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Paper review ***Pregledni rad***

Evaluating the Influence of Aerobic Exercise on Body Composition in Adolescents: A Systematic Review

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Abstract: *Aerobic exercise is beneficial for adolescents, according to studies. There is still little precise data, though, for young people and adolescents. This study's objective was to thoroughly examine and compile the most recent data regarding how aerobic exercise impacts adolescents' body composition. Google Scholar, PubMed, Mendeley, Web of Science, SCIndeks, Science Direct, and KOBSON databases were searched to find relevant information. Studies published between 2011 and April 2026, longitudinal design, English language, participants between the ages of 10 and 20, and results pertaining to body composition were the inclusion criteria. Sixteen papers in all satisfied the eligibility criteria and were incorporated into the final analysis. The results consistently show that aerobic exercise improves pupils' body composition. These findings contribute to a better understanding of the impact of aerobic exercise in modifying body composition among student populations and offer a helpful platform for future research.*
Keywords: *aerobic exercise, body composition, children, physical activity*

Introduction

One of the biggest health issues facing the world today is youth physical inactivity and its growing correlation with conditions like diabetes and obesity (Kljaljević et al. 2021). Concerns regarding children's health, daily routines, and physical exercise have grown as a result of these findings. The rise in childhood obesity seems to be influenced by how kids use their leisure time (Stellino, Sinclair, Partridge, & King, 2010). Based on this scientific fact, some authors believe that children spend most of their free time sitting in front of the television or computer (Jovanović et al. 2025, Bener et al. 2011; Hills, Katanić et al. 2024). Additionally, we belong in a bizarre circumstance where developments and technologies undoubtedly make it easier and faster for man to accomplish a variety of jobs while consuming less energy. The risk may increase further if no intervention is implemented during childhood (Jovanović et al. 2024).

Compared to individuals who simply depend on a decreased diet, those who engage in physical activity are far more likely to maintain or lose body mass over an extended period of time. However, a healthy lifestyle is also necessary to maintain body composition (Kljaljević et al. 2021). Through balancing body composition, physical activity influences the decrease in body mass. Nevertheless, when combined with a planned dietary regimen, this can be the optimal combination for body composition adjustment (Nieman et al. 2002). There is a 10% rise in the risk of cardiovascular diseases if the waist circumference rises by 1 cm. This is because a large amount of fat tissue is a risk factor for a number of ailments (Milanović, Sporiš, Pantelić, Trajković, & Aleksandrović, 2012). Adults with long-term established obesity typically do not respond well to treatment. Given the concerning rise in children's physical inactivity, early intervention is crucial to preventing negative outcomes in later stages of life (Malina, 2007), because prevention, particularly the prevention of obesity, is a means to reduce dangers to their health.

Numerous aerobic fitness programs and their advantages might provide a solution for kids and even teenagers (Centers for Disease Control. Prevention, 2007; Danaei et al. 2009; Jovanović et al. 2024; Jovanovic et al. 2025; Reed, Maslow, Long, & Hughey, 2013). Over time, aerobic exercise training limits risk accumulation in addition to lowering cardiovascular risk (Špirtović et al. 2025). Increased physical activity and dietary adjustment and modification are already components of obesity treatments approaches. Walking, jogging, dancing, and cycling are some of the fundamental aerobic exercise programs that are typically performed three to five times a week at moderate to submaximal intensity. According to Kelley & Kelley (2008), these are fairly satisfactory exercise opportunities for

students. Kostić (2009) states that alterations in students' body composition, which lead to obesity, are regarded as one of the most significant public health issues of the modern era. Because of this, it's critical to keep an eye on their energy consumption and physical activity levels.

In light of the existing research, there is a need to systematically evaluate the effects of aerobic exercise on adolescents' body composition. While studies have examined physical activity and dietary interventions, the evidence is often fragmented, short-term, or population-specific (overweight or obese participants). A clear research gap exists regarding long-term, structured aerobic programs in adolescents' populations, as well as their isolated effects on body composition, with limited consideration of exercise intensity, frequency, and interaction with lifestyle factors. Addressing this gap can inform evidence-based strategies for improving young people health. Therefore, the aim of this study was to evaluate the influence of aerobic exercise on body composition in adolescents.

Methods

Literature Identification

A comprehensive systematic literature search of relevant databases was conducted in February 2026 to identify studies meeting the predefined eligibility criteria. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) criteria were followed in the identification, screening, and analysis of the studies. Relevant literature was gathered from the following databases: Google Scholar, MEDLINE, Web of Science, SCOPUS, SCIndeks, Science Direct, and KOBSON. The research comprised studies published between 2011 and April 2026.

The following keywords served as a basis for the search strategy: ("aerobic exercise" OR "aerobic training" OR "physical activity") AND ("body composition" OR "fat mass" OR "BMI") AND ("children" OR "youth" OR "students" OR "adolescents" OR "university students").

