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THE CONTRIBUTION OF AEROBICS TO THE DEVELOPMENT OF SPEED AND STRENGTH IN LOWER SECONDARY SCHOOL STUDENTS

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Abstract. The study aimed to investigate the effects of an aerobic gymnastics program on the development of speed and strength in middle school students. The research was conducted in the 2023–2024 school year and involved seventh grade students. The experimental group followed a structured aerobic gymnastics program, integrated into physical education lessons, for a period of 14 weeks, while the control group continued with traditional activities. The program was designed to stimulate key motor qualities through dynamic, rhythmic exercises, adapted to the age of the students. The results showed significant improvements in the experimental group, compared to the control group, in terms of all the parameters analyzed. Clear improvements were observed in short sprints, agility tests, reaction speed and upper and lower body strength. Improvements were recorded in both girls and boys, with minor differences attributable to gender-specific physiological characteristics. In addition to the physical benefits, the aerobic gymnastics program had a positive impact on student motivation and engagement. Attractive and varied activities encouraged active participation and sustained interest. The results confirm the research hypothesis and support the inclusion of aerobic gymnastics as a complementary discipline in the school curriculum, contributing to motor development and educational effectiveness.

Introduction

Physical development and motor skills in physical education classes should be a priority objective, providing a solid foundation for daily life and performance sports [12]. Physical activity is known to bring multiple benefits to children and adolescents, including physical, psychological, social, and cognitive health [10]. In recent years, aerobic performance among young people has been declining, highlighting the essential role of families and teachers in promoting an active lifestyle. Regular exercise during adolescence can positively influence health and habits in

adulthood, and data collection should be expanded and conducted over the long term [8]. Studies have shown that programs combining resistance training with aerobic training in the same session, with RT followed by AT, can significantly improve overall body endurance. Future research could examine psychological factors, as well as the type, intensity, and duration of training, and habits related to physical activity and nutrition [16]. Most research on the relationship between the physical and cognitive domains has focused on the association between the cardiovascular components of physical fitness (aerobic fitness) and academic performance [1]. Multiple studies in the field of physical education and sport have identified morphological and functional indicators that reflect improvements in the physical condition of students practicing aerobics [17]. Aerobics is a popular form of gymnastics among students, and lesson planning requires adherence to the principles of nature-compliance: developing students' individual physical capacities, providing individualized psychological and pedagogical support, and creating conditions for the free development of acquired skills [15]. After 8 weeks of aerobic training, it was shown that aerobic exercises improve strength, speed, body control, and endurance in primary school students, and their widespread implementation in schools is recommended [9]. The Kick Aerobics program has proven to be an effective tool in physical education for developing the motor skills of high school students [2,11]. Improving physical education methods for young people is essential, given the low levels of physical health and the reduced motivation for physical activity, which requires the development of effective wellness strategies [13]. By applying the acmelogic concept in professional development, physical education teachers become essential in adapting learning to the individual characteristics of each student [3]. Over the past decade, most fitness activities have evolved significantly, and physical activity guidelines, as well as international research, have highlighted the importance of developing maximum strength, improving cardiovascular fitness, and optimizing body composition [5]. In the modern digital era, the training of physical education and sports teachers is continuous and focused on the improvement of professional competencies [6]. Thus, the current framework of research in physical education and sports emphasizes the integration of innovative methods, adaptation to the individual needs of students, and the promotion of an active lifestyle to enhance health and physical performance.

