taken to ensure patient anonymity.

The main methods of CBT that were used during coaching trainings: cognitive psychotherapy, reciprocal inhibition, rational-emotive psychotherapy, self-control.

### Statistics analysis

Statistical processing of the research results was carried out by the methods of variational statistics using the standard SPSS 13.0 program package for MS Windows. The Kolmogorov-Smirnov test was used to establish differences between samples. A difference was considered significant if the achieved significance level (p-value) was lower than 0.05. The Kruskal-Wallis test was used to establish correlation

between samples. Correlation between samples was considered to be present at p-value <0.05.

## Results

A correlation between body mass index and the severity of depressive disorders was found in all groups (in control group:  $\chi^2=46.357$ , p-value= $4.762e-10<0.05$ ; in 1st group:  $\chi^2=28.105$ , p-value= $3.452 e-06<0.05$ ; in 2nd group:  $\chi^2=12.019$ , p-value=0.007). In 1st group, the number of patients with severe depression was recorded 2.25 times more often, in the 2nd group 2.5 times more, respectively, than among patients of the control group. In patients with normal weight, there is no depression recorded in 4.77 and in 6.89 times more frequent than in overweight and obese people. Moderate depression was recorded in 2.91 times more often in 1st group and in 3.09 times in 2nd group, then in control group (Table 2).

Gender and age characteristics of patients also influenced the course of depressive disorders. Mild depressive disorders were in 1.9 times more common in young women (up to 45 years) than in men ( $D=0.304$ ,  $p=0.032<0.05$ ). The number of severe depressions in the 2nd group, under the age of 45, was recorded 2.5 times ( $D=0.130$ ,  $p=0.020<0.05$ ) more often in men than in women. After 45 years, in the 2nd group, in 2 times ( $D=0.124$ ,  $p=0.007<0.05$ ) more severe depression was recorded in men than in women (Table 3).

The course of CBT had a positive effect not only on the physical condition of the patients, but primarily on the psycho-neurological sphere. Separately, it was possible to achieve a decrease in the number of depressive disorders of moderate severity by 3.33 times ( $D=0.1837$ ,  $p=0.0133$ ) in patients of the 2nd group (who passed course of CBT), compared to patients of the 1st group of the group (Table 4).

Complex therapy (rational nutrition, regular aerobic exercises, cognitive-behavioral training) had a positive effect not only on the mental health of patients, but also on anthropological and physiological indicators. Thus, in patients of the 2nd group, on the 180th day of treatment, an average decrease in BMI by  $5.14 \text{ kg/m}^2 \pm 1.01$  ( $D=0.256$ ,  $p=0.049$ ), average waist circumference by  $8 \pm 1.2 \text{ cm}$  ( $D=0.467$ ,  $p=0.031$ ), hip circumference and  $10 \pm 1.02 \text{ cm}$  ( $D=0.038$ ,  $p=0.002$ ), blood pressure at  $19/4 \pm 1.5 \text{ mm Hg}$ . ( $D=0.456$ ,  $p=0.05$ ), in comparison with the initial indicators. A between-group difference in body mass index was recorded, depending on the type of therapy received by patients of different clinical groups ( $D=0.039$ ,  $p=0.05$ ), (Table 5).



Table 2  
Relationship between the course of depressive disorders and the weight of patients in different clinical groups

The severity of depressive disorders	The number of points scored on the Beck Scale	Control group, BMT <sub>mid</sub> '=22.4 ± 1.43 kg/m <sup>2</sup> (n = 90)				Group I, BMT <sub>mid</sub> '=27.7 ± 1.31 kg/m <sup>2</sup> (n = 90)				Group II, BMT <sub>mid</sub> '=31.74 ± 1.03 kg/m <sup>2</sup> (n = 92)			
		n	%	χ <sup>2</sup>	p-value	n	%	χ <sup>2</sup>	p-value	n	%	χ <sup>2</sup>	p-value
Absent of depression	0-13	62	68.9%	46.357	4.762e-10 < 0.05*	13	14.4%	28.105	3.452e-06 < 0.05*	9	9,8%	12.019	0.007*
Mild depression	14-19	13	14.4%			36	40.0%			39	42,4%		
Moderate depression	20-28	11	12.2%			32	35.6%			34	37,0%		
Severe depression	29-63	4	4.5%			9	10.0%			10	10,8%		