The collected data was analyzed using a descriptive approach, and all abstracts and titles were examined for possible inclusion. To improve sensitivity and guarantee thorough coverage of pertinent studies, the search approach was modified for every database. Studies that satisfied the predetermined inclusion criteria were deemed eligible.

Data Extraction, Quality Evaluation, and Study Selection

Data extraction, quality evaluation, and study selection were all done separately. To guarantee completeness, reference lists of previously discovered papers and pertinent reviews were also reviewed. Based on the predetermined criteria, every identified study was further assessed and either included in the final analysis or eliminated.

Inclusion Criteria

Abstracts and whole papers from searches were examined. The following requirements have to be fulfilled for publications to be considered for inclusion in the final stage of analysis:

- Publications published between 2011 and 2026 were searched for;
- Experimental studies
- English-language longitudinal research;
- Participant sample: males and females, ages 10 to 20;
- Description of outcomes obtained: The effects of aerobic exercise on students' body composition were the main findings for the systematic review.

The collected data was analyzed using a descriptive technique. For possible papers to be included in the systematic review, all abstracts and titles were evaluated.

Lists of references from earlier reviews and original studies were also examined. After a thorough assessment, pertinent studies that satisfied the inclusion criteria were found:

Exclusion Criteria

- Research published in a language other than English;
- Duplications;
- Research with individuals younger than 10 years old
- Research with individuals older than 20 years old.

In order to improve the sensitivity of the search, the search method was adjusted and tailored to each database and search, whenever feasible.

Risk of Bias

The PEDro scale was used to evaluate the included studies' methodological quality and risk of bias in compliance with PRISMA recommendations. Standardized checklists were used by two independent reviewers to assess each study. Inter-rater reliability analysis was used to assess reviewers' agreement. A third reviewer was consulted when there was dispute in order to make a final conclusion. The reviewers' assessments of study quality and bias risk were consistent, as evidenced by the high degree of overall agreement.

Data Extraction

After the cross-examination procedure, pertinent information was taken from studies that qualified and methodically arranged in an Excel spreadsheet. The Cochrane Consumer and Communication Review Group standards served as the basis for a standardized data extraction process. The study's authors, year of publication, sample size, participants' ages, kind of exercise intervention, program duration and frequency, and primary study outcomes were among the details that were retrieved.

Results

Quality of the Studies

The final study assessment scores were determined by dividing the total number of studies that were included in the quantitative synthesis by the points each research received on the PEDro scale. Maher et al. state that an ideal score is between 8 and 11; however, if a study receives between 0 and 3 points, it will be categorized as "poor," "fair," "good," and "excellent." Table 1 shows that out of all the studies that were part of this systematic review, two had acceptable quality, seventeen had good quality, and the other two had excellent quality of the studies. The average score of all studies is 5.8, which means good quality.

Table 1. *Pedro scale results*

	Criterion											
Study	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**∑**
Zorba et al. (2011)	Y	N	N	Y	N	N	N	Y	N	Y	Y	5
Martins et al. (2011)	Y	N	N	Y	N	N	N	Y	N	Y	Y	5
Sijie et al. (2012)	Y	Y	N	Y	N	N	N	Y	N	Y	Y	6
Reed et al. (2013)	Y	Y	N	Y	N	N	N	Y	N	Y	Y	6
Regaieg et al. (2013)	Y	Y	N	Y	N	N	N	Y	N	Y	Y	6
Barker et al. (2014)	Y	Y	N	Y	N	N	N	Y	N	Y	Y	6
Silva et al. (2014)	Y	Y	N	Y	N	N	N	Y	N	Y	Y	6
Lee et al. (2014)	Y	Y	N	Y	N	N	N	Y	N	Y	Y	6
Sigal et al. (2014)	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	7
Arazi et al. (2016)	Y	Y	N	Y	N	N	N	Y	N	Y	Y	6
Yoon et al. (2017)	Y	Y	N	Y	N	N	N	Y	N	Y	Y	6
Gholinejad et al. (2019)	Y	N	N	Y	N	N	N	Y	N	Y	Y	5
Lan et al. (2022)	Y	Y	N	Y	N	N	N	Y	N	Y	Y	6
Ma et al. (2023)	Y	Y	N	Y	N	N	N	N	N	Y	Y	5
Jovanovic et al. (2024)	Y	Y	N	Y	N	N	N	Y	N	Y	Y	6
Jovanovic et al. (2025)	Y	Y	N	Y	N	N	N	Y	N	Y	Y	6

