

Review Paper

The Effects Of Physical Activity On Obesity Among The Population Of Different Ages: A Systematic Review

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Abstract

The aim of this research is a systematic review of the available literature with the effects of physical activity (aerobic training, strength endurance training, etc.) on the obesity of the population of different ages. For collection of previous research on the impact of physical activity on motor fitness, the following electronic databases were searched: PubMed, SCIndeks, PEDro, J-GATE, SCIndes, DOAJ and Google Scholar. The works in the period from 2000 to 2019 were searched. The following keywords were used in the database search: exercise, physical activity, children, adult, aerobic training, resistance training, walking. This systematic review was conducted in agreement with the PRISMA guidelines. The results of the analyzed works indicated that only 20 works met the set selection criteria. In the analyzed works were 845 respondents. In the most researches, the training program lasted 12 weeks, while the shortest program lasted only 5 weeks. Combining endurance training with aerobic training has been shown as the most effective method in the prevention and treatment of obesity.

Keywords: BMI, Nutrition, Aerobic Training, Physical Activity, Fat Mass, Muscle Mass

Introduction

Diet and physical activity directly affect the health status of adults and children (Strong et al., 2005; Warburton, Nicol, & Bredin, 2006; Janssen & Leblanc, 2010; Petrović - Oggiano, Damjanov, Gurinović, & Glibetič, 2010; Mitić, 2001; 2011). The generally accepted scientific definition identify physical activity as „any bodily movement produced by skeletal muscles that results in energy expenditure“ (Caspersen, Powell, & Christenson, 1985). Physical activity is one of the key determinants of energy consumption and for this reason is very important for maintaining energy balance and weight control (World Health Organization, 2000; 2016).

To determine the prevalence of obesity and obesity in the population, the most commonly used estimate of nutritional levels based on body mass index (BMI - body mass index), which represents the ratio of body weight and square height. Previous research has shown that physical inactivity is negatively associ-

ated with BMI, waist circumference, and body fat percentage in both sexes (Du et al., 2013; Kaleta, Makowiec-Dabrowska, & Jegier, 2007). Physical activity increases energy consumption and thus affects the overall daily balance of energy intake and consumption. Weight gain occurs when the energy balance is positive, i.e. when energy intake is greater than consumption. (Zdravković, Banićević, & Petrović, 2009).

In children and adolescents, the definition of obesity is more complex because the total body fat content depends on the chronological age, sex and stadium of pubertal development (Leskošek, 1971). In children, due to normal changes in BMI (body mass index), specific for age and sex, percentiles are used, which are determined by entering the calculated BMI in the growth chart of body mass index specific for the sex of the respondents. At the age of 20, the value of BMI above the 85th percentile represents overnutrition, i.e. risk of obesity, from the 95th percentile is defined as obesity. Less than 5% of childhood causes of

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obesity are secondary obesity, associated with genetic disorders, endocrine diseases, lesions of the central nervous system or iatrogenic causes (Leskošek, 1971). The most significant factors that contribute to the growing obesity epidemic are physical inactivity, sedentary lifestyle and changes in diet (Štimec, 2012). Based on the aforementioned factors that contribute to the growing obesity epidemic, it can be concluded that physical activity is one of the most important factors for the prevention and treatment of obesity (Lee, Djoussé, Sesso, Wang, & Buring, 2010; Saris, 1998).

The aim of this systematic review was to gather available information on the impact of different types of physical activity on obesity depending on age and to draw a conclusion from this which physical activity gives the best results in practice.

Methods

Inclusion criteria

For an experimental study to be included in the final analysis, it had to meet certain criteria: the participant in the research were individuals suffering from obesity; the experimental study included subjects of both sexes; respondents participate in exercise programs during which its effects were evaluated and measurements taken of the parameters of body composition; the research was published in English or Serbian. The exclusion criteria included: papers not published in English or Serbian, studies in which the effect of physical activity on body composition has not been analyzed.

Search strategy

To collect previous research on the impact of physical activity on motor fitness, the following electronic databases were searched: PubMed, SCIndeks, PEDro, J-GATE, SCIndes, DOAJ

and Google Scholar. The works in the period from 2000 to 2019 were searched. The following keywords were used in the database search: exercise, physical activity, children, adult, aerobic training, resistance training, walking. The found research titles, abstracts and full texts were then read and analyzed. This systematic review was undertaken in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher et al., 2009).

