*REVIEW ARTICLE*

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# Mental illness and metabolic syndrome – a literature review

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## Abstract

**Introduction and objective**. Researchers' opinions are divided on whether metabolic syndrome is a separate clinical entity. Undoubtedly, the components of the syndrome, such as abdominal obesity, hypertension, impaired glucose tolerance, hypertriglyceridaemia, adversely affect metabolism, bringing with it a number of consequences, including type 2 diabetes and cardiovascular disease which significantly impair the quality of life.

**Abbreviated description of the state of knowledge**. In recent years, much attention has been paid to research on the prevalence of metabolic disorders in mentally ill patients. This is due to a growing awareness that some antipsychotic medications contribute to weight gain in patients suffering from mental illness, and consequently lead to the development of a number of interrelated somatic factors, such as abdominal obesity, impaired glucose tolerance, hypertriglyceridaemia, and hypertension. Weight gain and other metabolic syndrome components have been noticed not only in patients, but also in their families. This paper presents current research on the prevalence of metabolic syndrome in people with mental illness. An analysis of the causes of metabolic disorders in this population has been conducted, including the role of the hypothalamic-pituitary-adrenal axis and cortisol secretion in the development of components of metabolic syndrome.

**Conclusions.** Components of the metabolic syndrome are especially observed in mentally ill people. The mechanisms of their formation are not fully understood. A large role in their formation besides the negative effects of antipsychotic medication and specific lifestyle, play a specific dysregulation of the hypothalamic-pituitary-adrenal axis. Undoubtedly, further research and analysis in this area is necessary.

## Key words

metabolic syndrome, psychotic disorders, mood disorders, bipolar disorders, depressive disorders

## INTRODUCTION AND OBJECTIVE

Both mental illness and psychotic disorder entail a number of consequences and significantly contributes to the reduction in the quality of life of patients. This implies the need to adapt to new conditions of life, such as, among others, acceptance of the disease, long-term treatment, overcoming limitations, pain, deterioration of the socio-economic situation, family, and adapting to new procedures and limitations of treatment [1, 2].

Long-term mental illness also contributes to a number of somatic diseases which are often unrecognized or inadequately treated and lead to a significant deterioration in health. Life expectancy of people suffering from psychotic illness is lower than in the general population [3, 4]. Currently, it is assumed that in schizophrenia there is a 50% increased risk of death from somatic reasons, and a 20% shorter survival time relative to the general population [5]. Numerous studies show that mortality among people with psychotic illness, including schizophrenia, bipolar illness, schizoaffective disorder, and depression is 2–3 times higher than in the general population, while life expectancy is between 13–30 years shorter compared to people without mental disorders. Unfortunately, this trend is still increasing, even in countries where the healthcare system is rated as good. The 60% mortality in patients suffering from mental illness is caused by somatic diseases [3, 6].

There are many factors leading to the deterioration of the health of people suffering from severe mental disorders. One of them is a very rare and late use of medical care due to persistent symptoms (positive and negative). For this reason, patients are not always able to define their own somatic problems. Of great importance, as well as a specific, is the often unhygienic lifestyle of people with mental illness: low physical activity, poor diet, smoking and addiction to drugs [6, 7]. In addition, some drugs used for the treatment of psychiatric disorders (including anti-psychotics) cause somatic changes in patients, and in particular contribute to the formation of metabolic disorders. It also appears that the specific mode of life and factors associated with pharmacological therapy contribute to increased incidence in patients with somatic disorders. According to the CATIE study (Clinical Anti-psychotic Trials for Intervention Effectiveness) and its observations, there is sufficient evidence to conclude that patients suffering from mental illness receive a lower standard of primary health care, and who, regardless of factors caused by their life-style and the effects of psychotropic medication, should be changed so that the access to and quality of medical services are better for individual patients [8, 9].

The most common somatic disorders and diseases that occur in people with mental illness include: obesity, metabolic syndrome (MetS), type 2 diabetes, cardiovascular disease (CVD), coronary heart disease (CHD) and cerebrovascular disease [3, 4].