Legend: *1—eligibility criteria; 2—random allocation; 3—concealed allocation; 4—baseline comparability; 5—blind subject; 6—blind clinician; 7—blind assessor; 8—adequate follow-up; 9—intention-to-treat analysis; 10—statistical analysis; 11—point estimates and variability; Y—criterion is satisfied; N—criterion is not satisfied; ∑—total awarded points.*

Selection and Characteristics of Studies

The PRISMA guidelines were followed during the study selection procedure. Through database searching, 2140 records were found. 1086 records were eliminated because they did not fit the inclusion criteria after duplicates were eliminated and titles and abstracts were screened. 124 research were eliminated because the subjects did not fit the

necessary age requirements, while another 27 studies were eliminated because of linguistic limitations. After the eligibility of the remaining full-text publications was evaluated, 16 studies in all satisfied the predetermined requirements and were added to the final systematic review. The PRISMA flow diagram (Diagram 1) shows the specific steps involved in choosing a study.

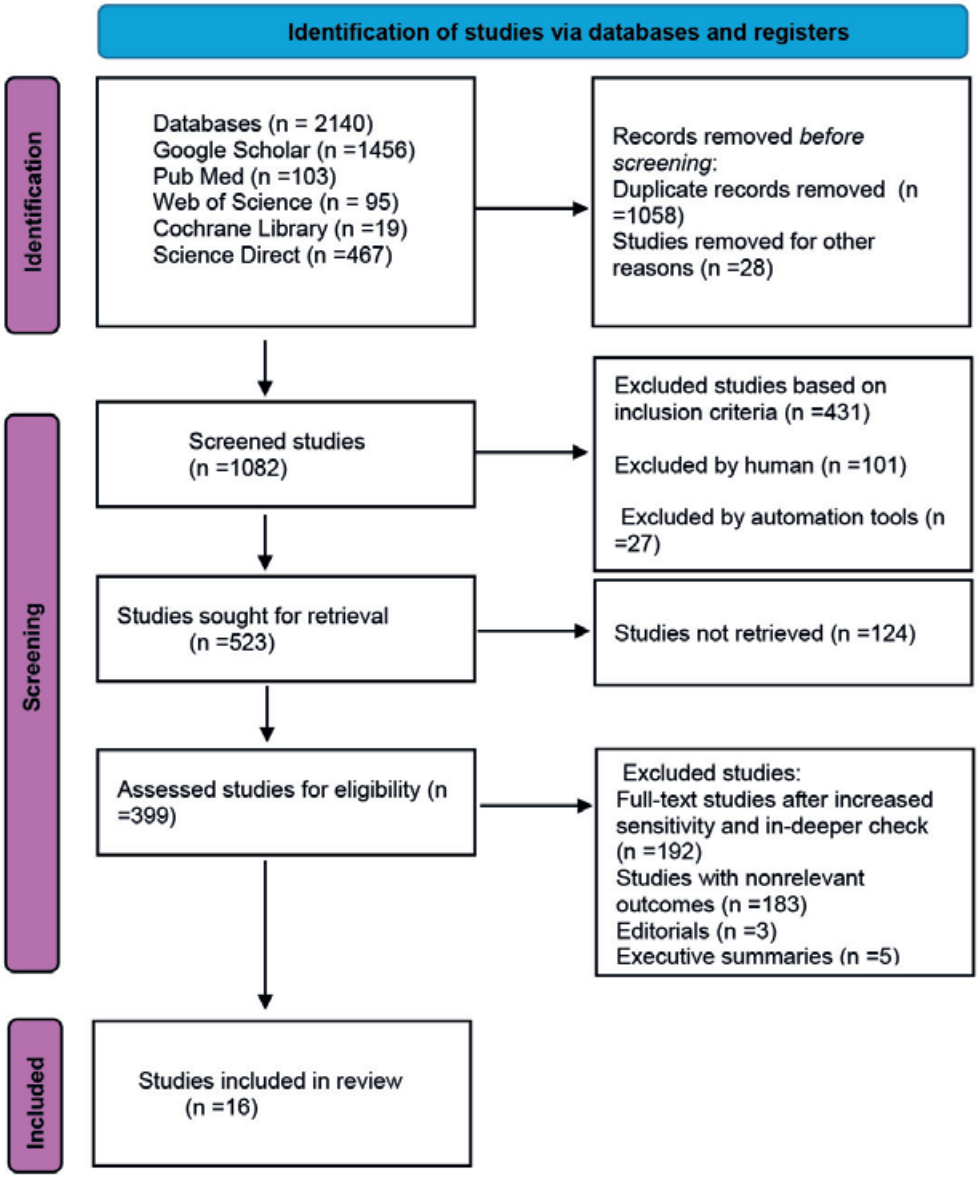

Figure 1. *Presentation of the process of collecting adequate works based on pre-defined criteria*

Table 1. *show in more detail the studies that met the set conditions and entered the qualitative analysis*