Data extraction and selection

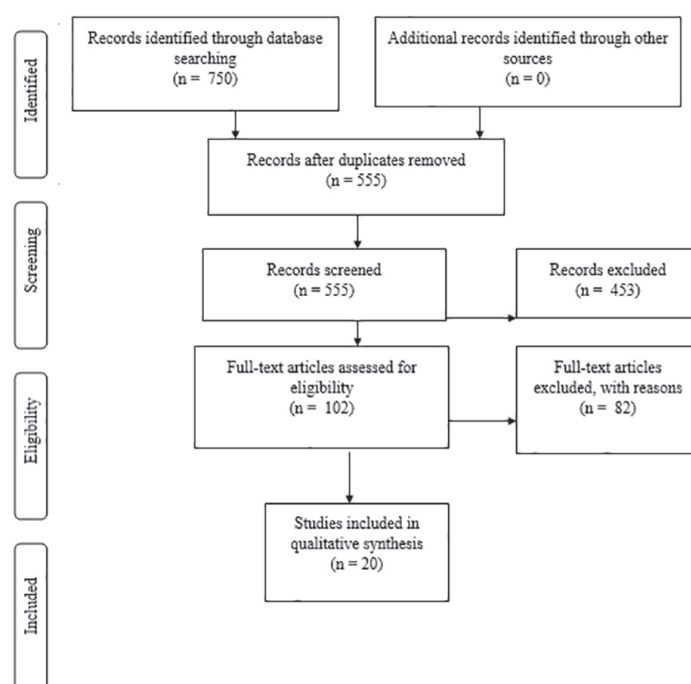
Experimental research which met the set criteria was then analyzed and presented based on the following parameters: references (the initials of the author and year of publication), the sample of participants (gender, BMI, age, overall number and subgroups of the participants), physical exercise program, the duration and frequency of exercise, research results.

Study quality and risk of bias

Risk of bias was evaluated according to the PRISMA recommendation and two independent reviewers assessed the risk of bias. When there was disagreement about the risk of bias a third reviewer checked the data and took the final decision on it.

Synthesis of results

By searching the electronic databases, 750 experimental studies were identified on the set topic. Primarily 195 studies were eliminated as duplicates, then 453 papers were rejected based on abstracts, while 82 studies were excluded because they were of the review type, or were not written in English. Applying the set criteria, the final analysis included 20 experimental studies.



GRAPH 1. Procedure of collection, analysis and elimination of found scientific research

Results

In this systematic review, overall 20 papers were analyzed. In 10 of 20 papers, the authors addressed the impact of physical activity on the treatment of obesity in children (Alberga, Farnesi, Lafleche, Legault, & Komorowski, 2013; Farris, Taylor, Williamson, & Robinson, 2011; Lee, Bacha, Hannon, Kuk, Boesch, & Arslanian, 2012; McGuigan, Tatasciore, Newton, & Pettigrew, 2009; Mendelson et al., 2015; Prado et al., 2009; Rey, Vallier, Nicol, Mercier, &

Maïano, 2017; Van der Heijden et al., 2010; Wong et al., 2008; Yu et al., 2005), while the remaining 10 papers analysed the effects of physical activity in adults obesity (Dobrosielski, Patil, Schwartz, Bandeen-Roche, & Stewart, 2015; Fogelholm, Kukkonen-Harjula, Nenonen, & Pasanen, 2000; Macura & Cirkovic, 2014; Meredith-Jones, Legge, & Jones, 2009; Mladenov, 2014; Okura, Nakata, Lee, Ohkawara, & Tanaka, 2005; S. Park, J. Park, Kwon, Kim, Yoon, & H. Park, 2003; Phillips et al., 2012; Saif & Alsenany, 2015; Skryp-

