The Relationship of Pharmacotherapy on Body Composition and Nutrition in Depressed Patients

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Abstract  Depression is recognized as one of the major mental illnesses. It often coexists with obesity, insulin resistance and related dietary conditions. There are many underlying causes of these conditions and one of them can be pharmacotherapy, used to treat depression. Therefore, the aim of this study was to assess the effect of pharmacotherapy on body composition of patients suffering from depression and the quantity and quality of food consumed by these individuals. This study involved 107 depressed patients, 32 of which were men treated with SSRI’s and SNRI’s and 75 were women treated with SNRI’s, NaSSA’s and SSRI’s. The test group was divided according to gender and the type of pharmacotherapy. The control group included 42 men and 62 women without any psychiatric treatment. All participants completed a questionnaire concerning their current diet and relevant medical history. Body composition was analysed using the BIA method. Data were analysed using Chi squared, Mann-Whitney U, Kruskal-Wallis tests and Spearman's rank correlation, where appropriate. Evaluation of the diet of depressed patients did not show any significant deviation from the recommended norms for consumption and the diet of the control group. However, in the group of men, BMI levels, waist circumference and SAT fatty tissue content depended on the calorific content of the diet and nutrient supply which correlated with SNRI treatment. In the group of women, treatment had little effect on calorific content of the chosen diet and nutrient intake, although significant differences in body composition were found, mainly among patients treated with NaSSA. Increased content of adipose tissue or higher BMI in men treated with SSRI’s may suggest that pharmacotherapy has a significant impact on the development of obesity and its complications in depressed individuals.

Keywords: depression, obesity, pharmacotherapy used in depression, adipose tissue

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1. Introduction

Depression is one of the main mental illnesses and thus is of worldwide significance. Most common symptoms include mood reduction, drowsiness, anhedonia, loss of physical energy, guilt, difficulty in concentration, loss of appetite and sleep disorders [1]. In order for patients to be able to improve their mental health, it is necessary to start them on pharmacological treatment. For the treatment of depression different groups of drugs are used, the most commonly used are: SSRI’s, SNRI’s and NaSSA’s. Drugs which belong to the selective serotonin uptake inhibitors (SSRI) are based on blocking the serotonin transporter therefore increasing the concentration of serotonin in the synaptic gap. Serotonin-noradrenaline reuptake inhibitors on the other hand increase the concentration of noradrenaline and serotonin in the synaptic gap. NaSSA group of drugs act by blocking the α2 autoreceptors on the presynaptic membrane of noradrenergic neurons [2,3,4]. Which drug will be more beneficial for a patient because of its appetite-reducing or increasing effect is also difficult to verify due to the fact that the symptoms of the disease themselves cause appetite fluctuations.

Depression is a chronic disease with many complications, not only related to mental health. Depressed individuals have a 40% higher rate of premature death compared to non-depressed individuals. Patients with this diagnosis are more likely to suffer from: cardiovascular disorders, cancer, diabetes mellitus and lipid disorders. The diseases mentioned above may be associated to a significant extent with abnormal body weight, obesity and increased visceral fat content [1]. Coexistence of cardiovascular diseases and depression is bi-directional. Lifestyle-related factors such as sedentary lifestyle, smoking or poor eating habits may contribute to the development of both diseases [5]. Next to depression, obesity is one of the main health problems around the world. Many studies have been carried out to show the relationship between these conditions. Some
reports only provide us with a significant correlation in the case of women [6]. The type of obesity and the distribution of adipose tissue in people with depression seem to be important [6]. There is also a convergence in the pathogenesis of depression and obesity. It was noted that patients suffering from depression have elevated levels of cortisol in blood serum at night. The hippocampus in patients with depression, which is exposed to the effects of chronic stress, is smaller compared to healthy people. Too high cortisol levels in the body contribute to the accumulation of body fats (mainly in the area of abdomen, neck and shoulders).

In both diseases, we deal with abnormal secretion of, among others, serotonin, norepinephrine and dopamine. Reduced serotonin levels in depression is already a well-known mechanism. In the case of obesity, lower concentration of serotonin is also observed. 5-HT1A receptors play an important role in regulating food intake. However, low levels of norepinephrine in a stressful situation increase the level of dopamine, and such a mechanism may contribute to the development of obesity.