Material-method: Research hypothesis: It is assumed that the use of aerobic gymnastics as a complementary discipline within physical education lessons, through a structured 14-week program, will lead to the development of motor qualities of speed and strength in middle school students. Research objectives: Identifying the impact of aerobic gymnastics on the development of speed and strength; Comparing the results between the experimental group and the control group; Determining the effectiveness of aerobic gymnastics in motivating students; Assessing the feasibility of implementing aerobic gymnastics in the school curriculum; Establishing

recommendations for improving the teaching-learning process. Organization and conduct of the experiment: The study was conducted during the 2023–2024 school year, the experimental part being carried out in Modules IV and V, involving two seventh-grade classes from the Moara Mică Middle School, located in the city of Moara, Suceava. Two distinct groups were formed: the experimental group and the control group, each consisting of 14 girls and 14 boys. The selection of participants was based on specific inclusion criteria, targeting physically and mentally healthy students, without medical conditions or disorders that could have negatively affected their ability to exert effort or active participation in physical education lessons. It was also aimed at ensuring a relatively homogeneous level of basic physical training, in order to minimize external variables that could have influenced the results of the experiment. As part of the experimental program, the experimental group was subjected to a structured aerobic gymnastics program, which had as its main goal the development of motor qualities of speed and strength. The exercises were dynamic and engaging, adapted to the age and level of physical development of the students, aiming to improve their performance in a pleasant and motivating way. In contrast, the control group continued with traditional physical education activities, without including aerobic-specific exercises, maintaining the conventional structure of the lesson. This difference in the structure of the activities allowed a direct comparison of the impact of the aerobic gymnastics program on the development of speed and strength, providing a controlled experimental framework for validating the research hypothesis.

Table 1 Aerobic gymnastics program for speed development

Week	Objectives	Activities	Dosage
1	Familiarization with the concepts of speed and quick reaction	Active warm-up (light jogging, mobility exercises) Quick reaction exercises Group games to develop fast reactions to music	- 10 min active warm-up - 15 min short sprints (10–20 m) - 10 min reaction games - 10 min stretching
2	Improving acceleration and change of direction	20 m sprints with short breaks to music Acceleration and deceleration exercises Quick direction change exercises (zig-zag)	- 10 min warm-up - 20 min sprints and acceleration - 10 min direction change exercises - 5 min relaxation
3	Increasing speed intensity under fatigue	Interval sprints to music (10 sec sprint + 20 sec rest) 20–30 m sprints with quick direction changes Reaction speed exercises	- 10 min warm-up - 15 min interval sprints - 10 min direction changes - 5 min stretching
4	Improving reaction speed and rapid acceleration	Reaction exercises to music 30 m sprints with rapid acceleration to music Quick start exercises (10–20 m)	- 10 min active warm-up - 20 min sprints with rapid acceleration - 10 min exercises to music - 5 min relaxation

5	Enhancing speed and power in short sprints	20 m sprints focusing on propulsion power Hill sprint exercises Quick reaction exercises (verbal commands)	- 10 min warm-up - 20 min hill sprints - 10 min quick reaction - 5 min stretching
6	Optimizing speed under fatigue	Sprint circuits (10 m sprint + 20 m recovery) Speed and direction change exercises on complex routes (zig-zag)	- 10 min warm-up - 25 min sprint circuit - 5 min direction changes - 5 min stretching
7	Progress assessment and speed testing	Speed test (20–30 m sprint) Final short-distance sprint exercises Evaluation of quick reaction and change of direction	- 10 min warm-up - 15 min speed test - 10 min short sprints - 5 min relaxation

Fig.1 Examples of exercises from the aerobic program

Table 2 Aerobic gymnastics program for strength development

Week	Objectives	Activities	Dosage
1	Familiarization with strength exercises and correct posture	Active warm-up (light jogging, joint mobility) Bodyweight strength exercises: push-ups, squats, planks Stretching exercises for flexibility	- 10 min active warm-up - 20 min strength exercises - 10 min stretching - 5 min relaxation
2	Increasing intensity of strength exercises	Push-ups variations (on knees / standard) Jump squats (plyometric) Abdominal exercises (crunches, plank)	- 10 min warm-up - 20 min plyometric exercises - 10 min abdominal exercises - 5 min stretching
3	Improving dynamic strength through plyometric exercises	Jumps on the spot (height, onto boxes) Clap push-ups Leg strength exercises (deep squats, lunges)	- 10 min warm-up - 20 min plyometric exercises - 10 min leg exercises - 5 min stretching
4	Increasing strength using weights	Exercises with light weights (dumbbells / water bottles) Plank variations (elbow, side) Abdominal strength exercises	- 10 min warm-up - 20 min exercises with weights - 10 min abdominal exercises - 5 min stretching