\*There are differences in the frequency of depressive episodes (p-value < 0.05)

Table 3  
The difference between depressive disorders among patients with NAFLD on the background of abdominal obesity, depending on gender and age

Degree of depression	Group II, women under 45, (n = 23)		Group II, women over 45 years, (n = 23)		Difference in the degree of depression in women of group II, depending on age		Group II, men under 45, (n = 23)		Group II, Men over 45 years, (n = 23)		Difference in the degree of depression in men of group II, depending on age		Difference in the degree of depression in women and men of group II under the age of 45 years		The difference in the degree of depression in women and men of group II age after 45 years old	
	n	%	n	%	D	P-value	n	%	n	%	D	P-value	D	P-value	D	P-value
Mild depression (14-19 points on the Beck scale)	15	16.3 %	12	13.0%	0.13	0.286	8	8.7%	6	6.5%	0.087	0.383	0.304	0.032*	0.261	0.067
Moderate depression (20-28 points on the Beck scale)	6	6.5%	8	8.7%	0.087	0.383	10	10.9%	11	12.0%	0.043	0.478	0.174	0.172	0.130	0.275
Severe depression (29-63 points on the Beck scale)	2	2.2%	3	3.3%	0.043	0.498	5	5.4%	6	6.5%	0.043	0.478	0.130	0.020*	0.124	0.007*

\*There are differences in the frequency of depressive episodes (p-value < 0.05).



Table 4

Differences in the distribution of depressive disorders in clinical groups, depending on the type of treatment

Degrees of severity of depressive disorders observed after 6 months of treatment	Amount of scored points on the Beck depression scale	2 group, BMI av.= 32.55 ±1.07 kg/m2 (n=90) After CBT + exercise, diet		1 group, Average BMI=31.95±1.03 kg/m2 (n=37), Physical activity and diet		Difference between 2 and 1 groups	
		n	%	n	%	D	P
No depression	0-13	4	8.9	2	2.2	1,5825	0,6927
Mild depression	14-19	20	44.4	4	11.1	5,7750	0,0017*
Moderate depression	20-28	3	5.6	10	33.3	0,1837	0,0133*
A severe course of depression	29-63	2	4.4	3	8.9	0,4969	0,6488

\*There are differences in the frequency of depressive episodes (p-value < 0.05).

Table 5

Dynamics of changes in anthropometric and physiological indicators in patients with NAFLD in the presence of abdominal obesity depending on the type of therapy

Indicators	1 <sup>st</sup> group n=90 (Diet, physical aerobic exercise)		2 <sup>nd</sup> group n=92 (Diet, physical aerobic exercise + CBT)		The difference between initial and final indicators in the 1st group		The difference between initial and final indicators in the 2nd group		The difference in initial indicators (1st) in the 1st and 2nd groups on the day of observation		The difference in the final indicators (180th day of observation) in the 1st and 2nd groups	
	1st day	180 <sup>th</sup> day	1st	180 <sup>th</sup> day								
	M+SEM	M+SEM	M+SEM	M+SEM	D	P	D	P	D	P	D	P
Weight (kg)	84±2.5	79±2.6	96±3.5	83±1.01	2.021	0.009	1.087	0.992	2.02	0.09	1.080	0.061
BMD (kg/m <sup>2</sup> )	27.5 ± 1.31	26.6±1.32	31.74±1.03	25.6±0.08	1.098	0.007	0.256	0.049*	2.000	0.867	0.039	0.05*
Waist circumference	92±2.97	89±2.01	110±2.08	92±1.01	0.998	0.008	0.467	0.031*	1.030	2.090	1.987	1.011
Hip circumference	115±1.02	100±0.09	120±1.65	110±1.08	2.098	1.003	0.038	0.002*	2.970	3.050	0.934	0.076
WC/HC (cm)	0.95	0.9	1.01	0.9	2.097	1.098	0.02	0.981	1.090	4.090	1.032	0.081
BP (mm Hg)	139/90 ± 5 mm.Hg	130/86±4 mm.Hg	149/95 ±6 mm.Hg	130/89±3 mm.Hg	2.076	2.03	0.456	0.05*	0.098	0.049	1.001	1.001

\*There are differences in the frequency of depressive episodes (p-value <0.05).





