



## Oats in the Treatment of Obesity and Metabolic Syndrome

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**Abstract:** The last decade is characterized by a significant increase in the number of patients with metabolic syndrome, which is a global public health problem and a leading risk factor for cardiovascular and non-communicable diseases. MS is characterized by an increase in the mass of visceral fat, a decrease in the sensitivity of peripheral tissues to insulin, and hyperinsulinemia, causing the development of a combined pathology of internal diseases (multimorbidity), disorders of carbohydrate, lipid, purine metabolism, and arterial hypertension.

The prevalence of MS reaches 24% in women and 23% in men. According to different studies, in some populations the prevalence of MS is 20-40%, and among obese patients - 49%; among persons with impaired glucose tolerance, the prevalence of MS is 50%, and in diabetes mellitus - 80%.

Although there is no international agreement on the definition and classification of fiber, there is established evidence for the role of dietary fiber in the development of obesity and metabolic syndrome. Beta-glucan ( $\beta$ -glucan) is a soluble fiber readily available from oat and barley grains that is of interest due to its multiple functional and bioactive properties. Its beneficial role in the treatment of insulin resistance, dyslipidemia, hypertension and obesity is constantly documented. The ability of  $\beta$ -glucans to ferment and their ability to form highly viscous solutions in the human intestine may form the basis of their health benefits. hence,  $\beta$ -glucan is widely considered as a food ingredient with the dual purpose of increasing the fiber content of foods and improving their health benefits.  $\beta$ -glucans in the prevention and treatment of the characteristics of the metabolic syndrome, their main mechanisms of action and their potential applications in foods.

**Keywords:** hyperglycemia, metabolic syndrome, obesity, oats.

Obesity is on the rise worldwide, with approximately 20% of patients in intensive care units suffering from it [33]. Adipose tissue is metabolically active, and visceral adipose tissue, in particular, has a negative adipocyte secretory profile, which leads to IR, persistent mild inflammation, T2DM, arterial hypertension (AH), CVD, dyslipidemia, obstructive sleep apnea, and chronic kidney disease. CKD), non-alcoholic fatty liver disease (NAFLD) and hypoventilation syndrome, physical disorders of many kinds and mental problems [33]. Excess fat deposited in visceral adipose tissue and ectopic deposits (eg, muscle and liver) is also associated with an increased cardiometabolic risk, as it has a high proportion of fat in muscle mass (eg, normal weight metabolic obesity) [5].

For the diagnosis of abdominal obesity, the experts of the ATP III program recommend determining the WC, while WHO considers the determination of the ratio of WC to OB to be more informative.

However, neither group discusses the procedure for measuring these indicators. For example, there is no clarity on how often measurements should be taken, how the patient should be dressed, at what points measurements should be taken (in various recommendations, it is proposed to measure the OT at the level of the navel or in the middle between the angle of the rib and the iliac crest), what reproducibility of measurement results, what is the allowable error of the method [30].

*Dyslipidemia and disorders of lipoprotein metabolism* are a generally recognized risk factor for the formation of diseases of the cardiovascular system. MS in the classical sense primarily implies hypertriglyceridemia [28]. At the same time, an increase in the serum level of TG is less dangerous than hypercholesterolemia, an increase in the concentration of LDL and VLDL [27].

Atherogenic dyslipidemia is a combination of elevated triglycerides and low HDL-cholesterol, in combination with elevated apoprotein B, small dense particles and LDL and small particles and HDL. All these components are independently atherogenic and occur in patients with MS [31].

**Arterial hypertension** The Framingham study showed that IR and hypertension are two interrelated conditions that predispose to the development of atherosclerotic vascular disease. However, the pathogenetic pathways of IR influence on the BP regulation system remain largely unclear. It has been shown that IR is more common in patients with AH and, perhaps, it is the combination of IR and elevated blood pressure that leads to an increase in the risk of CVD in this group, therefore, in AH, it is included in the concept of MS as one of the components [27].

