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STUDY ON IMPROVING GENERAL STRENGTH THROUGH CIRCUIT TRAINING IN 9TH GRADE FEMALE STUDENTS

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Abstract

Aim. This study aims to highlight the effectiveness of circuit training as a practical and applicable strategy for developing overall strength in adolescent girls during physical education classes. The study focuses on a sample of ninth-grade students, aged 14 to 15, who are at a critical stage of physical and motor development. By implementing a structured program of progressively challenging circuit exercises over a period of three and a half months, the research seeks to demonstrate how such an intervention contributes to improving muscular strength in the upper limbs, trunk, and lower limbs, as well as stimulating interest in physical activity among the students. The ultimate goal of the study is to provide an efficient and easy-to-implement model within the school environment that supports the harmonious development of students and promotes an active lifestyle (Bompa, 2001). Previous studies have highlighted that structured exercise programs in schools can significantly enhance adolescent physical capacity, supporting the rationale of this intervention (Dragnea, 1991; Matveev & Novicov, 1980).

Methods. Observation and intervention within the study were conducted over a period of three and a half months (October 2024 – January 2025) during physical education classes. The study involved 24 ninth-grade female students, divided into two homogeneous groups: experimental and control. Data were recorded regarding height, weight, and muscular strength, focusing on the arms, abdomen, and lower limbs. These measures are consistent with standard practices recommended in the literature for assessing adolescent strength (Cârstea, Bota, 2000). The circuit training program, applied only to the experimental group, took place twice a week for 16 weeks. It consisted of 6 to 8 stations, each containing two exercises targeting a specific muscle group. Exercises were performed for 30 seconds, followed by a 45-second rest, and there was a 2–3 minute break between circuit repetitions. Circuit-based training has been shown to improve multiple motor abilities simultaneously, which justifies the chosen design Previous studies have highlighted the effectiveness of circuit training in similar populations (Scholich, 1990; Cherkashina & Cherkashyn, 2017), supporting the rationale of our intervention.

Results. The training program was followed consistently throughout the entire study period, and the results were reflected in clear and steady progress in strength development. These improvements were highlighted during periodic evaluations, which allowed for close monitoring of the participants' progress and confirmed the effectiveness of the applied intervention.

Conclusions. The results obtained from the initial and final tests were analyzed by calculating the mean, standard deviation, and significance threshold. Following these analyses, it was found that the experimental group showed significant improvements, confirming the effectiveness of the circuit training method in enhancing overall strength. These findings support the use of circuit training as an efficient strategy for developing muscular capacity among adolescents. Furthermore, the metabolic demands imposed by the circuit contribute to increased caloric expenditure and improved cardiovascular condition (Weinek, 1992). The resulting metabolic adaptations can have a significant positive impact on an adolescent's ability to sustain high-intensity efforts, thereby facilitating superior performance in physical activities. The findings are in agreement with prior studies emphasizing the physiological benefits of systematic strength training in youth (Bompa, 2001; Dragnea et. al., 2006).

Keywords: general strength development, circuit training method, high school, female group, adolescent girls.

Introduction

Currently, there is a major concern regarding the improvement of the physical capacity of the young generation, particularly general strength, which is necessary both in sports training and daily activities. Strength is one of the basic motor qualities essential for an individual to exist and cope with daily challenges. Recent trends in physical fitness indicate that young people are less physically capable than they were 10 years ago, raising questions about how physical education and training are implemented in schools (Bota, 2000; Dember, 1981). Regular participation in strength exercises throughout childhood and adolescence improves movement mechanics, increases strength expression, minimizes the risk of sports-related injuries, and promotes long-term positive health outcomes for youth (Demeter, 1983).

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Physical education represents an essential component of students' physical development, providing motor, physiological, and mental skills (Dicționarul Explicativ al Limbii Române, 1996). However, uncertainties remain about the optimal amount of physical activity required to achieve these benefits and whether current physical education lessons are sufficient. Research recommends at least 60 minutes of daily physical activity for health benefits, while school hours allocate approximately 90-100 minutes per week. Limited time, insufficient resources, and unfavourable environments are significant barriers to achieving adequate physical fitness levels in students. Thus, exploring new and effective methods that increase motivation and ensure the development of physical capacities becomes a priority in the educational process (Firea, 1979; Manno, 1999).

The development of general strength represents a specialized process for improving the physical qualities of students of all ages, aiming to enhance health, physical capacity, and athletic form. Strength is not only about increasing muscle mass but also influences the skeletal system, the cardiorespiratory system, and reduces the risk of chronic diseases (Dragnea & Teodorescu, 2002). Mentally, individuals who regularly practice strength development exercises show improved mood, increased self-confidence, and better learning capacity.