## Discussion

The results of the study demonstrated a close relationship between the body mass index of NAFLD patients and the severity of depressive disorders. The interrelationship between NAFLD in the case of insufficiency and depression is primarily due to disorders of serotonin metabolism in the brain: the development of serotonin synthesis is enhanced by its receptors and its reuptake efficiency is achieved, which is why the concentration of serotonin in the synaptic cleft decreases. Eating behaviour and forces the patient to consume food, based not on the need for basic metabolism, but because of the need to stimulate the serotonergic system of the CNS, and on the other hand serotonin deficiency in the emotional sphere of the patient and causes depression. In our opinion, these statistical differences are partly due to the under diagnosis of depression in men and their over diagnosis in women. Women are more likely to seek help, and the symptoms of the disease are usually related to socio-psychological and family problems, which they actively tell doctors and researchers about. Men are not inclined to complain about their experiences. Depressed states are more often masked by manifestations of aggression [16-18].

They seek to overcome depression on their own, regain the ability to experience pleasure and interest in life, increasing the workload, doing extreme sports or entertainment, using psychoactive substances. Factors associated with depression in old age also include women's age, past depressive episodes, the presence of depression in close relatives, the status of a widow (widower), poverty, living in a residential institution, poor physical health, lack of social support, personality traits, CNS damage due to vascular diseases.

Factors in the manifestation of depression in the elderly are considered to be difficult life circumstances (in particular, severe somatic disorders, loss of loved ones, social difficulties), the status of a pensioner, the use of certain medications and alcohol. As protective, or buffer, factors are considered the appropriate level of medical care, a positive style of experiencing difficult life circumstances, adequate social support [19-24]. Correction of depressive disorders on the background of NAFLD and obesity must be comprehensive, including consultation with a psychologist, endocrinologist and gastroenterologist.

At the beginning of therapy, it is important to choose those tactics that are quite simple and possible for the patient to implement, and accordingly can give a certain sense of success, hope and some initial improvement in emotional state. For patients with severe depression, it is primarily a technique of behavioural activation, for patients with milder forms - cognitive distancing and distraction from depressive thoughts. Techniques of distancing / distracting from depressive thoughts. Applying them can be the second step after basic psycho education on the model of depression and explaining the relationship between negative thoughts and emotional well-being, and therefore behaviour. At this stage, patients are taught techniques that the cognitive behaviour therapy (CBT) has borrowed from the tradition of meditation - observation of thoughts, their awareness without identifying with them (respectively, this area of CBT is called mindfulness based CBT). Thus, the patient is invited to take the position of an observer of his thoughts and instead of following them, reacting to them, try to perceive them more critically and calmly from a certain internal distance. As additional techniques that can help refrain from constantly listening to the flow of depressive thoughts, behavioural activation techniques can be suggested (find/plan some positive activities - they are more useful and when you are busy with something easier to distract from the flow of negative thinking), as well as techniques shifting attention to the "here and now" (similar to meditative techniques of focusing attention/presence), or the technique of "stopping" negative thoughts and replacing them with a certain "positive" thought, resource thoughts / images (for religious people it can also be short repeated prayer phrase) or some cognitive activity (for example, mental arithmetic, singing songs about yourself, etc.).

Behavioural activation techniques include monitoring one's own activity, planning/organizing time, and assigning graded tasks. The purpose of these techniques is primarily to help the patient out of the malignant circle of depression, which is characterized by passivity, avoidance of important tasks and problems - and this in turn leads to the accumulation of problems and a new circle of negative thinking and affect. Behavioural activation helps to increase the overall tone, reduce the amount of time the patient spends in depressive "thoughts", it also helps to identify negative thoughts that become an obstacle to behavioural changes - these thoughts



will be the focus of the next stage of cognitive interventions.