First Author and Year of Publication	Aim of study	Sample of Participants		Exercise program	Outcomes	Results
		Number	Age			
Zorba et al. (2011)	Effects of 12-week aerobic training on BP, CV and insulin levels	N-40 E-20 C-20	11±1	3 times a week, 20-45 min.	AV, KV	E group significantly reduced body weight, BMI and AV
Martins et al. (2011)	Effects of an 8-week physical activity program on TK and FF	F-16 E-8 C-8	E-12.3±0.9 K-13.2±1.1	3 times a week, 30 and 45 min.	FG, AV, TK, FF, BE, T, Ks	The program gives positive effects
Sijie et al. (2012)	Effects of 12-week HIIT on BP, cardiac and aerobic function	F-60	19-20	5 times a week, 30-40 min.	HIIT, MICT, VO_2max	The high- and medium-intensity group reduced BP, with a significant improvement in VO2max

Reed et al. (2013)	Effects of 12-week physical activity on KS, motor skills and TK	N-470 E-165 C-305	E-10.2±2.3 K-11.2±1.9	5 times a week, 45-50 min.	KS, FG, TK	The program gives positive effects to group E, the girls showed significant results in all variables
Regaieg et al. (2013)	Effects of a 16-week physical activity program on BP and aerobic capacity	N-28 M-16 F-12	12-14	16 weeks, 4 times a week, 60 min.	AV, TK, BE, Kt, Ks	E group corrected BMI, waist circumference, fat and lean fat
Barker et al. (2014)	Effect of 2-week HIIT on aerobic fitness, fat oxidation, blood pressure and BMI	M-10	14-16	6 times a week.	HIIT, AV, TK, VO_2max, BE	The program did not significantly affect body mass and BMI
Silva et al. (2014)	Effects of a 12-week aerobic exercise program on BP and CV	N-14 E-9 C-7	13-17	3x a week	AV, BMI, KN, TK, KV, BE	Significant improvement of KN, reduction of %M and fats of group E
Lee et al. (2014)	Effects of a 22-week swimming program on BP and pulmonary flow	N-20 E-10 C-10	E-11.4±2.87 K-11.1±1.69	30-40 min.	TK, AV, FF	The program had a positive effect on the reduction of TK and %M
Sigal et al. (2014)	Effects of 22-week of aerobic exercise and training endurance, as well as combined training on the percentage of body mass	N-304 E_1-75 E_2-78 E_3-75 C-76	14-18	3 times a week, 60 min.	TK, AV, VO_{2peak}, T, FF	All types of training significantly corrected %M and waist circumference
Arazi et al. (2016)	Effects of 8-week and comparison of 2 aerobic training methods	N-33 E_1-12 E_2-11 C-10	11.2±0.64	4 times a week	TK, KN, FF VO_2max	Training with a screw significantly influenced the correction of TK and aerobic strength
Yoon et al. (2017)	Effects of 16-week cycling on TK, FF and KV	F-24 E_1-12 E_2-12	E_1-13.3±0.4 E_2-13.4±0.3	3 times a week, 30-60 min.	BE, TK, KV, FF, KV	Achieved positive effects on TK and FF
Gholinejad et al. (2019)	Effect of a 4-week aerobic training course on lower body muscle strength	F-42 I-21 C-21	E_1-12.71±0.9 E_2-12.24±1.29	3 times per week, 45 min	BMI, TBW, SMM, BFO, MBF, SLM	No significant effect on the body composition
Lan et al. (2022)	Effects of 8-week of three exercise programs on CRF and body composition indicators	N-40 LICT-13 MICT-13 HIIT-12 C-12	19.85 ± 1.46 20.77 ± 1.96 21.33 ± 2.54 20.42 ± 1.93	3 times per week, 45 min.	BMI, BFP, FM, MM, VFA, SMM, LBM, WTHR	Decrease in BFP in all E groups. The FM and VFA reduced significantly with a MM growth in the LICTBFR and MICT
Ma et al. (2023)	Effect of 6-week aerobic exercise on body morphology in obese university students.	N-60 E-30 C-30	18-19	4 times a week, 60 min	BW, BMI, BFR, THR, WHR, ULFR, LL, OFR	Reduce of body weight, BMI, BFR and body circumference decrease body weight
Jovanovic et al. (2024)	Impact of HIIT on health-related fitness in adolescents	N-60 HIIT-30 C-30	16.33 ± 0.62	2 times a week, 45 min	BH, BW, BMI	No significant differences between groups for body composition
Jovanovic et al. (2025)	Effect of 12-week HIIT training on body composition and fitness in female adolescents	N-40 EG-20 CG-20	EG-16.44±0.68 CG-16.73±0.62	HIIT warm-up 10 min	BH, BW, BMI, BF%	EG showed a significant reduction in all weight-related parameters