In this context, one of the methods gaining increasing recognition in general strength training is circuit training (Niță, 2018). This method was developed and popularized in 1952 by coaches at the University of Leeds, England, who demonstrated its superiority over other training methods in terms of efficiency and adaptability. Circuit training involves varied exercises that alternately stimulate multiple muscle groups, with well-timed and age-adapted rest periods. This type of training increases motivation and allows the simultaneous development of several motor qualities, such as speed, coordination, and endurance.

Nationally and internationally, studies confirm the effectiveness of circuit training for improving general strength in students. For example, Milenković (2022) conducted a study on 60 high school students divided into an experimental group that followed circuit training and a control group that had traditional physical education classes. After eight weeks, the experimental group showed significant improvements in strength tests compared to the control group. Another study compared circuit training effects with moderate weights and high repetitions versus heavy weights and low repetitions, highlighting increases in muscular endurance and explosive power in both cases, with specific advantages for each approach (Hermassi et al., 2020).

In the field of performance sports, circuit training has been associated with improvements in sprinting abilities and explosive power, crucial aspects for athletes. Research by Pramod and Divya (2024) demonstrated significant improvements in speed and explosive power following a circuit training program applied to an experimental group of boys aged 14 to 17. Additionally, a study on handball players by Hermassi and colleagues (2020) confirmed the efficacy of circuit training in improving sport-specific physical performance after a 12-week intervention. These results reinforce the educational relevance of circuit training by showing its applicability across different ages and performance levels (Nikola et al, 2023).

Thus, circuit training proves to be a highly effective strategy for developing general strength among adolescents, due to the organization of exercises in stations that allow training all muscle groups in a short time with minimal equipment (Tudor, 2007). This method supports not only strength development but also other motor qualities necessary in daily life and sports, such as speed and coordination. Adolescence, being a crucial stage of growth and maturation, requires effective methods to maintain correct posture and adapt to various physical efforts, and circuit training provides an adequate response to these needs (Șiclovan, 1984).

Methods

The present study was conducted during physical education and sports classes, with the primary aim of evaluating the effectiveness of the circuit training method in developing general strength in 9th-grade female students. The research included two groups, each consisting of 12 students—one experimental and one control group—all participants being between the ages of 14 and 15. The selection process was designed to ensure relative homogeneity of the subjects in terms of morphological and functional characteristics, which was confirmed by the initial anthropometric data analysis. Body weight values ranged between 49 and 56 kg, which are considered within normal limits for this age group.

Before the implementation of the training program, both groups underwent an initial assessment aimed at measuring their general strength level. This motor ability was evaluated using three standardized motor tests, whose validity is supported by the scientific literature (Popa & Larion, 2017):

- push-ups with feet supported on a bench (for upper body strength);
- simultaneous lifting of the torso and legs from a supine position (for abdominal strength);
- standing long jump (as an indicator of lower body strength).

The experiment lasted three and a half months, from October 7, 2024, to January 27, 2025. All activities took place in the school gymnasium, which provided a safe and well-equipped environment, including auxiliary materials and training equipment. During each session, participants wore appropriate sports attire, and activities were conducted under controlled conditions. The experimental program was structured based on the circuit training method, recognized for its efficiency in developing muscular strength and maintaining motivation among adolescents due to its dynamic nature,

alternation of exertion, and exercise variety. Each circuit consisted of 4 to 6 stations targeting different muscle groups and was repeated for two consecutive weeks (four lessons), allowing the body time to adapt neuromuscularly and physiologically, in accordance with methodological training principles.

In the first part of the program, we used only bodyweight exercises (Zatiorski, 1968) such as push-ups, squats, abdominal crunches, and lunges to ensure a safe and balanced development of the musculature. These exercises were carefully selected to meet the age-specific needs and motor fitness level of the subjects. In the second half of the program, the difficulty was progressively increased by introducing external objects:

- the gymnastics bench (for support and jump exercises);
- the stick (for posture and mobility drills);
- the medicine ball (for dynamic resistance work);
- elastic bands (for variable resistance).

The use of these tools had a dual purpose: on one hand, they increased the motor complexity and muscular engagement, and on the other hand, they helped sustain interest and promote active participation from the students.