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Abdominal obesity, impaired glucose tolerance, hypertriglyceridaemia and hypertension, are key factors that make up metabolic syndrome, otherwise known as 'Syndrome X', and in the past the 'deadly quartet' or 'insulin resistance syndrome' [10]. This syndrome was observed over 80 years ago and has been described in more detail in 1988 by Reaven as a syndrome of related factors (syndrome X), such as insulin resistance, hyperinsulinaemia, hypertension, dyslipidemia and glucose intolerance [11]. These are independent risk factors for cardiovascular complications. Reaven did not include obesity in the syndrome, despite the described connections of insulin resistance with overweight. He also noted that the syndrome X appeared in patients with normal body weight [12].

Since the 1990's there have been a few definitions of metabolic syndrome. The first outlined the WHO diagnostic criteria [13] which proposed the assessment of insulin, or insulin as an essential element of the syndrome [14]. To these factors were included additional diagnostic criteria which included at least two of the following: high blood pressure, elevated triglycerides, low HDL cholesterol, obesity, and microalbuminuria [13]. The WHO definition pointed out that every constituent element of metabolic syndrome is an independent risk factor for cardiovascular disease. Due to the special emphasis on the diagnosis of disorders of carbohydrate metabolism, it also allowed the identification of patients at risk of type 2 diabetes [15]. The use of such criteria for diagnostic and epidemiological studies, however, required specialized implementation of the oral glucose tolerance test (OGTT); therefore, their use in practice has been relatively limited [12].

**Table 1.** WHO clinical criteria for metabolic syndrome [13]

| | |
|---|---|
| Insulin resistance, identified by one of the following: | Type 2 diabetes<br>– impaired fasting glucose<br>– impaired glucose tolerance<br>– or for those with normal fasting glucose levels (<110 mg/dL), glucose uptake below the lowest quartile for background population under investigation under hyperinsulinemic, euglycemic conditions |
| Plus any two of the following: | – Antihypertensive medication and/or high blood pressure (≥140 mm Hg systolic or ≥90 mm Hg diastolic)<br>– Plasma triglycerides ≥150 mg/dL (≥1.7 mmol/L)<br>– HDL cholesterol <35 mg/dL (<0.9 mmol/L) in males or <39 mg/dL (1.0 mmol/L) in females<br>– BMI >30 kg/m$^2$ and/or waist-hip ratio >0.9 in males, >0.85 in females<br>– Urinary albumin excretion rate ≥20 µg/min or albumin:creatinine ratio ≥30 mg/g |

Taking into consideration these difficulties, the European Group for the Study of Insulin Resistance (EGIR) created another MetS diagnostic criteria. EGIR definition also emphasized the importance of insulin resistance as a primary etiologic factor of the metabolic syndrome, defined, however, by the indication of insulin. The concept of central obesity (abdominal) by marking only waist circumference, microalbuminuria was also eliminated as a criterion of little use in the diagnosis of metabolic syndrome [16].

Currently, WHO and EGIR definitions are primarily for scientific purposes and valid are those developed by the National Cholesterol Education NCEP-ATP III programme (National Cholesterol Education Program-Adult Treatment Panel III) and International Diabetes Federation (IDF) [14, 17].

The criteria for NCEP-ATP III [18] no longer included the indication of insulin resistance. It was decided that the measurement of insulin resistance and relatively low specific glucose tolerance test were not to be routinely performed in clinical practice. The definition of NCEP-ATP III is more clinically useful because it allows easy diagnosis of metabolic syndrome, and in particular for epidemiological studies. According to the NCEP-ATP III, metabolic syndrome is observed in persons in whom there are at least 3 of the 5 components of the definition: abdominal obesity (males> 102 cm, females> 88 cm), fasting triglycerides above 150 mg/dl (≥ 1; 7 mmol/L), low HDL cholesterol (males <40 mg/dL (<1.04 mmol/L), females <50 mg/dL (<1.3 mmol/L), blood pressure above 130/85 mmHg, fasting glucose ≥ 110 mg/dL (≥ 6.1 mmol/L), or diagnosed diabetes [18, 17, 19].

