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The Effect of Aerobic Training on Weight Loss in Middle-Aged and Older Adults: Is It a Sufficient Form of Exercise?

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Abstract

Introduction: Obesity is a serious health problem that affects a very large percentage of the population, including middle-aged and senior people. Overweight and obesity are risk factors for many diseases, including cardiovascular diseases and diabetes. Many papers have been produced investigating the effects of different types of training and diet on body fat levels in overweight and obese populations. One of the best studied forms of exercise is aerobic training. In this article, we will discuss the effects of aerobic training or its combination with resistance training on weight loss and fat burning in an elderly population, including those suffering from sarcopenic obesity.

Aim of the study: To demonstrate the effects of aerobic training and the combination of aerobic training and resistance training on weight loss, body fat reduction and other relevant health parameters in a middle-aged and older population.

Methods: A review of the literature available in PubMed and Google Scholar databases conducted using key words such as obesity, older adults, overweight, aerobic, resistance training. The review of available publications mainly focused on studies with the strongest scientific evidence such as randomised controlled trials and meta-analyses.

Conclusion: Physical exercise is a crucial part of the fight against obesity. The implementation of training supports weight reduction and, at the same time, has a positive impact on fitness and physical performance. Aerobic training has a positive effect on weight loss, but the best results are obtained when aerobic training is accompanied by resistance training, as it has a positive effect on muscle strength and muscle tissue quality and has a positive effect on bone mineral density (BMD). However, it should be noted that significant fat reduction requires the implementation of a calorie deficit.

Key words: obesity, overweight, older adults, middle aged adults, aerobic, resistance training

Introduction:

Obesity

Obesity is a disease that involving the accumulation of excessive body fat. The main indicator of obesity is the Body Mass Index (BMI), which is the quotient of the body mass to the square of the height and is given in the unit kg/m^2. It is not without disadvantages as it does not take into account body composition, i.e. percentage of body fat and muscle mass, but it is the most

popular and widely used index in clinical practice [1, 2]. The normal BMI range is 18.5 to 24.9 kg/m², the criteria for overweight are between 25.0 and 29.9 kg/m², while obesity can be said to occur when BMI ≥ 30 kg/m². Abdominal obesity is diagnosed when the waist to hip ratio (WHR), which is the quotient of the waist circumference to the hip circumference, is above 0.9 in men and above 0.85 in women [2,3]. Obesity is a risk factor for cardiovascular diseases, insulin resistance, diabetes mellitus, hyperlipidaemia, some cancers, osteoarthritis and many other somatic and psychiatric conditions, resulting in a reduced life expectancy [1].

Epidemiology of obesity

According to a study published in 2024 in the journal *Lancet*, in 2022, as many as 504 million of women and 374 million of men were obese, with the largest percentage of these being in the USA, China and India [4]. According to WHO data, up to 59% of adults in Europe are overweight or obese [1]. In the Polsenior2 study conducted on a population of Polish seniors aged 60 and over, the mean BMI of women was 29.3 kg/m² (95% CI: 29.0-29.7) and that of men was 28.5 kg/m² (95% CI: 28.2-28.8). Very concerning, women in the age group 70 to 74 years had a mean BMI of 30.1 kg/m², which corresponds to the criteria for obesity [5].

Sarcopenic obesity

Sarcopenic obesity is when obesity is accompanied by sarcopenia, i.e. loss of muscle mass and consequently muscle strength. This type of obesity mainly affects older people, especially those over 80 years of age. Sarcopenic obesity results in unfavourable changes in body composition in the form of a high proportion of adipose tissue and a low proportion of muscle tissue [6]. Factors responsible for the onset of sarcopenic obesity include hormonal changes (menopause, age-related decrease in testosterone levels in men), inflammation, excess calorie intake and insulin resistance [6,7,8]. Unfortunately, due to the lack of a definition of sarcopenic obesity that defines parameter values, it is difficult to determine the incidence of this condition in the population [6,7]. According to a metaanalysis published in 2021, sarcopenic obesity affects approximately 11% of older people worldwide [9].

