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Diet and physical activity in the treatment of obesity - current knowledge

Kinga Brzuszkiewicz

Students' Research Group at the Department of Toxicology, Medical University of Lublin

<https://orcid.org/0000-0003-3941-027X>

Gracjan Rudziński

Uniwersytet Medyczny w Lublinie

<https://orcid.org/0000-0001-8911-9144>

Kinga Pożarowska

Uniwersytet Medyczny w Lublinie

<https://orcid.org/0000-0003-0691-0155>

Arkadiusz Grunwald

Uniwersytet Medyczny w Lublinie

<https://orcid.org/0000-0002-9792-1118>

Abstract

Introduction: Obesity is now becoming a growing problem and challenge for medicine. The number of people with excessive body weight has now reached more than 2 billion, or about 30% of the world's population. The purpose of this article is to identify and describe some of the already known treatments for obesity, along with the latest research on the subject, in order to show the importance of developing and introducing new methods of weight loss.

Aim of the study: The purpose of this article is to review the impact of obesity on health and the diets offered to people struggling with the disease. **Materials and methods:** We reviewed the literature available in the PubMed database up to November 2022, using the keywords.

Results: Consistently limiting caloric intake is a must when losing weight. There are also diets such as low-carbohydrate, low-fat and high-protein diets, but following them can also have some side effects. For example, a high-protein diet can lead to kidney stones. The Mediterranean diet is also a good option for people with obesity. It lowers the risk of cardiovascular disease and cancer. All obesity treatment suggestions consistently recommend a balanced and low-calorie diet with reduced fat (along with saturated fatty acids) and optimal amounts of fiber. In addition to diet, physical activity is an important topic. The primary recommendation for people with obesity is at least moderate to vigorous physical activity of at least 150 minutes per week.

Summary: In conclusion, the overarching goal of obesity treatment is to improve quality of life. Calorie restriction, regular exercise or a combination of both is accepted as an effective strategy for preventing or treating obesity.

Keywords: obesity, exercise, diet, adipose tissue

INTRODUCTION

All over the world, the number of people struggling with obesity has been growing in recent years. The number of overweight people now stands at over 2 billion people, or about 30% of the world's population [1]. Since 1975, the number of people struggling with obesity has tripled [2]. Scientists say that we are dealing with a global epidemic [3]. In 2016, 39% of adults were overweight, while obesity was 13% [3]. The cause is too much caloric intake, consumption of processed and high-calorie foods [4]. UNICEF has determined that “there has been no progress in reducing obesity for over 15 years” [5]. The prospects for reducing the obesity epidemic are not optimistic.

PURPOSE OF THE WORK

The purpose of this article is to identify and describe some of the already known treatments for obesity, along with newly discovered alternatives, to show the importance of developing and introducing new methods of losing weight.

DESCRIPTION OF THE STATE OF KNOWLEDGE

Obesity is a disease that affects all body functions [6,7], leads to many diseases [8,9], and adversely affects the quality of life [10,11]. It also increases mortality [12]. The relationship between mortality and obesity was greater in younger age and in men than in older age and in women [12]. A study conducted in the United Kingdom among obese people showed that in people with a BMI ≥ 30.0 kg / m², the average life expectancy at 40 years was shorter by 4.2 in men and 3.5 in women [13] than in those with normal BMI, i.e., 18.5-24.9 kg / m². Another study by Dai and co-authors in 2017 found that high BMI caused the deaths of 2.4 million deaths in women and 2.3 million in men worldwide [14].

The significant increase in obesity in recent years has resulted in the development of prophylaxis to prevent the occurrence of this disease. Diet and exercise are the basic treatment strategies [15]. Research has shown that practicing sports for two years and maintaining an adequate supply of calories has a significant impact on the development of obesity-related diseases, and, importantly, reduces body weight by about 5 percent [16]. Regular aerobic exercise significantly reduces fat tissue in the liver, regardless of gender, age, or race [17]. Diet causes faster weight loss than by playing sports. However, exercise is better at lowering the amount of body fat [18].

Diet

Consistently restricting caloric intake is mandatory when losing weight. When it comes to reducing calories, we divide diets into very low-calorie diets (VLCD) with an intake of less than 800 kcal per day, low-calorie diets with a daily intake of 800 to 1200 kcal and finally low-

calorie balanced (HBD) diets with an intake of more than 1200 kcal per day [19]. In the case of their types, we distinguish, among others eating habits, such as: low-fats, low-carbs, high-protein [20]. Thanks to the use of the low-fat diet, we achieve a reduction in cholesterol levels, and a reduction in the risk of cardiovascular diseases and cancer has also been observed [21]. In many studies, a low-fat diet has had positive effects in people struggling with obesity. A meta-analysis that looked at low-fat diets (LFDs) for weight loss of 6 months or longer [22] found that people using this type of diet lost more weight (2.17 kg) compared to people who consumed this type of diet. they did not apply it.