Legend: *N- total number of subjects, M- male gender, F- female gender, E- experimental group, K- control group, TK- body composition, AV- anthropometric variables, CMJ- vertical jump, SJ- squat jump, MTo- manual resistance training, MTo+Ti- manual resistance training+endurance training, BMI- body mass index, KN- skin folds, HIIT- high intensity interval training, MICT- moderate intensity training, KS-cognitive abilities, VO2max- maximum oxygen consumption, KV- blood variables, VO2peak- oxygen volume during active work, BE- bicycle ergometer, T- treadmill, U- questionnaire, D- diet, Sp- sports program, FF- physical fitness, Ks- team sports, FG- Fitnessgram, Kt- circuit training, %M- fat percentage, TBW: Total Body Water; SMM: Skeletal Muscle Mass; BFO: Body Fat Optimal; MBF: Mass of Body Fat; SLM: Soft; LICT-BFR- low-intensity continuous training with blood flow restriction; MICT- moderate-intensity continuous training; HIIT- high intensity interval training; ULFR-Upper limb fat ratio- OFR- Overall fat ratio; Subjects' age values are shown as Mean±SD*

A total of 1261 participants participated in the studie, the largest number of them was in the study by Reed et al. (2013), with 470 participants, while the smallest number of participants was in the study by Barker et al. (2014), with 10 participants. The youngest subject was 10.2±2.3 years in experimental and 11.2±1.9 in control group, in the study

by Reed et al. (2013), while the oldest respondent was 20 years old, in the study by Sijie et al. (2012).

A detailed description of the process of collecting adequate works based on pre-defined criteria can be found in diagram 1.

Discussion

The aim of this research was to summarize the relevant literature on the influence of aerobic exercise on body composition in adolescents. The experimental program's duration should be suitable and tailored to the student body. Specifically, a two-week research by Barker et al. (2014) found no significant impacts. However, an 18-week trial (Dorgo et al., 2009) did not demonstrate any beneficial effects either, despite the authors' consideration of the possibility that they would increase the subjects' physical fitness. According to Kessler, Sisson, and Short (2012), a modified duration of the experimental program—at least 12 weeks for adolescent students—is required if we wish to achieve a positive effect on body composition. Longer protocols seem to be required for quantifiable adaptations, while short-term interventions (less than 12 weeks) typically fail to elicit significant changes in body composition (Martínez-Gómez, & Roberts, 2022).

A clear and noticeable improvement in physical fitness was insufficient to cause positive changes in body composition. High-intensity interval training (HIIT), moderate-intensity continuous training (MICT), and low-intensity continuous training with blood flow restriction (LICT-BFR) were compared in a recent randomized study conducted on college students by Lan et al. (2020). While all exercise regimens increased cardiorespiratory fitness, LICT-BFR and MICT were especially successful in increasing muscle mass and decreasing fat mass, underscoring the significance of exercise intensity and modality in determining body composition results.

Calorie intake was only tracked in two investigations (Lan et al. 2020; Sigal et al., 2014). All of the aforementioned studies showed favourable impacts on body composition, despite the fact that their training methods varied.

One of the key factors is the identification of the representative group of participants; in particular, we are discussing a healthy population and the promotion of such works and their caliber. A healthy population sample was used in six research (Barker et al., 2014; Reed et al., 2014; Arazi et al., 2016; Yoon et al., 2017, Jovanovic et al. 2024; Jovanovic et al. 2025). In order to improve students' health, it is crucial that both the non-obese and the obese population be faced with physical exercise and an active lifestyle, regular physical education sessions, a variety of school games and exercises for skill development, as well as numerous recreational and fitness activities (Dorgo et al., 2009).

Aerobic exercise was used in numerous research (Zorba et al., 2011; Barker et al., 2014; Silva et al., 2014; Arazi et al., 2016; Yoon et al., 2017). For example, Gholinejad et al. (2018) showed that, in comparison to a control group, an 8-week aerobic program considerably improved body composition and muscle strength in female elementary students. Their results, despite being non-randomized and quasi-experimental, confirm the beneficial effects of organized aerobic exercise in increasing lean mass and decreasing fat mass in young people. Long-term increases in aerobic capacity, which would dramatically alter body fat, should be pursued since inadequate aerobic capacity can be a prediction of death (Watts, Jones, Davis, & Green, 2005). Furthermore, compared to a control group, high-intensity interval training (HIIT) dramatically increased physical fitness and decreased body fat percentage in a recent Brazilian study on obese college students (2021). These findings support the efficacy of structured aerobic regimens and high-intensity interval training (HIIT) in young adults. Additionally, aerobic exercise improves body composition by lowering BMI and fat percentage (Ounis et al., 2008). It also strengthens muscles, increases bone mass, maintains oxygen intake, lowers the risk of cardiovascular diseases, lowers stress, and boosts self-confidence (Ekeland, Heian, & Hagen, 2005; Mota-Pereira et al., 2011). Because poor health outcomes at this age can be mirrored in later life, Cattuzzo et al. (2016) identified particularly relevant indicators for the development of students' body composition and physical fitness.

