The Impact of Using Modern Fitness Techniques vs. the Traditional Ones on the Strength of the Lower Limbs in Adolescent Girls

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Abstract: The issue of this paper is focused on identifying the positive influence that the means of fitness exert on the human body, as well as the ways to practice it, as an option for adopting an active lifestyle. As a component of fitness, along with cardio-respiratory endurance, mobility and body composition, strength fully contributes to daily activities, with vigour and efficiency, and to increase human performance, with effects on quality of life. Physical activity performed systematically, regularly contributes directly to improving the structure and functions of various organs and systems of the body. In the current pandemic context, exercising can counteract the appearance of anatomical and functional impairments or correct certain dysfunctions that occur as a result of improper living and/or working conditions (spending a long time in front of the computer, sedentary lifestyle, unhealthy diet). This topic is part of the concerns that link the goal of maintaining and improving health, with the development of a working concept in which exercise becomes a flexible tool to achieve the objectives of structural-functional development of adolescent girls and increase autonomy. in performing physical activity. In this regard, we started a study that investigated the impact of modern and traditional fitness techniques on the development of lower limb strength in adolescent girls. This study is part of amelioration type research. The research took place at the National College „G. Moisil ”(Bucharest), on a sample of 40 students, aged between 15 and 16 years. The action systems used to develop strength were based on the principle of varying muscle tension. Following the intervention program and the support of the tests, statistical data showed an improvement in muscle strength in the lower limbs in the subjects of the experimental group, compared to the control group.

Keywords: *Fitness techniques, strength, adolescent girls.*

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1. Introduction

Physical education and sports are an important antidote, active and accessible at the same time. It is one of the most important means of balancing the human body, eliminating internal tensions and increasing the body's adaptive possibilities (Ciomag, 2011).

In line with contemporary pedagogy which formulates the idea that physical exercise is a means of personality formation and preparation of man for the profession and contemporary requirements, the paper aims to highlight the multiple values of physical exercise, in general, and Fitness, in special.

Numerous specialized studies, present in databases such as Web of Science, Google Scholar, ResearchGate or Sport Discus, have documented the effectiveness of strength training for children and adolescents (Behm et al., 2017; Behringer et al., 2011).

Specialists in the field of physical education - Ayers & Sariscsany (2011) recognizes and supports the premise that many of the benefits associated with adult strength development are achievable by children and adolescents who follow age-specific strength training guidelines.

Because weight-bearing exercises involve more complex patterns of neural activation than other muscular endurance exercises, adolescence may be the ideal time to properly master the coordination technique and the skill of performing these exercises correctly (Bonney et al., 2018).

In this regard, Pichardo et al. (2019) determined the long-term effects of combined resistance training (traditional strength training and plyometrics) with or without weight lifting movements, on motor performance in adolescents. Following the experiment, the authors observed a small-medium improvement of all measured indicators, after 28 weeks of training.

Other studies (Faigenbaum et al., 2012; Zhamardiy, Shkola, Ulianova, Bilostotska et al., 2019; Channell & Barfield, 2008; Duehring et al., 2009) demonstrated the reliability of developing maximum strength with a single repetition (1 RM) in adolescent athletes. Maximum strength testing (1 RM) has a high degree of reproducibility in trained adolescents and can be safely evaluated in young athletes, provided that standard testing procedures are followed.

Most studies, which focused on the development of strength, focused on adolescents, and information on improving strength in adolescents is insufficient (Mozolev et al., 2019; Kolokoltsev et al., 2018; Slimani et al., 2018).

Thus, *the purpose* of this paper is to highlight the usefulness of training programs, based on the method of "working with relief", to increase the strength indices in the lower limbs at adolescents.

Study hypothesis. We believe that the use of the method of developing explosive force, based on the principle of varying muscle tension (the method of "working with relief") will highlight the efficiency of training, by increasing strength indices, compared to traditional means of developing strength.