Methodology

The review was based on papers available in PubMed and Google Scholar databases. The literature search was conducted using keywords such as obesity, overweight, older adults, middle aged adults, aerobic, resistance training. During the literature browsing, we focused most attention on trials with high academic value, such as metaanalyses and randomised controlled trials (RCTs). We primarily focused on studies investigating aerobic training for

weight reduction in older adults and the effect of a combination of aerobic and resistance training. In addition, the effect of diet on weight reduction in the study populations was included.

Aerobic training

In the US study conducted on a population of people over 65 years of age with a BMI ≥30 kg/m², the effectiveness of a reducing diet, a reducing diet combined with aerobic exercise or aerobic exercise alone was tested, and exercise was shown to have a beneficial effect, resulting in a smaller decrease in bone mineral density (BMD) and a smaller decrease in lean body mass. The use of a reduction diet alone, despite a minimally greater reduction in body weight from the group simultaneously exercising and dieting (9.7 kg vs. 8.6 kg), did not result in the increase in muscle strength that the exercisers scored. Aerobic training alone, unfortunately, was not effective in reducing body weight; these individuals lost an average of 1.8 kg in 6 months [10]. In a population of 54- to 77-year-olds with a BMI ≥ 25 kg/m², it was shown that a six-month programme of a slimming diet combined with aerobic exercise resulted in an average weight loss of 8% and a decrease in fat mass of 17% with statistical significance. Additionally, the intervention resulted in a reduction in fasting insulin levels ($p < 0.001$) [11]. In an obese population aged 65 to 79 years, the introduction of a treadmill exercise intervention for a period of 20 weeks resulted in a mean weight loss of -1.13% ± 3.44%. Participants who additionally had a caloric deficit of 250 kcal or 600 kcal implemented achieved significantly better weight loss (-9.45% ± 4.50% and -10.45% ± 3.97%, respectively, with no statistical difference between the diet groups), demonstrating the significant impact of a calorie deficit on weight loss outcomes. Those following a caloric deficit also achieved reductions in fasting insulin and glucose levels, decreasing Homeostatic Model Assessment for Insulin Resistance (HOMA-IR), demonstrating increased insulin sensitivity. Importantly, there was also a reduction in total cholesterol and triglycerides in the calorie deficit groups [12].

Aerobic and resistance training

Among overweight or obese 40- to 66-year-olds with a sedentary lifestyle, the introduction of a 12-week training plan resulted in the best weight loss in the combined aerobic and strength training group. Those doing both workouts achieved weight reduction, fat loss and a decrease in BMI that was statistically significant, which was not achieved by the strength-only or aerobic-only groups [13]. In a study on women between 65 and 84 years of age who had a low

percentage of muscle tissue and a BMI ≥ 25.0 kg/m², including resistance band training and aerobic training at a frequency of five times per week for a period of 24 weeks resulted in an average loss of 2% body fat and a reduction in waist circumference of 0.7 cm. Very importantly, participants in the study group scored an increase in muscle strength by an average of 2.5 kg on the left arm and 3.2 kg on the right arm, while the no-exercise control group even showed a decrease in muscle strength [14]. A study with the same inclusion period of the intervention among people aged 65 to 80 years with a sedentary lifestyle compared the effectiveness of aerobic training and aerobic training combined with resistance training, which were performed three times a week for 40 minutes. Although the training groups did not achieve significant weight loss (the aerobic group lost an average of 0.5 kg and the combined training group lost 1.2 kg), they did achieve statistically significant improvement in 30-second sit-to-stand ability and improvement in static balance, which were more significant for combined training. This shows that the lack of use of a reduction diet does not achieve satisfactory weight loss. The use of both types of training, i.e. aerobic and resistance training, is more effective than aerobic training alone [15]. In another US study of people over 65 years of age with a BMI ≥ 30 kg/m², after six months of intervention, weight reduction in those doing aerobic training or resistance training or both was similar (mean weight loss of 8.9kg, 8.4kg, 9.1kg, respectively), but resistance training or combined training resulted in greater bone mineral density (BMD) than aerobic training alone, indicating that in seniors it is beneficial to include resistance training as an additional or as a stand-alone intervention to prevent bone density loss and thus bone fractures [16]. The addition of resistance training also resulted in the greatest reductions in visceral adipose tissue and intramuscular adipose tissue levels. In addition, the group performing aerobic and resistance exercise achieved an 86% increase in insulin sensitivity index (those on a diet performing only aerobic training scored an increase in insulin sensitivity index of only 28%), demonstrating the beneficial effect of including resistance training on the metabolic effects achieved [17]. A study published in 2017 found similar results showing that resistance training has a positive effect on BMD and its implementation alone or as an adjunct to aerobic training is reasonable in older groups at risk of reduced bone density [18]. In a study of the effects of resistance training, aerobic training, or a combination of the two, there was comparable weight loss in the intervention groups, but the resistance or combined training group had less muscle tissue loss compared to the aerobic group (resistance group - 1 kg, combined training group -1.7 kg, aerobic group -2.7 kg). Those receiving resistance training