Table 1. Review of analysed researchs

Study	Respondents				Applied training program			Output data		
	Gender	Age	BMI	No of respondents	Subgroups	Program duration (weeks/days)	Duration of training (min)	Type of activity	Result	Conclusion
Alberga et al., 2013	M/F	8 - 12	/	19	EG KG	12 / 2	75	VITS	After vs before Body mass (57.6 ± 13.5 vs 59.6 ± 14.1 kg) Muscle mass (32.6 ± 6.8 vs 34.0 ± 7.0 kg)	High-intensity strength training has a positive effect on body composition, after 12 weeks of training in children aged 8 to 12 there was a decrease in body weight and BMI.
Farris et al., 2011	M/F	6 - 12	>95%	25	EG	12 / 2	60	AT + TI	Body composition was better after the program than before the program.	Aerobic training with endurance training has a positive effect on body composition.
Lee et al., 2012	M	12-18	>95%	43	KG EG1 EG2	12 / 3	60	AT TI	After the program, both experiments had a reduced body weight (aerobic training -0.004 ± 0.8 kg; endurance training -0.6 ± 0.8 kg), while body weight in the control group increased.	The obtained results indicate that both aerobic and endurance training have a positive effect on weight loss in boys aged 12 to 18 years. However, it should be noted that endurance training gives better results than aerobic training.
McGuigan, et al., 2009	M/F	9,7	25,6 ± 3,1	48		8 / 3	X	TS	After the program, the average value of the percentage of fat in the subjects decreased by 2.6%.	Strength training has a positive effect on reducing the percentage of fat in adolescents from 7 to 12 years.
Mendelson et al., 2015	M/F	14.5±1.5	≥95%	40	EG KG	12 / 2	X	AT TI	After the program in the experimental group, body weight, abdominal and visceral fat remained unchanged, while body fat decreased	The obtained results indicate that aerobic training with endurance training significantly affects only the reduction of fat, while body weight remains unchanged.
Prado et al., 2009	M/F	10±0,2	30+/-1	38	KG EG	X	X	X	After the program, all obese children reduced their body weight (p <0.05).	Based on the obtained results, it was shown that there is no statistically significant difference in children whether only diet or both diet and training were applied.

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Study	Respondents				Applied training program				Output data	
	Gender	Age	BMI	No of respondents	Subgroups	Program duration (weeks/ days)	Duration of training (min)	Type of activity	Result	Conclusion
Rey et al., 2017	M/F	14 - 15	>95%	24	EG	5	X	VIT	After the applied program, there was a reduction in body weight, body fat and BMI.	Based on the obtained results, it can be concluded that high-intensity interval training has a positive effect on weight reduction, body fat and BMI in subjects aged 14 to 15 years of both sexes.
Van der Heijden et al., 2010	M/F	15,6±0,4	33,7 ± 1,1	15	/	12 / 4	30	AT	After 12 weeks of the program, body weight, fat percentage, BMI, fat mass decreased.	The obtained results indicate that aerobic training is suitable and the correction of the body composition of obese children.
Wong et al., 2008	M/F	13-14	30,6 ± 2,1 31,8 ± 4,4	24	EG KG	12 / 2	45-60	AT + TI	After 12 weeks, the experimental group reduced their body weight, fat percentage and BMI, while muscle mass increased.	Aerobic training in combination with endurance training has a positive effect on the body composition of adolescents aged 13 to 14 years.
Yu et al., 2005	M/F	8 - 11	25,5 24,7	82	EG KG	6 / 3	75	AT TS TA	After six weeks of the program, the subjects of the experimental group had a greater increase in muscle mass compared to the control group (+0.8 kg [2.4%] vs. +0.3 kg [1.0%], p <0.05). Also, the percentage of fat in the experimental group decreased by 0.7%, while in the control group by only 0.2%.	Research has shown that strength training in children aged 8 to 11 has a better effect than dieting. After six weeks, the subjects of the experimental group had better results when it comes to the proportion of fat and muscle mass compared to the subjects of the control group.

M – male; F – female; X – no data specified; EG – experimental group; KG – control group; AT – aerobic training; TS – strength training; TA – agility training; ANT – anaerobic training; TI – endurance training; VIT – high-intensity interval training; CT – combined training; VITS – high-intensity strength training.

