The dietary treatment of obesity


Abstract. The review article represents an analysis of sources dealing with the issues of dietary therapy of obesity. The internet resources were used such as PubMed, MedLine, The Cochrane Databases, Google Scholar, Science Direct, Web of Science, and Scopus. Obesity has reached pandemic proportions worldwide, with more than 1 billion adults overweight (at least 300 million of them are clinically obese) and is a major contributor to the global burden of chronic disease and disability. This is a complex multifactorial disease, in which the accumulated excess fat in the body leads to negative impact on health. The main cause of obesity is a long-term energy imbalance between consumed and expended calories. Lifestyle modification remains the cornerstone of obesity treatment. An individually selected diet is recommended, which allows you to achieve a state of negative energy balance and is focused on quality food for health promotion. Most often, recommended diets for the treatment of obesity use the following energy restrictions based on changes in the composition of macronutrients: a low-fat diet, a low-carbohydrate and high-fat diet, a low-carbohydrate and high-protein diet, a paleo diet (with a high protein content). Intermittent fasting is considered an alternative to calorie-restricted diets. After an initial period on a high-protein diet, a Mediterranean diet may be an attractive option for continued treatment of obesity, provided that it is given in an energy-restricted form. This diet has been shown to be associated with lower levels of inflammatory biomarkers and metabolic markers of cardiovascular disease risk. The results of many studies indicate successful weight loss with the help of the Mediterranean diet, not only in the short term, but also in the long term. For the majority of obese patients, a purposeful change in lifestyle with adherence to the principles of dietary nutrition and regular physical activity allows for effective weight loss, adequate control of metabolic disorders, reduced risk of concomitant diseases, and long-term maintenance of body weight achieved in the process of losing weight.

Keywords: review; obesity; diet; diet therapy; weight loss

Obesity is a chronic relapsing disease, which is accompanied by an excessive accumulation of fat in the body, an increase in body weight and the subsequent development of various complications. The results of the Global Burden of Disease study indicate that obesity is the fifth leading cause of premature death each year (4.72 million). For comparison, this is 4 times more than the number of people who die in traffic accidents, and almost 5 times more than the number of people who die from human immunodeficiency virus infection. In Ukraine, obesity ranks fourth among risk factors for premature death (106.7 thousand cases every year) [1].

The results of the STEPS study indicate that 59.1 % of the population in Ukraine in 2019 were overweight, and 24.8 % were obese. It was also established that among Ukrainians, one in three women and one in five men suffer from obesity [2].

Among the main reasons for the global spread of overweight and obesity are an imbalance between energy intake and expenditure, lifestyle (eating habits, physical activity, social and psychological factors, economic status), genetic factors (violation of the control of leptin synthesis in adipose tissue cells) and various diseases (hypothyroidism, Cushing’s syndrome, polycystic ovaries, damage to the hypothalamus by a tumor or trauma, genetic syndromes associated with hypogonadism, etc.) [3, 4]. The nature of nutrition has changed dramatically towards increased consumption of energy-intensive products with a high content of fat, sugars, table salt and a low content of dietary fibers, vitamins, minerals and trace elements [5].

Obesity is a risk factor for the development of diabetes mellitus type 2, diseases of the cardiovascular system (CVD), musculoskeletal system, hepatobiliary system, obstructive sleep apnea syndrome, etc. 

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Full list of author's information is available at the end of the article.
sleep apnea, some types of cancer, etc. [6–8]. The progression of this pathology leads to a deterioration in the quality of life, an increase in the frequency of disability and a reduction in the life expectancy of patients [9, 10].

Patients suffering from obesity require long-term, almost lifelong treatment. A generally accepted strategy is to use a program of non-drug therapy, which, if necessary, can be supplemented with drug and/or surgical treatment [11]. The non-pharmacological program includes dietary therapy, dosed dynamic aerobic exercise and behavioral therapy (creating the patient’s motivation to lose weight, orienting the patient to life-long implementation of the anti-obesity program, self-monitoring with keeping a weight diary, nutrition and physical activity regime, limiting the intake of drugs that contribute to weight gain, treatment of sexual dysfunction and depressive disorders, combating stress, observing the rules of eating and other measures) [12, 13].