2. Material and methods

2.1. Research methods

To know the complex issue of improving the motor performance of adolescents, through sports programs that include fitness, we used the following research methods: bibliographic documentation (the bibliographic study helped us to build the theoretical background, as well as the entire course of the current research, using databases such as Google Scholar, Ebsco, ProQuest and SpringerLink, PubMed), pedagogical observation testing method (consisted in the systematic monitoring of motor actions and activities and included), test method – aimed at gathering accurate information about motor features, based on which predictions were made. The results were assessed by the statistical comparison with the results of the control group subjects in order to rank them in relation to the average success of the reference group, statistical and mathematical method, graphical representation method.

2.2. Subjects

The subjects of the research are 40 students of the National College "Grigore Moisil", aged between 15 and 16 years.

To perform the experiment, the subjects were divided as follows:

- Control group (20 students) - GC, for which the value of the independent variable is "zero";
- Experiment group (20 students) - GE, on which an independent variable acted.

The sample type is randomized, using the random selection technique. In the psycho-pedagogical / methodical researches where subjects cannot be selected without the risk of incomplete the number of classes, parallel classes are taken as experiment and control groups,

considering that the “chance” factor acted at the initial constitution of the classes (Epuran, 2005).

The subjects participated voluntarily in the research. At the beginning of the experiment, they have explained the particularities of the testing and the assessment techniques used, and they expressed their agreement in this regard. The research respected the ethical and medical conditions of the subjects' participation.

2.3. Research stages

The research took place in the school year 2019 - 2020 at the National College "Grigore Moisil" in Bucharest.

The groups participating in the experiment participated in two physical education lessons/week. The study was conducted over 8 weeks with a total of 16 lessons and initial and final tests were applied (Table 1).

Table 1. Research stages

Period	Activitate
09.12.2019 – 20.12.2019	Initial test
13.01.2020 – 06.03.2020	Implementation of the training programme
09.03.2020 – 10.03.2020	Final test

2.4. Design and procedure of the study

Methodical aspects. Under normal conditions, performing a repeated movement leads to the appearance of a habit of motor gesture that will damage progress. That is why the variation of the execution conditions is very important, so we can increase or decrease the muscle tension specific to the exercise. Thus, the degree of difficulty to obtain a smaller muscular contraction can be diminished by facilitating the performance of the movement. Therefore, it is very important to vary the conditions of execution (methods based on the principle of variation of muscle tension), as we can increase or decrease the muscle tension specific to the exercise.

The synthetic method is based on the variation of muscle tension that involves respecting the whole structure, that is the simultaneous approach of the 3 elements: an eccentric phase, a short moment of isometry and a concentric phase. Thus, the degree of difficulty can be diminished in

order to obtain a smaller muscular contraction by facilitating the performance of the movement (Cometti, 1996).

Sports practice has used a number of methods based on „working with relief". Among these, we mention:

- method "120-80" (standing with feet apart with the dumbbell bar weighing on the shoulders). This method consists of performing a lowering with a load equivalent to 120% of the maximum and lifting with 80%. This requires a handcrafted device that allows the load to be reduced between the lowering and lifting phases.

- the Berenice device, which allows the replacement of weights using an engine and, as such, the automatic change of load.

The disadvantage of the methods described above is the increase of the pressure on the spine because the force bar is supported by the shoulders.

In the present experiment, we used the method of „working with relief" performed at the end of the execution of the motor act. The means proposed by us for „working with relief" were the following:

1. Running by towing a parachute and manually detaching it from the student's body;

2. Exercises performed on the leg press. It consists of a plane inclined at 45°, on which slides a trolley connected to a stack of plates that can be selected every 5 kg (total 120 kg). The „working with relief" is done with the help of a partner who pushes the stroller, in the phase of semi-squat, until the extension of the legs. The result is thus an „explosive" end to the movement.

In compiling the fitness programs, the following aspects were taken into account: the duration of the effort, the effectiveness of the muscular activity compared to the engaged muscle groups, the rapidity of the body's recovery after the effort.

The exercises used in the programs followed a methodical sequence, a determined volume, being graded in terms of intensity and complexity.

