

Original Article

The influence of sports gymnastics on the motor skills of male students

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Abstract

The aim of this research is to determine the influence of the sports gymnastics program on the motor skills of male students. The research hypothesis is that a 15-week gymnastics training program will have positive influence on the motor skills of male students. The research was conducted on a sample of 54 male students aged 20-22 years \pm 6 months. A sample of specific motor tests for sports gymnastics: push-ups, pull-ups, sweeps, long jump, trunk lifting, leg lifting, lunge, squat. Despite the limitations of the study, it can be concluded that the experimental program of sports gymnastics lasting is an effective method that leads to a statistically significant improvement in motor skills of male students.

1. Introduction

Teaching physical education is very important in period of physical growth and development. Knowing what impact physical activity has on the growth and development of a child's organism, it is necessary to introduce additional classes or

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extracurricular activities into the curriculum (Aksović, Bjelica, Jovanović, Milanović, & Zelenović 2021). However, in practice this teaching is not conducted regularly or is not conducted by physical education pedagogues. Already in this period, by strengthening the organism, the child becomes capable of mastering the technique of certain sports disciplines, and it is necessary to facilitate the development of the child's basic psychophysical qualities through supplementary exercises and training of various sports disciplines (Modra, Bota, & Petracovschi, 2022).

Today, sports gymnastics undoubtedly represents a sports competition that reaches the highest level of artistic achievement. The development trend of top sports in general, and sports gymnastics in particular, most seriously confirms the unpredictability of human capabilities (Cabrejas et al., 2022). As a rule, evidence of overcoming limits in sport is new, very numerous exercises that innovators in sports gymnastics show from competition to competition (Potop, Boloban, Ulareanu, & Timnea, 2014).

The importance of motor skills in gymnastics is confirmed by numerous studies (Taboada-Iglesias, Santana, & Gutiérrez-Sánchez, 2017; Dallas, Theodorou, & Paradisis, 2019; Yılmaz, & Sicim-Sevim, 2020; Kravchuk, Sanzharova, Golenkova, & Katrechko, 2020; Bavli, & Dönmez, 2020). As a basic sport, gymnastics affects the development of motor skills: strength, coordination, flexibility and balance (Dimitrova, 2015; Vernetta, Maria Pelaez-Barrios, & López-Bedoya, 2022). Kravchuk et al. (2020) clearly indicate a significant positive impact of parterre exercises on the development of flexibility in young gymnasts. Paunović (2018) obtained results that show the positive effects of the implementation of the sports gymnastics program in the physical education curriculum for adolescents for 16 weeks on the body composition, flexibility and motor skills of young gymnasts. On the other hand, it should be emphasized that there are few studies that examine the influence of the program content of sports gymnastics classes among students.

In terms of coordination, gymnastic elements are classified as the most complex movements (Grigoriu, Pricop, Mezei, & Pelin, 2020). Also, testing and periodically monitoring the abilities of young athletes is important for defining training programs adapted to the demands of sport and age (Farana, 2022). In this way, a harmonious and optimal development of fundamental motor skills is achieved in accordance with the athlete's physical development (Dimitrova, 2015). The largest number of tests refers to motor abilities, but also to the assessment of psychological characteristics of gymnasts (Radaš, Milenković, & Milčić, 2022). The specificities of athletes in sports disciplines are the result of selection and, on the other hand, specific effects of activities that this discipline creates (Özer, & Soslu, 2019). In order to achieve top results, it is necessary to train twice a day, six days a week, so that the average number of hours per week is from 27 to 33 hours (Bradshaw, Hume, Calton, & Aisbett, 2010). Individual exercises, like acyclic movements, are composed of dynamic stereotypes into one whole with different connections (Miletić, 2021). Exercising on equipment, as a broader concept of

developmental gymnastics, is a motor activity rich in variety of movements and positions. The wealth of movements and positions in exercising on the devices enables the person who exercises them to create a huge fund of motor knowledge (Paunović, 2018).

Therefore, the aim of this research is to determine the influence of the sports gymnastics program on the motor skills of male students. The research hypothesis is that a 15-week gymnastics training program will have positive influence on the motor skills of male students.

2. Material and methods

The study was designed as a pre-test and post-test experimental study without control group.