**Table 2.** Clinical identification of metabolic syndrome by NCEP-ATP III [18]

| Risk Factor | Defining Level |
|---|---|
| Abdominal obesity<br>Males<br>Females | Waist circumference†<br>>102 cm (>40 in)<br>>88 cm (>35 in) |
| Triglycerides | ≥150 mg/dL |
| HDL cholesterol<br>Males<br>Females | <br><40 mg/Dl<br><50 mg/dL |
| Blood pressure | ≥130/85 mmHg |
| Fasting glucose | ≥110 mg/dL |

Other diagnostic criteria developed by the IDF [20] are affordable diagnostic tools, based on the finding of abdominal obesity, plus 2 of 4 four components of the definition (Tab. 3). This definition takes into account ethnic differences in determining the waist circumference. Studies of metabolic syndrome based on the above criteria are simple and cheap, and the information derived from them is of great practical importance [21, 22, 19].

**Table 3.** The new International Diabetes Federation (IDF) definition of metabolic syndrome [20]

| | |
|---|---|
| According to the new IDF definition, for a person to be defined as having metabolic syndrome they must have:<br>central obesity (defined as waist circumference* with ethnicity specific values: USA – male ≥ 102 cm, female ≥ 88 cm; Europe – male ≥ 94, female cm ≥ 80 cm) if BMI is >30kg/m$^2$, central obesity can be assumed and waist circumference t need not be measured, plus any 2 of the following 4 factors: | |
| Raised triglycerides | ≥ 150 mg/dL (1.7 mmol/L or specific treatment for this lipid abnormality |
| Reduced HDL cholesterol | < 40 mg/dL (1.03 mmol/L) in males<br>< 50 mg/dL (1.29 mmol/L) in femalesor specific treatment for this lipid abnormality |
| Raised blood pressure | systolic BP ≥ 130 or diastolic BP ≥ 85 mm Hg or treatment of previously diagnosed hypertension |
| Raised fasting plasma glucose | (FPG) ≥ 100 mg/dL (5.6 mmol/L), or previously diagnosed type 2 diabetes.<br>If above 5.6 mmol/L or 100 mg/dL, OGTT is strongly recommended, but is not necessary to define the presence of the syndrome. |

It is conclude that all definitions define metabolic syndrome as co-existing with related risk factors of metabolic origin that promote the development of cardiovascular disease with atherosclerotic and type 2 diabetes [10].

In this paper a review of articles in English and Polish has been conducted in order to present relationships between mental disorders and metabolic syndrome.

**Metabolic syndrome and mental disorders.** In recent decades the profile of health problems in patients with schizophrenia and affective disorders has changed. While the past was dominated by tuberculosis and gastrointestinal infections, since the 1990's cardiovascular disease, diabetes, obesity and metabolic syndrome are dominant. The prevalence of MetS in this group is 2–3 times higher than in the general population. Occurrence of the components is estimated as follows: obesity (45% -55%), hypertension (19% -58%), diabetes (10% -15%), lipid (25% -69%) [23, 7].

More and more often the problem of metabolic syndrome in people with severe mental illness is discussed. MetS components, such as overweight, obesity, abnormal glucose metabolism, dyslipidaemia and hypertension occur especially in patients with schizophrenia or bipolar disorder [3, 8]. In reviewing the literature, in particular the relationship between mental illness and metabolic syndrome was noted in the following diseases or mental states:

- schizophrenia and schizaffeffective disorders;
- mood disorders, such as bipolar, depressive and unipolar disorders;
- in states of anxiety, tension, anger, and stress.

Estimation of the prevalence of MetS in patients suffering from severe mental disorders encounters the same problems as in the group of healthy individuals. The results depend on the use of diagnostic criteria, racial or ethnic minorities. However, based on data from different parts of the world, it can be noted that the prevalence of metabolic syndrome among the mentally ill is higher than in the population without psychiatric disorders [8].

A Spanish study published in 2012 by Foguet et al., conducted among 137 patients suffering from mental illness, showed that the criteria for metabolic syndrome was met, respectively, in 37.9% of females and 48.4% of males [24].