Table 2. Review of analysed researchs for adults

Study	Respondents				Applied training program			Output data		
	Gender	Age	BMI	No of respondents	Subgroups	Program duration (weeks/ days)	Duration of training (min)	Type of activity	Result	Conclusion
Dobrosielski et al., 2015	M/F	≥60	33.8	25	/	X	X	AT	After the applied program, there was a reduction in body weight, fat percentage and BMI.	Based on the obtained results, it can be concluded that aerobic training has a positive effect on the body composition of adults.
Fogelholm et al., 2000	F	40 - 45	30-45	80	KG EG1 EG2	40	X	Walking	After a period of 40 weeks, the control group increased its average body weight, while this value decreased in both experimental groups, with the group with lower intensity achieving a slightly better result.	The obtained results show that walking as a type of physical activity is effective for losing excess weight.
Macura & Cirkovic, 2014	F	34,2	/	9	EG	8 / 3	60-75	AT ANT	In the assessment of body composition, statistical significance was obtained in body mass, body fat, muscle mass, waist circumference and thigh circumference.	Based on the obtained results, it has been shown that the continuous training method has a positive effect on the body composition of women.
Meredith-Jones et al., 2009	F	59 ± 9	33 ± 5	18	/	12 / 3	60	KT	The results showed that when it comes to body composition, such a program had a statistically significant effect only on the ratio of waist and hips.	Based on the obtained results, it can be concluded that such a high-intensity program does not have a significant impact on reducing fat and body weight in obese people.
Mladenov, 2014	F	31,33	25.29	9	/	12 / 3	60	AT	The average value of BMI (kg / m ²) at the initial measurement was 25.29 kg / m ² while at the final measurement it was 23.97 kg / m ² .	Based on the obtained results, it can be concluded that physical aerobic activity with diet has a much better effect on body composition than diet alone.
Okura et al., 2005	F	21 - 66	>25	209	EK KG	14	X	AT	A statistically significant difference appeared only in the respondents who were in the group that applied a program of aerobic exercises in addition to the diet. Significantly decreased body weight, body mass index, fat percentage, total adipose tissue mass.	Based on the obtained results, it can be concluded that physical aerobic activity with diet has a much better effect on body composition than diet alone.

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Study	Respondents				Applied training program			Output data		
	Gender	Age	BMI	No of respondents	Subgroups	Program duration (weeks/ days)	Duration of training (min)	Type of activity	Result	Conclusion
Park et al., 2003	F	40 - 45	25,56±0,86 25,3 ± 1,74 25,8 ± 1,43	30	KG EG1 EG2	24 / 6	60	AT AT + TI	After 24 weeks, the following results were obtained Body mass: KG +0.6; AT -4.7; CT -6.4 Fat percentage: KG +2.3; AT -9.2; CT -10.3 Muscle mass: KG -0.4; AT +0.9; CT + 5.6	Based on the obtained results, it can be concluded that both combined and aerobic training have a positive effect on body composition. There is no statistically significant difference between the groups that applied aerobic and combined training, but it can be noticed that the subjects who applied combined training achieved better results than the subjects who applied only aerobic training.
Phillips et al. 2012	F	65±2,6	33	23	EG KG	12 / 3	X	TS	After the applied program in the experimental group, there was a decrease in body weight, the percentage of BMI fat.	Based on the obtained data, it can be concluded that strength training has a positive effect on body composition.
Saif & Alsenany, 2015	M/F	18 - 25	36,45±3,36	40	A B	12 / 3		AT ANT	After the program was applied, both groups reduced their average BMI.	The obtained results showed that both aerobic and anaerobic activity for adults aged 18 to 25 years have a positive effect on BMI reduction.
Skrypnik et al., 2015	F	18 - 56	35,23 ± 3,9 34,9 ± 3,8	44	A B	12 / 3	60	TI TI + TS	In both groups, there was a significant reduction in body weight, body mass index and adipose tissue after the program. However, in group B there was a significant increase in muscle mass and the mass of non-fat components.	Both physical activities have a positive effect on the body composition of women, but it was also concluded that strength training has a positive effect on increasing muscle mass and non-fat components.