Participants

The research was conducted on a sample of 54 regular male students aged 20-22 years \pm 6 months who attended and successfully completed the third-year gymnastics program at the study program of sports and physical education of the State University in Novi Pazar. For the period of one semester (15 weeks), the practice frequency is 2 hours a week. That was the main incentive to focus on the question of the effectiveness of teaching sports gymnastics among students. During the experiment, they did not participate in any other physical activity, and were advised to continue with their daily life activities and with their usual diet. The study was conducted accordingly the Declaration of Helsinki and the protocol was fully approved by the Ethics Committee of the of the State University in Novi Pazar and the Sport and Physical Education study program before commencement.

Sample of variables

A sample of specific motor tests for sports gymnastics (Paunović, 2018; Kravchuk et al., 2020; Miletić, 2021): Push-ups (MPUS), Pull-ups (MPUL), Sweeps (MSWE), Long jump (MLGJ), Trunk lifting (MTLI), Leg lifting (MLLF), Lunge (MLUN), Squat (MSQU).

Procedures

The program consisted of the realization of gymnastic elements from sports gymnastics that were realized in the summer semester and lasted continuously until May 26, 2022. year, more specifically, one semester. Students applied the plan and program that they had to take in the practical part of the exam. At the beginning of the implementation of the program, an initial, and finally a final measurement of the tests represented in the research was carried out, with the aim of determining the variability of the results of the initial and final condition in the students' motor abilities (*a detailed description of the program is given in the Appendix at the end of the paper*).

The initial and final measures was done by professors in the subject of theory and methodology of sports gymnastics. The initial assessment was carried out on February 22, 2022. ie on the first day of work in the 6th semester when, according to the curriculum, the implementation of the Theory and Methodology of Sports Gymnastics course began. The final evaluation was carried out on May 24, i.e. at

the end of the 6th semester. The evaluation was done in the afternoon at a temperature of 18-22 C°.

Table 1. Plan and program
Practical examination for male student

GROUND FLOOR

Part	Description of the exercise	Value
I	With 2-3 steps of running, jumping into a flying reel, with persistence to the halting position, hand over.	1.50
II	Reel forward to the stop in stride, with the trunk bending the arms forward in relinquishment.	0.50
III	By placing the head on the ground by pulling through the legs until connected, stand on the head, hold on.	0.70
IV	By extending the arms, hold on the hands, crouched through to the hold in front of the hands, indicate, turn 180* to the hold on the hands, and sp. sločnosti upor standing, slošno, to cause.	0.80
V	With a deep forward bend, sit and s.p. roll back through the stance on the fists, standing still.	1.00 am
VI	Leaning and with a high foreleg of the right, the page is turned to the right and sp. with a ¼ turn to the right of the hand in a handstand (preparation for the stance on the fists)	1.00 am
VII	Stance on the fists, indicate also sp. roll forward to squat.	0.80
VIII	Lateral circles down in the back of the shoulders to create a "wave" with the trunk, leaning into a standing stance, step forward ld In a jump forward with a change of legs - "back jump"	0.70
IX	By stepping forward with the right and swinging the left, the scale (scale) on the right, hold on.	0.50
X	Leaning, bending and lunging to the position of the fists and sp. "Kurbet jump" - jump from hands to feet, cross-legged jump and sp.	0.50
XI	turn for 180* with arms, frontal circles, landing in a crouch, stance braced to hand.	2.00 am
Total		10.00

HORSE WITH GRIPPERS

Part	Description of the exercise	Value
I	Swing forward with the right leg, swing with the left, and sp. swing with the right leg back to the stop of the front and sp.	1.50
II	Swing forward with the left leg, swing with the right, and sp. swing with the left leg back to the support of the front and sp.	1.50
III	Move forward with right leg then left leg, right leg then left leg back "throwing" and so on.	0.70
IV	Forefoot one-legged circuit left to right.	1.50
V	Move forward with right leg then left leg, right leg then left leg back "throwing" and so on.	0.80
VI	Premah with the right leg and then the left forward and sp. round with one leg left to right to the rear stop.	2.00 am
VII	Premah immediately with the right and then with the left back to the abutment of the front and sp.	0.50