BMI is calculated using height and weight according to the Quetelet equation (body weight in kg / height in m<sup>2</sup>) and is classified according to WHO criteria into five groups: normal weight (18.5–24.99 kg / m<sup>2</sup>), overweight (25.0–29.99 kg / m<sup>2</sup>), obesity of the I degree (30.0–34.99 kg / m<sup>2</sup>), obesity of the II degree (35–39.99 kg / m<sup>2</sup>) and obesity of the III degree (> 40 kg / m<sup>2</sup>).

The World Health Organization (WHO) has described overweight and obesity as a condition characterized by excessive or abnormal accumulation of fat that increases health risk [33]. It is considered a major public health problem and is the fifth leading cause of death in the world. WHO predicts that by 2030, lifestyle-related diseases will cause 30% of deaths, and they can be prevented by eliminating and identifying associated risk factors and implementing behavioral engagement policies [23].

The study indicates the priority importance in the primary and secondary prevention of MS in the elderly and senile, primarily monitoring its components and indicates the possibility of improving the "epidemiological prognosis" of life in patients with MS by influencing the polyfactoriality of mild, moderate and high severity [22].

The global prevalence of overweight and obesity has increased since 1980, and it is estimated that one third of the world's population is overweight or obese [32]. Regardless of socioeconomic level, geographic location, or ethnicity, obesity rates have increased across all age groups and genders; however, older people and women are more prone to obesity. Although the absolute prevalence of overweight and obesity varied widely across regions and countries, this pattern remained unchanged. There was a high frequency of detection of polyfactoriality with a high degree of severity ("mild polyfactoriality + salt load + insufficient consumption of vegetables and fruits") due to the presence of MS in the examined population [51].

Body mass index (BMI) is often used in epidemiological studies to detect overweight and obesity, although it has limited sensitivity due to significant individual variability in body fat percentage, which depends in part on age, sex, and ethnicity [5]. In the treatment of MS, measures aimed at normalizing metabolic disorders and reducing body weight are paramount and pathogenetically justified [53].

Numerous clinical, experimental and epidemiological studies conducted in various regions of the world convincingly show the expediency of wide introduction of the principles of therapeutic nutrition into a comprehensive program to combat MS [1]. Therefore, diet therapy is one of the important links in the prevention and treatment of MS [3]. At the same time, treatment should be

aimed not only at optimal compensation of existing metabolic disorders, but also, first of all, at reducing IR [11].

One of the main principles of any diet aimed at normalizing metabolism and general health improvement of the body is a balanced diet [52]. The effective impact of dietary nutrition in MS involves control of calorie content, quantity and qualitative composition of proteins, fats, carbohydrates, dietary fiber, determination of the content of vitamins, macro- and microelements in the diet, corresponding to the needs of each individual person [3; 4].

In the treatment of MS, measures aimed at normalizing metabolic disorders and reducing body weight are paramount and pathogenetically justified [49]. Numerous clinical, experimental and epidemiological studies conducted in various regions of the world convincingly show the expediency of wide introduction of the principles of therapeutic nutrition into a comprehensive program to combat MS [5].

MS is a reversible state, those. with appropriate treatment, achieve extinction, or at least measure, reducing the severity of the main its manifestations [ 29 ]. Due to this the primary challenge facing doctors, is timely started treatment, including medication [ 13 ] and non-drug methods for correcting metabolic disorders caused by IR.

When there are only laboratory manifestations of disorders of carbohydrate or lipid metabolism, i.e. at the stage of absence clinical manifestations, optimal start treatment with non-drug impact [ 5 , 6 ].

Cereals are grown for their nutrient-rich edible grains and are used as food throughout the world. Since the beginning of civilization, some cereals such as oats and barley have been used by man as a staple food, either directly or indirectly in terms of livestock feed [5]. Oats (*Avena sativa* L) are grown all over the world. After wheat, corn, rice, barley and sorghum, oats are the only grain unique among all grains, ranking sixth in world grain production [5]. It has been experimentally proved that the phytochemical, elemental, compositions of primary metabolites in different varieties of the same species are different. To fulfill human nutritional and health requirements, the best varieties should be selected. Genetic diversity among different varieties is determined in several ways [13]. However, when choosing the best germplasm with high nutritional value, defining diversity for the closest and elemental compositions is a better option.