5	Improving strength under fatigue	Strength circuit: push-ups, squats, jumps, plank Arm and leg exercises with weights Plyometric leg exercises	- 10 min warm-up - 25 min circuit exercises - 5 min plyometric exercises - 5 min stretching
6	Consolidating strength through complex training	Lessons with light weights Intense plyometric exercises (long jumps / rapid change of direction) Abdominal and arm strength exercises	- 10 min warm-up - 20 min training with weights and plyometrics - 10 min abdominal exercises - 5 min stretching
7	Progress assessment in strength and skill testing	Strength test (number of push-ups / squats in one minute) Final exercises (plank, squats, push-ups) Evaluation of physical endurance	- 10 min warm-up - 15 min strength test - 10 min final exercises - 5 min relaxation

Results

The detailed results of the experiment are presented, analyzed across different motor skills and compared between the experimental and control groups.

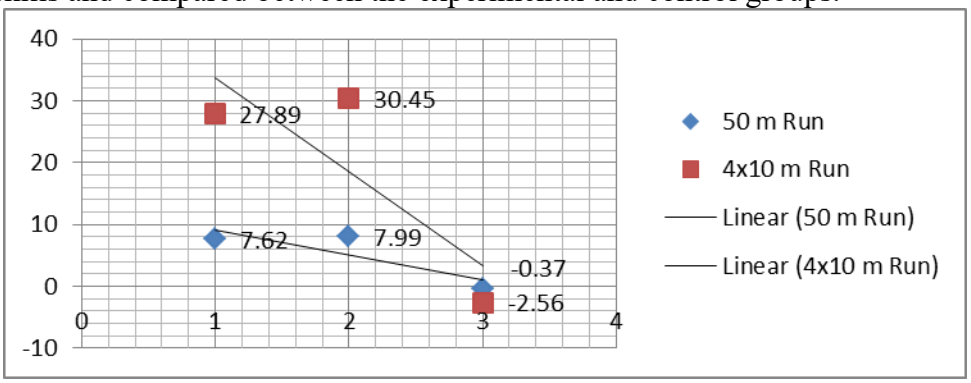

Fig. 1Dynamics of sprint speed in girls after aerobic training-50 m and 4x10 m

To assess the effects of the aerobic gymnastics program on speed, two specific tests were performed: the 50 m sprint and the 4x10 m sprint. Compared to the control group, which followed the traditional physical education program, the experimental group participated in a structured aerobic gymnastics program for 14 weeks. In the 50 m sprint test, the final average for the experimental group was 7.62 seconds, while the control group recorded an average of 7.99 seconds, resulting in a difference of -0.37 seconds. The shorter time achieved by the girls in the experimental group indicates an increase in linear speed due to aerobic exercise. Although the difference may seem small in absolute terms, at middle school age, a reduction of 0.37 seconds per 50 m is significant and reflects improved efficiency of impulse and muscle coordination. This improvement reflects the positive effect of dynamic and rhythmic exercises on pure speed. In the 4x10 m sprint test, the final average for the experimental group was 27.89 seconds, while the control group recorded an average of 30.45 seconds, resulting in a difference of -2.56 seconds. The 4x10 m test assesses

reaction speed, agility and the ability to make rapid changes of direction, which are essential components of applied speed. The difference of 2.56 seconds between the groups indicates a significant improvement in motor performance as a result of the aerobic program.