VIII	Premah with the right foot "deflects" a jump left flank towards the device-disconnect.	1.50
Total		10.00
CIRCLES		
Part	Description of the exercise	Value
I	From a simple height, with a reinforced grip and pull.	2.00 am
II	Advantage, hold on.	0.50
III	With the body slowly bent, pull forward until the head is straight, hold on.	0.50
IV	High brought out and sp., with a strengthened backward swing, for them and sp.	1.00 am
V	Spin forward to the top and sp.	2.00 am
VI	Strengthened for them and sp.	1.00 am
VII	With the forehand, a wide back kick "Raznoška" jump to a stance on the ground, a break.	3.00 am
Total		10.00
SKIP		
Jump	Horse - goat height 135cm	Value
I	Dispensing with overhanging above the horizontal.	8.00
II	A crunch with a stretch above the horizontal.	9.00
III	Suffix with a drop above the horizontal.	10.00
LOOM		
Part	Description of the exercise	Value
I	On the first third of the loom, jump into the support, take the front to the support and strengthen it by swinging it, advantage, hold on.	2.50
II	By slowly pulling the stance on the shoulders, hold on.	1.50
III	Handstand, crossing the body through the lower vertical, front support, behind them.	2.00 am
IV	The former fall into the support and sp. with the "Spad splka" stop, for them.	2.50
V	Front leg to the right with a 180* turn to the left.	1.50
Total		10.00
SHAFT		
Part	Description of the exercise	Value
I	From a still height by pulling up, the front stop is connected.	0.50
II	Roll forward in support of the front and sp.	1.50
III	Underhand swing, for them and forehand	1.00 am
IV	Naupor with the curtain on the right lower leg, to the butt of the rider - indicate.	2.00 am
V	With an overhand grip in a move, roll forward in a riding position, a handover in a move.	2.00 am
VI	Premach with the right leg back to the point of the front one.	0.50
VII	One-handed roll back and sp. underhand jump to stance on the ground, disqualify.	2.50
Total		10.00

Statistical analysis

The basic descriptive statistical parameters were calculated, especially for the initial and especially for the final assessment. The evaluation of the effectiveness of the teaching of sports gymnastics was performed by testing the differences of arithmetic means using the student T-test of paired samples.

3. Results

Table 2 shows the basic descriptive parameters of the motor skills of male students at the initial measurement.

Table 2. *Basic statistical parameters of male students at the initial measurement*

Variables	Min	Max	Mean	Std. Dev.	Skewness	Kurtosis
MPUS	16	53	30,98	8,083	,107	-,382
MPUL	0	19	4,54	3,956	1,636	3,101
MSWE	0	12	5,31	2,583	,388	-,190
MLGJ	210	280	243,74	16,819	,363	-,356
MTLI	3	50	27,76	9,186	,345	,500
MLLF	6	40	16,00	8,105	,885	,096
MLUN	3	22	12,81	5,169	-,087	-,723
MSQU	1	30	12,43	7,956	,501	-,612

Legend: Min - minimum value, Max - maximum value, Mean - arithmetic mean, Std. Dev. - standard deviation, Skewness - measure of asymmetry of distribution, Kurtosis - measure of roundness of distribution

Skewness values show that there are no significant deviations from the normal distribution, given that the values do not exceed 1. This means that the distribution of all variables at the initial measurement is symmetrical, that is, that the distribution curve of the results is within normal limits and that there are the most results around the mean value. Only in the case of the MPUL variable (Skewness=1,636), where this value is positive and slightly above the limit, making the distribution curve inclined towards smaller values.

Kurtosis values in all tests are below 2,75, which indicates a platykurtic distribution, i.e. smaller values of the flattening of the result distribution curve indicate that for all variables at the initial measurement the flattening is within the limits of the platykurtic curve. Only for the variable MPUL (Kurtosis=3,101) do the values show a leptokurtic distribution. The obtained results of motor abilities do not deviate from the results of similar research on this population of participants, and thus the application of statistical methods of processing the results in this research is enabled.

Table 3 shows the basic descriptive parameters of motor skills of male students at the final measurement.