The efficacy of HIIT in physical education contexts is further supported by the latest school-based experiment. In a research by Jovanović et al. (2025), adolescent girls who participated in a 12-week HIIT warm-up program during normal physical education sessions showed notable increases in physical fitness metrics and body composition (body mass, BMI, and body fat). However, no significant differences were seen between the experimental and control groups, which is consistent with some earlier observations. Increased fat oxidation, enhanced mitochondrial efficiency, and hormonal changes during adolescence are examples of physiological adaptations that may account for why improvements in aerobic fitness do not always result in appreciable changes in body composition. Inadequate energy imbalance and continued biological maturation in adolescent populations could account for the lack of notable

alterations in body composition (Papadopoulou, Feidantsis, Hassapidou, & Methenitis, 2021). The aforementioned findings are in line with another recent investigation (Jovanovic et al. 2024; Jovanovic et al. 2025) that looked at the impact of high-intensity interval training in schools on teenagers and found that while body composition changed little or not at all, cardiorespiratory fitness improved significantly. All of these findings suggest that although HIIT is a useful and effective method for enhancing physical fitness in educational environments, its independent effects on body composition may be less noticeable, particularly in groups that are physically active and non-obese.

Aerobic and resistance training were combined in four different trials (Martins et al., 2011; Regaigeg et al., 2013; Reed et al., 2014; Sigal et al., 2014). Combining these two forms of exercise has several advantages, including enhanced cardiorespiratory fitness and metabolic capacity (McArdle, Katch, & Katch, 2001), as well as measurable modifications to skeletal muscles and increased muscle strength (Kraus & Levine, 2007).

Despite the positive results, several limitations should be considered. First, the conclusions' generalizability was limited by the small sample sizes of many of the included research. Second, direct comparisons are difficult because to variations in exercise modes, duration, and intensity between research. Third, bias may have been introduced by certain studies' lack of blinding or randomization. Furthermore, there was inconsistent control over dietary intake and lifestyle factors, which may have an impact on body composition results. Lastly, the majority of research concentrated on short- to medium-term interventions, and it is yet unknown how aerobic exercise will affect students' body composition in the long run.

In general, adolescents benefit from aerobic exercise in terms of their physical fitness and body composition. Particularly when paired with moderate- to high-intensity protocols, interventions lasting at least 12 weeks seem to be more successful. HIIT, MICT, and LICT-BFR are examples of structured aerobic programs that regularly increase lean muscle growth and decrease fat mass, improving general health and body composition. Larger sample numbers, longer follow-up times, and strict methodological designs should be the goals of future studies in order to bolster the body of data and direct the best exercise recommendations for students.

References

Arazi, H., Jalali-Fard, A., & Abdinejad, H. (2016). A comparison of two aerobic training methods (running vs rope jumping) on health-related physical fitness in 10 to 12 years old boys. *Physical Activity Review*, *4*, 9-17.

Barker, A. R., Day, J., Smith, A., Bond, B., & Williams, C. A. (2014). The influence of 2 weeks of low-volume high-intensity interval training on health outcomes in adolescent boys. *Journal of sports sciences*, *32*(8), 757-765.

Bener, A., Al-Mahdi, H. S., Ali, A. I., Al-Nufal, M., Vachhani, P. J., & Tewfik, I. (2011). Obesity and low vision as a result of excessive Internet use and television viewing. *International Journal of Food Sciences and Nutrition, 62*(3), 60-62.

Cattuzzo, M. T., dos Santos Henrique, R., Ré, A. H. N., de Oliveira, I. S., Melo, B. M., de Sousa Moura, M., ... & Stodden, D. (2016). Motor competence and health related physical fitness in youth: A systematic review. *Journal of science and medicine in sport*, *19*(2), 123-129.

Centers for Disease Control. Prevention. 2007 *Youth Risk Behavior Survey.*

Danaei, G., Ding, E. L., Mozaffarian, D., Taylor, B., Rehm, J., Murray, C. J., & Ezzati, M. (2009). The preventable causes of death in the United States: comparative risk assessment of dietary, lifestyle, and metabolic risk factors. *PLoS Med*, *6*(4), e1000058.