However, in practice, the reduction in fat consumption is often compensated by a higher carbohydrate intake and then becomes a high-carbohydrate diet. Such a diet inhibits weight loss and increases the production of triglycerides [23]. The LOW-CARB diet, characterized by a lower intake of carbohydrates, leads to ketosis, and thus suppresses the feeling of hunger and lowers the concentration of triglycerides [24]. Rapid weight loss can be achieved with a high-protein diet, which unfortunately causes deterioration of liver and kidney function and, therefore, leads to acid-base imbalances, osteoporosis and kidney stones [25]. Both diets have a disadvantage such as monotony, i.e., the consumption of the same substances. This can result in a deficiency of certain nutrients, vitamins, and minerals.

The Mediterranean diet (MD) differs from the diets mentioned above. MD is characterized by a high intake of vegetables, fruits, and nuts. Providing less saturated fats in favor of monounsaturated fats, the said diet delivers a high amount of fiber, glutathione and antioxidants and is characterized by a balanced ratio of omega-6/omega-3 essential fatty acids [26]. Therefore, Mediterranean Diet can be helpful in diabetes, obesity, and other chronic diseases. Studies have shown that long-term use of the conventional Mediterranean diet reduces the risk of both cardiovascular disease and cancer by approximately 50%, with allegedly similar or even greater benefits for diabetics compared to the general population [26]. Obesity, especially its central type, usually precedes the development of type 2 diabetes [27]. All obesity treatments consistently recommend a balanced, low-calorie, reduced-fat diet [28].

Eating a vegan and vegetarian diet with a predominance of plant-based substances can also be an effective dietary intervention. Studies have shown that vegetables, fruits, grains, and legumes have a beneficial effect on blood lipids and obesity [29]. Vegetarian and vegan [30] diets, as well as Mediterranean [31] and Nordic [32] diets usually do not contain meat but may contain dairy products as well as eggs and fish. These diets reduce the risk of developing chronic diseases [33,34]. Additionally, some studies show that the use of the above-mentioned diets can be an effective dietary approach, promoting weight loss [35]. In a study of meat eaters and non-eaters, the mean BMI was found to be highest in those who ate meat. The lowest, however, was observed in people following vegetarian and vegan diets [36]. Some plant foods contain bioactive compounds that have anti-obesity and anti-inflammatory effects [37]. Fruits and vegetables as well as seeds and spices are full of biologically active compounds. Recent studies show their significant impact on health. They regulate gene expression in adipose tissue [38]. Further research on bioactive food substances may lead to the development of new effective strategies for the prevention of obesity and metabolic diseases in the future.

The plant-based diet also contains large amounts of unsaturated fatty acids and fiber. A large amount of dietary fiber leads to an increase in the volume of food in the stomach and may lead to weight loss [39]. Moreover, dietary fiber is effective in lowering cholesterol levels [40]. Regular consumption of it not only improves body weight, but also leads to a reduction in blood pressure, the risk of type 2 diabetes and an improvement in the composition of blood lipids [41]. They also cause oxidation of fatty acids in the liver [41].

Simply increasing the amount of plant-based food intake may help prevent obesity in middle-aged and elderly people [42]. The cohort study showed that the advantage of consuming plant substances over animals resulted in a lower incidence of obesity in these people in the future, regardless of the overall health of the organism [42]. The study by Turner-McGrievy and co-authors [43] proved that the greatest weight loss occurred in people following a vegan diet. However, it should be remembered that such a diet may result in nutritional deficiencies, especially in pregnant and breastfeeding women, as well as in children and adolescents [44].

Intermittent fasting

It is a common idea that the daily food intake should be divided into three square meals: breakfast, lunch, and dinner. Dieticians often suggest adding two snacks (morning and afternoon) to help appetite control. The influence of meal frequency on health has been an interesting topic since many years. While epidemiological evidence indicates an association between higher meal frequencies and lower disease risk, experimental trials have shown conflicting results. The research showed significant increase in disease risk with a high meal frequency (≥ 6 meals / day) as compared to a low meal frequency (1-2 meals / day) [45]. Another important thing is breakfast consumption and the distribution of daily energy intake, caloric restriction, and night-time eating. A crucial role is played by the fasting period length between two meals. Food consumption that is asynchronous with natural circadian rhythms may exert adverse health effects and increase disease risk. Additionally, alterations in meal frequency and meal timing have the potential to influence energy and macronutrient intake [46]. Cohort study, the Malmo Diet and Cancer study, reported that eating more than six meals per day reduces the risk of obesity compared to less than three meals daily [47].