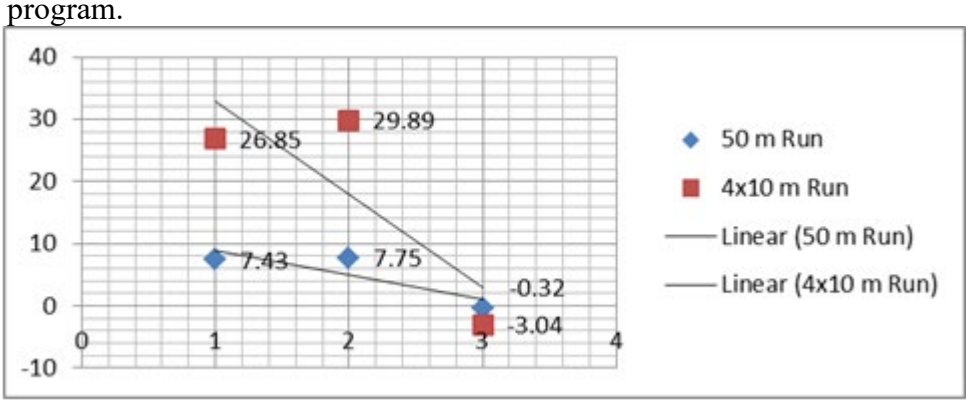

Fig.2 Dynamics of sprint speed in boys after aerobic training - 50 m and 4x10 m

The tests applied to evaluate speed were the 50 m sprint and the 4x10 m sprint, comparing the performance of boys in the experimental group (aerobic gymnastics program) with that of boys in the control group (traditional physical education program). In the 50 m sprint, the final average for the experimental group was 7.43 seconds, while the control group recorded an average of 7.75 seconds, resulting in a difference of –0.32 seconds. This difference highlights a slight increase in linear speed among boys who participated in the aerobic program. The improvement indicates better muscle efficiency and motor coordination, suggesting that dynamic exercises performed during aerobic sessions contribute to the development of pure speed, even among middle school students. In the 4x10 m sprint event, the final average for the experimental group was 26.85 seconds, while the control group recorded an average of 29.89 seconds, with a difference of –3.04 seconds. The difference between the groups indicates a strong impact of the aerobic program on applied speed, agility and the ability to quickly change direction. The results show that complex and rhythmic exercises stimulated both explosive strength and muscular endurance necessary for repetitive tasks. This confirms that the boys in the experimental group benefited from an effective training program, adapted to their age and level of physical development. Comparative analysis between girls and boys: Both girls and boys in the experimental group showed similar improvements in linear speed, around 0.3-0.4 seconds, compared to the control group. The relatively equal difference suggests that the aerobic program has comparable effects on pure speed, regardless of gender. The absolute values show that, on average, boys ran the 50 m distance faster than girls, reflecting natural physiological differences in muscle strength and mass at this age. In the 4x10 m test, which assesses applied speed and agility, both experimental groups showed significant improvements, but the difference was greater in boys (-3.04 sec) than in girls (-2.56 sec). This indicates that boys responded more strongly to exercises

involving explosive strength, agility and rapid changes of direction, probably due to their greater muscle mass and power. However, the substantial improvement observed in girls confirms that the aerobic program is also effective for the development of complex motor skills in both sexes.