Đorđić, V. (2006). Roditelji i fizička aktivnost decepredškolskog i mlađeg školskog uzrasta. U: G. Bala (ur.), *Antropološki status i fizička aktivnost dece i omladine*(127-134). Novi Sad: Fakultet sporta i fizičkog vaspitanja. [in Serbian]

Dorgo, S., King, G. A., Candelaria, N., Bader, J. O., Brickey, G. D., & Adams, C. E. (2009). The effects of manual resistance training on fitness in adolescents. *Journal of strength and conditioning research/National Strength & Conditioning Association*, *23*(8), 2287.

Ekeland, E., Heian, F., & Hagen, K. B. (2005). Can exercise improve self esteem in children and young people? A systematic review of randomised controlled trials. *British journal of sports medicine*, *39*(11), 792-798.

Hills, A. P., Obkely, A. D. & Baur, L. A. (2010). Addressing childhood obesity through increased physical activity. *Nature Reviews Endocrinology, 6*(10), 543-549.

Jin, M. (2022). Effects of aerobic exercise on body morphology in obese university students. *Revista Brasileira de Medicina do Esporte*, 29, e2022_0221.

Jovanović, R., Živković, M., Stanković, M., Zoretić, D., & Trajković, N. (2024). Effects of school-based high-intensity interval training on health-related fitness in adolescents. *Frontiers in physiology,* 15, 1487572.

Jovanović, R., Katanić, B., Trajković, N., Đorđević, D., & Stanković, M. (2025). School-Based High Intensity Interval Warm-Up Has Positive Effects on Physical Fitness in Adolescent Girls. *Journal of School Health,* 95(10), 855-863.

Katanic, B., Bjelica, D., Stankovic, M., Vukovic, J., Milosevic, Z., Đorđević, D., & Curic, M. (2024). Association of Weight Status with Geographic Region, Residential Status and Sex of 8th Grade School Children: The Prevalence of Overweight and Obesity in Montenegro. *Sport Mont,* 22(3), 55-60.

Kostić, R. (2009). Bazične fitnes komponente. Niš: Fakultet sporta i fizičkog vaspitanja. [in Serbian]

Kljajević, V., Stanković, M., Đorđević, D., Trkulja-Petković, D., Jovanović, R., Plazibat, K., ... & Sporiš, G. (2021). Physical activity and physical fitness among university students—A systematic review. *International journal of environmental research and public health*, 19(1), 158.

Kelley, G. A., & Kelley, K. S. (2008). Effects of Aerobic Exercise on Non–High-Density Lipoprotein Cholesterol in Children and Adolescents: A

Meta-Analysis of Randomized Controlled Trials. *Progress in cardiovascular nursing*, *23*(3), 128-132.

Kessler, H. S., Sisson, S. B., & Short, K. R. (2012). The potential for high-intensity interval training to reduce cardiometabolic disease risk. *Sports medicine*, *42*(6), 489-509.

Klijn, P. H., van der Baan-Slootweg, O. H., & van Stel, H. F. (2007). Aerobic exercise in adolescents with obesity: preliminary evaluation of a modular training program and the modified shuttle test. *BMC pediatrics*, *7*(1), 19.

Knöpfli, B. H., Radtke, T., Lehmann, M., Schätzle, B., Eisenblätter, J., Gachnang, A., ... & Brooks-Wildhaber, J. (2008). Effects of a multidisciplinary inpatient intervention on body composition, aerobic fitness, and quality of life in severely obese girls and boys. *Journal of Adolescent Health*, *42*(2), 119-127.

Kraus, W. E., & Levine, B. D. (2007). Exercise training for diabetes: the "strength" of the evidence. *Annals of internal medicine*, *147*(6), 423-424.

Lan, C., Liu, Y., & Wang, Y. (2022). Effects of different exercise programs on cardiorespiratory fitness and body composition in college students. *Journal of Exercise Science & Fitness*, 20(1), 62-69.

Lee, B. A., & Oh, D. J. (2014). The effects of aquatic exercise on body composition, physical fitness, and vascular compliance of obese elementary students. *Journal of exercise rehabilitation*, *10*(3), 184.

Maher CG, Sherrington C, Herbert RD, Moseley AM, Elkins M. Reliability of the PEDro scale for rating quality of random-ized controlled trials. *Physical Therapy.* 2003;83(8):713-721.

Malina, R. M. (2007). Physical fitness of children and adolescents in the United States: status and secular change. In *Pediatric Fitness* (Vol. 50, pp. 67-90). Karger Publishers.

Martins, J. C., Marialva, A. F., Afonso, M., Gameiro, N. F., & Costa, A. M. (2011). Effects of an 8-week physical activity program on body composition and physical fitness on obese and pre obese female students. *Journal of Physical Education & Sport/Citius Altius Fortius*, *11*(2).

Martínez-Gómez, M. G., & Roberts, B. M. (2022). Metabolic adaptations to weight loss: a brief review. *The Journal of Strength & Conditioning Research*, 36(10), 2970-2981.