Thus, based on comparisons and studies of the effectiveness of depression therapy, the NICE (2019) protocol recommends [25]:

- In mild depression - the method of choice is CBT;
- In moderate depression - the method of choice is pharmacotherapy with antidepressants (SSRI) or at the choice of clients - CBT;
- In severe depression - a combination of antidepressant therapy and CBT;
- In case of drug-resistant depression - along with various possibilities of augmentation/change of pharmacotherapeutic agents, it is suggested as an option to add CBT to pharmacotherapy;
- In chronic and recurrent depression - a combination of antidepressant therapy and CBT;

For depression in children and adolescents, CBT (along with interpersonal and short-term family psychotherapy) is always the method of choice, and only in case of insufficient effect of psychotherapeutic methods or unavailability of the latter - to add pharmacotherapy with antidepressants (SSRI).

It is the combination of a complex of physical exercises, CBT, and rational nutrition that is of great importance.

Properly organized training is a powerful weapon against excess weight. In addition, running helps to develop endurance, strengthen muscles, improve health and keep your body in good shape. The key to success is consistency of actions and self-discipline. It is necessary to choose the optimal program of classes for weight loss, which includes a training algorithm available for a specific person (corresponding to his physical capabilities and health indicators).

The high efficiency of running is explained by the fact that during classes the metabolism accelerates, as a result of which calories are burned and a large amount of energy is released. The circulatory system is saturated with oxygen, which stimulates the work of all body systems. In addition, immunity increases during regular aerobic exercise; additional energy appears, due to which the working capacity increases; together with sweat, toxins come out, thanks to which the body is cleansed of impurities and harmful substances; the amount

of cholesterol in the blood decreases; metabolism improves, the circulatory system is saturated with oxygen, the work of organs and tissues is stimulated; running is one of the best ways to relax and have a good mood, which is especially important for patients with depressive disorders; such classes improve the coordination of movements; there is an opportunity to lose several kilograms (exactly how much depends on the duration, distance and frequency of training).

First, you need to find out your level of physical fitness and health. First of all, it is important that there are no problems with the musculoskeletal system and the cardiovascular system, there are no injuries and other contraindications. At the same time, pain in the knee joints caused by excess weight does not belong to injuries, and no matter how strong the desire is to find an excuse to give up daily jogging, this number will not work here. You need to pull yourself together and, no matter what, move forward towards a slim figure and a healthy lifestyle.

## Conclusions

Regular sports and physical activity not only help to improve physical shape and reward a person with a beautiful body, but also help to overcome various mental problems, including depression. There are a number of reasons explaining the positive impact of sports on a person's mental state. In the process of physical activity, blood circulation accelerates, metabolism improves, perception of the surrounding world normalizes, and more oxygen enters the cells, which accelerates carbohydrate metabolism. Thus, physical activity has a positive effect not only on muscles, but is also a useful factor in activating brain activity. People who play sports are more resistant to stress, their self-esteem increases, and there is also a distraction from unpleasant obsessive thoughts. And the complex of CBT allows to modify the mental sphere of the patient through cognitive restructuring, adjusting the patient to a positive way.

## Conflict of interest

The authors declare that there is no conflict of interest.