Training sessions followed a structured pedagogical format: the warm-up included joint mobility exercises, cardiovascular activation, and coordination drills; the main part involved completing the circuit one or two times depending on the difficulty level; and the final part focused on gradual recovery through breathing and relaxation exercises. Rest intervals between stations and circuits were carefully managed to support active recovery and maintain an optimal level of intensity.

Meanwhile, the control group participated in standard physical education lessons, which included general activities (such as running, games, and basic exercises), without using the circuit training method or applying any specific progression aimed at strength development. After completing the training period, both groups were re-evaluated using the same motor tests, under identical conditions, in order to assess any changes in strength parameters. The data collected were compiled into tables and graphical representations, and will be subjected to statistical analysis to determine the significance of differences observed between the initial and final assessments, as well as between the experimental and control groups.

In conclusion, the study's methods were designed in accordance with all principles of applied pedagogical research, with an emphasis on validity, objectivity, and practical relevance, and supported by specialized literature in the field of motor skills development in adolescents.

Results

The evaluation of general strength in this study was conducted through the application of three standardized motor tests targeting the major muscle groups: push-ups with feet supported on a gymnastics bench, simultaneous lifting of the trunk and legs from a supine position to assess abdominal muscle strength, and standing long jump.

These tests were applied identically to both the experimental and control groups, under standardized, equal, and optimal conditions for all participants. In cases where multiple attempts were allowed, the best performance was recorded. The results obtained from anthropometric measurements and strength tests are presented in Tables 1, 2, and 3.

Throughout the duration of the experiment, none of the subjects sustained injuries, and all activities were conducted under safe conditions. The attendance rate was high for both groups, exceeding 100%, which contributed to the consistency and validity of the collected data.

Initial tests conducted prior to the implementation of the experimental program did not reveal statistically significant differences between the two groups in any of the analysed variables, confirming the homogeneity of the sample and the comparative validity of the subsequent results.

Table 1. Push-ups with feet supported on a bench

Experimental group		**Control group**	
T.I	**T.F**	**T.I**	**T.F**
M±DS 12,83±1,031	M±DS 16±0,953	M±DS 12,66±0,778	M±DS 13±0,953
		p>0,05 (T.I) p<0,0005 (T.F)	

Table 2. Simultaneous lifting of the torso and legs from a supine position

Experimental group		**Control group**	
T.I	**T.F**	**T.I**	**T.F**
M±DS	M±DS	M±DS	M±DS
7,75±0,866	10,75±1,215	7,58±0,669	8,25±0,866
p>0,05(T.I)			
p<0,0005(T.F)			

Table 3. Standing long jump

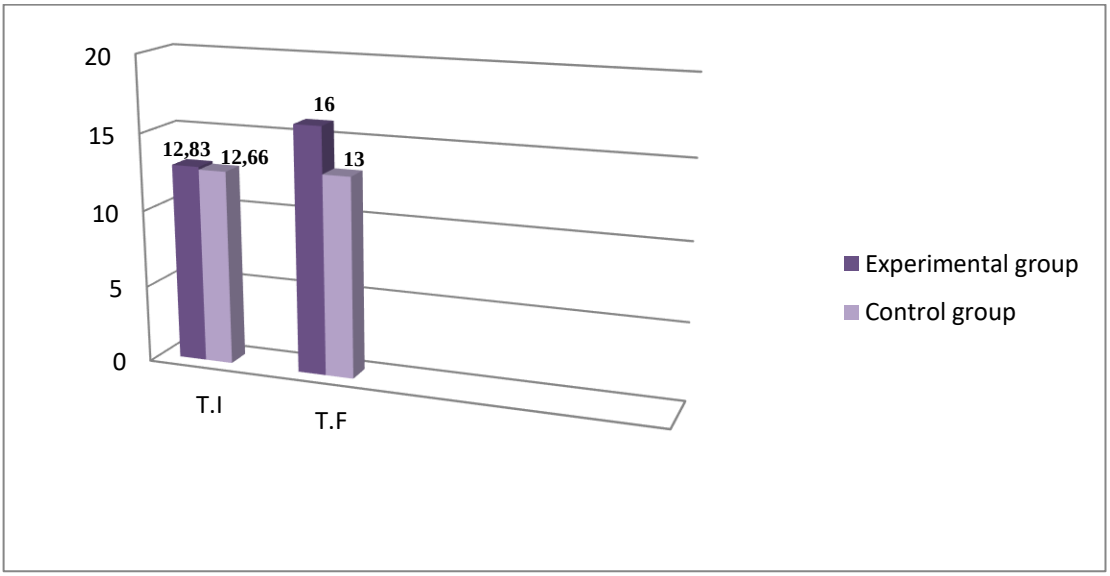
Experimental group		**Control group**	
T.I	**T.F**	**T.I**	**T.F**
M±DS	M±DS	M±DS	M±DS
1,51±0,045	1,55±0,069	1,47±0,038	1,49±0,043
p<0,05 (T.I)			
p<0,0005 (T.F)			

Analysis of results

The initial testing results of the ninth-grade students indicate a similar level of motor skills between the two subject groups, as reflected by the average values obtained. Thus, the experimental group recorded an average of 12.83, while the control group had an average of 12.66, confirming the homogeneity of the motor skill level between the groups at the start of the experiment.

