FACTA UNIVERSITATIS
Series: **Physical Education and Sport** Vol. 7, Nº 1, 2009, pp. 101 - 112

Original empirical article

THE RELATIONS BETWEEN ANTHROPOMETRIC CHARACTERISTICS AND COORDINATION SKILLS

UDC 796.012.2:572.08

Radmila Kostić, Ratomir Đurašković, Saša Pantelić, Dobrica Živković, Slavoljub Uzunović, Mladen Živković

Faculty of Sport and Physical Education, University of Niš, Serbia

Abstract. *The aim of the research was to determine the nature of the relation between the anthropometric characteristics and coordination skills on a sample of girls and boys. A total of 91 boys and 85 girls made up the sample of subjects. They were all first grade elementary school students from Niš. We used three measures for the evaluation of longitudinal dimensionality (body height, leg length, and arm length), three measures for the evaluation of transversal dimensionality (shoulder width, pelvic width and hip width), five measures for the evaluation of circular dimensionality and body mass (body weight, thorax volume, upper arm volume, thigh volume and calf volume)and five measures for the evaluation of subcutaneous fatty tissue (triceps skin folds, subscapular skin folds, abdominal skin folds, thigh skin folds and medial calf skin folds). The following measuring instruments were used for the evaluation of coordination skills: horizontal jump rope, 20 side steps with a baton, and running and rolling (a newly constructed test). A multivariate analysis of variance showed that there is a statistically significant difference between the coordination skills of the boys and girls at the p=0.003 level. There is no statistically significant connection between the anthropometric characteristics and coordination skills for the sample of boys, while there is one for the girls. The resulting canonical factor of anthropometric characteristics was defined as the factor of transversal dimensionality, circular dimensionality and subcutaneous fatty tissue, and the canonical factor of coordination skills was defined as the general factor of coordination.*

Key words: *anthropometrics, coordination, relations, skills, children*

Received March 31, 2009 / Accepted May 15, 2009
Corresponding author: Radmila Kostić
Faculty of Sport and Physical Education, 18000 Niš, Čarnojevica 10/a, Serbia
Tel: +381 18 526 804 • Fax: +381 18 242 482 • E-mail: rkost@medianis.net

INTRODUCTION

Coordination skills are a complex motor skill which can be further developed by means of exercise. During exercise, complete movement structures are repeated, in which the movement of all the body parts or just certain sections of the body are connected. Coordination skills are especially pronounced during physical activities, sport, recreational activities, fitness or kinesitherapy. Neuro-muscular activity represents the basic function in all forms of physical activity and is used to harmonize the movement of the body and all its parts in time and space. The efficiency of movement and individual motions depends on the ability of the athlete, person involved in recreational activities, or other participants in physical exercise to harmonize various skills with the anthropometric characteristics of his own body. Considering the fact that physical exercise practice has pointed to the fact that the relations between anthropometric characteristics and coordination skills differ during various growth periods, it is necessary to scientifically prove that there are significant relations between anthropometric characteristics and coordination skills.

Waskiewicz (1998) carried out a study with the aim to identify motor coordination skills within all the remaining coordination skills, which he called motor harmonization within the remaining coordination skills. The research was carried out on a sample of 92 subjects. Both laboratory and motor tests were used. The results were processed by means of a factor analysis. The factor structure of coordination skills that he obtained confirmed the initial hypothesis of the research in terms of the existence of a coordination factor called motor harmony. Using the discussion of these results as his basis, the author concluded that it was possible that motor harmonization was a motor coordination skill which could be described as being heterogeneous.