The prevalence of metabolic syndrome in people with schizophrenia is estimated to be between 19.4% – 68%. These differences result from the use of different diagnostic criteria of belonging to ethnic groups, and are evident between countries. In patients suffering from bipolar disorder and schizoaffective disorder this rate varies between 22–30% [8]. In a healthy population, the prevalence of metabolic syndrome varies between countries. Recent studies conducted in the USA by Ford on a group of 3.601 men and women, based on criteria developed by the IDF, indicate that as much as nearly 40% of Americans suffer from metabolic syndrome [25]. In Europe, the European Group for the Study of Insulin Resistance estimated that the prevalence of metabolic syndrome varies between 7% – 36% in males aged 40–55 years, and among females of the same age, from 2–22% (MetS criteria according to the WHO) [26].

There are several studies on the prevalence of metabolic syndrome in people with psychotic illness. Extensive research carried out by the CATIE (Clinical Antipsychotic Trials for Intervention Effectiveness) in a group of 1231 people with schizophrenia, has shown that the prevalence of metabolic syndrome is equal to 35.8%, based on the diagnostic criteria proposed by NCEP-ATP III [34]. According to research by Kato et al. in 2003, conducted in 63 patients with schizophrenia and 16 with bipolar disorder, as many as 60% of those with schizophrenia and 75% of those with affective disorders had metabolic syndrome (NCEP criteria-ATP III) [27]. Another study by the same author in 2002, carried out on 48 patients suffering from schizophrenia, showed the prevalence of metabolic syndrome at 63%, while in a group of Latin Americans, it was much higher and reached 74%, and indicated that an increase in waist circumference is positively correlated with metabolic syndrome in the above-mentioned group of patients [28]. Other studies carried out on 98 patients in the USA and Taiwan by Litterell et al., produced a somewhat different picture. In the USA, 51% of schizophrenia patients had MetS, while patients in Taiwan, only 22% [27]. Data from Finland give yet another picture, as the metabolic syndrome was observed in 37% of schizophrenia among 35 active people [28].

A study published in December 2012 by Grover et al., conducted in India in a group of 227 people suffering from schizophrenia, showed that the prevalence of metabolic syndrome ranged from 43.6% – 44.5%, depending on the definition of the MetS diagnostic criteria used, i.e. IDF and NCEP-ATP III. Interestingly, there was no difference in the prevalence of the metabolic syndrome according to the antipsychotic drugs used [29].

Bobes et al. showed that the prevalence of coronary artery disease and metabolic syndrome in Spanish patients with schizophrenia (n = 1,452) who were subjected to treatment with antipsychotics, was the same as in the general population, but who were older by about 10–15 years [30].

Many authors have suggested that abdominal obesity is an essential determinant of insulin resistance, resulting in pathophysiological changes leading to metabolic syndrome [27].

Individuals suffering from psychotic disorders, including schizophrenia, have a tendency to become overweight or obese. Additionally, Ryan et al. showed that the incidence of glucose intolerance in patients with previously untreated schizophrenia is 15% higher than in the healthy population [31]. Both type 2 diabetes and schizophrenia are disorders of a complex, polygenic and multifactorial model of inheritance. The increase in the incidence of diabetes in schizophrenic patients was pointed out earlier, before there appeared the current spread of risk factors of obesity and diabetes in psychiatric patients. Glucose intolerance was observed in patients with a first episode of the disease who did not yet take medication. More importantly, abnormal glucose values were observed in family members of patients; it is therefore possible that the same genetic loci are partly responsible for the tendency to disclose these diseases [32].

Weight gain is a common problem associated with the use of neuroleptics. Antipsychotic medications not only cause increases in body weight, they may also lead to impaired glucose tolerance, resulting in hyperglycaemia, diabetes, ketoacidosis or impact on lipid metabolism, by increasing low-density lipoprotein (LDL) and lowering cholesterol (HDL). The effect of medications differ in this respect [35].

These drugs affect the alimentary system in the hypothalamic tract. The operation of this system depends on a number of neural structures. It was found that antipsychotic drugs, by blocking the serotonin receptor 5-HT 2, histamine H1 or dopamine D2, induce increased appetite and consequently weight gain. On the other hand, these drugs affect the hormonal regulation of food intake. Leptin,

a hormone produced by adipose tissue, has a long-lasting inhibitory effect on neurons in the hypothalamus hunger centre. It is known that in the case of constant exposure to leptin, hypothalamic neurons contribute to the development of leptin resistance. It has been shown that antipsychotic drugs increase the concentration of leptin in the blood and intensify of leptin resistance, hence the increased appetite and weight gain [32, 33].

