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10. МЕЂУНАРОДНА НАУЧНА КОНФЕРЕНЦИЈА
„АНТРОПОЛОШКИ И ТЕОАНТРОПОЛОШКИ ПОГЛЕД НА ФИЗИЧКЕ АКТИВНОСТИ“

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INFLUENCE OF COMBINED TEACHING OF PHYSICAL EDUCATION AND SPORTS GYMNASTICS ON THE ANTHROPOLOGICAL STATUS OF ELEMENTARY SCHOOL STUDENTS

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Abstract: The aim of the research was to determine whether regular physical education classes in combination with additional training in sports gymnastics lead to statistically significant changes in morphological characteristics, motor and functional abilities. The sample of participants consisted of 65 male fifth-grade students aged 11 years (± 0.5 years). In addition to regular classes, the students additionally, once a week for a duration of 60 minutes, applied training in sports gymnastics, for a duration of 12 weeks. Statistically significant changes at the level of statistical significance of ($p<0.05$) occurred in the following variables: body height, body mass, hand tapping, standing long jump, trunk lifting, polygon backwards, standing long jump. For variables: forearm circumference, deep bend various, stand up with a pull-up and running for 3 minutes, there were also differences compared to the initial measurement, however, they are not at a statistically significant level. Therefore, it can be concluded that the teaching of physical education in combination with gymnastics training has a positive effect on the motor abilities and morphological characteristics of the students, while there were no statistically significant transformations in functional ability. The authors of the study are aware of the need to carefully limit their own conclusions considering the age and level of competition, as well as the absence of a control group of participants.

Key words: physical education, sports gymnastics, motor abilities, anthropometry, functional abilities.

INTRODUCTION

Physical education classes for elementary school students are represented three times a week, and this is a period of sensitive phases where students decide which additional sports activity they will apply in order to maintain proper growth and development, i.e. improve the anthropological characteristics of elementary school students (Pržulj et al., 2020). Growth and development during that period is enhanced so that three hours of physical education classes are definitely not enough. This actually means that additional physical activity, in the form of gymnastic training, increases the effects of physical education and positively affects the development of anthropological characteristics in elementary school students (Mekić et al., 2017). However, unfortunately, in spite of these findings, there are still problems in the form of maintaining the quality of class implementation, as well as problems with the status of physical education. Apart from the problems mentioned above, there are also problems related to the effectiveness of physical education classes in younger grades of elementary schools, and some of them are attributed to the effect of endogenous and exogenous factors (Aksović, Bjelica, Jovanović, Zelenović, & Milanović, 2023). Endogenous factors primarily represent the innate characteristics of the individual (psychological, social, motor and biological), while exogenous limiting factors are: lesson fund, work technology, implementation of teaching in accordance with the plan and program, staff expertise, material conditions (Karomatovich, 2022).

Numerous studies have shown the positive effects of teaching physical education in combination with sports gymnastics training. Miletić (2022) conducted a study with the aim of determining the effects of an acrobatics program combined with physical education classes on the fitness components of seventh grade elementary school students. The results of the research showed that after the experimental acrobatics program lasting 16 weeks, the experimental group made statistically significantly greater progress than the control group on all variables that assessed body composition, flexibility and motor fitness. Similar results are confirmed by (Paunović, 2018), where the study showed positive effects of the developmental gymnastics program on the development of motor abilities in elementary school students aged 9 to 11 years. Miletić, Aksović, Bjelica, Ilić, & Zdravković (2022) also showed that teaching physical education in combination with gymnastics training has a positive effect on flexibility and body composition in elementary school students aged 14. The positive effects of the sports gymnastics program have also been proven in female students. Mekić et al. (2022) conducted a study whose primary purpose was to determine the effects of a 15-week sports gymnastics program on the motor skills of female students of the State University in Novi Pazar. Therefore, research examining the effects of sports gymnastics programs in physical education classes clearly show the positive effects of sports gymnastics programs on the anthropological characteristics of elementary school students. On the other hand, Halasi et al. (2018) indicates that physical education classes are not sufficiently intensive and do not have positive effects on the anthropological status of elementary school students. Also, it should be emphasized that the examination of anthropological characteristics among students of younger age categories is not proportionately and sufficiently represented, because in gymnastics, research is mostly carried out at the professional level, that is, with professional gymnasts (Forest, Lenzen, & Öhman, 2018). There is no doubt that determining the status of morphological characteristics, motor and functional abilities makes the orientation process in gymnastics more efficient. This actually means that we should point out the obvious lack of data on the importance of examining anthropological characteristics in elementary school students.