It is known that there is a relationship between symptoms of depression and parameters such as: fat content, distribution of fatty tissue and bone mass [1,6,7]. Body composition can be measured using magnetic resonance (MRI), computed tomography (CT), dual energy X-ray absorptiometry (DXA) and bioelectrical impedance analysis (BIA). Currently, the most frequently used method is BIA, due to its low cost, lack of side effects and high correlation with other methods [6,7,8].

The aim of the study was to analyse the effects of the applied pharmacotherapy on the body composition of patients suffering from depression and the quantity and quality of food consumed by them.

2. Material and Methods

The study involved 32 men and 75 women with depression in the period September-November 2017. The mean age of the subjects was 46.6±12.2 years in women and 44.0±12.4 years in men. The group of subjected individuals were patients of the Psychiatry Clinic of the Medical University of Białystok. The control group consisted of 42 men and 62 women (healthy volunteers coming to our facility for health monitoring). The study was approved by the local Bioethical Commission No. R-I-002/355/2016. Participants in the study were informed about the purpose and methodology of the study. Each patient agreed in written consent for carrying out the study. The main eligibility condition for the study was the diagnosis of recurrent depression according to ICD-10 guidelines. Patients were treated with SNRI’s, NaSSA’s and SSRI’s during their stay in the Clinic.

The following drug doses were used in women:

- SNRI: venlafaxine 124.6±14.0 mg,
- SSRI: escitalopram 10.0±7.0 mg, sertraline 90.0±41.83 mg, citalopram 20.0±5.0 mg, paroxetine 30.0±4.14 mg;
- NaSSA: mirtazapine 30.0±50.0 mg.

In men:

- SNRI: venlafaxine 131.0±15.5 mg,
- SSRI: citalopram 21.0±5.8 mg, sertraline 200.0±100.0 mg; escitalopram 20.0±8.0 mg, paroxetine 40.0±17.3 mg.

Subjects completed a questionnaire on their current diet written by the Department of Dietetics and Clinical Nutrition, Medical University in Białystok. Moreover, their body composition was analysed with the help of the Maltron BioScan 920-2 analyzer (Maltron International LTD). Each patient was evaluated on the basis of their medical history and other secondary materials thanks to which information on the course of the disease has been collected.

The results which were obtained concerning the subjects usual diet and quantitative nutritional interview were prepared with the use of a computer program named Dieta 5.0, published by the Institute of Nutrition and Food in Warsaw. A quantitative analysis of 3 days of foods which were consumed by the subjects was performed and consisted of 2 working days and 1 weekend day, further on the results were averaged. In order to correctly estimate the size of food portions, the Album of photographs of products and dishes developed by IŻŻ in Warsaw was used. The obtained results were compared with the current standards of nutrition for the Polish population. The consumption at the level of 90-110% of nutrition standards was considered appropriate [9]. Statistical analysis was performed with the use of Statistica 12.0 software from StatSoft. Average values, standard deviation and percentage calculations were used. Chi squared, Mann-Whitney U, and Kruskal-Wallis tests and Spearman’s rank correlations were used to test for significant differences. Results were considered significant at p <0.05.

Criteria for inclusion and exclusion:

The study excluded patients with severe metabolic disorders, CNS damage and neurological disorders, with other mental disorders, and those addicted to psychoactive substances or alcohol were excluded from the study.

The study included patients suffering from recurrent depressive disorders lasting for 5 years, while the current depressive episode could not last more than a month, as well as current antidepressant treatment.

3. Results

The study involved 107 patients with recurrent depression (75 women and 32 men) hospitalized in the Department of Psychiatry, Medical University of Białystok and 104 individuals (62 women and 42 men) untreated psychiatrically (healthy volunteers, who were the control group). The subjects were divided according to their gender and type of antidepressant treatment used. The group of depressed women treated with SNRI’s (venlafaxine) consisted of 38.7% (n=29) of women, treated with SSRI’s (escitalopram, sertraline, citalopram, paroxetine) consisted of 48.7% (n=35) of women and NaSSA’s (mirtazapine) consisted of 14.6% (n=11) of women. In case of men, SNRI treatment was used in 37.5% (n=12) and SSRI’s were used in 62.5% (n=20) of men. The results of the analysis of body composition and the method of treatment are presented in Table 1 for men and in Table 2 for women.