Although the initial tests showed a comparable degree of motor skills, the final tests revealed improvements in both groups, with a more pronounced progress in the experimental group. The latter demonstrated a superior capacity for performance development, the difference between the final averages being 16 for the experimental group and 13 for the control group.

The progress recorded by the experimental group was statistically significant, at a significance level of $p < 0.0005$. To illustrate these differences between the averages, Graph no. 1 was created:



Graph 1. Push-ups with feet supported on a bench

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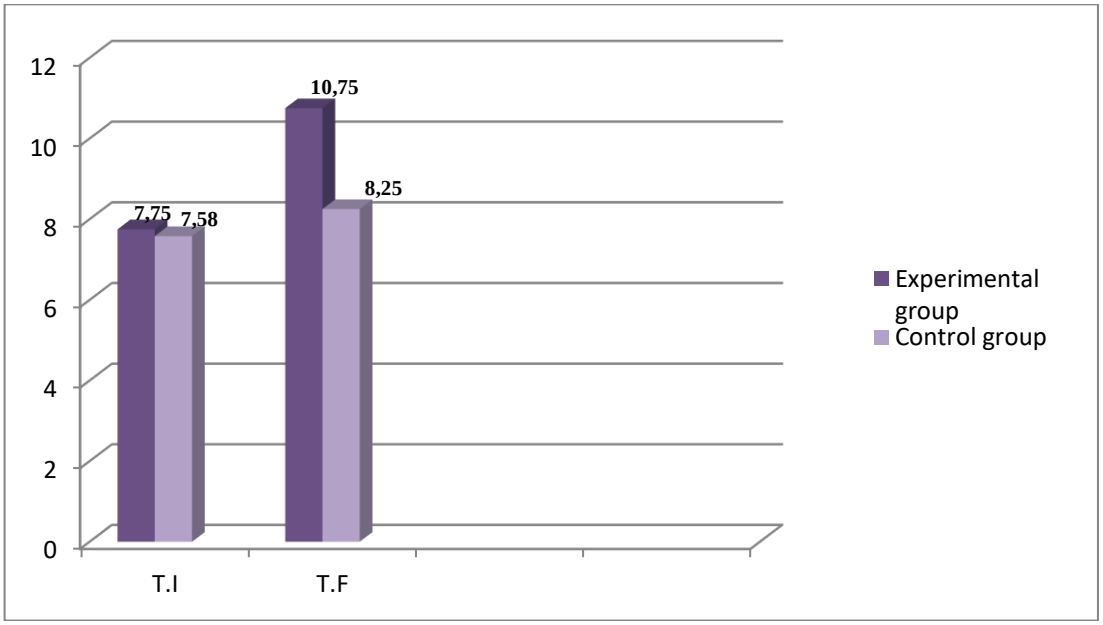
A key aspect observed in the second test, similar to the first one, is that the results once again confirm that the subjects in the experiment started from a comparable level of physical fitness. The experimental group recorded an average score of 7.75, while the control group had a very close average of 7.58.

