Health, Sports & Rehabilitation Medicine
Vol. 21, no. 4, October-December 2020, 223–230

Comparative study on the development of the motor skill (strength) through the circuit method versus dynamic games in physical education classes

Ramona Elena Tulbure-Andone, Nicolae Neagu, Dan Alexandru Szabo
"George Emil Palade" University of Medicine, Pharmacy, Science, and Technology, Targu Mures, Romania

Abstract

Background. A balanced lifestyle has long been synonymous with physical activity. Unfortunately, nowadays, there is a decline in physical activity due to the advancement of technology and the economy, the installation of sedentarism, which implicitly contributes to a reversal of physical development and metabolic changes.

Aims. The research aimed to create an informative document as objective as possible on developing motor quality indices of *the strength* of 18 students enrolled in the research, using the circuit method through testing and comparing the results obtained with motor quality strength.

Methods. The research took place at the gymnasium of the "Augustin Maior" Middle School in the municipality of Reghin. The experiment took place over six weeks, and the test period took place between January 13 and February 28, 2020, on a sample of 18 students.

Results. Following the final evaluation samples, the experimental girls and boys group achieved more significant progress than the control group.

Conclusions. We conclude, according to the above findings, that the hypothesis we started from was disproved. Even if there was a slight improvement compared to the control group in the experimental group to which the circuit method was applied for the production of strength, it was not proven that the circuit work method used in eighth graders would be more successful than the method of using dynamic games for the development of strength.

Keywords: motor skill, strength, dynamic games.

Introduction

This article aims to address the comparative study of strength motor quality development through the circuit method versus dynamic games in physical education classes.

Physical activity has always been associated with a healthy lifestyle. Unfortunately, nowadays, due to the development of technology and economy, there is a decrease in physical exertion, the adoption of a sedentary life, which implicitly leads to a regression of physical development and muscular metabolic changes.

Physical activity can occur spontaneously (leisure/work/transport) or it can be organized and divided according to its purpose: Physical exercise aims primarily to improve health and physical capacity. Physical training aims to increase the individual's maximum physical capacity and performance (Malm et al., 2019).

Puberty is the stage of life that progresses to adulthood through drastic physiologic and psychological changes. The emergence of secondary sex characteristics, especially the appearance of breasts in females, testicular enlargement in males, and pubic/axillary hair in both sexes, clinically announces the onset of puberty. According to Tanner's standards, these characteristics develop from appearance to maturity and are rated in five phases (Tanner, 1962; Beccuti & Ghizzoni et al., 2010).

Besides the physiological changes that exemplify puberty, numerous psychological and interpersonal problems characterize the pubertal experience (Graber, 2013; Thompson et al., 2016). The transition to puberty among girls is characterized by a drastic rise in the rates of depressive symptoms, promoting the development of a gender gap in the prevalence of depression that persists for most of adulthood (Kessler, 2003; Kuehner, 2003; Wade et al., 2002; Thompson et al., 2016). Given the severity of the gender gap in the prevalence of depression, it is

Received: 2020, September 14; *Accepted for publication:* 2020, September 20
Address for correspondence: "George Emil Palade" University of Medicine, Pharmacy, Science, and Technology of Targu Mures, Gheorghe Marinescu Street. no. 38, 540139, Romania
E-mail: dan-alexandru.szabo@umfst.ro
Corresponding author: Dan Alexandru Szabo, dan-alexandru.szabo@umfst.ro
https://doi.org/10.26659/pm3.2020.21.4.223

crucial to recognize variables that may lead to the onset and persistence of increased depressive symptoms among women. Research has shown that differences in puberty experience can lead to increases in adolescent female depression (Graber, 2013; Mendle et al., 2007; Thompson et al., 2016) and that the impact of puberty on the growth of depression continues throughout adolescence and into emerging adulthood (Copeland et al., 2010; Graber et al., 2004; Thompson et al., 2016).

Adolescence refers to the period marking the transition from childhood to adulthood, in the broadest sense. Historically, this usually ranges from 12 to 18 years of age, approximately corresponding to the period from pubertal onset (i.e., complex hormonal changes) to maturity (i.e., in many countries the legal concept of 'adulthood') (Dahl, 2004; Jaworska & MacQueen, 2015). A biological process characterized by a constellation of events driven by changes in adrenal and gonadal hormones, including secondary sex properties and modulations in muscle and fat, adolescence also co-occurs with puberty (Jaworska & MacQueen, 2015). It is characterized by increased emotional reactivity, and is correlated with a duration of increased risk-taking behaviors (Spear, 2000; Jaworska & MacQueen, 2015)

Puberty is a transformation from a non-reproductive child into a reproductively capable adult, a significant life transition. Puberty and adolescence, the puberty-related developmental period, are periods of major physiological, psychosocial, and cultural shifts. As such, puberty and adolescence are also periods of remarkable plasticity for growth (Dahl & Gunnar, 2009; Patton & Viner, 2007; Holder and Blaustein, 2014).