Currently in clinical practice first generation drugs are used, otherwise known as classical druygs, e.g. perazine, chloroprotixen, haloperidol or sulpiride, and second-generation drugs, such as clozapine, olanzapian, risperidone [34]. These drugs differ in the severity of side-effects, and the intensity of metabolic disorders caused by them, especially weight gain and changes in the carbohydrate and lipid systems [23]. Second-generation drugs, in addition to molindone, ziprasidone, and aripiprazole, cause weight gain. Especially noticeable is the large increase in the use of clozapine and olanzapine (more than 4 kg after 10 weeks of treatment), while in the case of first generation drugs, interference with glucose metabolism is noticeable after using chlorpromazine [7, 21].

It has been pointed out that in the case of use of antipsychotic medications, the average weight gain is noticeable during the first few months and is equal to 2–9 kg. The degree of weight gain depends on the type and not the size of the daily dose of medication [35].

A good example illustrating the effects of second-generation medication and especially clozapine are tests by Brunero et al. in 2009. Data from operations carried out among 73 patients with schizophrenia suggest that as many as 61.6% of them had metabolic syndrome, with respect to the definition of IDF [38].

To better describe the impact of neuroleptics on lipid and glucose parameters it is worth mentioning the research conducted by Lindenmayer et al. in a group of 101 patients with schizophrenia or schizoaffective disorder. During the 14 weeks of treatment, the patients were randomly prescribed the following medications: clozapine, olanzapine, haloperidol, risperidone. It was noted that the use of clozapine, olanzapine and haloperidol was associated with an increase in glycaemia, and olanzapine and clozapine with an increase in cholesterol (20.1 mg / dL and 14.7 mg / dL) [36].

Extensive research by Koro et al. showed the impact of neuroleptics on the formation of diabetes among 19,637 patients with schizophrenia. It was demonstrated that patients taking olanzapine were more likely to develop diabetes than those not using antipsychotics, or using classical neuroleptics. The safest in this respect seems to be the use of risperidone, which does not affect the formation of diabetes, in addition to causing less body weight gain than olanzapine or clozapine. [37].

The mechanisms leading to metabolic consequences of antipsychotic drugs are still not fully understood. It is suggested that in this respect the role of a number of factors, including drug-induced increase in adipose tissue leads to metabolic syndrome, antagonistic effects of drugs in relation to the receptor for serotonin, leptin resistance, pancreatic beta cell damage induced dyslipidemia (produced in excess of fatty acids induces oxidative stress) or disruption of hepatocyte nuclear factor 1-alpha (HNF-1) [32].

In addition to genetic susceptibility, the effects of the use of some antipsychotic drugs cause development of overweight, obesity and susceptibility to disorders of carbohydrate metabolism, characterized by the effect of factors such as unhygienic lifestyle, poor diet, poverty, smoking, poor access to basic health care and poor insight into own person [3, 23, 7, 8, 5].

In this review of research literature on the relationship between mood disorders and metabolic syndrome testing the relationship between depression and the components of metabolic syndrome, there emerge fasctors such as obesity and type 2 diabetes. However, it should be noted that the results in this area are not clear. Some studies have shown a positive association between obesity and depressive disorders, while others exclude the existence of such a relationship.

Pálinkás et al. checked the relationship between depressive disorders and type 2 diabetes (971 males and females over 50 years of age). They pointed out that depressive symptoms measured by the Beck Depression Inventory were positively correlated with the concentration of glucose in the blood. At the same time, there was no relationship between the level of glucose in the blood serum of a greater number of points in the Beck Scale [39]. The same authors checked the relationship between obesity and depressive disorders, also measured by the Beck Depression Inventory (score above 13 points), in 2, 245 people over 50 years of age. Severity of depressive symptoms was inversely related to body weight in the males but not in the females. Overweight or obese females in the age group 50–69 years showed more severe depression than females hose body mass index was normal [40].