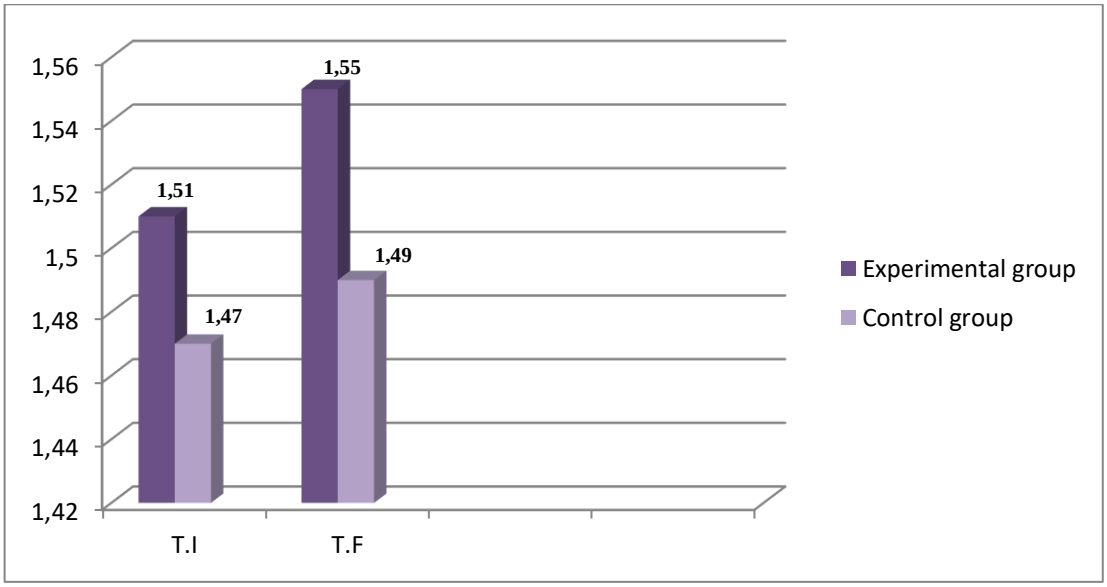
Statistically significant differences were observed in the final test results between the two groups. The control group achieved an average of 8.25, which is significantly lower compared to the experimental group's average of 10.75. The level of statistical significance reached for the experimental group was $p < 0.0005$. The progression of the averages is illustrated in graph no. 2



Graph 2. Simultaneous lifting of the torso and legs from a supine position

In the final test, the initial assessments revealed no significant differences between the average scores of the two groups. The experimental group recorded an average of 1.51, while the control group had a very similar average of 1.47, confirming once again the initial homogeneity of the sample.

The final assessments showed a slight improvement in performance for both groups, with the experimental group achieving a higher average of 1.55 compared to the control group's 1.49. The progress made by the experimental group, following the implementation of a specifically designed training program, was reflected in the statistically significant result of $p < 0.0005$. The differences between the two groups are illustrated in the final graph.



Graph 3. Standing long jump

Discussions

The results obtained following the application of the circuit training method highlight a significant improvement in general strength among the female students in the experimental group compared to those in the control group. The notable progress across all three motor tests demonstrates the effectiveness of this method in activating the main muscle groups and stimulating neuromuscular adaptations, without compromising the students' safety or engagement. The dynamic structure of the circuit, tailored to the participants' age-specific characteristics and fitness level, contributed both to performance improvement and to maintaining motivation throughout the intervention period.

These findings are also supported by existing literature. For instance, Cherkashina and Cherkashyn (2017) emphasized the effectiveness of strength training in developing high school-aged children involved in athletic activities, underlining the importance of structured programs in enhancing muscular development. Similarly, the recent study by Mitchell et. al. (2024) confirms that high-resistance circuit training contributes to increased strength and active engagement in untrained adolescents. At the national level, Niță (2018) advocates for the use of circuit training during physical education lessons in high schools, noting its effectiveness in developing muscular strength in a pedagogically controlled and efficient manner.

Nevertheless, the study presents certain limitations that must be acknowledged. The small sample size and the relatively short intervention period (three and a half months) limit the generalizability of the findings. Additionally, the exclusive use of standardized motor tests without supplementary instrumental measurements may reduce the precision of some interpretations. However, the consistency of the data and the validity of the tests used provide a strong foundation for the conclusions drawn.

From a practical standpoint, the results support the integration of the circuit method into the physical education curriculum at the high school level. Through its exercise variety, adaptable difficulty levels, and motivating nature, circuit training offers an effective alternative for developing muscular strength and increasing students' engagement in school-based physical activity.

Conclusions

The results obtained and the statistical analysis of the data confirm the research hypothesis: circuit training significantly improves general strength among 9^{TH} grade female students compared to traditional methods used in physical education classes. The applied program proved effective due to its progressive structure, age-appropriate design, and the variety of exercises, which stimulated both motivation and student engagement.

Circuit training, through alternating anaerobic demands and targeting major muscle groups, contributed not only to the development of muscular strength but also to improvements in endurance, effort capacity, and overall physical condition. Moreover, the high metabolic demands of circuit exercises led to increased energy expenditure and better cardiovascular functioning.

These findings support the idea that integrating circuit training into physical education lessons can serve as a sustainable and efficient working model, contributing to the achievement of curricular goals and the promotion of an active, healthy lifestyle among adolescents.

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