Variables of the experiment

In our experiment, we used an independent variable, under experimental control, with which the changes studied in the experiment are correlated, namely:

V1 - Intervention program using "relief work" means applied to the experimental group:

- running with the towing of a parachute on a distance of 30 meters, then detaching it by operating the band around the waist and easy running

(without a parachute) for another 20 meters. This exercise was also performed in the gym on a length of 30 meters.

- sitting, with the legs obliquely up to the foot press at 45^0 , pushing the trolley at the end of the respective execution at the moment of approaching the complete stretching of the legs, namely after 160^0 .

The control group followed the training program with specific means of traditional fitness in physical education classes. Schematically, the experiment can be presented as follows:

Control group: pretest (initial test / IT) - no intervention - posttest (final test / FT)

Experimental group: pretest (initial test / IT) - V 1– posttest (final test / FT)

The following tests were used to materialize the strength increase indices:

A. *Squat Jump*:

Description: measures explosive force.

Methodology: on the spot, the student performs a vertical jump helped by a slight flexion of the knee joint and the advancing of the arms in order to reach the highest possible point with the tip of the index finger.

Observations: the distance between the initial position with the arm stretched vertically and the maximum point reached; it is measured in centimetres.

B. *Triple jump from the spot*

Description: measures the explosive force of the legs.

Methodology: from the stand with the legs apart at shoulder level, two jumping steps are performed followed by a long jump with landing on a soft surface (mattress or sand).

Observations: the test is performed twice and is measured in meters.

C. *Penta jump from the spot*:

Description: measures the explosive force of the legs.

Methodology: from the stand with the legs apart at shoulder level, perform four jumped steps followed by a long jump with landing on a soft surface (mattress or sand).

Observations: the test is performed twice and is measured in meters.

D. *Long jump from the spot*

Description: measures the explosive force of the legs.

Methodology: the departure, as well as the landing in the jump, is done simultaneously on two legs. The departure in the jump is done with the

knees bent and with a balance of the arms back and forth to facilitate an efficient detachment.

Observations: it is measured in meters, 2 tests are performed taking into account the longest jump; it is executed on an adherent flat surface.

2.5. Statistical Analysis

Statistical data processing was made using SPSS program calculating the descriptive data: mean, the error of standard mean, SD standard deviation; sum. To highlight the fact that the chosen training program produces significant effects, in terms of the results obtained, the dependent and independent t-test was applied, the level of significance being established in our case for $N = 20$, at the level of $p < 0.05$. The calculations of the statistical values mentioned above were performed using the SPSS program.

3. Results

Through this study, we wanted to find out if there are significant differences between the results of the two groups (experimental and control groups) at the end of the experimental intervention, by applying drive systems, using modern and traditional fitness means, to improve strength at the level of the lower limbs of adolescents.

Thus, in the *Squat Jump* test, the subjects of the Experiment group registered a statistically significant increase between the two tests, from an average of 5.63 cm at the initial test to an average of 7.10 cm at the final test, the increase being 1.48 cm (26.6%), according to table 2. The statistically significant difference is demonstrated by applying the dependent T-test, the calculated value of t being 10.473, and the value of p being 0.000, less than 0.005. In the case of this group, the homogeneity of the group is high in both the initial test and the final test, the value of the coefficient of variation being 17.1% in the initial test and 11.7% in the final test, respectively.

The subjects of the Control group registered a statistically significant increase between the two tests, from an average of 6.90 cm at the initial test to an average of 7.18 cm at the final test, the increase being 0.28 cm (an increase of 4.1%). The statistically significant difference is demonstrated by applying the dependent T-test, the calculated value of t being 4,326, and the value of p being 0.000, less than 0.005. In the case of this group, the homogeneity of the group is average for both the initial test and the final test, the value of the coefficient of variation being 22.4% at the initial test and 22.5% at the final test (Table 2, figure 1).