The purpose of correcting excess body weight and the basic criteria for the effectiveness of obesity treatment are weight loss of 10–15% from the initial values, maintaining the achieved indicators over a long period of time, reducing the risk of developing concomitant diseases and their complications [14–16].

Energy balance in a person depends on the interaction between energy intake and expenditure. Dietary energy can be obtained from proteins, carbohydrates, fats and ethanol. Changes in weight are accompanied by an imbalance between intake and expenditure of calories. To lose weight, “energy input” (i.e. energy intake from food) must be less than “energy expended” (i.e. total energy expenditure). Thus, most dietary interventions for weight loss involve some form of energy restriction [17, 18].

A low-energy diet (LED) is usually defined by a target energy intake of 800–1800 kcal/day and a balanced nutrient profile (carbohydrates 45–65%, fats 20–35%, and proteins 10–35%) [19]. 30–50% of the fats used should consist of polyunsaturated fatty acids. The amount of saturated fatty acids is limited, their energy value should not exceed 10% of the daily caloric intake. The source of animal fats can be low-fat fish, poultry (without skin), occasionally lean beef tenderloin is allowed. Cholesterol content in food should not exceed 300 mg/day. The energy value of protein in LED is about 15% of the daily caloric intake of food. The share of carbohydrates is 50–60% of the number of kilocalories consumed daily. Carbohydrates should be represented mainly by fiber (vegetables, fruits, unsweetened berries) and soluble dietary fibers (bread from coarsely ground flour, bran, whole oats and barley, legumes). The milk or kefir is allowed. Cholesterol content in food should not exceed 300 mg/day. The energy value of protein in LED is about 15% of the daily caloric intake of food. The share of carbohydrates is 50–60% of the number of kilocalories consumed daily. Carbohydrates should be represented mainly by fiber (vegetables, fruits, unsweetened berries) and soluble dietary fibers (bread from coarsely ground flour, bran, whole oats and barley, legumes). The milk or kefir is allowed. Cholesterol content in food should not exceed 300 mg/day.

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A meta-analysis of 20 RCTs (2,106 participants) compared low-density lipoprotein (LDL) cholesterol levels [32]. The result of consuming less fat is an average weight loss of 0.8 to 13.0 % from baseline with no serious side effects. Twelve studies that compared IF with a constant caloric restriction diet showed equivalent results [28]. A meta-analysis of 11 RCTs lasting 8–24 weeks allowed us to conclude that the effectiveness of intermittent energy restriction (up to 25 % of daily energy requirement) is comparable to continuous energy restriction in promoting weight loss and improving metabolism [29].

Currently, the search for the optimal ratio of macronutrients to promote weight loss is receiving considerable attention. The accepted range of energy distribution among the three main macronutrients (fats, carbohydrates, and proteins) for adults, established by the Food and Nutrition Board of the US Institute of Medicine, involves the relative intake of fat 20–35 %, protein 10–35 %, and carbohydrates 45–65 % of total energy intake [19]. Diets with different macronutrient compositions can be prescribed with or without caloric restriction (assuming that calorie reduction will be achieved by limiting or eliminating certain foods). It is important to follow a diet that creates a negative energy balance and focuses on quality food for health promotion [30].

Most often, the following energy restrictions are used in the recommended diets for the treatment of obesity based on changes in the composition of macronutrients: a low-fat diet, a low-carbohydrate and high-fat diet, a low-carbohydrate and high-protein diet, and a paleo diet (with a high protein content).

Traditionally, obesity was considered to be simply the result of an inappropriately high intake of energy-dense food, that is, the consumption of a large proportion of fat. A low-fat (25–35 % daily) low-calorie diet can cause significant short-term weight loss. Saturated fats in such a diet (< 7 % of total calories, polyunsaturated fatty acids up to 10 %, monounsaturated fatty acids up to 20 %). Complex carbohydrates make up 50–60 %, especially those used to replace saturated fats, sufficient fiber, protein is 15 % of the total caloric content [20].