## References

1. Albillos A, de Gottardi A, Rescigno M. The gut-liver axis in liver disease: Pathophysiological basis for therapy. *J Hepatol.* 2020 Mar; 72 (3):558-577. doi: 10.1016/j.jhep.2019.10.003. Epub 2019 Oct 14. PMID: 31622696.
2. Dalle Grave R, El Ghoch M, Sartirana M, Calugi S. Cognitive Behavioral Therapy for Anorexia Nervosa: An Update. *Curr Psychiatry Rep.* 2016 Jan; 18(1):2. doi: 10.1007/s11920-015-0643-4. PMID: 26689208.
3. Hayes SC, Luoma JB, Bond FW, Masuda A, Lillis J. Acceptance and commitment therapy: model, processes and outcomes. *Behav Res Ther.* 2006 Jan; 44(1):1-25. doi: 10.1016/j.brat.2005.06.006. PMID: 16300724.
4. Jaurigüe MM, Cappell MS. Therapy for alcoholic liver disease. *World J Gastroenterol.* 2016 Mar 7; 20(9):2143-58. doi: 10.3748/wjg.v20.i9.2143. PMID: 24605013; PMCID: PMC3942819.
5. Kalinowska S, Nitsch K, Duda P, Trzeźniowska-Drukała B, Samochowiec J. Depresja u dzieci i młodzieży-obraz kliniczny, etiologia, terapia [Depression in children and adolescents -symptoms, etiology, therapy]. *Ann Acad Med Stetin.* 2018; 59(1):32-6. Polish. PMID: 24734332.
6. Kampman O, Viikki M, Leinonen E. Anxiety Disorders and Temperament-an Update Review. *Curr Psychiatry Rep.* 2017 May; 19(5):27. doi: 10.1007/s11920-017-0779-5. PMID: 28417269.
7. Małek A, Golińska P. Depression in Tourette syndrome. *Psychiatr Pol.* 2020 Feb 29; 54 (1):69-82. English, Polish. doi: 10.12740/PP/OnlineFirst/94471. Epub 2020 Feb 29. PMID: 32447357.
8. Meuret AE, Tunnell N, Roque A. Anxiety Disorders and Medical Comorbidity: Treatment Implications. *Adv Exp Med Biol.* 2020; 1191:237-261. doi: 10.1007/978-981-32-9705-0\_15. PMID: 32002933.
9. Piché ME, Tchernof A, Després JP. Obesity Phenotypes, Diabetes, and Cardiovascular Diseases. *Circ Res.* 2020 May 22; 126(11):1477-1500. doi: 10.1161/CIRCRESAHA.120.316101. Epub 2020 May 21. Erratum in: *Circ Res.* 2020 Jul 17; 127(3):e107. PMID: 32437302.
10. Postorino V, Kerns CM, Vivanti G, Bradshaw J, Siracusano M, Mazzone L. Anxiety Disorders and Obsessive-Compulsive Disorder in Individuals with Autism Spectrum Disorder. *Curr Psychiatry Rep.* 2017 Oct 30; 19 (12):92. doi: 10.1007/s11920-017-0846-y. PMID: 29082426; PMCID: PMC5846200.
11. Rachman S. The evolution of behaviour therapy and cognitive behaviour therapy. *Behav Res Ther.* 2015 Jan; 64:1-8. doi: 10.1016/j.brat.2014.10.006. Epub 2014 Oct 29. PMID: 25462876.
12. Stefan S, Cristea IA, Szentagotai Tatar A, David D. Cognitive-behavioral therapy (CBT) for generalized anxiety disorder: Contrasting various CBT approaches in a randomized clinical trial. *J Clin Psychol.* 2019 Jul; 75(7):1188-1202. doi: 10.1002/jclp.22779. Epub 2019 Apr 20. PMID: 31004521.
13. Stein DJ, Scott KM, de Jonge P, Kessler RC. Epidemiology of anxiety disorders: from surveys to nosology and back. *Dialogues Clin Neurosci.* 2017 Jun; 19(2):127-136. doi: 10.31887/DCNS.2017.19.2/dstein. PMID: 28867937; PMCID: PMC5573557.
14. Thoma N, Pilecki B, McKay D. Contemporary Cognitive Behavior Therapy: A Review of Theory, History, and Evidence. *Psychodyn Psychiatry.* 2015 Sep; 43(3):423-61. doi: 10.1521/pdps.2015.43.3.423. PMID: 26301761.
15. Vecchiè A, Dallegri F, Carbone F, Bonaventura A, Liberale L, Portincasa P, Frühbeck G, Montecucco F. Obesity phenotypes and their paradoxical association with cardiovascular diseases. *Eur J Intern Med.* 2018 Feb; 48:6-17. doi: 10.1016/j.ejim.2017.10.020. PMID: 29100895.
16. Paluska SA, Schwenk TL. Physical activity and mental health: current concepts. *Sports Med.* 2000 Mar;29(3):167-80. doi: 10.2165/00007256-200029030-00003. PMID: 10739267.
17. Taylor CB, Sallis JF, Needle R. The relation of physical activity and exercise to mental health. *Public Health Rep.* 1985 Mar-Apr;100 (2):195-202. PMID: 3920718; PMCID: PMC1424736.
18. Rosenbaum S, Tiedemann A, Stanton R, Parker A, Waterreus A, Curtis J, Ward PB. Implementing evidence-based physical activity interventions for people with mental illness: an Australian perspective. *Australas Psychiatry.* 2016 Feb;24(1):49-54. doi: 10.1177/1039856215590252. Epub 2015 Jul 2. PMID: 26139698.
19. Zschucke E, Gaudlitz K, Ströhle A. Exercise and physical activity in mental disorders: clinical and experimental evidence. *J Prev Med Public Health.* 2013 Jan; 46 Suppl 1(Suppl 1):S12-21. doi: 10.3961/jpmph.2013.46.S.S12. Epub 2013 Jan 30. PMID: 23412549; PMCID: PMC3567313.
20. Ashdown-Franks G, Firth J, Carney R, Carvalho AF, Hallgren M, Koyanagi A, Rosenbaum S, Schuch FB, Smith L, Solmi M, Vancampfort D, Stubbs B. Exercise as Medicine for Mental and Substance Use Disorders: A Meta-review of the Benefits for Neuropsychiatric and Cognitive Outcomes. *Sports Med.* 2020 Jan;50(1):151-170. doi: 10.1007/s40279-019-01187-6. PMID: 31541410.
21. Kumar S, Kelly AS. Review of Childhood Obesity: From Epidemiology, Etiology, and Comorbidities to Clinical Assessment and Treatment. *Mayo Clin Proc.* 2017 Feb; 92(2):251-265. doi: 10.1016/j.mayocp.2016.09.017. Epub 2017 Jan 5. PMID: 28065514.
22. Tsao-Wu M, Williams RJ, HENDY HM, Novick MB. Associations between obesity severity and