In more detailed studies by Roberts et al. at the turn of 1994–1999, in a group of 2,123 people aged over 50, indicated that there is a relationship between obesity and the severity of depressive symptoms. It was noted that in obese people the risk of developing depression increased after 5 year. It was also found that obesity can lead to depression, but depression does not increase the risk of obesity [41].

Analysis of the results of a study by Gil et al. (2003–2004) in a group of 795 people (477 females and 318 males) showed that the disclosure of depression is associated with an increased risk of metabolic syndrome components, such as hypertension, obesity, and impaired glucose tolerance. Metabolic syndrome was diagnosed in 32% of patients, and depression, on the Beka Depression Scale, in 37% (more common in females than in males). Males diagnosed with depression were more often diagnosed with abdominal obesity [42].

In another study published in 1993 by Gluecki et al. described 30 patients with familial hypertriglyceridaemia and depression -15 men and 15 women, who after 54 weeks of intensive treatment with fibrates and diet lowering triglyceride levels, showed significant alleviation or complete resolution of the symptoms depression. According to the researchers, the mood improvement was made possible by the improvement in cerebral perfusion and oxygen supply to the neurons [43].

The pathomechanism of depression formation is primarily associated with the body's response to stress. An essential element of adaptive response to stress is to stimulate the sympatho-adrenal system (SAS) and the hypothalamo-pituitary axis (HPA), in conjunction with the limbic system. Serotonin is involved in the activation of the HPA axis stress, exercising control over both the same axis as the sympatho-adrenal system. Glucocorticoids and catecholamines secreted in times of stress may control the activity of the HPA and SAS. Under the influence of excessive and chronic stressors,

there is increased activity of the HPA axis, resulting in hypercortisolemia, connected not only with the development of depression, but also metabolic syndrome. A link that connects the two disorders is the high level of glucocorticoids, accompanying the development of adipose tissue, leading to insulin resistance and other components of the metabolic syndrome [44, 45].

In addition, it should be noted that people with depression tend to isolate themselves and keeping an unhealthy lifestyle: overeating, choosing a nutrient-poor diet, and avoidance of exercise. The antidepressants used also affect the body weight of patients [27].

When analyzing the literature on the metabolic syndrome in people suffering from depression, it is noted that MetS is accompanied by negative emotional states. Here it is worth mentioning a study conducted by Raikkonen et al., who assessed the relationship between emotions and the development of metabolic syndrome. In long-term studies conducted over several years in a group of 425 women, psychological risk factors such as depression, anxiety, tension, stress, and biological components of MetS were studied: plasma glucose, triglycerides and HDL cholesterol, waist circumference and blood pressure. It was found that the likelihood of developing metabolic syndrome increased in females characterized by high baseline levels of depression, tension and anger. On the other hand, the development of metabolic syndrome resulted in the emergence of negative emotions, such as anger and anxiety [7, 2, 46, 47].

Hartley et al. (2004–2009, ATP-III) conducted interesting research in an occupational group particularly vulnerable to stress – the police. Police officers are people who at the beginning of their service must comply with relevant health conditions, i.e., good physical condition and health, broadly defined, including mental health. However, with time, due to exposure to chronic stress associated with the type of work, their health deteriorates. It has been shown that this group is particularly vulnerable to diseases of the circulatory system. The study was conducted in two parallel groups of police officers from various regions of Buffalo and Spokane in the USA. The prevalence of metabolic syndrome was higher among police officers from Spokane and was 37.2% for males and 33.3% for females, while in the Buffalo officers it was 32.6% and 8.5%, respectively. The researchers assessed the relationship between the severity of depressive symptoms and the number of components of the MetS. This showed that there was a statistically significant positive correlation between the severity of depressive symptoms and the number of components of the metabolic syndrome in the group of male police officers from Spokane. This dependence increased with the age of the respondents. [48].

Several investigators have indicated that chronic stress leads to depression, which increases the risk of developing the metabolic syndrome and thus cardiovascular disease [42, 49].

In summary, discussion of the causes of increased risk of metabolic disorders in the mentally ill it is worth noting the role of the axis of substructure-pituitary-adrenal axis and cortisol secretion in situations of chronic stress in the development of components of MetS [27].