Ljah & Sokolkina (1997) studied simple motor reactions, visual-motor coordination, spatial orientation and proprioreceptive sensitivity. They consider that a simple motor reaction is not genetically determined to a great extent, and that the proprioreceptive sensitivity does not depend at all on genetic factors. The sample in their research consisted of 88 pairs of same-sex twins aged 7-9, 44 pairs of which were monozygotic and dizygotic. The aim behind their study of the changeable indicators of coordination skills was to pay special attention to the analysis of their structure: 1. dynamic balance, 2. the accuracy of the reproduction of large motion amplitudes ($70\text{-}75^0$), 3. the accuracy of the reproduction of medium motion amplitudes ($40\text{-}50^0$), 4. the accuracy of the reproduction of small motion amplitudes ($20\text{-}25^0$), 5. the accuracy in differentiating between the increases in amplitude, 6. the accuracy in differentiating between the decreases in amplitude, 7. the reproduction of the parameters of force, 8. differentiating between the parameters of the force of motion (a decrease in parameters), 9. differentiating between the parameters of the force of motion (an increase in the parameters), 10. vestibular stability and 11. the reproduction of the time interval. In the discussion section, the authors pointed out that the similar influence of genetic and natural effects can explain the changes in the ability to reproduce motion parameters in force and time for differentiating between the increases in motion amplitudes. On the basis of the discussion, the conclusion they reached was: 1. the reproduction and differentiation between spatial and force parameters, the accuracy in reproducing time parameters of motion, vestibular stability and dynamic balance are of a **single** nature, which is best suited by a simple genetic model. The effects of the environment are responsible for a sequence of defining influences in the change in coordination

skills such as dynamic balance, amplitude reproduction, differentiation between decreases in amplitude, differentiation between the parameters of force during motion.

Juras, Waskiewicz & Raczek (1998) set up, as the aim of their research, the identification of spatial orientation within the inner structure of coordination skills. The basis of their research was the determination of valid methods of diagnosis. Their sample of subjects consisted of 58 male and 51 female students from the Physical Education Academy in Katovice, aged 20 to 24. The students were chosen according to their sports and computer experience. Spatial orientation was diagnosed with the help of a computer, laboratory and motor tests. The remaining coordination skills were also diagnosed. The data that was gathered was processed by a factor analysis with varimax rotation and the Hotteling main components with the addition of the Tuckers modification. The factor analysis was used for the following variables: the visual aspects of orientation in space were diagnosed (with the help of a computer program), the evaluation of parameters used to characterize the studied skills, and the variables which determine the diagnosed coordination skill (a model created following the reduction in variables). The research results clearly pointed to the complex structure of the visual aspect of spatial orientation. The factors not greatly affected by the gender of the subjects were the following: orientation speed, distance evaluation, perception of shapes, the angle of evaluation and complex orientation. The final phase of the factor analysis determined the following structure for the coordination skills: spatial orientation, motion differentiation, motor adaptability, a sense of balance and reaction speed. It was concluded that spatial orientation was a specific coordination skill and that it possessed a complex inner structure, in addition to precision and speed, which are its most significant aspects.

Quan, Hu, Yian, Huang, Pan, Xu, Lu, Guo Zhao & Zhang (2000) focused their research on the critical sensitivity period and the general tendencies in the development of children's motor coordination. A structural model was set up for motor coordination skills, based on the factor theory, while the authors took the non-linear dynamic view of the development of coordination skills. Nine measuring instruments were used on a sample of 1539 Chinese children aged 7 to 12. The results indicated the following: 1) a sensitivity period during the development of coordination skills was noted among children aged 7 to 10; the development of speed becomes much slower at the around the age of 11 and these years are a critical period for education; 2) before the age of 9, the speed of development is greater among girls than among boys, and after the age of 9, the speed of development is greater among boys. In terms of the level of development, until the age of 11 there is no difference between boys and girls, but after the age of 11, boys are at a higher level; 3) girls are superior to boys when it comes to balance, rhythm, and independent free motion; boys are superior when it comes to strength, speed and movement coordination.

Starosta, Hirtc, & Pavlova-Starosta (2000) set as their aim to determine how the period of development among children and the young influences the development of movement coordination. They were supposed to determine the changes in the area of selected coordination skills (KS) among children and the young of various ages, in addition to highly visible improvements or decreases in their results and their sensitivity to the influence of sports training. The sample in their research consisted of young people from Poland and Germany: a total of 3086 subjects, elementary school students, high school students and students from the Academy of Physical Education in Poznan and young people from Germany aged 7-27. Certain conclusions were reached and methodological recommendations made.