- medical comorbidities for children with obesity in low intensity hospital intervention. *Obes Res Clin Pract.* 2019 Nov-Dec;13 (6):555-560. doi: 10.1016/j.orcp.2019.11.001. Epub 2019 Nov 30. PMID: 31791923.
23. Woo S, Ju YS, Seo YG, Kim YM, Lim H, Park KH. Additive Effects of Exercise or Nutrition Intervention in a 24-Month Multidisciplinary Treatment with a Booster Intervention for Children and Adolescents with Overweight or Obesity: The ICAAN Study. *Nutrients.* 2022 Jan 17;14 (2):387. doi: 10.3390/nu14020387. PMID: 35057568; PMCID: PMC8781150.
24. Mead E, Brown T, Rees K, Azevedo LB, Whittaker V, Jones D, Olajide J, Mainardi GM, Corpeleijn E, O'Malley C, Beardsmore E, Al-Khudairy L, Baur L, Metzendorf MI, Demaio A, Ells LJ. Diet, physical activity and behavioural interventions for the treatment of overweight or obese children from the age of 6 to 11 years. *Cochrane Database Syst Rev.* 2017 Jun 22;6 (6):CD012651. doi: 10.1002/14651858.CD012651. PMID: 28639319; PMCID: PMC6481885.
25. Martin A, Booth JN, Laird Y, Sproule J, Reilly JJ, Saunders DH. Physical activity, diet and other behavioural interventions for improving cognition and school achievement in children and adolescents with obesity or overweight. *Cochrane Database Syst Rev.* 2018 Mar 2;3 (3):CD009728. doi: 10.1002/14651858.CD009728.pub4. PMID: 29499084; PMCID: PMC5865125.

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