Dietary fat has a significant effect on blood lipid levels in overweight or obese individuals. A meta-analysis of 32 RCTs that evaluated the long-term effect of low-fat diets on blood lipid levels compared with high-fat diets found that reducing fat intake from 40 to 20 % of total calories reduced total cholesterol by about 15 %; which can be explained by lower consumption of saturated fats [31].

An analysis of 37 RCTs (57,000 participants) with a duration of at least 6 months was conducted, in which the effects of low- and high-fat diets on body weight, body mass index (BMI), body fat percentage, and waist circumference were evaluated. The result of consuming less fat is an average weight loss of 1.4 kg, a decrease in total cholesterol and low-density lipoprotein (LDL) cholesterol levels [32]. A meta-analysis of 20 RCTs (2,106 participants) comparing low- and high-fat diets on cardiometabolic risk factors in overweight or obese individuals showed that reductions in total cholesterol and LDL cholesterol levels were more pronounced in the low-fat versus high-fat diet group [33].

A low-carbohydrate and low-glycemic-load diet (10–40 % of energy from carbohydrates) reduces insulin secretion while maintaining adequate levels of glucagon-like peptide-1. The hormonal shift leads to increased fat oxidation [34].

A review of studies conducted by an expert panel in 2013 demonstrated that following a carbohydrate-restricted diet resulted in equivalent weight loss as a low-fat diet with comparable caloric restriction [21]. This finding was confirmed in the DIETFITS RCT involving 609 overweight and obese adults (BMI 28 to 40 kg/m²) who followed a low-fat or low-carbohydrate diet for 12 months, with no significant difference in weight loss [35]. In addition, all obese patients treated with a low-carbohydrate diet (< 40 % of energy from carbohydrates) or a low-fat diet (< 30 % of energy from fat) improved markers of the metabolic syndrome [36]. However, a low-carbohydrate diet, especially if combined with an adequate intake of dietary fiber, will suppress secretion of ghrelin more effectively than a low-fat diet and thus suppresses the feeling of hunger.

Low-carbohydrate diets restrict carbohydrates and replace them with fats and/or proteins.

A low-carbohydrate, high-fat diet, known as the ketogenic diet, involves consuming at least 70–80 % of energy from fat and severely restricting carbohydrates, low in protein. Carbohydrate intake is limited to less than 20 g/day for up to 12 weeks, and then gradually increased to 80–100 g/day. The amount of carb restriction needed to achieve ketosis varies from person to person, but is usually less than 50 g/day. The diet mimics the fasting state, altering the metabolism, to use fats as the main source of energy. Catabolism of fatty acids in the liver occurs, ketone bodies are produced, which induces urinary ketosis [37].

Diet-induced weight loss leads to increased hunger and decreased satiety, increased ghrelin levels, and decreased concentrations of satiety peptides (glucagon-like peptide-1, cholecystokinin). A ketogenic diet minimizes or suppresses some of these responses [38].

Clinical studies have shown significant weight loss and a positive effect on the lipid profile in obese patients following this diet. Seventy-seven participants were randomized to a ketogenic diet containing 5, 15, or 25 % of total energy from carbohydrates for 12 weeks. The greatest improvement in anthropometric and metabolic parameters (reduction in weight and BMI, increase in high-density lipoprotein cholesterol, and decrease in triglyceride (TG)) occurred in the very low-carbohydrate group (5 % of total energy from carbohydrates) [39]. However, the side effects of the ketogenic diet should be taken into account, which include headaches, muscle cramps and general weakness.

A high-protein diet, in which more than 20–35 % of energy comes from protein, promotes significant weight loss in a short period of time. Among overweight or obese individuals, consuming more protein than the recommended dietary allowance may affect appetite, increasing satiety as well as total energy expenditure [40]. The high feeling of satiety caused by high-protein diets is generated by an increase in the level of anorexigenic and a decrease in the level of orexigenic.
hormones. An increase in muscle mass is achieved by activating the synthesis of muscle protein. In addition, proteins have significantly higher thermogenesis than carbohydrates and fats [41]. Diet-induced increased thermogenesis, increased blood amino acid concentration, increased hepatic gluconeogenesis, and increased ketogenesis caused by higher dietary protein content contributed to increased satiety [42, 43].