McArdle, W. D., Katch, F. I., & Katch, V. L. (2001). Energy transfer in the body. *Exercise Physiology: Energy Nutrition and Human Performance. 5th ed. Baltimore, MD: Lippincott Williams & Wilkins*, 131-156.

Milanović, Z., Sporiš, G., Pantelić, S., Trajković, N., & Aleksandrović, M. (2012). The Effects of Physical Exercise on Reducing Body Weight and Body Composition of Obese Middle Aged People. A Systematic review. *Health MED Journal, 6*(6), 2175-2189.

Mohammad Gholinejad, P., Hojjati, H., & Ghorbani, S. (2019). The effect of aerobic exercise on body composition and muscle strength of female students at elementary schools of Ali Abad Katoul in 2018. *International Journal of School Health*, 6(4), 27-33.

Mota-Pereira, J., Silverio, J., Carvalho, S., Ribeiro, J. C., Fonte, D., & Ramos, J. (2011). Moderate exercise improves depression parameters in treatment-resistant patients with major depressive disorder. *Journal of psychiatric research*, *45*(8), 1005-1011.

Nieman, D. C., Brock, D. W., Butterworth, D., Utter, A. C., & Nieman, C. C. (2002). Reducing diet and/or exercise training decreases the lipid and lipoprotein risk factors of moderately obese women. *Journal of the American College of Nutrition, 21*(4), 344-350.

Ounis, O. B., Elloumi, M., Chiekh, I. B., Zbidi, A., Amri, M., Lac, G., & Tabka, Z. (2008). Effects of two-month physical-endurance and diet-restriction programmes on lipid profiles and insulin resistance in obese adolescent boys. *Diabetes & metabolism*, *34*(6), 595-600.

Papadopoulou, S. K., Feidantsis, K. G., Hassapidou, M. N., & Methenitis, S. (2021). The specific impact of nutrition and physical activity on adolescents' body composition and energy balance. *Research quarterly for exercise and sport*, 92(4), 736-746.

Reed, J. A., Maslow, A. L., Long, S., & Hughey, M. (2013). Examining the impact of 45 minutes of daily physical education on cognitive ability, fitness performance, and body composition of African American youth. *Journal of Physical Activity and Health*, *10*(2), 185-197.

Regaieg, S., Charfi, N., Kamoun, M., Ghroubi, S., Rebai, H., Elleuch, H., ... & Abid, M. (2013). The effects of an exercise training program on body composition and aerobic capacity parameters in Tunisian obese children. *Indian journal of endocrinology and metabolism*, *17*(6), 1040.

Sigal, R. J., Alberga, A. S., Goldfield, G. S., Prud'homme, D., Hadjiyannakis, S., Gougeon, R., ... & Wells, G. A. (2014). Effects of aerobic training, resistance training, or both on percentage body fat and cardiometabolic risk markers in obese adolescents: the healthy eating aerobic and resistance training in youth randomized clinical trial. *Jama Pediatrics*, *168*(11), 1006-1014.

Sijie, T., Hainai, Y., Fengying, Y., & Jianxiong, W. (2012). High intensity interval exercise training in overweight young women. *The Journal of sports medicine and physical fitness*, *52*(3), 255-262.

Silva, D. A. S., Petroski, E. L., & Pelegrini, A. (2014). Effects of aerobic exercise on the body composition and lipid profile of overweight adolescents. *Revista Brasileira de Ciências do Esporte*, *36*(2), 295-309.

Stellino, M. B., Sinclair, C. D., Partridge, J. A., & King, K. M. (2010). Differences in children's recess physical activity: recess activity of the week intervention. *Journal of School Health*, *80*(9), 436-444.

Špirtović, O., Čaprić, I., Katanić, B., Govindasamy, K., Geantă, V. A., Ardelean, V. P., ... & Stanković, M. (2025). Group aerobic exercise improves body composition and lipid profile in young women with elevated BMI: A randomized controlled trial. *Applied Sciences*, 15(13), 7489.

US Department of Health and Human Services. (2008). Physical activity guidelines for Americans: be active, healthy, and happy!. *http://www. health. gov/paguidelines/guidelines/default. aspx*.

Watts, K., Jones, T. W., Davis, E. A., & Green, D. (2005). Exercise training in obese children and adolescents. *Sports Medicine*, *35*(5), 375-392.

Yoon, J. G., Kim, S. H., & Rhyu, H. S. (2017). Effects of 16-week spinning and bicycle exercise on body composition, physical fitness and blood variables of middle school students. *Journal of exercise rehabilitation*, *13*(4), 400.

Zorba, E., Cengiz, T., & Karacabey, K. (2011). Exercise training improves body composition, blood lipid profile and serum insulin levels in obese children. *Journal of Sports Medicine and Physical Fitness*, *51*(4), 664.

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