Therefore, the aim of the research was to determine whether regular physical education classes in combination with sports gymnastics training lead to statistically significant changes in morphological characteristics, motor and functional abilities. In relation to the set aim of the research, as well as on the basis of previous research, the following hypothesis is given: There is a statistically significant difference in anthropological characteristics at the final compared to the initial measurement after the application of combined physical education and gymnastics training for 12 weeks.

MATERIAL AND METHODS

Research Pattern

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

Participants

The sample of participants consisted of 65 male students of the fifth grade of the elementary schools "Stefan Nemanja", "Rifat Burdžović Tršo" and "Desanka Maksimović", from the territory of the City of Novi Pazar, aged 11 years (± 0.5 years). In addition to regular physical education classes, the participants applied gymnastics training as a sports activity at school.

Sample of variables

Ten variables were used to assess anthropological characteristics. Three variables were used to assess the morphological characteristics:

Body height (BHE);
Body mass (BMA);
Forearm circumference (FCI).
Six variables were used to assess motor ability:
Hand tapping (HTA);

Standing long jump (SLJ);
Deep bend various (DBV);
Polygon backwards (PBA);
Trunk lifting (TLI);
Stand up with a pull-up (SUP).

One variable was used to assess functional ability:
Running for 3 minutes (R3min).

The mentioned variables are standardly used to monitor the effects of physical education classes, and they were taken from the study (Findak, Metikoš, Mraković, & Neljak, 1996).

Research Design

The initial measurement was carried out at the beginning of the school year and the final measurement at the end of the first semester, i.e. after 12 weeks. Measurements were carried out during regular physical education classes, using standardized measuring instruments with satisfactory metric characteristics (Findak et al., 1996; Paunović, 2018; Miletić, 2022). The measurement was carried out by expert and trained meriocims, physical education professors and students of doctoral academic studies. The participants regularly implemented a program of regular physical education classes twice a week, which was conducted in accordance with the curriculum for their age. In addition to regular classes, the students additionally, once a week for a duration of 60 minutes, applied training in sports gymnastics, for a duration of 12 weeks. In sports gymnastics classes, we worked on the basics of sports gymnastics, where exercises were done on the floor, pommel horse, vault and circles.

Data processing

The evaluation of the effectiveness of the teaching of sports gymnastics was performed by testing the differences of arithmetic means using the t-test of paired samples, within which the basic parameters of descriptive statistics (mean and standard deviation) were calculated. The statistical significance was set at the level of $p<0.05$. All statistical analyses were performed using SPSS 19.0 software (SPSS Inc., Chicago, IL).

RESULTS

Table 1 shows the results of the t-test of paired samples, which checked the statistical significance of the obtained differences between the initial and final measurements in morphological variables.

Table 1 Results of t-test for morphological variables

Variable	Mean	Standard deviation	Paired Differences	t-value	p-level
BHE Initial	147.85	6.63	-3.16	-2.58	0.01
BHE Final	151.01	6.61			
BMA Initial	38,47	9.23	-2.86	-1.67	0.01
BMA Final	41.33	14.52			
FCI Initial	212.49	20.89	-1.78	-0.47	0.63
FCI Final	214.26	20.52			

Table 1 shows the results of the t-test of paired samples of morphological variables, which tested the difference between the initial and final measurements. Based on the obtained results, it can be concluded that after the experimental program there were statistically significant changes, and in a positive sense, at the level of statistical significance of ($p<0.05$). Statistically significant changes at the final measurement were observed in two variables for the assessment of morphological characteristics: body height BHE ($t = 2.58$; $p = 0.01$) and body mass BMA ($t = -1.67$; $p = 0.01$). For the variable forearm

circumference FCI (t = -0.47; p = 0.063) there were changes compared to the initial measurement, however, these changes are not at a statistically significant level.

Table 2 shows the results of the t-test of paired samples, which tested the statistical significance of the obtained differences in motor and functional abilities. Table 2 shows the results of the t-test of paired samples of motor variables and one variable for the assessment of funtctional abilities, which tested the difference between the initial and final measurements. Based on the obtained results, it can be concluded that after the experimental program there were statistically significant changes, and in a positive sense, at the level of statistical significance of ($p<0.05$). Statistically significant changes at the final measurement were observed in the following variables: hand tapping HTA (t = -3.36; p = 0.00), standing long jump SLJ (t = -3.39; p = 0.00), polygon backwards PBA (t = 2.46; p = 0.01), trunk lifting TLI (t = -3.36; p = 0.00).