The development of motor skills is one of the objectives of physical education, which at first glance would be another component of the "motor literacy" of students, but, in the course of our work with them, we have noticed a significant interdependence between the two, defined as "mutual potentiation" (Neagu, 2010).

Motor activity involves every form of movement from spontaneous twitches to goal-directed movements, from head to toe in every part of the body, from solo play to group interactions in every physical and social sense. Motor activity growth bridges the entire lifespan from the first fetal motion to the last dying breath (Adolph & Franchak, 2017).

While movements fundamentally rely on the generation, control, and utilization of physical strength, it takes more than muscles and biomechanics to manage strength. Adaptive movement control depends on the development of core psychological functions (Bernstein, 1996; Gibson, 1994; Adolph & Franchak, 2017). To prepare and direct behavior, awareness and cognition are needed (Keen, 2011; Adolph & Franchak, 2017). Social and cultural influences enhance motor activities and restrict them (Adolph et al., 2010; Adolph & Franchak, 2017). In essence, motor actions include vision, memory, and social contact with the raw material (Gibson, 1988; Piaget, 1954; Adolph & Franchak, 2017). Movements produce perceptual data, provide the means to acquire world knowledge, and make social interactions possible (Adolph & Franchak, 2017).

Good motor skills are considered necessary for the physical, social and psychological growth of children (Gallahue & Ozmun, 2002; Hestbaek et al., 2017) and may also be the basis for an active lifestyle because many studies have shown a strong association between good motor skills and higher levels of physical activity (Lubans et al., 2010; Fisher et al., 2005; Williams et al., 2008; Hestbaek, 2017).

Power is the body's capacity to conduct muscle contraction efforts to resolve, give up, or sustain internal or external resistance. Power, a motor quality, is defined as the maximum or torsional power produced by a muscle or muscle group (twisting strength). Without the presence of power, it is hard to perform any motor activity. The strength conditions the degree of manifestation of the other motor characteristics in general (Bompa & Haff, 2009). The most readily obtained results are obtained by acting correctly on its growth, but at the same time, if it is not used for a long time, it is most easily lost.

In our analysis of the efficiency of using the method of strength development by the circuit method versus motor actions from dynamic games, we tried to apply some tests to effectively measure the level of the strength motor quality in the students of the 8th grades. Thus, we obtained specific objective parameters of the force motor qualities, then comparing the results of the two groups: experimental and control.

This work aims to reiterate the significance of the circuit method by presenting the theoretical benchmarks in the field, the foundation of some basic concepts, and their application in the study.

Material and methods

We complied with the European Union privacy regulations and signed an agreement with every legal respondent from the sample of our subjects, given that our participants were under the age of 18 and are considered minors in our country. All attendees voluntarily took part in the investigation and could discontinue their participation at any time, without any consequence. A trained and independent person obtained the participants' written informed consent.

This investigation was performed in accordance with the Declaration of Helsinki (2013) and was approved by the Ethics Committee of the "George Emil Palade" University of Medicine, Pharmacy, Science, and Technology before the beginning of the study. It also met the ethical standards for Sport and Exercise Science Research.

The research aimed to create an informative document as objective as possible regarding the development level of the indices of the motor quality strength in 18 students enrolled in the study using the circuit method through testing and comparing the results obtained with the level of development of the motor quality strength in 18 students in whom dynamic games were used.

The hypothesis from which we started in the elaboration of the present research was that the development of the motor quality strength during physical education classes in students of the secondary school cycle - 8th grade, by applying the method of the circuit compared to the use of dynamic games, leads to the achievement of superior individual results for the parameters investigated by us.

The research methods were aimed at continuously improving the instructional-educational process with

direct implications on the harmonious development of the students' body, the development of force and the increase in the exercise capacity given the increasing demands of the educational process in general.

In order to carry out this work, we used the following methods in the lessons involved throughout the research:

- verbal methods: verbal exposure, conversation;
- intuitive methods: demonstration, free observation of the execution of other subjects;
- practical method: practice for motor skill training, for the development of motor skills;
- anthropometric method;
- test method;
- the method of data presentations.

Stages of the research

The experiment was designed to take place in three stages:

a) *Stage I*

Stage I included

- Initial investigations/tests, initial assessment of motor skill development, and physical development of strength for both groups (experiment and control).
- Anthropometric measurements: height, weight, total lateral scope.

For the evaluation/investigation of the degree of development of the motor quality strength, the following tools/samples were used:

- long jump from the spot;
- vertical jump;
- push-ups;
- throwing the medicine ball with two hands from the chest;
- lifting the trunk from sitting on the mattress;
- extension of the trunk from supine position.

b) *Stage II*

Stage II consisted of applying the circuit method for strength development in the experimental group, and motor structures of dynamic games with the same purpose in the control group.

c) *Stage III*

Stage III included final testing, recording, and ordering data for processing by the statistical-mathematical method. Another activity of this stage was the analysis by comparing and determining the degree of achievement of the proposed objectives and confirming or disproving the working hypothesis.