On the basis of the conducted studies, it was found that the percentage of total body fat was significantly higher in the group of men treated with SSRI’s and SNRI’s than in the control group, while the percentage of lean body mass
was significantly lower, despite a similar BMI in all groups indicating obesity. The highest mean BMI was found in patients treated with SSRI’s (28.7±4.2 kg/m²). In the group of men treated with SNRI’s, a favourable, significantly lower ratio of visceral adipose tissue (VAT) to subcutaneous adipose tissue (SAT) was observed, while an unfavourable, higher VAT/SAT ratio was observed in the individuals treated with SSRI’s. Abdominal fat accumulation in the group of men which used SSRI’s was observed on the basis of significantly higher waist circumference (p=0.047) and at the same time significantly higher BMI than in the control group (p=0.048).

In the group of women the dependence of body composition analysis on the treatment applied in three groups was analysed: SNRI, SSRI, NaSSA and compared to the control group of women (Table 2).

The BMI index of women in the control group and women with depression treated with SSRI’s and SNRI’s did not differ significantly, with the highest percentage of adipose tissue in those treated with SNRI’s (mirtazapine) had the highest BMI (29.3±7.4 kg/m²; p=0.016), they also had the highest body fat content (mean 37.7±9.0%; p=0.005). At the same time, this was due to the lowest percentage of lean body mass. The visceral accumulation of adipose tissue in women with depression is evidenced by the higher waist circumference compared to the control group, but statistically significantly higher in those treated with SNRI’s (mean 94.7±11.8 cm; p=0.004) and in those treated with NaSSA’s (mean 103.3±18.7 cm; p=0.001). Patients treated with NaSSA’s also had the highest content of visceral adipose tissue measured at the height of the navel (VAT=418.0±278.4 cm², p=0.007) and VAT/SAT mean 3.1±1.7 (p=0.056).

Anthropometric parameters of women treated with SNRI’s, NaSSA’s and SSRI’s are presented in Table 3.

### Table 1. Analysis of Male Body Composition with Respect to the Treatment Used

| Feature evaluated | Control (n=42) X ± SD | SSRI group (n=20) X ± SD | p* | SNRI group (n=12) X ± SD | p* |
|-------------------|-----------------------|--------------------------|----|--------------------------|----|
| Adipose tissue (%)| 19.4±5.5              | 27.3±6.8                 | 0.003 | 26.5±7.3 | 0.18 |
| Adipose tissue (kg)| 16.5±6.4             | 25.1±8.6                 | 0.007 | 22.7±8.6 | 0.067 |
| Lean Body Mass (%)| 80.6±5.5              | 72.7±6.8                 | 0.003 | 73.5±7.3 | 0.018 |
| Lean Body Mass (kg)| 67.3±6.7             | 64.3±9.7                 | 0.368 | 60.9±8.3 | 0.063 |
| VAT (cm²)         | 471.9±344.0          | 490.8±410.8              | 0.899 | 362.6±345.4 | 0.477 |
| SAT (cm²)         | 114.4±45.8           | 114.3±33.1               | 0.998 | 155.06±73.4 | 0.139 |
| VAT/SAT           | 3.82±1.9             | 4.4±3.2                  | 0.602 | 2.06±1.4 | 0.029 |
| Waist circumference (cm) | 95.4±9.1 | 102.6±9.3 | 0.047 | 100.5±9.9 | 0.225 |
| Hip circumference (cm) | 107.5±5.6 | 108.7±6.0 | 0.671 | 105.1±6.6 | 0.292 |
| WHR               | 0.9±0.1              | 0.9±0.0                  | 0.006 | 0.9±0.07 | 0.048 |
| Body mass (kg)    | 83.9±10.2            | 90.5±12.2                | 0.141 | 83.7±14.3 | 0.972 |
| Height (cm)       | 180.4±4.7            | 178.2±6.4                | 0.331 | 174.9±6.0 | 0.028 |
| BMI (kg/m²)       | 25.7±4.2             | 28.7±4.2                 | 0.048 | 27.1±3.7 | 0.331 |

* p - statistically significant level<0.05, comparison of the control group with the group of men treated with SSRI’s