Table 2 Results of the t-test for the variables of motor abilities and functional abilities

Variables	Mean	Standard deviation	Paired Differences	t-value	p-level
HTA Initial	25.71	3.27	-1.65	-3.36	0.00
HTA Final	27.35	3.05			
SLJ Initial	161.12	19.77	-12.00	-3.39	0.00
SLJ Final	173.12	22,24			
DBV Initial	55.40	8.61	-1.22	-0.82	0.41
DBV Final	56,62	9.07			
PBA Initial	14.49	3.88	1.56	2.46	0.01
PBA Final	12.94	3.15			
TLI Initial	34.78	6.84	-3.71	-3.36	0.00
TLI Final	38,49	5.76			
SUP Initial	29.79	18.69	-4.00	-1.13	0.26
SUP Final	33.79	22.35			
R3min Initial	6.82	3.44	-0.74	-1.40	0.16
R3min Final	7.56	3.09			

For the variables deep bend various DBV (t = -0.82; p = 0.41), stand up with a pull-up SUP (t = -1.13; p = 0.26) and running for 3 minutes R3min (t = -1 .40; p = 0.16) there were changes compared to the initial measurement, however, these changes are not at a statistically significant level.

DISCUSSION

The primary purpose of the study was to examine whether a program of regular physical education classes in combination with sports gymnastics training for 12 weeks leads to statistically significant changes in morphological characteristics, motor and functional abilities. The obtained results showed that there were statistically significant differences compared to the initial measurement in most of the tested variables.

The obtained results show statistically significant changes in two variables for the assessment of morphological characteristics: body height BHE (p = 0.01) and body mass BMA (p = 0.01), while in the variable forearm circumference FCI (p = 0.63) although there was a difference compared to the initial measurement, they are not at a statistically significant level. The average increase in body height of students of 3.16 cm is in accordance with the characteristics of the stage of growth and development for this age. However, it is necessary to take into account the time correction or the difference of 3 months that exists between the initial and final measurement. An average increase in body mass of 2.86 kg can be considered satisfactory from the aspect of maintaining optimal body mass, taking into account that this increase is to a considerable extent conditioned by an increase primarily in the longitudinal dimensions of the skeleton, but probably to a lesser extent and by the observed slight trend of increasing

the range at the expense of a slightly higher proportion of muscle mass. The positive effects of the gymnastics program on the morphological characteristics of elementary school students are also confirmed by other studies (Claessens, Lefevre, Beunen, & Malina, 1999; Kezic, Culjak, Miletic, Kalinski, & Zuvela, 2014; Paunović, 2018; Miletić, Ilić, Jeremić, Parlić, Ilić, & Vidaković, 2019).

In addition to the positive effects on morphological characteristics, the obtained results clearly show the positive effects of the gymnastics program on the students' motor skills in most of the tested variables. Statistically significant changes at the final measurement in relation to the initial measurement were observed in the following variables: hand tapping HTA ($p = 0.00$), standing long jump SLJ ($p = 0.00$), polygon backwards PBA ($p = 0.01$), trunk lifting TLI ($p = 0.00$), while in the case of the variables deep bend various DBV ($p = 0.41$), stand up with a pull-up SUP ($p = 0.26$) and running for 3 minutes R3min ($p = 0.16$) although there have been changes compared to the initial measurement, these changes are not at a statistically significant level.

A significant improvement in the results of speed and explosive power in the HTA and SLJ variables indicate a positive impact of combined teaching with additional activities from sports gymnastics on the development of movement speed and explosive power. The obtained results can be explained by the fact that the gymnastics trainings contained various types of jumps, tumbling during training and team sports games, which due to their structure are conducive to the development of speed-explosive properties. In contrast to the above, strengthening the abdominal musculature and its role in stabilizing the spine is gaining more and more value among experts who work with younger age groups. In accordance with this, there is also a statistically significant improvement in the average score for the TLI. At the same time, there was no significant improvement in the static strengthening of the arms and shoulder girdle, which confirms the correct distribution of priorities in training strength. However, it should be kept in mind that it is less susceptible to changes in static compared to dynamic strength, but also the overall significantly greater possible impact of programmed exercise on strengthening in general in relation to coordination and explosive speed abilities, which are determined to a much greater extent by genetics (Mkaouer, Hammoudi-Nassib, Amara, & Chaabène, 2018; Gasparetto et al., 2022; Cabrejas et al., 2023).