Research protocol

a) *Period and place of the research*

The research took place at the gymnasium of the "Augustin Maior" Middle School in the municipality of Reghin. The experiment was conducted over a 6-week observation and testing period between January 13 and February 28, 2020.

b) *Subjects and groups*

The sample of subjects consisted of an experimental group including 18 students (nine girls and nine boys) from the "Augustin Maior" Middle School in Reghin, represented by students of the 8th grade, in whom strength development exercises were used by the circuit method, and a control group also consisting of 18 students (nine girls and nine boys) from the same school, represented by students of the 8th grade A, in whom motor structures were applied for the development of the motor quality strength through dynamic games.

In the experimental group, strength development exercises were applied by the circuit method, while in the control group, strength development through dynamic games was used.

In both the experimental and the control groups, the methods and means used respected the annual and semi-annual planning, as well as the structure of the physical education lesson, the development/education of motor qualities having well-defined locations in the component of this structure, the development of strength being carried out before the "recovery of the body after effort".

c) *Applied tests*

Strength circuit

The strength circuit was organized in 8 workshops:

Development of the strength of the lower limbs:

1. Detachments on the gym bench: the initial standing position, knees slightly bent, the detachments on the bench and return to the original position;
2. Semi-genuflections with lifting on the tips: the initial position standing, the knees bent at 90 degrees, the legs apart at shoulder level, the arms stretched forward, the lifts are performed on the tips with the arms leading up.

Development of the strength of the upper limbs:

1. Floats at the bench for the triceps: the initial support position on the palms and heels, the elbows bent to 90 degrees;
2. Floats at the bench: the initial position: the body stretched in a straight line, in support on the palms with fingers open and the tips, with the arms in full extension and the head in the extension of the body is executed by bending the arms until the chest touches the ground or reaches a few centimeters from it. The return is performed by pushing into the arms until the elbows become entirely stretched.

Development of trunk strength:

1. Front board: maintained in the front board with support on the forearms and tips, the abdomen is strained;
2. Torso lifts with twisting: the initial prone position, hands at the back of the neck, the torso is raised to the right or left with the knee raised at the same time to 90 degrees;
3. Vertical arm and leg shears: initial supine position, arms stretched in torso extension, alternative arm-up lift opposite leg;
4. Board alternated with the knee forward: the initial position: the body stretched in a straight line, in support on the toes and palms, with the arms in full extension and the head in the extension of the body, the knee is alternately brought forward, the torso holding straight, the abdomen strained.

To develop strength, the experimental group used a number of 10 dynamic games specific to the subjects' age.

At the beginning of the experiment, we conducted initial testing and anthropometric measurements in the two groups to determine the level of physical development and individual strength motor quality in the students. At the end of the experiment, we applied identical final evaluation for the two samples to reveal how the experimental class evolved.

We then compared the averages obtained in the initial samples with the averages obtained in the final samples to determine whether the difference was significant.

d) *Statistical processing*

The statistical-mathematical analysis included Sum, Average, and Delta Δ. All the analyses were performed using Microsoft Office 2019 Professional Plus / Microsoft Excel, Product ID: 00414-50000-00000-AA810.

Results

Presentation and interpretation of the results recorded in the measurement of anthropometric indices

Table I shows the measurement of the students' anthropometric indices. Thus, the difference in the mean of the groups is 2.23 for the body height, 4.43 for the body weight, and 1.66 for the total lateral scope, which shows the homogeneity of the groups.

Table I

Centralizer comparing anthropometric indices experimental group/control group - girls.

Groups ↓	Anthropometric indices - averages ($\overline{X}$)		
	AI (MU=cm)	BW (MU=kg)	TLS (MU=cm)
Experimental group	165.56	55.52	164.88
Control group	163.33	51.09	163.22
Delta Δ (ExG/CG)	2.23	4.43	1.66

Table II shows the results of the measurement of the boys' anthropometric indices. The difference in the group mean is 2.23 for the body height, 1.15 for the body weight, and 6.96 for the total lateral scope, the differences being insignificant to the groups.

Table II

Centralizer comparing anthropometric indices experimental group/control group - boys.

Groups ↓	Anthropometric indices - averages ($\overline{X}$)		
	AI (MU=cm)	BW (MU=kg)	TLS (MU=cm)
Experimental group	168.22	61.83	168.66
Control group	171.44	60.68	175.62
Delta Δ (ExG/CG)	-2.23	-1.15	-6.96

Table III shows the difference in the averages of the results recorded after the initial test of the strength motor quality in girls, the experimental group recording the following results compared to the control group:

- in the push-up sample there was a difference of 0.78;
- when throwing the medicine ball from the chest, a difference of 0.7;
- in the trunk lift sample, a difference of 3.89;
- in the trunk extension sample, the difference between groups was 3.22;
- there was a difference of 7.33 between the two groups in the long jump on the spot;
- a difference of 5.45 in the test.

Table III

Comparative average values $\overline{X}$ -girls/ experimental group/control group - Initial Test.