were able to expect a smaller decrease or maintenance of BMD and a greater increase in muscle strength, confirming the beneficial effects of resistance training [19]. A published meta-analysis that evaluated the effectiveness of different interventions on, among other things, weight loss in older people showed that a combination of training (including aerobic and resistance training) and diet has the best effect, as this will enable improved fitness, reduced body fat and the use of resistance training will have a positive effect on muscle tissue [20]. In a study on seniors with a BMI between 28-42 kg/m² in which participants followed a reduction diet, the weight loss in the resistance training group was comparable to that of the aerobic group (mean 8.7 ± 0.7 kg vs. 8.5 ± 0.7 kg), while the resistance training group had a smaller loss of muscle tissue than the aerobic training group (decrease of 0.8 ± 0.3 kg vs. 1.6 ± 0.3 kg). It should be noted that those who trained achieved significantly greater weight reduction than the diet-only group over the 18 months of the entire intervention [21]. In a randomised controlled trial conducted at Iowa State Univeristy, where the mean age of participants was 54 years, mean BMI was 32.7 kg/m² and participants had a sedentary lifestyle, resistance training or aerobic training (e.g. running on a treadmill, stationary bike) or both were introduced for a period of 12 months. The implementation of aerobic training resulted in a significant reduction in body fat by an average of 1% and a mean weight loss of 1.3 kg (95% CI: -2.5 to -0.1; P = .04), an increase in HDL-c of 2.0 mg/dL (95% CI: 0.2 to 3.9; P = .03). There was no significant reduction in body weight in the resistance training and combined training groups, but there was a reduction in fat mass of -0.9% (95% CI: -1.4 to -0.3; P = .001) in the resistance group and -1.0% (95% CI: -1.6 to -0.5; P < .001) in the combined training group. The greatest increase in HDL-c was achieved by the combined training group- an increase of 2.3 mg/dL (95% CI: 0.5 to 4.1; P = .01). Unfortunately, there was no significant reduction in blood pressure in either group [22]. Of the rural New Hampshire residents who were 65 years and older and had a BMI >30 kg/m², implementation of a reducing diet and exercise based on resistance and aerobic training for 12 weeks resulted in a mean reduction of 4.3 ± 3.2 kg in body weight, a mean reduction of 7.6 ± 4.9 cm in waist circumference and, among other things, a statistically significant improvement in 6-minute walking distance (6MWD). In addition, participants improved their score on the Physical and Mental Health (*PROMIS*) scale, demonstrating the positive impact of the intervention on mental health and well-being [23].