M – male; F – female; X – no data specified; EG – experimental group; KG – control group; AT – aerobic training; TS – strength training; TA – agility training; ANT – anaerobic training; TI – endurance training; VT – high-intensity interval training; CT – combined training; VITS – high-intensity strength training.

nik et al., 2015). There were 845 participants overall, where 358 were children and 487 were adults. Lee et al., (2012) was only study with male participants, boys aged 12 to 18 years. In 11 of the 20 papers, subjects were of both sexes (Alberga et al., 2013; Dobrosielski et al., 2015; Farris et al., 2011; McGuigan et al., 2009; Mendelson et al., 2015; Prado et al., 2009; Rey et al., 2017; Saif & Alsenany, 2015; Van der Heijden et al., 2010; Wong et al., 2008; Yu et al., 2005). In the eight papers, the participants were only women (Fogelholm et al., 2000; Macura & Cirkovic, 2014; Meredith-Jones et al., 2009; Mladenov, 2014; Okura et al., 2005; Park et al., 2003; Phillips et al., 2012; Skrypnik et al., 2015), while in remaining one paper, the participant were only men (Lee et al., 2012). In most papers, the training program lasted 12 weeks (Alberga et al., 2013; Farris et al., 2011; Lee et al., 2012; Mendelson et al., 2015; Meredith-Jones et al., 2009; Mladenov, 2014; Phillips et al., 2012; Saif & Alsenany, 2015; Skrypnik et al., 2015; Van der Heijden et al., 2010; Wong et al., 2008), the shortest program lasted only five weeks (Rey et al., 2017).

As far as physical activities are concerned, aerobic training program was the most used training program in this systematic review, 10 of 20 papers. There were obese children in four studies (Lee et al., 2012; Mendelson et al., 2015; Van der Heijden et al., 2010; Yu et al., 2005) and adults in six (Dobrosielski et al., 2015; Macura & Cirkovic, 2014; Mladenov, 2014; Okura et al., 2005; Park et al., 2003; Saif & Alsenany, 2015). In most of already mentioned papers, BMI was decreased the most (Dobrosielski et al., 2015; Mladenov, 2014; Okura et al., 2005; Saif & Alsenany, 2015; Van der Heijden et al., 2010). Second most used training program was the combination of aerobic training and endurance training program. Farris et al., (2011) and Wong et al., (2008) had children population, while Park et al., (2003) had adults and this training program decreased body weight and BMI, which resulted increasing muscle mass, in both children and adults. Only one paper (Alberga et al., 2013) applied high intensity interval training, which resulted reduction in body mass, muscle mass and BMI, while Fogelholm et al. (2000) applied walking program, which resulted better results in treatment of obesity in diet group. Macura & Cirkovic (2014) applied anaerobic training program, resulting correction of all measured body composition variables (body fat, body mass, muscle mass, waist and thigh circumference), while McGuigan, et al. (2009) used strength training as physical exercise program, which resulted body fat reduction.

Discussion

This analysis of previous experimental work provides an opportunity to see which types of physical activities are used to combat obesity. Certainly the most common type of program that was applied was the aerobic type of training. However, it is not the most effective type. Aerobic training in combination with endurance training proved to be the most effective type of training (Farris et al., 2011; Park et al., 2003; Meredith-Jones et al., 2009). It's a training method that lasts from 20 to 60 minutes, with low-intensity exercises and a heart rate zone of 50 to 75%. During such training, fats are mostly used as energy sources, which affects the reduction of body fat. However, such training can lead to a decrease in muscle mass, so it is combined with endurance training, which affects the increase in muscle mass (Rey et al., 2017).

The second most effective in combating obesity would be aerobic training alone. Aerobic physical activity is of low intensity and longer duration and as such provides energy without the appearance of lactic acids. Although this type had positive effect on weight loss, fat percentage and BMI, this phenomenon can lead to a decrease in muscle mass or a significantly smaller increase in muscle mass compared to other physical activity (Park et al., 2003).

And as the least effective types of training we are left with the

remaining types such as strength training, endurance training, anaerobic training, high-intensity interval training. In all these studies, it was shown that they had a positive effect on reducing the fat percentage. However, these types of trainings are short, so the mechanism of using fat as an energy source is not activated, and primarily for these trainings is an increase in muscle mass, which is the reason for reducing the percentage of fat in the body. More precisely, the mass of adipose tissue itself changes very little, almost not at all (Meredith-Jones et al., 2009; Saif & Alsenany, 2015; Skrypnik et al., 2015). Based on the obtained results of previous research, it can be concluded that physical activities have a positive effect on obesity regardless of the age of the respondents. All types of training are used for both children and adults.

Acknowledgments

There are no acknowledgements.

Conflict of Interest

The authors declare that there is no conflict of interest.

Received: 21 December 2020 | **Accepted:** 03 February 2021 | **Published:** 16 July 2021

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