Groups ↓	Comparative strength-average values ($\overline{X}$) girls					
	Upper body				Lower body	
	PU	TMBC	TL	TEx	LJS	VJ
Experimental group	6.78	5.73	19.11	30.44	150.77	28.22
Control group	6.00	5.08	18.23	28.55	143.44	22.77
Delta Δ (ExG/CG)	0.78	0.7	0.89	1.89	7.33	5.45

Legend:
(Ft-It) = the difference between final and initial testing
TMBC = throwing the medicine ball from the chest
TEx = trunk extensions
TL = torso lifts
PU = push-ups
LJS = long jump on the spot
VJ = vertical jump
$\overline{X}$ = group average

At the end of the experiment, we applied identical final evaluation samples for the two groups to reveal how the experimental class evolved.

We then compared the averages obtained in the initial samples with the averages obtained in the final samples to determine whether the difference between the two samples was significant, in which case the hypothesis of the research was confirmed, i.e., the efficiency of the use of the circuit method versus dynamic games in strength development.

Following the final evaluation samples, the experimental girls' group obtained the following results compared to the control group, the results being recorded in Table IV:

- in the push-up test there was a regression of 1.44;
- when throwing the medicine ball from the chest there was a progress of 1.3;
- a progress of 1.00 in the trunk lift sample;
- in the trunk extension sample, there was a progress of 3.00;
- in the long jump on the spot, there was a progress of 3.44;
- in the vertical jump test, a regression of 1.89.

Table IV

Comparative Strength Index Parameters experimental group/ control group - girls - Final Test.

Groups ↓	Comparative strength - average values ($\overline{X}$) girls					
	Upper body				Lower body	
	PU	TMBC	TL	TEx	LJS	VJ
Experimental group	9.67	7.49	24.00	37.66	158.77	30.66
Control group	11.11	6.18	23.00	34.66	155.33	28.77
Delta Δ (ExG/CG)	-1.44	1.3	1.00	3.00	3.44	1.89

Legend:
(Ft-It) = the difference between final and initial testing
TMBC = throwing the medicine ball from the chest
TEx = trunk extensions
TL = torso lifts
PU = push-ups
LJS = long jump on the spot
VJ= vertical jump
$\overline{X}$ = group average

Table V shows the difference in the averages of the results recorded after the initial test of the strength motor quality in boys, the experimental group recording the following results compared to the control group:

- in the push-up test there was a difference of 0.11;
- when throwing the medicine ball from the chest, an insignificant difference of 0.8;
- in the trunk lift sample, a difference of 10.55;
- in the trunk extension sample, the difference between groups was 5.89;
- in the long jump on the spot, there was a significant difference of 10.33 between the two groups;
- a difference of 1.89 in the test.

Table V

Comparative Strength Index Parameters experimental group/control group - boys - Initial Test.

Groups ↓	Comparative strength-average values ($\overline{X}$) boys					
	Upper body				Lower body	
	PU	TMBC	TL	TEx	LJS	VJ
Experimental group	12.00	7.48	18.66	35.77	173.44	29.22
Control group	12.11	7.56	8.11	29.88	183.77	27.33
Delta Δ (ExG/CG)	-0.11	-0.8	10.55	5.89	-10.33	1.89

Legend:
(Ft-It) = the difference between final and initial testing
TMBC = throwing the medicine ball from the chest
TEx = trunk extensions
TL = torso lifts
PU = push-ups
LJS = long jump on the spot
VJ = vertical jump
$\overline{X}$ = group average

Following the final boys' evaluation samples, the experimental group obtained the following results compared to the control group, the results being recorded in Table VI:

- in the push-up test there was a progress of 0.33;
- when throwing the medicine ball from the chest there was a regression of 0.4;
- in the trunk lift sample, a progress of 4.22;
- in the trunk extension sample, there was a progress of 5.89;
- in the long jump on the spot, a regression of 17.00 was recorded;
- in the vertical jump test, a regression of 0.23.

Table VI

Comparative Strength Index Parameters experimental group/ control group - boys - Final Test.

Groups ↓	Comparative strength-average values ($\overline{X}$) boys					
	Upper body				Lower body	
	PU	TMBC	TL	TEx	LJS	VJ
Experimental group	18.33	8.57	27.44	35.77	181.33	36.77
Control group	18.00	8.97	23.2	29.88	198.3	37.00
Delta Δ (ExG/CG)	0.33	-0.4	4.22	5.89	-17.00	-0.23

Legend:
(Ft-It) = the difference between final and initial testing
TMBC = throwing the medicine ball from the chest
TEx = trunk extensions
TL = torso lifts
PU = push-ups
LJS = long jump on the spot
VJ = vertical jump
$\overline{X}$ = group average

The averages of the experimental and girl control groups for the upper body at the initial/final test and the difference between them are recorded in Table VII, and for boys in Table VIII.

Table VII

Centralizer comparing individual parameters of strength / lower body/ girl control group.