Clinical studies lasting 6–12 months have shown that a high-protein diet not only provides a weight-loss effect, but has long-term effects and can prevent weight regain after weight loss. Strengthening the satiety signal leads to a decrease in food intake. In addition, consuming more protein helps maintain fat-free body mass, which helps maintain resting energy expenditure despite visceral fat loss. The researchers concluded that a high-protein diet is an effective and safe weight loss tool that can be used to treat obesity and obesity-related diseases [44].

The study, which examined the effect of different diets on body weight, lipids, and serum glucose levels in 135 obese patients, lasted 60 days. According to the diet, groups of diets with calorie restriction, diets with a high protein content and IF 5 + 2 group are distinguished. All short-term dietary regimens reduced weight and body fat in obese subjects and improved blood lipids and glucose. However, the effectiveness of a high-protein diet on weight loss, body fat, and blood lipid levels was greater than that of a low-energy diet or intermittent fasting [45].

Due to the significant impact of a high-protein diet on metabolic processes, its use should be limited to the initial phase of a weight loss regimen lasting up to 6–12 months, and is not recommended as a lifelong diet [30]. However, when combining a high-protein diet with a high dietary fiber intake, this option may be better for weight control even after the initial period of weight loss. Results of a meta-analysis of 17 prospective cohort studies suggest that higher dietary fiber intake was associated with a reduced risk of all-cause mortality. A 10% risk reduction was observed for each 10 g/day increase in dietary fiber intake [46].

A type of high protein diet is the paleo diet. The diet has a high protein content (25–35% of energy) and a moderate content of fats and carbohydrates, including those with a low glycemic index [47].

The paleo diet is based on adoption of food intakes that mimic the food groups of our pre-agricultural hunting and gathering ancestors. The hunter-gatherer lifestyle has characterized humanity and its ancestors for hundred-thousands of years, causing the human genome to be adapted to it. The purpose of the paleo diet is to optimize human health and reduce weight. Only foods that were available in the hunting-gathering stage of the development of mankind can be included in this diet, such as meat, nuts, eggs, fruits, berries and vegetables. Avoid consumption of grain, dairy and refined food products, as well as sugar and salt [47].

A meta-analysis of RCTs with the determination of anthropometric indices, lipid profile, markers of inflammation and blood pressure showed that the paleo diet has a beneficial effect on CVD risk factors [48]. A systematic review and meta-analysis of RCTs was conducted to assess the effects of a paleo diet in patients with metabolic disorders. The results showed a significant decrease in homeostatic model assessment of insulin resistance (HOMA-IR), fasting insulin levels, total cholesterol, TG, LDL cholesterol levels, C-reactive protein, and blood pressure in the paleo diet group compared to the control group [49].

A meta-analysis of 21 RCTs on the effects of the paleo diet on body composition, lipid profile, carbohydrate metabolism and blood pressure in the short-term and long-term perspective of intervention in the nutrition of adults allowed establishing a stronger positive effect of the paleo diet than other diets on anthropometric indicators, levels of lipids, fasting plasma glucose, and glycated hemoglobin [50].

Fifty-eight postmenopausal women with I–II obesity (BMI 32.5 ± 5.3 kg/m²) were randomized to follow a paleo diet high in protein and unsaturated fatty acids or a reasonable control diet for 24 months. Anthropometry, plasma adipokines, gene expression of proteins involved in fat metabolism in subcutaneous adipose tissue and lipoprotein lipase activity and mass were measured at baseline and after 6 months. Lipoprotein lipase mass and activity were also measured after 24 months. The paleo diet resulted in improved insulin sensitivity and decreased circulating TG and lipogenesis-related factors, including lipoprotein lipase activity and mass; as well as gene expressions of CD36, fatty acid synthase and diglyceride acyltransferase 2. LDL activity and gene expression of diglyceride acyltransferase 2 and fatty acid synthase were significantly lowered in the paleo diet group versus the control group at 6 months and the LDL activity remained significantly lowered in the main group at 24 months [51].