The fasting diet is popular in many countries, cultures, or religions. For example, fasting is popular among Muslims during Ramadan. Fasting has many positive effects on the cardiovascular system, increasing parasympathetic activity, which in turn reduces heart rate and blood pressure [48]. It has been demonstrated that time-restricted feeding could protect mice against obesity, hyperinsulinemia, hepatic steatosis, and inflammation when rodents were fed with a high-fat diet (HFD) [49]. Additionally, beyond body weight and composition, it is likely that different eating patterns may exert some degree of differential effects on physiological processes, even in isocaloric conditions [49]. Different chronotypes should be considered: being larks and owls or morning types (M-types) and evening types (E-types), might probably influence also eating behavior and food metabolism [50]. Intake of a greater number of calories earlier in the day, which often involves breakfast consumption, is better when compared to consuming many calories later at night [50]. Moreover, extending the daily fasting period beyond a standard overnight fast or implementing occasional fasting periods, may be more beneficial [50].

Intermittent fasting (IF) diet may elicit alterations in the gut microbiota that protect against Multiple Sclerosis (MS). IF can reverse as well as prevent MS in rodents. Their abdominal fat and blood pressure decreases, inflammation disappears. Insulin sensitivity increases and the functioning of the nervous, muscular, and cardiovascular systems improves [51]. Another diet, fasting for 2 days, 2 days / week fasting diet in overweight women at risk for breast cancer, exhibited reduced oxidative stress levels and inflammation [51]. The same diet in elderly men showed reductions in body weight and body fat as well as improved mood [52]. Periodic fasting can reverse multiple features of the metabolic syndrome in humans: it enhances insulin sensitivity, stimulates lipolysis, and reduces blood pressure [52]. Three weeks of alternate day fasting resulted in reductions in body fat and insulin levels in men and women with weight considered as normal [53].

Ramadan fasting (2 meals / day separated by approximately 12 hours) resulted in decreased daily energy intake, decreased plasma levels, and increased insulin sensitivity [54]. It is important to acknowledge the fact that IF can improve glucose metabolism even with little or no weight change. It is also important that during the first 4 - 6 weeks of implementation of the fasting regimen, a physician or registered dietitian should be in regular contact with the patient to monitor their progress and to provide advice and supervision [54].

Overall, intermittent fasting strategies may vary in length and frequency of fasting. The main goal of this diet is to alter metabolic pathways. The most common changes are improvement in insulin sensitivity and a reduction in blood pressure, fasting glucose and inflammation [55]. One study found that this diet led to a 3-8% reduction in body weight after 3-24 weeks and 4-14% after 6-24 weeks [56]. Trepanowski et al. Compared the effect of fasting every other day versus daily caloric restriction on weight loss among participants [57]. The study showed that both

groups lost similar weight in both the sixth and twelfth months. The significant fact is that people who fasted every other day were more likely to quit their diets than those who restricted the number of calories every day [58]. It was probably caused by short-term side effects after following a fasting diet, such as fatigue, headaches, and constipation [58].

Research shows that this type of diet can have a beneficial effect on eating behavior among overweight and obese people, but it should be noted that it can have a detrimental effect on people of normal weight with unrestrained eating behavior [59]. Additionally, IF may be detrimental to children and the elderly [59].

Overall, there is mounting evidence of a metabolic benefit from intermittent fasting diets. Current research indicates that IF does not lead to greater weight loss compared to continuous calorie restriction regimens.

Time-limited feeding

Time-limited feeding (TRF) is a form of intermittent fasting and includes a longer daily fasting phase [60]. Eleven overweight adults in the study took part in a 4-day randomized crossover study. They ate between 8 and 14, which determines early TRF (eTRF), and on an inspection schedule between 8 and 20. The inclusion criteria were for generally healthy adults between 20 and 45 years of age, with a body mass index of 25.0 kg to 35.0 kg / m², body weight from 68.0 kg to 100.0 kg, regular bedtime between 21:30 and 24:00 and regular menstrual cycle in women [61]. The participants were constantly monitored for their glucose levels. Relative to the control regimen, eTRF lowered mean daily glucose levels, fluctuations in blood glucose, and lowered mean blood glucose levels in sleep. Other research results indicate that in men with prediabetes, eTRF improves insulin sensitivity, blood pressure and oxidative stress without losing weight [62,63].