1. The research results clearly indicated the existence of sensitivity periods in the development of the KS between the ages of 7 and 11.

2. The critical period (a period of stalling or decrease) in the development of motor coordination can be noted between the ages of 11 and 11, 5, which is an indication of the necessity of emphasizing the need for special care for the development of these skills during this period in both a quantitative and qualitative sense. A lack of appropriate measures could lower the level of coordination skills of the individuals who are exercising and lead to a loss, which cannot be compensated.

3. The great amounts of research material confirm the onset of a critical period in the development of KS between the ages of 11 and 13, 5. The clearly visible changes can be noted during the analysis of individual results. An awareness of these facts should enable the creation of plans for training sessions which would suit the abilities of the person exercising, that is, would take into account the "difficult" periods in their motor development. This is especially true of complex sports, where we often have cases of people, those with very strong critical periods, being dismissed from training sessions due to being characterized as those "lacking potential".

4. The obtained results indicate the necessity for implementing changes in the preliminary system in use so far, and emphasize the importance of the development of coordination skills (with an emphasis on stimulation) for those aged 7 to 11, irrespective of the type of sports activity. For that reason it is necessary to gradually increase the level of coordination skills, or in other words, not to allow a decrease or period of stagnation in their development due to the excessive development of the level of other motor skills (especially force and endurance). That is why it is necessary to develop a new model of sports training.

Nazarenko (2001) claims that the precision of every motor movement is determined by the degree of harmony between outer form and content. The outer form is determined by the direction, amplitude and harmony between certain motions, that is, forms of physical exercise. The inner contents of movement are determined by the connection between various physiological processes in the body under the influence of a certain physical load and represent the content of physical exercise. Three components are responsible for the precision of motor work: form, content and rhythm.

With the aim of studying the growth tempo of the indicators of precision according to the spatial-temporal characteristics of movement, an experimental research of precision, as the quality of movement coordination, was set up. The sample consisted of 128 subjects, elementary school students and high school students. The subjects were divided into three experimental groups (the youngest, those middle-aged and the oldest) and a control group. The experiment lasted from the end of December to the end of May of one school year. This paper presents only the results of two of the tests used: the test for the dynamics of precision growth between the control and experimental group (test one) and for the dynamics of precision growth between the control and experimental group (test six). The greatest improvement in precision in most of the tests was found to be during the ages between 12 and 14. Precision, just like other motion-coordination qualities, develops and improves upon setting up certain situations and using certain methods. Depending on the concrete occurrence of this quality, the goal behind the sports training, age and fitness level, the necessary elements are varying durations of exercise and various aims, as well as specific methods. Thus, precision as a motion-coordination quality, is best provided by means of fully suitable movement, its spatial, temporal and strength

parameters, depending on the given situation and conditions. This complex quality has an appropriate structure, diverse manifestations, factors, conditioning and specific evaluation criteria.

Kambas, Fatouros, Aggeloussis, Gourgoulis, & Taxildaris (2003) studied the influence of gender and age on the performance of coordination tests by children of preschool and school age, by measuring their coordination skills. The linear nature of motor performance in childhood was also studied. Their sample consisted of 64 children of a preschool age, 62 first graders, 65 second graders, 61 third graders and 61 fourth graders. The Bruininks-Oserski Test for Motor Proficiency was used to measure the coordination skills. The results of the multivariate analysis of variance (MANOVA) indicated that neither gender nor age influenced the children's performance. At the end of the study, it was determined that there was no linear development when it came to performing tests of coordination among children aged 8 to 10. This rule was not confirmed on a sub-sample of children aged 4 to 7.

Coordination skills are connected to the successful performance of primarily complex movement structures which are found in dance (Kostić, Miletić, Jocić, and Uzunović, 2002; Stanišić, Kostić, Uzunović, and Marković, 2008), sports gymnastics (Petković, 2004), rhythmic gymnastics (Popović, 1998) and other sports.