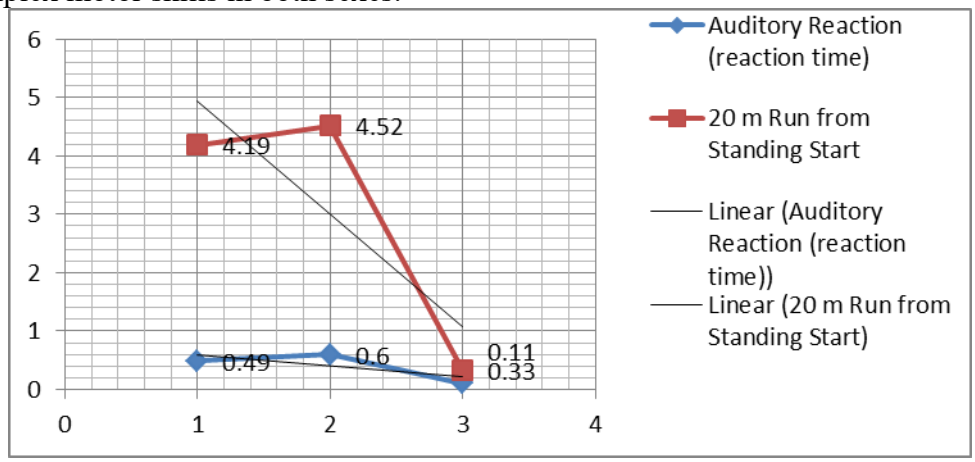

Fig.3 Dynamics of auditory reaction and 20 m sprint performance -girls

In the Auditory Reaction test, the difference of-0.11 seconds indicates an improvement in reaction speed in girls in the experimental group. Aerobic exercises, being rhythmic and coordinated with music or signals, stimulate the nervous system and the ability to respond quickly to external stimuli. In the 20 m sprint with a standing start, the difference of-0.33 seconds reflects an increase in initial speed and explosive force. Aerobic exercises that include jumping, acceleration and rapid changes of pace contribute to the development of fast muscle strength and explosiveness, essential for sprint starts and low-speed tasks. The results show that the experimental program had a positive impact on motor skills specific to initial speed and force, complementing the longer sprint tests.

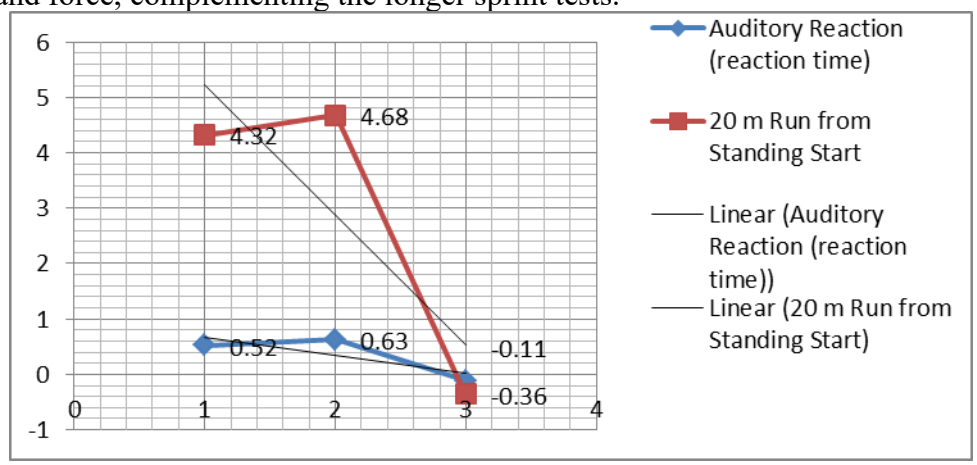

Figura 4 Dynamics of auditory reaction and 20 m sprint performance -boys

Analyzing the results of the boys who participated in the aerobic gymnastics program, improvements were observed in the Auditory Reaction test and the 20 m standing sprint. In the Auditory Reaction test, the boys in the experimental group achieved an average time of 0.52 seconds, compared to 0.63 seconds in the control group, representing a reduction of 0.11 seconds. This difference indicates an improvement in reaction speed, demonstrating that rhythmic and coordinated exercises in aerobic training stimulate the nervous system, reflexes and the ability to respond quickly to auditory stimuli. Regarding the 20 m standing sprint, the boys in the experimental group recorded an average time of 4.32 seconds, 0.36 seconds faster than the control group. Comparative analysis between girls and boys: Both girls and boys in the experimental groups experienced the same reduction in reaction time (-0.11 seconds) compared to the control groups. The absolute values show that girls had a slightly faster average time than boys, but the difference is insignificant, indicating that aerobic exercise enhances reflexes and quick reaction capabilities regardless of gender.