Table 3. Basic statistical parameters of male students at the final measurement

Variables	Min	Max	Mean	Std. Dev.	Skewness	Kurtosis
MPUS	20	53	33,89	7,006	,074	,363
MPUL	1	19	6,65	3,958	1,144	1,109
MSWE	2	13	7,81	2,403	-,011	-,153
MLGJ	218	280	249,61	14,600	,278	-,531
MTLI	6	50	30,83	8,018	.025	1,130
MLLF	7	40	19,70	7,726	,405	-,645
MLUN	3	30	16,46	5,830	,030	-,162
MSQU	4	30	15,57	7,873	,395	-,908

Legend: Min – minimum value, Max – maximum value, Mean – arithmetic mean, Std. Dev. – standard deviation, Skewness – measure of asymmetry of distribution, Kurtosis – measure of roundness of distribution.

Skewness values show that there are no significant deviations from the normal distribution, given that the values do not exceed 1. This means that the distribution of all variables at the initial measurement is symmetrical, that is, that the distribution curve of the results is within normal limits and that there are the most results around the mean value. Only in the case of the MPUL variable (Skewness=1,144), where this value is positive and slightly above the limit, making the distribution curve inclined towards smaller values.

Kurtosis values in all tests are below 2,75, which indicates a platykurtic distribution, i.e. smaller values of the flattening of the result distribution curve indicate that for all variables at the initial measurement the flattening is within the limits of the platykurtic curve. The obtained results of motor abilities do not deviate from the results of similar research on this population of participants, and thus the application of statistical methods of processing the results in this research is enabled.

The results of the T-test of paired samples to determine the differences between the initial and final measurements in the applied variables for the assessment of motor abilities between the initial and final measurements are shown in Table 4.

Table 4. Results of T test of paired samples

Statistics	Paired Differences					t	df	p
	Mean	Std. Dev.	Std. Error Mean	95% Con. Interval of the Diff.				
				Lower	Upper			
Pair 1 MPUS - MPUS	-2,907	3,199	,435	-3,781	-2,034	-6,678	53	,000
Pair 2 MPUL - MPUL	-2,111	1,341	,183	-2,477	-1,745	-11,567	53	,000
Pair 3 MSWE - MSWE	-2,500	1,424	,194	-2,889	-2,111	-12,899	53	,000
Pair 4 MLGJ - MLGJ	-5,870	7,631	1,038	-7,953	-3,788	-5,653	53	,000
Pair 5 MTLI - MTLI	-3,074	3,586	,488	-4,053	-2,095	-6,299	53	,000
Pair 6 MLLF - MLLF	-3,704	4,567	,621	-4,950	-2,457	-5,960	53	,000
Pair 7 MLUN - MLUN	-3,648	4,062	,553	-4,757	-2,540	-6,600	53	,000
Pair 8 MSQU - MSQU	-3,148	3,794	,516	-4,184	-2,113	-6,098	53	,000

Based on the results obtained in Table 4 it can be concluded that after the experimental gymnastics program there were statistically significant differences between the initial and final measurements at the level of statistical significance ($p < 0,05$) in all variables MPUS ($t = -6,678$; $p = ,000$), MPUL ($t = -11,567$; $p = ,000$), MSWE ($t = -12,899$; $p = ,000$), MLGJ ($t = -5,653$; $p = ,000$), MTLI ($t = -6,299$; $p = ,000$), MODN ($t = -4,258$; $p = ,001$), MLLF ($t = -5,960$; $p = ,000$), MSQU ($t = -6,098$; $p = ,000$).

Discussions

The research was conducted with the aim of determining the effects of the sports gymnastics program on students' motor skills. The results of the study showed that the experimental program of sports gymnastics lasting 15 weeks (2 hours per week) achieved statistically significantly higher progress compared to the initial measurement among students. This actually means that the experimental gymnastics program had positive effects on the transformation of motor skills in students. The obtained results can be said to be expected. The reason for such a statement lies in the fact that the participants of the study implemented the plan and program of sports gymnastics according to the curriculum within the subject of theory and methodology of sports gymnastics.

The research participants were students (20-22 years old \pm 6 months), whose age is suitable for using adequately planned sports gymnastics exercises. The age of the examinees is an important component because the maturity of the bone-nervous system greatly affects the motor skills of gymnasts (Miletić, Aksović, Bjelica, Veličković, & Ilić, 2022). Certainly, sports gymnastics programs are

recommended for adolescents and children of younger school age (Zetaruk, 2000; Trajković, Madić, Sporiš, Aleksić-Veljković, & Živčić-Marković, 2016; Miletić et al., 2022), because the bone-joint system is in the growth phase, and more intensive ossification begins after the ninth year, but not equally in all body segments (Hassmannová, Pavlů, & Nováková, 2019). Therefore, experimental sports gymnastics programs are fully recommended for all ages as a means of improving motor skills.