Oats have long been used as a nutritious food. it is a tasty and nutritious food containing carbohydrates in the form of starch, well-balanced proteins, high lipid levels [13]. In addition, oatmeal contains small amounts of B vitamins, especially thiamine, folate, biotin, and pantothenic acid [21]. Its protein can maintain a good balance of essential amino acids. acids in the body when eaten. Many essential amino acids are found in oats, including methionine, cysteine, threonine, isoleucine, tryptophan, valine, leucine, histidine, methionine, phenylalanine, and tyrosine [24 ] . Oat crops are commonly used as a companion crop for fodder legumes for seedlings. Cereals such as wheat, corn, barley and rice contain less proteins, fats and acids, iron, magnesium, phosphorus and zinc compared to oats [21]. In addition, oats are a rich source of fiber (especially  $\beta$ -glucan) and minerals (manganese, phosphorus, copper, iron, selenium, magnesium and zinc). The bioactive compound present in oats, such as phenols, carotenoids, and sterols, are essential for maintaining good human health [13]. It has been reported that oat products in gluten-free and normal diets play an important role in controlling celiac disease in humans [9].

Oats have been grown globally for over 2,000 years and are a staple food in several countries. [26]. Oats are currently one of the most widely used cholesterol-lowering aids. The soluble fiber  $\beta$ -glucan has long been recognized as an essential active ingredient in cholesterol-lowering drugs [20]. Food agency standards from North America to Europe and Asia indicate that oat  $\beta$ -glucan (OBG) lowers cholesterol levels [11].

Previous metadata analyzes have also demonstrated that oat-derived  $\beta$  -glucan has a cholesterol-lowering effect, but these studies have focused primarily on a single ingredient. relevant studies [8]. Others have focused on oats. However, they studied the effects of oats on inflammatory or cardiovascular disease risk factors rather than meta-analyses specifically focusing on dyslipidemia.

In addition, the target population varies, which can lead to incomparable results [9]. Oat products such as rolled oats, rolled oats and rolled oats are readily available in a real practical diet plan .

*Avena sativa*, sometimes known as "oats", belongs to the Poaceae family. In the United States, this cereal is the third most important after wheat and corn, and in the world it ranks fourth. They are one of the most widely produced plants in terms of nutrients. [12].

Oats are a food crop and an ancient grain grown and consumed all over the world. Its nutritional composition and multifunctional effects of some biologically active components are becoming increasingly important [21]. Oats are a highly nutritious and healthy grain that can be used in a variety of culinary products, depending on its chemical properties and mineral composition [18]. Oat grains are an excellent source of nutrients, minerals, and phytochemicals that can be used both as nutraceuticals and as food [14]. Oats have five health certificates from the European Food Safety Authority. Four of these relate to soluble fibers unique to oats, beta-glucans, and include controlling blood cholesterol levels, increasing fecal bulk, and improving blood glucose balance. [48 ] . The sixth argument is that a large amount of unsaturated fatty acids, especially in the endosperm, reduces the risk of cardiovascular disease. Oat starch also has a low glycemic index, which is good for weight loss. [4 9 ] . The polyphenols and avenanthramides (AVN) found in oats are antioxidants and anti-inflammatory agents. Oat products can be labeled gluten-free in the European Union (EU) (since 2009), the United States (since 2013) and Canada (since 2015) if the gluten contamination level is less than 20 ppm [25] . Beta-glucan is a dietary fiber component present in oats. It is the main active ingredient in oats and has cholesterol-lowering and anti-diabetic properties. Oats also contain phenolic acid, tocopherols, sterols, avenacosides and AVN, which are beneficial for health. [45 ] . Oats have been shown to improve human health by enhancing immunomodulation and improving intestinal flora. [44 ] . In addition, eating oats helps prevent diseases such as atherosclerosis, dermatitis, and certain types of cancer. [21]. B -glucan, a soluble dietary fiber found in oat bran, oatmeal, and oatmeal, helps lower blood cholesterol levels [39]. Oats have been shown to be a possible preventative for intestinal dysfunction, cancer, celiac disease, obesity, and other disorders. [33].