In times of stress, there is a distortion of the body's homeostasis, which activates the hypothalamic-pituitary-adrenal axis. In response to stress, the hypothalamus releases corticotropin-releasing hormone (CRH), thus stimulating the pituitary gland to release the adrenocorticotropic hormone (ACTH). This results in the synthesis and release of adrenal glucocorticoids, which direct the processes of metabolism glycogenolysis in the liver and muscles, and gluconeogenesis in the liver and kidneys. This allows the body to respond appropriately to the additional stress factors [50, 51].

In the case of patients with schizophrenia, demonstrated by axis dysfunction of the substructure-pituitary-adrenal axis in the form of hypercortisolism, this leads to increased accumulation of visceral fat, and impaired glucose tolerance. A high level of cortisol in the tissues can produce an image of pseudo-Cushing's syndrome, characterized by abdominal obesity, hyperinsulinaemia, insulin resistance and hypertension [27]. Interestingly, Weber-Hamann et al. showed similar relationships in patients with major depressive disorder – 22 females with depression after menopause and 22 healthy females aged 23 years. They found that the females who suffered from depression and who had elevated cortisol levels, were characterized by an increase in body fat and a higher concentration of glucose OGTT [47].

There is the hypothesis that dysregulation of the hypothalamic-pituitary-adrenal axis may lead to the risk of psychosis, and the concentration of cortisol in patients with schizophrenia is related to the depth of psychosis, cognitive deficits and changes in the brain [52]. According to Walker et al., the concentration of cortisol in adolescents who present schizotypal symptoms, which may lead to the development of psychosis, is the severity of psychosis one or two years later.

Similar results are observed in major depressive disorder. For example, it is worth mentioning the study by Goodyear et al. (2000), conducted in a group of adolescents aged 8–16 years, with a high risk of depression. This showed that increased levels of cortisol, measured in the morning over several weeks, increased the risk of depression (according to those studied in relation to life events) [53].

## DISCUSSION AND SUMMARY

People who manifest mental problems have a tendency to obesity, which carries a number of consequences. Increased body weight predisposes to disorders of glucose and lipid metabolism. Data on the prevalence of somatic diseases in people with mental illness, especially schizophrenia, bipolar disorder, or depression, clearly indicate that this group is particularly vulnerable to the diseases associated with metabolic disorders, such as metabolic syndrome, type 2 diabetes, cardiovascular diseases, ischaemic heart disease, and cerebrovascular diseases.

Metabolic disorders in patients suffering from mental illnesses are caused by a number of factors, the most important of which are: the side-effects of antipsychotic medications, a specific, less active lifestyle and nutrient-poor diet, as well as the tendency to insulin resistance before taking medication. These tendencies are also noticed in healthy family members which may indicate a genetic disposition to psychotic and metabolic disorders.

The treatment of patients with mental problems is still symptomatic and has a number of problems, including the choice of the appropriate medication which, in the case of psychotic disorders, affect the reduction of symptoms, both negative and positive. Although the second generation medications improve reduction of the above-mentioned symptoms, they can also contribute to the formation of, or

exacerbate, the components of metabolic syndrome, such as weight gain, increased blood glucose levels, hyperlipidaemia, and resistance to insulin. Therefore, the selection of appropriate antipsychotic medication should take into account all aspects, including those related to metabolic transformation.

Both in the case of the population manifesting mental disorders and those who are healthy, stress is a factor predisposing to abdominal body fat, which contributes largely to the development of the components of metabolic syndrome. This is evidenced by reports on increased levels of cortisol, even before taking medications, in people with mental illness.

In the case of long-term treatment of mentally ill patients, not only effective medication therapy, but also the impact of skills aimed at reducing tension, stress, and the psycho-education for healthy lifestyles seem to be justified.

Mortality rates among the mentally ill patients are particularly worrying. In recent years, knowledge about the effects of some antipsychotics on weight gain, as well as on independent from pharmacology, increased susceptibility for the development of metabolic disorders in people suffering from mental illness, has been expanded. However, despite significant advances in knowledge, to date there are no uniform rules of conduct that are specifically aimed at educating patients on a diet and physical activity, and would undoubtedly contribute to improving the quality of life of this particular population.

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