Sarcopenic obesity

In a metaanalysis of the effects of different types of training among people with sarcopenia, resistance exercise showed the highest effectiveness, as it had a positive effect on muscle strength and increased muscle mass. Aerobic exercise (e.g. walking, stationary cycling) did not have such satisfactory effects on muscle tissue and muscle strength, but resulted in an overall improvement in fitness and performance [24]. In a metaanalysis of studies on seniors with obesity and concomitant sarcopenia, exercise was shown to help reduce body fat, and resistance training was the most effective in this group. In addition to the best effectiveness in reducing body fat with SMD= -0.27; 95% CI: -0.49 to -0.06; p = 0.01, resistance training significantly increased upper and lower limb strength, which was not observed with aerobic training, which mainly helped to reduce body fat [25]. Among participants with sarcopenia and a BMI ≥25 kg/m² aged 65 to 75 years, combined aerobic and resistance training had the best fat reduction effects after 8 weeks, with a mean decrease of -3.1 kg. Muscle mass increased both among those doing aerobic training and those doing both activities, which was also associated with the best effect in this aspect. Resistance training showed the best effectiveness in terms of improving muscle strength. In summary, combined training was most effective among people with sarcopenic obesity [26].

Effects on blood sugar levels

In a study carried out on a group of obese seniors to assess the effect of diet alone or diet combined with aerobic and strength training on insulin sensitivity, it was found that the group that performed a reducing diet in addition to exercise achieved significantly better results. There was a significant improvement in insulin sensitivity in the exercise group, which was not observed in the group that only followed a reducing diet. The exercise group also scored a decrease in fasting insulin levels and a significant decrease in glycated haemoglobin (HbA1c) of -0.4%. The exercise group experienced a greater loss of abdominal adipose tissue over the six months of the intervention compared to the diet-only group (-16 ± 9% vs. -3 ± 8%), clearly indicating that the implementation of exercise has a meaningful impact [27].

A metaanalysis by researchers from Peru, where the effects of aerobic exercise on the carbohydrate metabolism in older people with diabetes were analysed, showed that performing aerobic exercise resulted in lower fasting glucose levels compared to control groups with a standardised mean difference (SMD)= -1. 76; (95% CI: -2.78, -0.74; I2 = 91%) and a reduction in HbA1c levels (SMD: -0.63; 95% CI: -0.87, -0.39; I2 = 0%), indicating that aerobic exercise training has a positive effect on the carbohydrate metabolism of seniors with type II diabetes [28].

People with cardiovascular disease

Among patients with heart failure with preserved ejection fraction, interventions such as aerobic training or a weight-loss diet or a combination of both interventions were implemented for a period of 20 weeks. The modifications applied resulted in significant weight loss in all study groups. The effects of an average loss of 7±1 kg of body weight, including 5 kg of body fat and 2 kg of muscle mass, were achieved by the diet group. The aerobic training group without dietary restrictions only achieved a mean reduction of 4±1 kg, but the combination of diet and exercise led to a mean reduction of 11±1 kg. The use of both interventions was the most appropriate, as these participants achieved the greatest improvement in physical performance measured by 6- minute walking distance (6MWD) in addition to weight loss [29]. In a study on people with heart failure with preserved ejection fraction (i.e. ejection fraction (EF) ≥ 50%) who were at least 60 years old and had a BMI ≥ 28 kg/m², the addition of resisitance training to a low-calorie diet and aerobic training was shown to result in a reduction in body weight (by an average of 8kg) and an increase in muscle strength and improvement in the quality of lower limb muscle tissue (as visualised by magnetic resonance imaging, among others). Those who trained only with aerobic exercise and diet, despite a comparable decrease in body weight (average 9kg), did not achieve an increase in muscle strength, suggesting that resistance training is a beneficial intervention to achieve additional benefits [30].

Among seniors with cardiovascular diseases or metabolic syndrome, after 18 months of follow-up, those exercising - doing resistance or aerobic training - had the best weight loss (mean weight loss -10.1 kg vs. -9.9 kg). Seniors following only a diet reduced only 5.7 kg on average, showing how adding exercise to the diet increases the effectiveness of the intervention [31]. In a Spanish study involving overweight or obese older people with hypertension, different types of aerobic physical activity and a weight-loss diet were introduced. The group performing High-Intensity Interval Training (HIIT) at a frequency of 45 minutes twice a week for 12 weeks achieved the best weight loss by an average of 7% to 10%. The group performing Low-Volume HIIT, a workout similar to High-Intensity HIIT but of shorter duration, and Moderate-Intensity Continuous Training achieved worse weight loss results. The group following only a diet achieved by far the worst results. The findings indicate that short but high-intensity workouts most effectively promote weight reduction in this population [32].