Table 2 Squat Jump (cm)

Group	Test	Experimental		Control	
		Initial Test	Final Test	Initial Test	Final Test
Arithmetic Average		5.63	7.10	6.90	7.18
Median		5.55	6.90	6.90	7.00
Diff. (TI-TF)	Diff.	1.48		0.28	
	%	26.6%		4.1%	
Standard deviation		0.960	0.833	1.546	1.618
Coefficient of variation		17.1%	11.7%	22.4%	22.5%
T Test Dependent (IT - FT)	t	10.473		4.326	
	p	0.000		0.000	
T Test Independent (Experiment vs. Control Initial Test)	t			3.132	
	p			0.004	
T Test Independent (Experiment vs. Control Final test)	t			0.197	
	p			0.846

Figure 1 Squat Jump (cm) – Medium values

In the *Triple Jump* test, the subjects of the Experiment group registered a statistically significant increase between the two tests, from an average of 2.60 m at the initial test to an average of 2.99 m at the final test, the increase is 0.39 m (15.8%), according to table 3. The statistically significant difference is demonstrated by applying the dependent T-test, the value of t calculated being 11,826, and the value of p being 0.004, less than 0.005. In the case of this group, the homogeneity of the group is high in both the initial test and the final test, the value of the coefficient of variation being 15.8% in the initial test and 7.6% in the final test, respectively.

The subjects of the Control group registered a statistically significant increase between the two tests, from an average of 2.44 m at the initial test to an average of 2.62 m at the final test, the increase being 0.18 m (an increase of 7.6%). The statistically significant difference is demonstrated by applying the dependent T-test, the calculated value of t being 8,745, and the value of p being 0.001, less than 0.005. In the case of this group, the homogeneity of the group is high in both the initial test and the final test, the value of the coefficient of variation being 11.5% in the initial test and 11.8% in the final test, respectively.

At the final testing, the results of the Experiment group are statistically significantly higher than those of the Control group, a fact demonstrated by applying the independent t -test, the calculated t value being 3.355 and the p -value 0.002, lower than the threshold of 0.005.

Table 3 Triple jump from the spot (m)

Group		Experimental		Control	
Test		Initial Test	Final Test	Initial Test	Final Test
Arithmetic Average		20	20	20	20
Median		2.60	2.99	2.44	2.62
Median		2.50	2.90	2.38	2.53
Diff. (TI-TF)	Diff.	0.39		0.18	
	%	15.8%		7.6%	
Standard deviation		0.357	0.388	0.282	0.308
Coefficient of variation		13.8%	13.0%	11.5%	11.8%
T -Test Dependent (TI - TF)	t	11.826		8.745	
	p	0.004		0.001	
T-Test Independent (Experiment vs. Control Initial test)	t	1.543			
	p	0.131			
T-Test Independent (Experiment vs. Control Final Test)	t	3.355			
	p	0.002

Figure 2 Triple jump (m)

In the *Penta jump* test, the subjects of the Experiment group registered a statistically significant increase between the two tests, from an average of 3.40 m at the initial test to an average of 3.78 m at the final test, the increase being 0.37 m according to table 4 (an increase of 11.3%). The statistically significant difference is demonstrated by applying the dependent T-test, the calculated value of t being 9.046, and the value of p being 0.003, less than 0.005. In the case of this group, the homogeneity of the group is high in both the initial test and the final test, the value of the coefficient of variation being 8.8% at the initial test and 9.4% at the final test, respectively.

The subjects of the Control group registered a statistically significant increase between the two tests, from an average of 3.58 m at the initial test to an average of 3.63 m at the final test, the increase being 0.06 m (an increase of 1.6%). The statistically significant difference is demonstrated by applying the dependent T-test, the value of t calculated being 6.006, and the value of p being 0.002, less than 0.005. In the case of this group, the homogeneity of the group is high in both the initial test and the final test, the value of the coefficient of variation being 8.8% in the initial test and 9.0% in the final test, respectively.