Groups ↓	Individual strength/upper body parameters—averages ($\overline{X}$)											
	PU (MU=rep)			TMBC (MU=m)			TL (MU=rep)			TEx (MU=rep)		
	IT	FT	Δ(Ft-It)	IT	FT	Δ(Ft-It)	IT	FT	Δ(Ft-It)	IT	FT	Δ(Ft-It)
Experimental group	6.78	9.67	2.89	5.73	7.49	1.75	19.11	24	4.89	30.44	37.66	6.78
Control group	6.00	11.11	5.11	5.03	6.18	1.15	18.22	23	4.78	28.55	34.66	6.11
Delta Δ (ExG/CG)	0.78	-1.44	-2.22	0.7	1.3	0.6	0.89	1	0.11	1.89	3	0.67

Legend:
(Ft-It) = the difference between final and initial testing; TMBC = throwing the medicine ball from the chest; TEx = trunk extensions; TL = torso lifts; PU = push-ups; LJS = long jump on the spot; VJ= vertical jump; $\overline{X}$ = group average

Table VIII

Centralizer comparing individual parameters of strength / lower body/ boy control group.

Groups ↓	Individual strength/upper body parameters—averages ($\overline{X}$)											
	PU (MU=rep)			TMBC (MU=m)			TL (MU=rep)			TEx (MU=rep)		
	IT	FT	Δ(Ft-It)	IT	FT	Δ(Ft-It)	IT	FT	Δ(Ft-It)	IT	FT	Δ(Ft-It)
Experimental group	12	18.33	6.33	7.48	8.57	1.09	26.77	27.44	0.67	35.77	39.44	3.67
Control group	12.11	18	5.89	7.56	8.97	1.41	18.66	23.22	4.56	29.88	36.77	6.89
Delta Δ (ExG/CG)	-0.11	0.33	0.44	-0.8	-0.4	-0.32	8.11	4.22	-3.89	5.89	2.67	-3.22

Legend:
(Ft-It) = the difference between final and initial testing; TMBC = throwing the medicine ball from the chest; TEx = trunk extensions; TL = torso lifts; PU = push-ups; LJS = long jump on the spot; VJ= vertical jump; $\overline{X}$ = group average

Discussion

To develop healthy behaviors such as physical activity, early childhood is considered crucial (Ward et al., 2010; Zeng et al., 2017). Physical activity services provide young children with an environment for motor skill development, with motor skills being the basis for early and subsequent physical activity years (Jones et al., 2011; Zeng et al., 2017). However, in their motor skills, young children demonstrate inadequate maturity (Hardy et al., 2009; Zeng et al., 2017). Indeed, early childhood environments play an important role in encouraging involvement in physical activity and the development of motor skills since these environments typically provide the resources to incorporate programs for physical activity and motor skills (Ward et al., 2010; Khan & Hillman, 2014; Zeng et al., 2017). Interventions to strengthen young children's motor skills and physical activity have also become priorities (Zeng et al., 2017).

Some authors (Salvy et al., 2008; Adams et al., 2018) observed that children participate in physical activities more passionately and more vigorously while with colleagues in different environments and contexts than when alone. Children at the conventional playground were found to play almost entirely with others in the current study (99 percent) compared to 81% at the contemporaneous and 77% at the escapade recreation ground. More involved play may also have been fostered by this more critical engagement in interactive play. Besides, it was anecdotally found that parents on the conventional playground were more interested in their children's play than parents on the adventure playground who appeared to observe from far away. By developing a positive environment throughout recreation and physical behavior, involved begetters have appeared to motivate kids to play (Gustafson & Rhodes, 2006; Adams et al., 2018). This indicates that physical activity levels can be positively influenced by playing with others (Salvy et al., 2009; Adams et al., 2018). The relationship is considered mutual between abilities and physical activity. It is expected that physical activity participation will also increase as motor skill competence increases, and increased participation will feedback into motor skill competence (***, 2013). Due to various variables, including environmental factors, circumstances, parental pressure, and past participation in physical education programs, the bilateral connection between motor ability competence and physical behavior lacks the early boyhood phases (Stodden et al., 2008; ***, 2013). Youngsters in this period are also less capable of differentiating continually between supposed physical skills and precise motor skills competences (Harter & Pike, 1984; Goodway & Rudisill, 1997; Robinson & Goodway, 2009; Robinson, 2011), and motor abilities are supposed to have an enormous impact on physical activity (***, 2013). This hypothesis is confirmed in the leaflet, as demonstrated by soft to acceptable associations between motor skill capability and pre-school physical movement (Sääkslahti et al., 1999; Williams et al., 2008; Cliff et al., 2009; Robinson & Goodway, 2009; Robinson, 2011) and early elementary school age (Raudsepp & Päll, 2006; Hume et al., 2008; Morgan et al., 2008; Houwen et al., 2009; Ziviani et al., 2009; Lopes et al., 2011; ***, 2013) of children. Other scientific papers highlighted the importance of motor development, agility, speed, and balance in sports performance (Sopa, 2015; Sopa & Szabo, 2015; Sopa & Pomohaci, 2016; Sopa, 2019).