Each class in the conducted research involved exercises with the aim of warming up the students' bodies and preparation of the locomotor apparatus for the realization of tasks in the main part of the lesson. During the performance of each exercise in the main part of the class, the correct position and maximum concentration were insisted upon in order to reduce the risk of injuries. In the final part of the lesson the goal was to gradually calm down the students' bodies by applying less dynamic and low-intensity exercises. The fact that no injuries were recorded during the experimental program indicates proper planning and dosage of the load. Numerous authors (Jeričević, Radenović, Horvatin-Fučkar, Antekolović, & Krističević, 2002; Akin, 2013; Paunović, 2018; Miletić et al., 2019; Kravchuk et al., 2020) recommend that the duration of experimental gymnastics programs with positive effects on motor skills is 12 weeks or more. According to their recommendation, the experimental program of sports gymnastics in this study lasted 15 weeks, after which the results confirmed the positive impact on motor skills and the recommendations of previous research. However, some studies indicate that experimental gymnastics programs lasting six weeks (Hall, Bishop, & Gee, 2016) or eight weeks (Ahmed, 2016; Rudd et al., 2017; Sterkowicz-Przybycień et al., 2019) have a positive effect on the motor skills of gymnasts. Therefore, new research is necessary in order to fully clarify the impact of sports gymnastics programs on the motor skills of gymnasts.

It is known that the implementation of sports gymnastics in the curriculum of primary and secondary school students and students develops motor fitness better than the regular curriculum. Miletić (2021) confirmed in her doctoral dissertation that the implementation of the experimental acrobatics program in the curriculum physical education for a duration of 16 weeks achieves greater progress in all variables for the assessment of motor skills and body composition in young gymnasts. Similar results are confirmed by (Ilić, Popović-Ilić, Ilić, Petković, & Mekić, 2014; Rudd, 2016; Dabović, 2017; Madić et al., 2018; Paunović, 2018) where the results showed that the gymnastics program implemented in the physical education curriculum develops motor fitness better than the regular curriculum. Dallas et al. (2019) examined the effects of dynamic restrictions on motor skills, the results showed positive effects on speed and agility. Quite the opposite results were obtained in the study Trajković et al. (2016) where the authors indicate that the gymnastics program has a positive effect on motor fitness, but the effect was absent on agility and sprint speed. Interesting results were obtained in the study Santos, Lebre, & Carvalho (2016) where the results showed that the top gymnasts of the national team do not achieve the expected superiority on tests of explosive strength,

compared to the gymnasts of the junior team.

Therefore, the obtained results clearly indicate the positive effects of the experimental gymnastics program lasting 15 weeks (2 hours per week) on the students' motor abilities, but it is necessary to point out the limitations of the study. The first limitation of this study is the lack of a control group to make the results more objective. Second, although the obtained results indicate a positive impact of the experimental gymnastics program on the motor skills of students, the applicability of the obtained results remains limited to other ages, levels of competition (level of competition) and female gymnasts. This actually means that further studies are necessary to fully clarify the impact of sports gymnastics programs of different durations on the motor skills of male and female gymnasts, which is a recommendation to future researchers on this or a similar topic.

4. Conclusions

The research was carried out on a sample of 54 male students aged 20-22 years \pm 6 months who attended and successfully completed the third-year course in the sports and physical education study program of the State University in Novi Pazar. Despite the limitations of the study, it can be concluded that the experimental program of sports gymnastics lasting 15 weeks (2 hours per week) is an effective method that leads to a statistically significant improvement in motor skills of male students. So, our hypothesis is confirmed. The practical applicability of the obtained results implies supplementing the program that would be applied at faculties within the subject Theory and Methodology of Sports Gymnastics. The results can be used in physical education classes for primary and secondary school students, as well as for supplementing validated test batteries for assessing the physical growth and development of students. Also, trainers and experts in the field of gymnastics need exercises that will contribute to the improvement of motor skills in the shortest possible time, with a reduced risk of injury.

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