### Table 2. Analysis of Female Body Composition with Respect to the Treatment Used

| Feature evaluated | Control (n=62) X ± SD | SSRI group (n=35) X ± SD | p* | SNRI group (n=29) X ± SD | p* |
|-------------------|-----------------------|--------------------------|----|--------------------------|----|
| Adipose tissue (%)| 29.4±8.7              | 29.4±8.5                 | 0.987 | 34.0±8.4 | 0.018 |
| Adipose tissue (kg)| 20.6±9.8             | 20.2±8.7                 | 0.879 | 24.7±9.6 | 0.058 |
| Lean Body Mass (%)| 70.5±9.0              | 70.6±8.5                 | 0.959 | 66.0±8.5 | 0.024 |
| Lean Body Mass (kg)| 46.2±4.2             | 46.2±6.5                 | 0.097 | 45.1±4.3 | 0.337 |
| VAT (cm²)         | 208.2±219.1           | 270.7±272.7              | 0.230 | 249.9±148.1 | 0.351 |
| SAT (cm²)         | 97.7±42.2             | 113.4±42.6               | 0.087 | 112.1±39.8 | 0.125 |
| VAT/SAT           | 2.0±1.7               | 2.2±1.5                  | 0.642 | 2.52±1.23 | 0.388 |
| Waist circumference (cm) | 85.8±14.2 | 88.5±14.0 | 0.374 | 94.7±11.8 | 0.004 |
| Hip circumference (cm) | 104.1±9.1 | 102.9±10.1 | 0.590 | 105.3±8.9 | 0.531 |
| WHR               | 0.8±0.1               | 0.8±0.1                  | 0.430 | 0.9±0.1 | 0.002 |
| Body mass (kg)    | 66.9±12.2             | 66.1±12.7                | 0.773 | 70.2±12.3 | 0.223 |
| Height (cm)       | 165.2±5.3             | 164.4±6.2                | 0.488 | 164.5±6.5 | 0.557 |
| BMI (kg/m²)       | 24.8±5.2              | 24.5±4.2                 | 0.804 | 26.2±4.7 | 0.019 |

* p - statistically significant level<0.05, comparison of the control group with the group of women treated with SSRI’s

### Table 3. Analysis of Anthropometric Parameters of Women with Depression Depending on the Type of Treatment

| Feature evaluated | SSRI Group X ± SD | SNRI Group X ± SD | NaSSA Group X ± SD | p |
|-------------------|-------------------|-------------------|--------------------|---|
| BMI (kg/m²)       | 24.5±4.2          | 26.2±4.7          | 29.3±7.4           | 0.016 |
| Lean Body Mass (%)| 70.6±8.5          | 66.0±8.5          | 62.7±9.4           | 0.042 |
| Adipose Tissue (%)| 29.4±8.5          | 34.0±8.4          | 37.7±9.0           | 0.035 |
| Waist Circumference (cm) | 88.5±14.0 | 94.7±11.8 | 103.3±18.7 | 0.028 |
The effect of pharmacotherapy for depression on the nutritional value of the diet was evaluated. The analysis of average energy efficiency of diet and nutrient intake depending on the treatment applied in men is presented in Table 4.

Table 4. Average Energy Value of Diet and Intake of Main Nutrients Depending on the Treatment Used in the Studied Men

|                      | Control n=42 | SSRI group n=20 | p  | SNRI group n=12 | p  |
|----------------------|--------------|-----------------|----|-----------------|----|
|                      | X±SD         | X±SD            |    | X±SD            |    |
| Energy (kcal)        | 2391.0±850.3 | 2171.2±720.2    | 0.4623 | 2090.2±557.3 | 0.355 |
| Protein overall (g)  | 93.9±30.2    | 79.5±22.3       | 0.153 | 78.9±29.2     | 0.261 |
| Fats overall (g)     | 96.7±32.0    | 91.8±39.9       | 0.736 | 82.3±32.8     | 0.322 |
| Carbohydrates overall (g) | 303.1±161.3  | 272.9±83.2      | 0.510 | 276.2±76.0    | 0.636 |
| Energy from proteins (%) | 16.4±3.5    | 15.3±2.2        | 0.152 | 15.7±2.1      | 0.722 |
| Energy from fats (%)  | 37.5±10.5    | 36.3±5.6        | 0.703 | 34.0±6.0      | 0.362 |
| Energy from carbohydrates (%) | 46.1±12.5   | 48.4±5.7        | 0.504 | 50.3±6.5      | 0.360 |

*p - statistically significant level<0.05, comparison of the control group with the group of men treated with SSRI’s

A lower energy value of the dietary intake was observed in men with depression in comparison to men from the control group (no statistically significant differences). There were no statistically significant differences in the supply of the main nutrients. However, in the case of men treated with SSRI drugs, the intake of protein and fat was adequate, while carbohydrates were not consumed in sufficient amounts. Same as in the group of men treated with SSRI’s, the SNRI treatment group did not cover the carbohydrate intake as well.