The selection and elaboration of the means of action is a fundamental condition, based on which the teacher can shape the content of the instructional-educational activity. They must be appropriate to the dynamic and kinematic structure of the fundamental physical education exercises in secondary classes to correspond to the pupils' behavioral and motivational characteristics.

The results obtained entitle us to say that the proposed means fall within the teaching techniques of physical education and ensure the successful achievement of the objectives of physical education for primary-secondary school students.

The high use of dynamic games leads to students' active participation, improving their motor parameters and motor skill failure. At the same time, they positively influence and develop personality traits such as spirit of competition, attractiveness, attitude, fair play, will, diligence, and determination.

Conclusions

1. According to the results above, the hypothesis from which we started is disproved. Even if the experimental group, to which the circuit method was applied for strength development, had a slightly increased progress compared to the control group, we cannot demonstrate that the circuit work method used in eighth graders would be more effective than the method of using dynamic games for strength development.

2. Thus, while both girls and boys started with insignificant differences at the initial testing, in terms of anthropometric indices and strength parameters, both groups (experimental and control) recorded higher values of strength development indices at the final testing. This leads us to conclude that both methods are useful in physical education classes for 8th grade students to develop the strength motor quality.

3. On the other hand, during the experiment, we noticed that students were more stimulated and engaged in running dynamic games instead of repetitive structures.

4. The high use of dynamic games led to students' active participation in improving their motor parameters.

Limitations of the study

Given the small number of subjects in our research, the findings that emerged are relevant, with some limitations regarding the statistical interpretation and validity of the results. In order to achieve greater relevance, similar studies should be extended to more comprehensive samples of subjects.

Conflicts of interests

Nothing to declare.

References

Adams J, Veitch J, Barnett L. Physical Activity and Fundamental Motor Skill Performance of 5-10 Year Old Children in Three

Different Playgrounds. Int J Environ Res Public Health. 2018;15(9):1896. doi:10.3390/ijerph15091896.

Adolph KE, Franchak JM. The development of motor behavior. Wiley Interdiscip Rev Cogn Sci. 2017;8(1-2):10.1002/wcs.1430. doi:10.1002/wcs.1430.

Adolph KE, Karasik LB, Tamis-LeMonda CS. Motor skills. In: Bornstein MH, ed. Handbook of cultural development science. Vol. 1. Domains of development across cultures. New York, NY: Taylor and Francis; 2010,61-88.

Beccuti G, Ghizzoni L. Normal and Abnormal Puberty. [Updated 2015 8 August]. In: Feingold KR, Anawalt B, Boyce A, et al., ed. Endotext [Internet]. South Dartmouth (MA): MDText.com, Inc.; 2000—. Available from: https://www.ncbi.nlm.nih.gov/books/NBK279024/Case-Smith J. Occupational therapy in children. Elsevier Mosby: St. Louis, 2010.

Bernstein NA. Dexterity and its development. In: Latash ML, Turvey MT ed. Dexterity and its development. Mahwah NJ: Erlbaum; 1996, 3-244. doi: 10.1002/wcs.1430.

Bompa T, Haff G. Periodization: theory and methodology of training. Human Kinetics; Champaign IL: 2009, 63-84.

Cliff D, Okely A, Smith L, McKeen K. Relationships between fundamental movement skills and objectively measured physical activity in pre-school children. Pediatr Exerc Sci. 2009;21(4):436. doi: 10.1123/pes.21.4.436.

Copeland W, Shanahan L, Miller S, Costello EJ, Angold A, Maughan B. Outcomes of early pubertal timing in young women: A prospective population-based study. J Psychiatry. 2010;167(10):1218-1225. doi: 10.1176/appi.ajp.2010.09081190.

Dahl RE, Gunnar MR. Heightened stress responsiveness and emotional reactivity during pubertal maturation: implications for psychopathology. Dev Psychopathol. 2009;21(1):1-6. doi: 10.1017/S0954579409000017.

Dahl RE. Adolescent brain development: a period of vulnerabilities and opportunities. Keynote address. Ann N Y Acad Sci. 2004;1021:1-22. doi: 10.1196/annals.1308.001.

Fisher A, Reilly JJ, Kelly LA, Montgomery C, Williamson A, Paton JY, Grant S. Fundamental movement skills and habitual physical activity in young children. Med Sci Sports Exerc. 2005;37(4):684–688. doi: 10.1249/01.MSS.0000159138.48107.7D.

Gallahue DL, Ozmun JC. Motor Development: A theoretical model. Understanding motor development: infants, children, adolescents, adults. 5th ed. New York: McGraw-Hill, 2002.

Gibson EJ. Exploratory behavior in the development of perceiving, acting, and the acquiring of knowledge. Ann Rev Psychol. 1988;39:1-42.

Gibson EJ. Has psychology a future? Psychol Sci. 1994;5(2):69-76. doi: 10.1111/j.1467-9280.1994.tb00633.x.