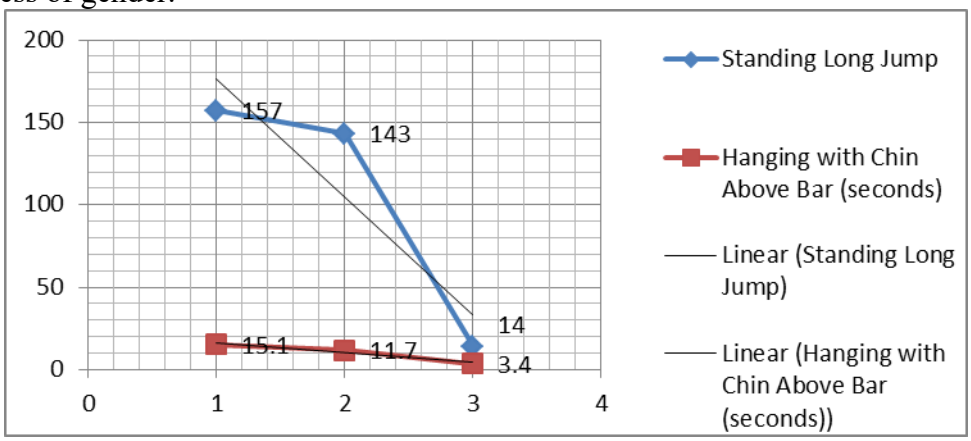

Fig.5 Dynamics of strength development in girls – standing long jump and flexed arm hang

In the standing long jump test, the girls in the experimental group achieved an average of 157 cm, 14 cm more than the control group, which recorded 143 cm. This highlights a significant development of explosive strength in the lower limbs, demonstrating that dynamic exercises and jumps specific to aerobic gymnastics contribute to increasing muscle power and general coordination. Regarding hanging with flexed arms, the experimental group was able to maintain the position for an average of 15.1 seconds, compared to 11.7 seconds in the control group, representing a gain of 3.4 seconds. This result indicates an improvement in the muscular endurance of the arms, shoulders and trunk, demonstrating that aerobic gymnastics develops not only strength, but also the ability to maintain short-term isometric muscle contractions.

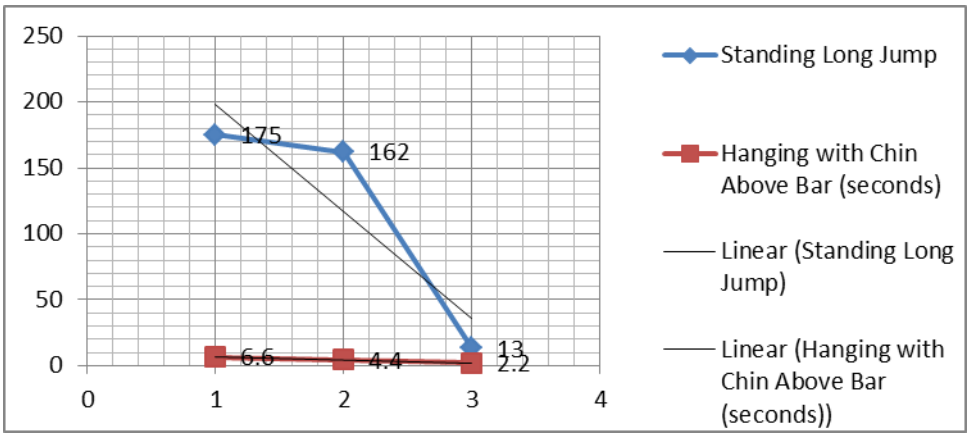

Fig.6 Dynamics of strength development in girls-standing long jump and flexed arm hang