In the group of depressed women (Table 5) treated with SSRI’s, the average energy value of the diet was 1742.5 kcal ±552.7, treated with SNRI’s - 1657.4 kcal ±618.9, and with NaSSA’s - 1745.6 ±558.3 kcal/day. No statistically significant differences were found with respect to the control group. In the studied group of women treated with SSRI’s the protein was consumed at the level of 120% of the norm, carbohydrates at 92%, fats at 106%. In the group of women treated with SNRI’s the protein was consumed at the level of 119% of the norm, carbohydrates at 87%, fats at 103%. In the studied group of women using NaSSA treatment, the norm for nutrients was: protein - 109%, carbohydrates - 97%, fats - 102% respectively.

However, a significantly lower energy content of protein was found in all women with depression compared to women from the control group. Furthermore, significantly higher carbohydrate preference was observed in patients with depression treated with SSRI’s (p=0.006) and NaSSA’s (p=0.032) with reference to the control group.

Table 5. Average Energy Value of the Diet and Intake of the Main Nutrients Depending on the Treatment Used in the Studied Women

|                      | Control n=62 | SSRI group n=35 | p  | SNRI group n=29 | p  | NaSSA group n=11 | p  |
|----------------------|--------------|-----------------|----|-----------------|----|-----------------|----|
|                      | X±SD         | X±SD            |    | X±SD            |    | X±SD            |    |
| Energy (kcal)        | 1787.0±2833.0| 1742.5±552.7    | 0.922 | 1657.4±618.9  | 0.788 | 1745.6±558.3  | 0.958 |
| Protein overall (g)  | 62.6±25.3    | 65.0±21.9       | 0.655 | 64.3±23.9      | 0.768 | 59.6±14.3      | 0.699 |
| Fats overall (g)     | 52.4±27.6    | 63.8±28.6       | 0.069 | 62.3±30.6      | 0.137 | 61.5±25.1      | 0.329 |
| Carbohydrates overall (g) | 191.6±85.5  | 241.9±75.9      | 0.006 | 228.2±95.6    | 0.069 | 253.3±89.4    | 0.032 |
| Energy from proteins (%) | 18.3±5.5    | 15.1±3.3        | 0.002 | 15.8±3.3      | 0.025 | 14.4±3.3       | 0.026 |
| Energy from fats (%)  | 31.7±10.4    | 31.7±8.1        | 0.971 | 32.3±9.5      | 0.762 | 30.9±8.1       | 0.813 |
| Energy from carbohydrates (%) | 49.6±19.7 | 53.2±8.1       | 0.102 | 51.8±9.2      | 0.334 | 54.7±6.6       | 0.134 |

*p - statistically significant level<0.05, comparison of the control group with the group of women treated with SSRI’s

Table 6. Correlation in the studied group of men treated with SSRI’s and SNRI’s between Selected Body Composition Parameters, Nutrient Intake and Energy Value of the Diet