The results of the PBA indicate an intensive development of coordination under the influence of applied kinesiology operators, which is in accordance with the findings of previous research (Delignières et al., 1998; Williams et al., 2016). Since coordination is the foundation for the development of other motor abilities (Farana et al., 2023), the achieved progress encourages and confirms the possible large contribution of additional sports activities to the development of coordination among students of this age. The reason for statistically non-significant changes for flexibility (DBV) should be found in insufficient attention to the development of this ability, both by teachers at school and in the structure of training programs for selected sports (Sands, & McNeal, 2000). On the other hand, studies (Paunović, 2018; Miletić et al., 2022) clearly showed the positive effects of physical education classes in combination with sports gymnastics training on the flexibility of elementary school students.

In the case of the variable for assessing functional abilities R3min, although there was an improvement in the average result compared to the initial measurement, these changes are not at a statistically significant level. The stated reasons may possibly be due to insufficient attention being paid to the development of this ability in 11 years due to outdated beliefs about the unsuitability of children's bodies to stimuli of this type. In the 70s of the last century, some researches believed that the child's organism, and subsequently the aerobic capacity, was functionally limited, which prevented a significant impact on improving endurance (Kirkendall, 1985). Completely opposite results were obtained in studies (Jemni, Sands, Friemel, Stone, & Cooke, 2006; Tibenská, Kyselovičová, & Medeková, 2010) where the results clearly show the positive effects of the gymnastics program on variables for assessing functional abilities in elementary school students. Therefore, further studies are necessary in order to further clarify the effects of the combined physical education and gymnastics program on the motor and functional abilities of elementary school students.

However, the limitations of the study should definitely be emphasized. The first limitation of the study is the lack of a control group, in order to make the obtained results more objective. Second, our study cannot be fully generalized primarily due to the age and gender of the subjects, as well as the level of

competition. However, despite the limitations, we consider our results promising and strongly recommend them to future sports researches to further investigate the role and importance of morphological characteristics, motor and functional abilities in elementary school students, young gymnasts. It seems that even today in some of the most expert scientific circles, the very important role of functional abilities on the overall physical and mental health of gymnasts is not recognized, which is explicitly emphasized in the recommendations of the study (Lamošová, Kyselovičová, & Tomková, 2021) and unequivocally confirmed by numerous researches.

CONCLUSION

The obtained research results indicate the positive effects of combined teaching of physical education and sports gymnastics training on the transformation of morphological characteristics and motor abilities. The expected findings of this study could be significant in early selections and trainings in gymnastics, as well as in determining the specialization and evaluation of young gymnasts. However, the authors of the study are aware of the need to carefully limit their own conclusions considering the age and level of competition, as well as the absence of a control group of participants. Therefore, based on the above, we can conclude that teaching physical education in combination with gymnastics training has a positive effect on the morphological characteristics and motor abilities of students aged 11 years (± 0.5 years), while there were no statistically significant transformations in functional ability. This actually means that further studies are necessary to additionally examine the effects of different types of programmed exercise in order to improve the overall performance of primary school students, young male and female gymnasts.

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UTICAJ KOMBINOVANE NASTAVE FIZIČKOG VASPITANJA I SPORTSKE GIMNASTIKE NA ANTROPOLOŠKI STATUS UČENIKA OSNOVNIH ŠKOLA

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Sažetak: Cilj istraživanja je bio utvrditi da li redovna nastava fizičkog vaspitanja u kombinaciji sa dodatnim treningom iz sportske gimnastike, dovodi do statistički značajnih promena u morfološkim karakteristikama, motoričkim i funkcionalnim sposobnostima. Uzorak ispitanika činilo je 65 učenika muškog pola petog razreda uzrasta 11 godina (± 0.5 godina). Pored redovne nastave učenici su dodatno, jednom nedeljno u trajanju od 60 min, primenjivali trening iz sportske gimnatike, u trajanju od 12 nedelja. Do statistički značajnih promena na nivou statističke značajnosti od ($p<0.05$), došlo je kod sledećih varijabli: telesna visina, telesna masa, taping rukom, podizanje trupa, poligon natraške, skok udalj iz mesta. Kod varijabli: obim podlaktice, pretklon raznožno, izdržaj u visu zgibom i trčanje na 3 minuta je takodje došlo do razlika u odnosu na inicijalno merenje, medjutim one nisu na statistički značajnom nivou. Dakle, može se zaključiti da nastava fizičkog vaspitanja u kombinaciji treningom gimnastike pozitivno utiče na motoričke sposobnosti i morfološke karakteristike učenika, dok kod aerobne izdržljivosti nije došlo do statistički značajnih transformacija. Autori studije su svesni potrebe pažljivog ograničavanja vlastitih zaključaka sa obzirom na uzrast i nivo takmičenja, kao i nepostojanje