Due to the numerous health benefits they bring, their consumption has skyrocketed and they have quickly become more popular [17].

Oats are one of the most nutritious, highly functional and nutraceutical cereals that have been eaten for centuries. [34]. Several evidence-based studies conducted on various varieties of oats have proven their valuable composition (The stated approximate moisture content of oats was 4.21%, ash content was 1.97%, nitrogen-free extract was 55.75%, crude fat was 6.91% , crude protein at 12.62%, and total fiber at about 13.65% [18] Another study reported percentage ranges of oats as moisture from 8.5 to 9.8, crude protein (from 11. 9 to 15.8), crude fat (6.7 to 10.3), crude fiber (2.1–3.5), ash (1.2–1.3), and nitrogen free extract (72 .6–74.3%) [ 36 ].The approximate composition of some oat varieties showed a protein content of 12.69% (Avon variety), a crude fiber content of 17.83% (SGD-81 variety), a fat content of 6.67% ( Avon variety), moisture content 9.29% (SGD variety. -81 var.), ash content 6.02% (SGD-2011 var.), nitrogen-free extract 60.78% (S-2000 var.) [13] . Similarly, the claimed starch content is 494 mg/g, total soluble sugars 5.3 mg/g and total protein 182.9 mg/g [16].

Oats contain significantly more insoluble and soluble dietary fiber and beta-glucans than hulled wheat. This property makes it an important nutrient [24].

Oats are very popular in modern folk medicine. Kissels from oat flour are used as an enveloping agent for diseases of the gastrointestinal tract, diarrhea [35]. Baths in a decoction of straw are used as a diuretic, antipyretic, diaphoretic for rheumatism, joint diseases, rickets. [ 17 ] . Local baths with a decoction of straw are used for excessive sweating of the legs. Inside, a decoction of oat straw is used for skin diseases, sciatica - [29]. Oats are a well-known food product. It also has medicinal properties. Ancient medicine believed that if you use oats with laxative oils, then it is suitable for the chest, treats cough, and relaxes. The external use of its flour is useful in the beginning of the development of hot tumors. [44 ] . In folk medicine, oatmeal kissels are used as an enveloping agent

for gastrointestinal diseases and diarrhea [30]. Consumption of oatmeal and cereal results in faster satiety than other grains [12].

A large-scale US study from 2002-2013 found that approximately 6% of the population consumed oatmeal, with an average intake of 238 g/day. Most oatmeal eaters are infants (14.3%) and older women (11.1%) [21].

Oats are perfectly absorbed by the body, are able to reduce the concentration of sugar in the blood, therefore it is recommended for therapeutic diets. Oat-based infusions have a strong choleric effect. Special substances, polyphenols contained in oat straw, are able to bind and remove toxins from the body [19].

A similar study by the Institute of National Health and Nutritional Expertise found that oatmeal consumers had a higher Healthy Food Index and lower body weights, waist circumferences, and body mass indices [10]. A cohort study conducted in Scandinavia showed that the consumption of oat grains leads to low mortality among the population - [4].

The degree of restriction of exogenous cholesterol in the diet of patients with MS varies from 250 to 500 mg per day, depending on the level of hyperlipidemia. [53]. According to WHO recommendations, with a moderate degree of hypercholesterolemia, its amount in the diet should not exceed 300 mg / day, and with severe - 200 mg / day [49].

Reducing the calorie content of the diet not only leads to weight loss and most effectively improves glycemic control, but also has a corrective effect on a number of metabolic disorders, helping to reduce the risk of developing cardiovascular complications.

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