Table 4 Penta jump from the spot (m)

Group Test		Experimental		Control	
		Initial Test	Final Test	Initial Test	Final Test
Arithmetic Average		20	20	20	20
Median		3.40	3.78	3.58	3.63
Median		3.30	3.80	3.69	3.76
Diff. (TI-TF)	Diff.	0.37		0.06	
	%	11.3%		1.6%	
Standard deviation		0.355		0.315	0.327
Coefficient of variation		9.4%		8.8%	9.0%
Testul T Dependent (TI - TF)	t calculated	9.046		6.006	
	p	0.003		0.002	
T Test Independent (Experiment vs. Control Initial test)	t calculated	1.782			
	p	0.083			
T Test Independent (Experiment vs. Control Final Test)	t calculated	1.322			
	p	0.194

Figure 3 Penta jump (m)

In the *Long Jump* on the spot, the subjects of the Experiment group registered a statistically significant increase between the two tests, from an average of 1.39 m at the initial test to an average of 1.62 m at the final test, the increase being 0.23 m according to table 4 (an increase of 16.0%). The statistically significant difference is demonstrated by applying the dependent T-test, the calculated value of t being 6,790, and the value of p being 0.004, less than 0.005. In the case of this group, the homogeneity of the group is high in both the initial test and the final test, the value of the coefficient of variation being 8.8% at the initial test and 9.4% at the final test, respectively.

The subjects of the Control group registered maintenance between the two tests at an average of 1.40m. In the case of this group, the homogeneity of the group is high in both the initial test and the final test, the value of the coefficient of variation being 14.4% in the initial test and 12.9% in the final test, respectively.

At the final testing, the results of the Experiment group are statistically significantly higher than those of the Control group, a fact demonstrated by applying the independent t-test, the calculated t value being 4.115 and the p-value 0.002, lower than the threshold of 0.005.

Table 5 Long jump from the spot (m)

Group		Experimental		Control	
Test		Initial Test	Final Test	Initial Test	Final Test
Arithmetic Average		20	20	20	20
Median		1.39	1.62	1.40	1.40
Median		1.43	1.60	1.35	1.35
Diff. (TI-TF)	Diff.	0.23		0.00	
	%	16.0%		-0.2%	
Standard deviation			0.158	0.201	0.180
Coefficient of variation			9.8%	14.4%	12.9%
T Test Dependent (TI - TF)	t calculated	6.790		0.383	
	p	0.004		0.706	
T Test Independent (Experiment vs. Control Initial test)	t calculated			0.164	
	p			0.871	
T Test Independent		t calculated		4.115	

(Experiment vs. Control Final Test)	p	0.002
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4. Discussions

The theoretical analysis and generalization of the experimental data allowed to establish the effective influence of the “work with relief” method on the development of the force at the level of the lower limbs, according to the intervention programs carried out by the investigated subjects.

According to existing studies in the literature (Huotari et al., 2013; Mozolev et al., 2019; Blando, 2012; Kamandulis, 2013; Pricop et al., 2018), the implementation of methods for the development of strength in adolescents, in the lessons of Physical education, using the means of fitness have contributed to the development of students' motor skills, physical health and physical activity of young girls.

The results obtained in our study confirmed the data of previous research on modernizing the educational process in the lesson of physical education through the comprehensive use of modern fitness technology (Masteller, 2018; Kolokoltsev et al., 2018; Zhamardiy et al., 2019; Pricop et al. 2016). The validity of the teaching strategy was also highlighted, which confirms the research hypothesis. Improving strength indices in the lower limbs (initial and final testing) emphasizes the effectiveness of the "work with relief" method.

We consider that the information obtained from the study, regarding the level of strength development in adolescents, represent important landmarks in the design of the teaching strategy and its application in physical education lessons.

5. Conclusions

The analysis of the scores recorded in the 4 tests, which highlights the motor profile, shows that the average result determined statistically-mathematically for adolescents who practised specific means "work with relief" is significantly higher than the average score obtained by adolescents who practice traditional fitness.

The study confirmed and expanded scientific views on the need to systematically improve and assess the level of development of adolescent strength so that timely changes and adjustments to the training process in the physical education lesson are possible.

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All authors contributed equally to this study and should be considered as main authors.

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