|                  | SSRI                  | SNRI                  |
|------------------|-----------------------|-----------------------|
|                  | Energy (kcal)         | Proteins(g)           | Fats (g) | Carbohydrates (g) | Energy (kcal) | Proteins(g) | Fats(g) | Carbohydrates (g) |
| BMI (kg/m²)      | r -0.2884             | -0.2208               | -0.3554 | -0.1813           | 0.7365        | 0.3174      | 0.5597 | 0.7304            |
|                  | p 0.246               | 0.379                 | 0.148   | 0.471             | 0.015         | 0.372       | 0.107  | 0.016             |
| Waist circumference (cm) | r 0.0198              | -0.0092               | -0.0328 | -0.1066           | 0.7240        | 0.0185      | 0.5477 | 0.8351            |
|                  | p 0.938               | 0.971                 | 0.897   | 0.674             | 0.0189        | 0.960       | 0.101  | 0.003             |
| Adipose tissue (%) | r -0.5046             | -0.5534               | -0.6417 | -0.4801           | 0.4383        | 0.0372      | 0.2810 | 0.5334            |
|                  | p 0.009               | 0.022                 | 0.004   | 0.0400            | 0.205         | 0.919       | 0.432  | 0.112             |
| VAT (cm²)        | r -0.0853             | -0.0574               | -0.1177 | -0.0447           | 0.4797        | 0.8015      | 0.4858 | 0.0973            |
|                  | p 0.736               | 0.821                 | 0.642   | 0.860             | 0.191         | 0.009       | 0.185  | 0.803             |
| SAT (cm²)        | r -0.4567             | -0.4309               | -0.4757 | -0.3780           | 0.7850        | 0.9130      | 0.7434 | 0.3951            |
|                  | p 0.0570              | 0.074                 | 0.046   | 0.1220            | 0.012         | 0.001       | 0.022  | 0.293             |
| VAT/SAT          | r 0.8169             | 0.0665                | 0.1169  | 0.1132            | 0.1991        | 0.3403      | 0.1864 | 0.0478            |
|                  | p 0.644               | 0.793                 | 0.644   | 0.655             | 0.608         | 0.370       | 0.631  | 0.903             |
| Lean body mass (%) | r 0.5046             | 0.5354                | 0.6417  | 0.4801            | -0.4383       | -0.0372     | -0.2810 | -0.5334          |
|                  | p 0.009               | 0.0220                | 0.004   | 0.044             | 0.205         | 0.919       | 0.4320 | 0.112             |
There was also an analysis of the correlation between body composition of men in relation to the supply of nutrients and the energy value of the diet depending on the applied treatment. The results are presented in Table 6.

In the group of men treated with SNRI’s, significant correlations of BMI and waist circumference with energy value of diet and carbohydrate intake were found. The content of subcutaneous adipose tissue (SAT) was significantly correlated with the energy value of diet (p=0.012), protein (p=0.001) and fat (p=0.022). The content of visceral adipose tissue (VAT) was significantly correlated only with the supply of protein in the diet (p=0.009).

In the group of depressed men treated with SSRI’s, the content of fat tissue % correlated with the energy value of diet (p=0.009), supply of fats (p=0.004), proteins (p=0.022), and also with the supply of carbohydrates (p=0.04) but with the least extent. Significant correlations with dietary fat intake were observed only in relation to the content of subcutaneous adipose tissue SAT (p=0.046).

Similarly, energy values of the diet (p=0.0570) and protein supply (p=0.004) showed a tendency to correlate with SAT. Lean body mass correlated significantly with energy value of the diet (p=0.009), protein supply (p=0.0200), fats (p=0.004) and carbohydrates (p=0.044).

In the group of women treated with SSRI’s and NaSSA’s there was no statistically significant correlation between body composition and energy value of diet and nutrients. Only patients treated with SNRI’s showed significant correlations between body fat content (%) and protein intake in the diet (p=0.036), the results are presented in Table 7. Also, the protein supply correlated significantly with lean body mass (p=0.036) and statistically insignificantly with BMI (p=0.069).

### Table 7. Correlation in the Studied Group of Women Treated with SNRI’s between Body Composition Parameters and Nutrient Intake and Energy Value of the Diet.

| BMI (kg/m²) | Energy (kcal) | Protein (g) | Fats (g) | Carbohydrates (g) |
|------------|---------------|-------------|----------|-------------------|
| r          | p             | r           | p        | r                 | p             | r             | p            |
| 0.789      | 0.0791        | -0.3369     | -0.0411  | -0.0371           |
| 0.678      | 0.069         | 0.825       | 0.516    | 0.475             |
| -0.0438    | 0.115         | 0.559       | 0.516    | 0.096             |
| 0.818      | 0.115         | 0.559       | 0.516    | 0.475             |

4. Discussion

Studies indicate that the risk of excessive body weight or obesity increases with the onset of depression. Excessive visceral adipose tissue (VAT) and its abnormal relationship to subcutaneous adipose tissue (SAT) appear. This, in turn, increases the risk of cardiac complications, diabetes mellitus or metabolic syndrome [8,10]. Both depression and obesity are increasingly common public health problems worldwide [11].