Among first-degree Hypertension patients aged 55 to 75 years who were overweight or obese, a programme combining aerobic and strength training implemented for a 12-week period, in addition to reducing body weight by an average of 2.2 kg ($p < 0.01$) and lowering body fat levels by 3.5% ($p < 0.01$) including visceral fat by 12% ($p < 0$, 01), led to a significant decrease in diastolic blood pressure by a mean of 3.7 mm Hg ($p < 0.01$), a mean decrease in fasting glucose by 8% ($p < 0.01$), a mean increase in HDL-C by 3.0 mg/dL ($p < 0.01$), compared with the control group, showing the range of benefits of exercise for the hypertensive group [33]. Among older, obese men, the use of aerobic and resistance training, in addition to a significant reduction in body weight by an average of 3.1 kg and a decrease in body fat percentage by 2.7%, resulted in a decrease in systolic blood pressure (SBP) by an average of 10.4 mmHg ($p < 0.001$) and a decrease in LDL- C by an average of 10 mg/dL after 12 weeks, demonstrating that, in addition to the positive effects on weight loss and fat burning, aerobic and resistance training were good for improving the lipid profile and adequate blood pressure control [34]. A metaanalysis evaluating the effect of aerobic exercise on arterial stiffness did not show that it had a significant effect on this parameter in the obese group. Improvements in arterial elasticity were only seen among those who lost relatively more kilograms and among those who significantly lowered SBP [35].

Conclusion

Obesity is a disease that affects a very large part of the population. Overweight and obesity are serious health problems in the elderly population, leading to the development of many complications including cardiovascular diseases, diabetes, malignancies and earlier deaths. Tackling these conditions is thus very important from a public health perspective. A problem particularly affecting the senior population is sarcopenic obesity, i.e. obesity accompanied by a decrease in muscle mass and muscle function. In this group, it is very important to implement resistance training, as this is the type of activity that boosts muscles and improves muscle strength, which is extremely important in this group. Aerobic training alone is not a sufficient intervention in the course of sarcopenic obesity, but when combined with resistance training it helps to reduce body fat. Exercise has a number of metabolic benefits such as sensitising tissues to insulin, lowering fasting glucose levels and improving lipid profile. Very important in the context of the elderly is the positive effect of exercise on BMD, which can be crucial in preventing bone fractures in seniors. The implementation of aerobic and resistance exercise is important and helps to reduce body fat, but using only an exercise based intervention without an appropriate calorie deficit does not allow significant weight loss to be

achieved. Based on the studies and analyses presented, it can be concluded that the use of a low-calorie diet is essential to achieve satisfactory results and exercise has an additive effect. In the future, researchers should focus on carrying out trials among people suffering from sarcopenic obesity and searching for suitable training programmes that will allow them to reduce body fat and increase muscle mass and strength. Conducting reliable studies in this group requires additional body composition analysis. Basing it only on BMI and circumference measurements is not reliable enough. In addition, studies should be conducted on prophylactic interventions to prevent the development of sarcopenic obesity. In addition, it is important to work towards establishing universally accepted parameters for when we can speak of sarcopenic obesity, which will enable reliable research and study group selection.

In conclusion, aerobic training is effective, promotes fat reduction and has a positive effect on metabolism, but it is beneficial to include elements of resistance training as this has additional measurable benefits. Aerobic training is not as effective on muscle tissue as resistance training. Muscle stimulation among older people is important and allows them to perform better, so resistance training should not be overlooked.

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Author's contribution:

Conceptualization: Anita Ptak, Michał Szyc

Methodology: Michał Szyc, Anita Ptak

Software: Michał Szyc

Check: Anita Ptak

Formal analysis: Michał Szyc, Anita Ptak

Investigation: Michał Szyc, Anita Ptak

Resources: Michał Szyc, Anita Ptak

Writing- rough preparation: Anita Ptak, Michał Szyc

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