Goodway JD, Rudisill ME. Perceived physical competence and actual motor skill competence of African American preschool children. Adapted Phys Activ Q. 1997;14:314-326.

Graber JA, Seeley JR, Brooks-Gunn J, Lewinsohn PM. Is pubertal timing associated with psychopathology in young adulthood? J Am Acad Child Adolesc Psychiatry. 2004;43(6):718-726. doi: 10.1097/01.chi.0000120022.14101.11.

Graber JA. Pubertal timing and the development of psychopathology in adolescence and beyond. Horm Behav. 2013;64:262-269. doi: 10.1016/j.yhbeh.2013.04.003.

Gustafson S, Rhodes R. Parental correlates of physical activity in children and early adolescents. Sports Med. 2006;36(1):79-97. doi: 10.2165/00007256-200636010-00006.

Hardy LL, King L, Farrell L, Macniven R, Howlett S. Fundamental movement skills among Australian preschool children. J Sci Med Sport. 2010;13(5):503-508. doi: 10.1016/j.jsams.2009.05.010.

Harter S, Pike R. The pictorial scale of perceived competence and social acceptance for young children. Child Dev. 1984;55(6):1969-1982. https://doi.org/10.2307/1129772.

Hestbaek L, Andersen ST, Skovgaard T, Olesen LG, Elmose M, Bleses D, Andersen SC, Lauridsen HH. Influence of motor skills training on children's development evaluated in the Motor skills in PreSchool (MiPS) study-DK: study protocol for a randomized controlled trial, nested in a cohort study. Trials. 2017;18(1):400. doi:10.1186/s13063-017-2143-9.

Holder MK, Blaustein JD. Puberty and adolescence as a time of vulnerability to stressors that alter neurobehavioral processes. Front Neuroendocrinol. 2014;35(1):89-110. doi:10.1016/j.yfrne.2013.10.004

Houwen S, Hartman E, Visscher C. Physical activity and motor skills in children with and without visual impairments. Med Sci Sports Exerc. 2009;41(1):103-109. doi: 10.1249/MSS.0b013e318183389d.

Hume C, Okely A, Bagley S, Telford A, Booth M, Crawford D, Salmon J. Does weight status influence associations between children's fundamental movement skills and physical activity. Res Q Exerc Sport. 2008;79(2):158-166. doi: 10.1080/02701367.2008.10599479.

Jaworska N, MacQueen G. Adolescence as a unique developmental period [published correction appears in J Psychiatry Neurosci. 2015;40(5):291-293. doi:10.1503/jpn.150268.

Jones R. A., Riethmuller A., Hesketh K., Trezise J., Batterham M., Okely A. D. Promoting fundamental movement skill development and physical activity in early childhood settings: A cluster randomized controlled trial. Pediatr exerc sci. 2011;23(4):600-615. doi: 10.1123/pes.23.4.600.

Keen R. The development of problem solving in young children: A critical cognitive skill. Annu Rev Psychol. 2011;62:1-21. doi: 10.1146/annurev.psych.031809.130730.

Kessler RC. Epidemiology of women and depression. J Affect Disord. 2003;74(1):5-13. doi: 10.1016/s0165-0327(02)00426-3.

Khan NA, Hillman CH. The relation of childhood physical activity and aerobic fitness to brain function and cognition: a review. Pediatr exerc sci. 2014;26(2):138-146. doi: 10.1123/pes.2013-0125.

Kuehner C. Gender differences in unipolar depression: An update of epidemiological findings and possible explanations. Acta Psychiatr Scand. 2003;108(3):163-174. doi: 10.1034/j.1600-0447.2003.00204.x.

Lopes VP, Rodrigues LP, Maia JA, Malina RM. Motor coordination as predictor of physical activity in childhood. Scand J Med Sci Sports. 2011;21(5):663-669. doi: 10.1111/j.1600-0838.2009.01027.x.

Lubans DR, Morgan PJ, Cliff DP, Barnett LM, Okely AD. Fundamental movement skills in children and adolescents: review of associated health benefits. Sports Med. 2010;40(12):1019-1035. doi: 10.2165/11536850-000000000-00000.

Malm C, Jakobsson J, Isaksson A. Physical Activity and Sports-Real Health Benefits: A Review with Insight into the Public Health of Sweden. Sports (Basel). 2019;7(5):127. doi:10.3390/sports7050127.

Mendle J, Turkheimer E, Emery RE. Detrimental psychological outcomes associated with early pubertal timing in adolescent girls. Dev Rev. 2007;27:151-171. doi: 10.1016/j.dr.2006.11.001.

Morgan PJ, Okely AD, Cliff DP, Jones RA, Baur LA. Correlates of objectively measured physical activity in obese children. Obesity. 2008;16(12):2634-2641. doi: 10.1038/oby.2008.463.

Neagu N. Teoria şi practica activităţii motrice umane (Theory and practice of human motor activity). Univ Press. Târgu Mureş, 2010.

Patton GC, Viner R. Pubertal transitions in health. Lancet. 2007;

369(9567):1130-9. doi: 10.1016/S0140-6736(07)60366-3.