Everson-Rose and his team examined 409 middle-aged, overweight and obese, white and Afro-American women, and the severity of symptoms of depression were evaluated. Significant correlation between the occurrence of symptoms of depression and increased VAT content was found. However, among women with normal body weight the symptoms of depression did not correlate with the content of VAT. Therefore, the relationship between the amount of visceral adipose tissue in women with symptoms of depression and the increased risk of cardiovascular diseases or diabetes mellitus was sought. On the other hand, there were no significant differences between the symptoms of depression and the content of subcutaneous adipose tissue (SAT) or WHR index. Further analysis is required to assess which of the factors influencing the increase in VAT content in patients with depression [8].

Vogelzangs and colleagues [10] carried out a study with a group of elderly people (70-79 years old). The study was carried out for five years, where initially the subjects did not show symptoms of depression and in result showed that men with an increased content of visceral adipose tissue, ≥194 cm² had a 35% higher risk of developing depression within 5 years, compared to the subjects with a normal content of VAT. These results suggest that a primary abnormality in the quantity of VAT may contribute to the development of symptoms of depression at a later stage [10]. However, this relationship was not observed among women. The results of Murabito and colleagues [12] indicate that there is a significant correlation between VAT content and depressive symptoms in middle-aged women. In turn, these studies do not confirm such a relationship in the male gender. On the basis of these studies, a conclusion has been reached regarding the need for a closer examination of the relationship between higher VAT content and symptoms of depression in the context of increased risk of cardiovascular diseases and diabetes mellitus [12].

Our own studies showed statistically significant differences in the amount of visceral fat tissue (VAT) in women treated mainly with NaSSA’s. However in the studied group of men treated with SNRI’s, the VAT/SAT ratio was significantly lower than in the control group (which was a positive phenomenon), and a significantly higher VAT/SAT ratio was found in patients treated with SSRI’s.

Studies carried out by Noh and his team which was conducted among adults indicate an important relationship between BMI and depressive symptoms. The results indicate the occurrence of severe depressive symptoms not only in individuals with significant obesity, but also which are underweight [11]. The influence of obesity on symptoms of depression were also studied. Studies carried out by Koksai and colleagues [6] involved obese patients and showed that symptoms of depression occurred in 63.5% of obese individuals in comparison to 24% of the control group with normal body weight. In the group of obese individuals, it was women who showed a stronger intensity of depressive features. Positive correlation was
observed in the following body composition parameters: BMI, waist circumference, hips and percentage of visceral fat tissue [6]. Study of Kim and his team [1] also confirms that women show a higher tendency to depression compared to men and that there is a significant relationship between the economic status, metabolic risk factors and the severity of symptoms of depression.

Guedes et al. found no correlation between the severity of symptoms of depression and BMI, waist circumference, WHR index. However, the results show a correlation between the severity of symptoms of depression and the total percentage of adipose tissue. Furthermore the results show a reverse correlation between the lean body mass and the severity of symptoms of depression [13]. Our own studies of male patients showed that individuals treated with SSRIs and SNRIs had a significantly higher BMI compared to men from the control group. In the case of the studied women, the highest BMI was observed in the group treated with NaSSA’s and the lowest in the group with SSRIs. At the beginning of the treatment with SSRI drugs there may be a loss of appetite, but later it may be increased. And hence it may cause weight gain. However, we know that some drugs can have a significant influence on weight gain, and other drugs have smaller influence on it. In the studied group of SSRIs, paroxetine may contribute the most to weight gain, while sertraline and citalopram may contribute the least [14]. The highest content of adipose tissue and waist circumference (p=0.028) were also found in the group treated with NaSSA’s [14].

Olguner’s study [15] confirms an increase in BMI in the studied group of patients treated for depression and anxiety compared to the control group. The study covered 40 individuals with depressive disorders and a control group of 32 healthy individuals. Sertraline, escitalopram, fluoxetine and venlafaxine were used in patients.