Analyzing the results of the boys who followed the aerobic gymnastics program, improvements in explosive strength and muscular endurance are observed. In the long jump test, the boys in the experimental group achieved an average of 175 cm, 13 cm more than the control group, which recorded 162 cm. In the pull-up test, the experimental group performed an average of 6.6 repetitions, compared to 4.4 repetitions in the control group, representing a gain of 2.2 repetitions. This result demonstrates an increase in muscular endurance of the arms, shoulders and back, highlighting the effectiveness of the program in developing short-term muscle support and control. In the long jump test - explosive strength, both sexes showed significant improvements, indicating the development of explosive strength in the lower limbs. The absolute gain was slightly greater in girls (+14 cm) compared to boys (+13 cm); however, the absolute values show that boys jumped further on average, reflecting physiological advantages such as greater muscle mass. The results confirm the effectiveness of the aerobic program in developing muscle strength and general coordination, regardless of gender. In the hanging/pull-up test with bent arms - muscular endurance, both experimental groups recorded significant improvements, either by maintaining the isometric position in girls or by performing pull-ups in boys. The relatively greater gain in girls (+3.4 sec vs. +2.2 repetitions) suggests that aerobic exercises are effective for developing static muscular endurance, while in boys the effects are more evident in terms of dynamic strength and traction capacity.

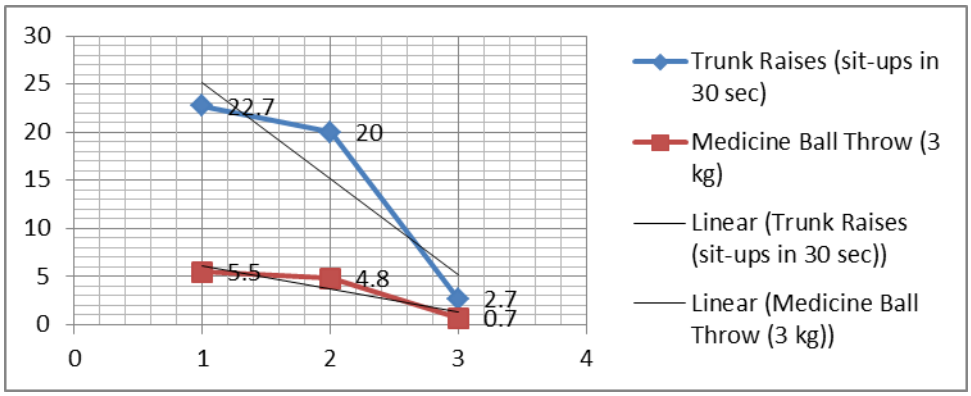

Fig.7 Evolution of core strength and medicine ball throw performance in girls

In the trunk lift test (abdominals in 30 seconds), the experimental group performed an average of 22.7 repetitions, compared to 20.0 repetitions in the control group, resulting in a gain of 2.7 repetitions. This indicates an increase in muscular strength and trunk endurance, essential for postural stability and control of complex movements during aerobic exercise. In terms of throwing the 3 kg medicine ball, the girls in the experimental group achieved an average distance of 5.5 m, compared to 4.8 m in the control group, an improvement of 0.7 m. This reflects the development of upper limb strength and explosive power, demonstrating that aerobic exercise involves not only the lower limbs and trunk, but also the ability to generate force through the arms and shoulders.