Physical activity

The American College of Sports Medicine recommends 3-5 times 20-60 minutes of aerobic exercise per week [64]. In the Diabetes Prevention Program studies, the risk of developing diabetes was reduced by 58% among people with prediabetes compared to the entire population over a three-year period [65]. Physical exercise plays an important role, in addition to weight loss, it is responsible for the reduction of metabolic risk factors [66]. Training exercises are divided into acute and chronic. Acute means a single training session, while chronic means regular, repeated every week [67]. Intense physical effort increases blood flow through adipose tissue, supplies fat to the muscles. Additionally, it reduces its stored amount, and fatty acids are mobilized [68]. Despite these reports, it is still not fully understood whether the changes in adipose tissue are caused by exercise or negative energy balance [69]. This topic remains an important area of research.

The following sections discuss the effects of different types of exercise on obesity and body fat, based on research over the past five years. The exercise studies are detailed in Table 1.

Table Number 1 (Tab. 1.) Types of exercises and their impact on obesity and adipose tissue.

AUTHOR	YEAR	PARTICIPANTS	EXERCISES – DURATION AND TYPE	RESULTS
Tanaka and co-authors	2020	Healthy adults	4 months, walking/aerobic training	Brown adipose tissue is significantly related to the percentage of body fat in your body [70].
Islam and co-authors	2018	Active young men	1 day, running, different intensity	Increased oxidation of adipose tissue in all groups in the post-exercise period [71].
Zhang and co-authors	2017	Obese young women	12 weeks, 3-4 times a week, cycling	Large loss of abdominal fat [72].
Riis and co-authors	2019	Healthy young men	10 weeks, 3 days a week, cycling	Improving the sensitivity of adipose tissue to insulin [73].
Taylor and co-authors	2020	Patients with coronary artery disease	12 months, 3 times a week, high-intensity interval training	In addition to significantly reducing body fat, training also reduced fat in the liver [74].
Stinkens and co-authors	2018	Obese men	12 weeks, 3 times a week, aerobic exercise 30 minutes	No related changes with gene expression of adipose tissue markers involved in browning and lipolysis in obese individuals [75].
Allman and co-authors	2019	Trained women	1 day, high-intensity interval training	Increased oxidation of adipose tissue in the post-workout period [76].

Endurance training has a significant impact on adipose tissue. In addition to increasing the amount of training, the caloric deficit is important. The study showed that increasing the number of steps from 7013 to 8840 reduced the level of body fat in obese men [77]. Training with a shorter duration (30 minutes) has a profound effect on adipose tissue. 24 weeks of such training for 5 days a week resulted in a reduction of the waist circumference in women and men struggling with obesity [78]. Research has proven that high-intensity interval training is more effective in reducing the amount of total body fat than moderate-intensity training. Additionally, they help in reducing fat storage in people with metabolic syndrome [79]. Moreover, thirteen weeks of moderate-intensity training, i.e. 5 times a week for 60 minutes, reduced visceral fat in men with type 2 diabetes [80].

In a research study, weight loss along with resistance training or aerobic training results in a greater overall weight reduction compared to weight loss alone, driven by increased fat loss. Results indicate that the combination of weight loss and resistance training can generate the greatest weight loss and the most beneficial change in body composition compared to weight loss with aerobic training or weight loss alone, maximizing the potential functional benefit [81].

SUMMARY

This study reviews the role of diet, exercise interventions in obesity prevention and the improvement of adipose tissue metabolism. It is now known that the cause of obesity is multifactorial. Genetics, nutrition, and lack of exercise have a significant influence on the development of this disease. This complex influence of factors should be considered when recommending interventions to prevent and treat this condition. The best

effectiveness will be the occurrence of a permanent negative caloric balance. Regular physical exercise can help, in addition to helping to maintain an adequate number of calories, additionally reducing the mass of subcutaneous and stored adipose tissue. It has been proven in numerous scientific studies that the Mediterranean diet, in addition to its beneficial effect on the number of kilograms, reduces the risk of cardiovascular diseases and has a great influence on diabetes. It has also been shown that including more than six meals a day reduces the risk of obesity compared to less than three meals a day. Combined high-protein diet and resistance exercise significantly increase fat free mass, improve body functions, lead to a beneficial change in body composition, as well as reverse brittleness and prevent loss of muscle and bone mass in obese elderly people. In addition, recent studies have shown that a low-calorie diet and playing sports will be most effective in reducing body weight as well as improving metabolism. In addition to losing unnecessary kilograms, regular exercise also improves health by increasing muscle mass and secreting anti-inflammatory markers. It has been proven that cytokines that are secreted because of contractions of muscles working during exercise may be an important object of scientific research in the future, as it has been proven that they change the amount of white adipose tissue and increase gene expression. In summary, the overarching goal of obesity treatment is to improve the quality of life. Another important task is maintaining weight loss in the long term.

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