Higher waist circumference was observed among patients treated with escitalopram (SSRI). However, no changes were observed in patients treated with fluoxetine (SSRI), sertraline (SSRI) and venlafaxine (SNRI). The results of the study indicate a higher level of BMI, body weight and waist circumference among patients with diagnosed depression, but no changes were observed after treatment in patients with anxiety disorders [15]. Similar results were achieved in the group of adults studied by Calarge and colleagues [16]. It was observed that in 15-20 year olds treated with SSRI’s there was a significant increase in all body composition parameters when citalopram and escitalopram were used. No difference were noted in the case of treatment with sertraline and only a slight increase was seen when fluoxetine was used. Wyshak’s study [7], conducted among 1704 women which were 39-49 years old, indicated a statistically significant correlation between the percentage of adipose tissue and symptoms of depression in the study group [7]. Our own studies of women patients show that percentage of adipose tissue was significantly higher in patients treated with SNRI’s and NaSSA’s compared to the control group. Research suggests that female sex predisposes to increased body weight in diagnosed and pharmacologically treated depression, especially if female patients were treated with NaSSA’s (mirtazapine was used) [17]. One study compares patients using mirtazapine and paroxetine (SSRI’s). After a six-week treatment period, the results indicate a higher body weight gain in mirtazapine using individuals [17]. A similar relationship was observed in the comparison of mirtazapine with citalopram (SSRI’s). Additionally, these patients reported higher hunger levels than SSRI using patients [17]. In our study, mirtazapine was the only drug used in the NaSSA group in women, while in men it was not used at all. In the group of patients taking NaSSA’s, significantly higher anthropometric parameters were observed (BMI, waist circumference, % fat content and VAT/SAT ratio). Slightly lower body fat rate was observed in patients treated with SNRI’s whereas the lowest body fat rate was observed in those individuals treated with SSRI’s. In other studies, some patients experience an increase in body weight when treated with SSRI’s. Research results indicate that this effect may mainly apply to women. It also turns out that in the case of women with obesity, their reaction to SSRI treatment results in a much greater reduction of symptoms, compared to men with obesity treated with the same group of pharmaceuticals [18,19]. Our study did not show significant differences in body weight among men treated with SSRI’s, SNRI’s, but a significantly higher content of body fat (in percent and kilograms) was observed. In both groups of men (SSRI, SNRI) a significantly lower content of lean body mass was observed in comparison to the control group.

One of the reasons for the accumulation of excessive amounts of body fat may be an inappropriate diet.

In this study, increased carbohydrate intake was observed in the group of women treated with SSRI’s and NaSSA’s. In men treated with SNRI’s, the increased incidence of visceral adipose tissue correlated significantly with the supply of protein. Subcutaneous adipose tissue correlated with the supply of proteins and fats, while BMI and waist circumference correlated with the supply of carbohydrates. In men treated with SSRI’s, significant correlations of total adipose tissue with the supply of all nutrients and energy value of diet were observed, but the content of subcutaneous adipose tissue correlated significantly only with the supply of fats. On the other hand, in women treated with SNRI’s, BMI and total adipose tissue correlated with protein supply.

Patients with depression have a higher risk of developing cardiovascular disorders and diabetes mellitus. On the other hand, the treatment of depressed patients with diabetes mellitus is a major challenge, due to the impact of the treatment on glycaemia. Treatment of these SSRI patients brings improvement of symptoms in case of depression, however, there is a risk of increasing the level of blood glucose. The results published on this subject are contradictory and require further research [19]. On the basis of the present study, in the group of women with depression, it was found that patients treated with NaSSA’s have a particular risk of weight gain and visceral fat accumulation, the risk is slightly lower in those treated with SNRI’s, while no adverse changes in body composition were observed in patients treated with SSRI’s. However the medicine used in this group was mirtazapine, when using this substance, a frequent side effect is an increase in appetite and weight gain.

In the group of men with depression, both SSRI’s and SNRI’s had a significant influence on the total body fat
content, however, the waist circumference was significantly higher in individuals treated with SSRI’s. In individuals treated with SNRI’s, the VAT/SAT ratio was more favourable.

5. Conclusions

1. Greater accumulation of visceral adipose tissue was observed in the group of men with depression when compared to healthy subjects with similar BMI, regardless of the treatment applied weather SSRI’s or SNRI’s.
2. In the group of women with depression treated with SSRI’s, no effect of the pharmacotherapy on body weight gain and/or adipose tissue was found. On the other hand visceral fat accumulation occurred with SNRI’s despite the lack of statistically significant differences in BMI with healthy subjects.
3. Regardless of treatment method, many nutritional errors have been found in patients with depression, which may additionally contribute to the development of concurrent diseases, such as: diabetes or cardiovascular diseases.

6. Limitations of the Study

- Too small size of the examined group;
- Inclusion in SSRIs the drugs with different effects on body weight;
- In the study only mirtrazapine was used among NaSSA-treated patients, which is a drug that significantly increases body weight.

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