Piaget J. The construction of reality in the child. New York: Basic Books, 1954.

Raudsepp L, Päll P. The relationship between fundamental motor skills and outside-school physical activity of elementary school children. Pediatr Exerc Sci. 2006;18(4):426-435. DOI: 10.1123/pes.18.4.426.

Robinson LE, Goodway JD. Instructional climates in pre-school children who are at risk. Part I: object-control skill development. Res Q Exerc Sport. 2009;80(3):533-542. doi: 10.1080/02701367.2009.10599591.

Robinson LE. Effect of a mastery climate motor program on object control skills and perceived physical competence in preschoolers. Res Q Exerc Sport. 2011;82(2):355-359. doi: 10.1080/02701367.2011.10599764.

Sääkslahti A, Numminen P, Niinikoski H, Rask-Nissilä L, Viikari J, Tuominen J, Välimäki I. Is physical activity related to body size, fundamental motor skills, and CHD risk factors in early childhood. Pediatr Exerc Sci. 1999;11(4):327-340. DOI: 10.1123/pes.11.4.327.

Salvy S, Bowker J, Roemmich J, Romero N, Kieffer E, Paluch R, Epstein LH. Peer influence on children's physical activity: An experience sampling study. J Pediatr Psychol 2008;33(1):39-49. doi: 10.1093/jpepsy/jsm039.

Salvy S, Roemmich J, Bowker J, Romero N, Stadler P, Epstein L. Effect of peers and friends on youth physical activity and motivation to be physically active. J Pediatr Psychol. 2009;34(2):217-225. doi: 10.1093/jpepsy/jsn071.

Sopa IS. Developing attack point in volleyball game using plyometric exercises in 13-14 years old volleyball players. Bulletin Transilvania Univ Braşov. Series IX, Sci Human Kinetics. 2019; 12(2):67-76.

Sopa IS. Testing agility skill in a basketball team. Discobolul Phys Educ Sport Kinetother J. 2015; 11.2(42):101-108.

Sopa IS, Pomohaci M. Study regarding the development of agility skills of students aged between 10 and 12 years old. Timişoara Phys Educ Rehabil J. 2016; 9(17):7-16.

Sopa IS, Szabo DA. Testing agility and balance in volleyball game. Discobolul Phys Educ Sport Kinetother J 2015;11.3(41):167-174.

Spear LP. The adolescent brain and age-related behavioral manifestations. Neurosci Biobehav Rev. 2000;24(4):417-463. doi: 10.1016/s0149-7634(00)00014-2.

Stodden DF, Goodway JD, Langendorfer SJ, Roberton MA, Rudisill ME, Garcia C, Garcia LE. A developmental perspective on the role of motor skill competence in physical activity: An emergent relationship. Quest. 2008;60(2):290-306. doi: 10.1080/00336297.2008.10483582.

Tanner JM. Growth at adolescence. 2nd. Springfield: Charles C Thomas 1962.

Thompson SM, Hammen C, Brennan PA. The Impact of Asynchronous Pubertal Development on Depressive Symptoms in Adolescence and Emerging Adulthood Among Females. J Youth Adolesc. 2016;45(3):494-504. doi:10.1007/s10964-015-0402-1.

Wade TJ, Cairney J, Pevalin DJ. Emergence of gender differences in depression during adolescence: National panel results from three countries. J American Acad Child Adolesc Psychiatry. 2002;41(2):190-198. doi: 10.1097/00004583-200202000-00013.

Ward DS, Vaughn A, McWilliams C, Hales D. Interventions for increasing physical activity at child care. Med Sci Sports Exerc. 2010;42(3):526-534. doi: 10.1249/MSS.0b013e3181cea406.

Williams HG, Pfeiffer KA, O'Neill JR, Dowda M, McIver KL, Brown WH, Pate RR. Motor skill performance and physical activity in pre-school children. Obesity. 2008;16(6):1421-1426. doi: 10.1038/oby.2008.214.

Zeng N, Ayyub M, Sun H, Wen X, Xiang P, Gao Z. Effects of Physical Activity on Motor Skills and Cognitive Development in Early Childhood: A Systematic Review. Biomed Res Int. 2017;2017:2760716. doi:10.1155/2017/2760716.

Ziviani J, Poulsen A, Hansen C. Movement skills proficiency and physical activity: A case for Engaging and Coaching for Health (EACH)-child. Aust Occup Ther J. 2009;56(4):259-265. doi: 10.1111/j.1440-1630.2008.00758.x.

***. Committee on Physical Activity and Physical Education in the School Environment; Food and Nutrition Board; Institute of Medicine; Kohl HW III, Cook HD, editors. Educating the Student Body: Taking Physical Activity and Physical Education to School. Washington (DC): National Academies Press (US); 2013 October 30. 3, Physical Activity and Physical Education: Relationship to Growth, Development, and Health. Available from: https://www.ncbi.nlm.nih.gov/books/NBK201497/