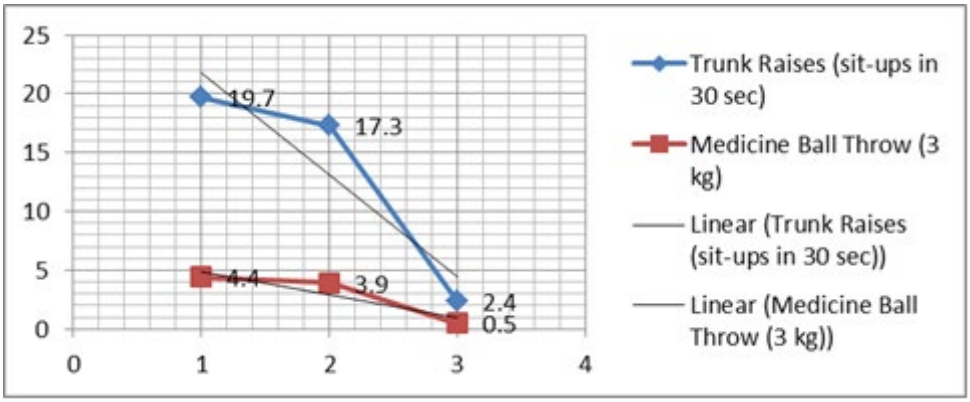

Fig.8 Evolution of core strength and medicine ball throw performance in boys

In the trunk lift test (abdominals in 30 seconds), the experimental group performed an average of 19.7 repetitions, compared to 17.3 repetitions in the control group, resulting in a gain of 2.4 repetitions. In terms of throwing the 2 kg medicine ball, boys in the experimental group achieved an average distance of 4.4 m, compared to 3.9 m in the control group, an improvement of 0.5 m. This reflects the development of explosive strength in the upper limbs, demonstrating that aerobic exercise contributes to the ability to generate power through the arms and shoulders, even in boys. The comparative analysis between girls and boys (trunk and upper limb strength) shows

that both sexes recorded significant improvements in trunk strength and endurance, with relatively comparable gains (+2.7 repetitions for girls and +2.4 repetitions for boys). The results indicate that the aerobic program stimulates postural stability and trunk movement control in both sexes, regardless of the absolute number of repetitions, which was higher in girls in this case. This demonstrates the effectiveness of aerobic gymnastics in developing trunk muscle endurance, an essential component for overall physical performance. In the medicine ball throwing test, both sexes showed significant improvements in upper limb explosive strength, with a slightly greater gain in girls (+0.7 m vs. +0.5 m in boys). The absolute differences also reflect the fact that the ball used was heavier in girls (3 kg) than in boys (2 kg), making the results comparable in terms of effort. The findings demonstrate that aerobic gymnastics contributes to the development of explosive strength in the arms and shoulders, being effective for both sexes.

Discussions

The results of the study [14] show statistically significant differences between the initial and final assessments of the motor skills of the students. The experimental treatment had a significant positive effect on their development, with aerobics contributing in particular to the improvement of endurance, strength, flexibility and coordination. These findings highlight the need to include aerobic exercises in physical education programs, as current activities do not produce the desired improvements in motor skills. Although physical activity is recommended, the aerobic performance of young people remains low, highlighting the essential role of families and teachers in promoting an active lifestyle, which can positively influence health and habits in adulthood [7].

Conclusions

The research highlighted the important role of aerobic gymnastics in the development of motor skills in middle school students. Implementing a structured aerobic exercise program over several weeks significantly contributed to improving speed, strength and muscular endurance, confirming the initial hypothesis of the study. Regarding the impact on speed, the results showed clear progress both in short sprints and in tasks requiring agility and rapid changes of direction. These improvements demonstrate that dynamic and rhythmic aerobic exercises positively influence the speed of execution and the overall coordination of movements. In addition, explosive strength of the lower limbs and strength of the upper limbs and trunk showed a significant improvement, highlighting the effectiveness of the program in stimulating the muscles involved in intense and repeated efforts. Comparison of the results between the experimental and control groups revealed clear advantages for students who participated in the aerobic gymnastics program. These differences confirm that the integration of aerobic gymnastics into physical education lessons offers additional benefits compared to traditional teaching methods. Progress was observed in both sexes, with some variations determined by biological

characteristics and the initial level of physical development. Another important aspect highlighted by the study concerns student motivation. The attractive, varied and musically coordinated nature of aerobic gymnastics exercises contributed to increased interest and active involvement during the lessons. Students demonstrated a positive attitude towards physical activity, participating with pleasure and consistency throughout the entire program. Regarding the possibility of implementation in the school curriculum, aerobic gymnastics proved to be an accessible, flexible and easily adaptable method for the gymnasium level. It does not require complex equipment and can be effectively integrated into the structure of physical education lessons, contributing to the modernization of the teaching-learning process.

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