Reductions of body weight and body fat mass and improvements in metabolic balance (insulin sensitivity, glycemic control, and leptin levels) in those who follow paleo diet have been reported both from short- and long-term studies [52]. However, concerns have been raised regarding problems with long-term adherence and the high costs of this diet.

After an initial period on a high-protein diet, a Mediterranean diet may be an attractive option for continued treatment of obesity, provided that it is prescribed in an energy-restricted form. It is high in antioxidants and dietary fiber, and has a low glycemic load compared to conventional Western diets. The Mediterranean diet is not a typical low carbohydrate diet. It is rich in minimally processed plant-based foods, monounsaturated fats from extra virgin olive oil, seafood, but lower in saturated fat, red meat and dairy products. Certain components of the Mediterranean diet, such as nuts, have a positive effect on reducing the feeling of hunger [53]. RCT results suggest that nuts may be useful for weight control and prevention of weight gain after weight loss [54]. Biologically active polyphenols, which are present only in extra virgin olive oil (but not in refined olive oil), contribute to the cardioprotective effect of the diet [55].

The Mediterranean diet is one of the best dietary patterns analyzed for CVD risk. It has been proven that this diet is associated with a decrease in the level of inflammatory biomarkers and other CVD risk markers (coronary heart disease, ischemic stroke, etc.) [56].

The CORDIOPREV (CORonary Diet Intervention with Olive oil and cardiovascular PREVention) study randomized approximately 1,000 patients with confirmed coronary heart disease to either a Mediterranean diet or a low-fat diet.
diet (up to 30 % fats daily). A 7-year follow-up showed that the Mediterranean diet was superior to a low-fat diet in the prevention of major cardiovascular events (myocardial infarction, ischemic stroke, peripheral artery disease, and cardiac death) [57].

The results of many studies indicate successful weight loss with the Mediterranean diet, not only in the short term, but also in the long term [58], and the data were comparable to weight loss achieved by other diets in overweight or obese patients, provided the caloric intake was similar [59].

Since the success of obesity therapy, like any chronic disease, depends first of all on the patient’s participation in the treatment process, the formation of conscious motivation for long-term treatment and self-control, gradual transition to proper nutrition in combination with increased physical activity is important. The patient must accept the concept of a moderate, gradual and step-by-step reduction in body weight, a lifelong change in eating habits and lifestyle.

Thus, although obesity has recently acquired the character of a pandemic, which has covered the population of most countries of our planet, nevertheless, it can be argued that in the arsenal of modern medicine there are effective methods of treating this disease, which allow not only to improve the quality of life of patients, but also to significantly reduce mortality from its complications. For the majority of obese patients, a purposeful lifestyle change with adherence to the principles of dietary nutrition and regular physical activity makes it possible to achieve a reduction in body weight, adequate control of metabolic disorders, a reduction in the risk of developing concomitant diseases, and maintenance of body weight achieved in the process of losing weight in the long term.

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Дієтотерапія ожиріння

Резюме. В оглядовій статті проведено аналіз джерел, присвячених питанням дієтотерапії ожиріння. Для пошуку інформації використовували інтернет-ресурси PubMed, MedLine, The Cochrane Databases, Google Scholar, Science Direct, Web of Science та Scopus. Ожиріння набуло масштабів пандемії в усьому світі, адже більше 1 мільярда дорослих людей мають надлишкову вагу (принаймні 300 мільйонів із них страждають на клінічне ожиріння), і є основним фактором глобального тягаря хронічних захворювань та інвалідності. Це складне багатофакторне захворювання, при якому накопичений надлишок жиру в організмі призводить до негативного впливу на здоров’я. Основною причиною ожиріння є тривалий енергетичний дисбаланс між споживаними і витраченими калоріями. Модифікація способу життя залишається наріжним каменем лікування ожиріння. Рекомендується індивідуально підбірена дієта, що дозволяє досягти стану негативного енергетичного балансу і орієнтована на якісну їжу для зміцнення здоров’я.

Ключові слова: огляд; ожиріння; дієта; дієтотерапія; втрата ваги