The connection between anthropometric characteristics and coordination skills among subjects aged 7 has not been subject to extensive study. Usually research is carried out with the aim of determining the connection between anthropometric and motor skills, and coordination skills are just a part of these skills. Ivanović (2008) selected a sample of 164 subjects, first grade elementary school students from Valjevo, aged 7, 5, on which he used 14 anthropometric measurements and 11 tests for the evaluation of coordination, balance, explosive strength motion frequency and arm strength in order to test the relations between morphological (the predictor) and motor dimensions (the criterion) of first grade elementary school students. The data was processed by means of a canonical analysis of correlation. A statistically significant canonical coefficient was obtained ($p< .01$) with 55% of the information explained in relation to the overall variance. The canonical function was defined as the general canonical morphological factor and general motor factor. It was concluded that if the subjects showed greater values in latent morphological dimensions, they would achieve better results for motor factors and vice versa.

Katić, Srhoj, and Pašanin (2005) studied the relations between a set of morphological-motor variables and the coordination variable of the polygon backwards as the criterion on a sample numbering 2205 boys aged 7 to 11. Only four measuring instruments were used to evaluate their morphological dimensions and seven measuring instruments to evaluate their motor skills. The data were processed by means of a regression analysis. The results and discussion have shown that the best predictors of the polygon backwards are explosive strength, movement frequency, repetitive and static strength in a positive sense, and body weight and the longitudinal dimensionality of the skeleton and subcutaneous fatty tissue in a negative sense.

Using the assumption that the effectiveness of the physical activity of children depends on anthropometric characteristics and coordination skills (in addition to everything else) as a starting point, the aim of this research was to determine the nature of the relations between the anthropometric characteristics and coordination skills of girls and boys aged 7.

METHOD

Participants

The sample consisted of 176 subjects, 91 of which were boys, and 85 of which were girls. All of the subjects were first grade elementary school students from Niš. The elementary schools were selected at random, and the sample included only those subjects whose parents had given their written consent for their children to participate in the study. The children whose parents agreed to let them be tested attended the following elementary schools: "Sveti Sava", "Car Konstantin" and "Ratko Vukićević". All of the children were healthy on the day of the measuring. The measuring took place in the school facilities which met the necessary requirements, and were taken by a team of doctors, all specialists in the field of sports medicine.

Instruments

The following parameters were used *to evaluate longitudinal dimensionality*: body height, leg length, and arm length.

The following parameters were used *to evaluate transversal* dimensionality: shoulder width, pelvic width and hip width.

The following was used *to evaluate circular dimensionality and body mass*: body weight, thorax volume, upper arm volume, thigh volume and calf volume.

The following was used *to evaluate subcutaneous fatty tissue*: triceps skin folds, subscapular skin folds, abdominal skin folds, thigh skin folds and medial calf skin folds.

The measures for longitudinal dimensionality and transversal dimensionality were determined with the help of the Martin's metal anthropometer (GPM Swiss Made). The measures for circular dimensionality were determined with the help of centimetric tape (GPM Swiss Made). Body weight was measured on a digital scale (Body Composition Monitor) TANITA UM-72 (Made in Japan). Skin fold thickness was determined with the help of calipers (GPM Swiss Made).

The measurings were realized during the morning hours. No more than 3 to 5 same sex subjects were present in the room during measuring. The measuring technique followed the guidelines of the methodology recommended by the International Biological Program (Weiner & Lourie, 1981).

For the evaluation of coordination skills the following measuring instruments were used: horizontal jump rope for the evaluation of leg coordination (Kurelić et al., 1975), 20 sidesteps with a baton for the evaluation of body coordination (Kurelić et al., 1975), and running and rolling for the evaluation of spatial orientation. This test was constructed for the needs of a research project being realized at the Faculty of Sport and Physical Education in Niš. Its reliability was calculated on the basis of a test-posttest calculation of a coordination coefficient on a sample numbering 30 seven-year-old boys, and had a value of 0.89. The measurings were ten days apart.

Considering the fact that we are not aware of whether the running and rolling test has been used before, we would like to give its description.

Running and rolling (Figure 1)

Aim*:* the evaluation of spatial orientation

Task

At a distance of 2.5 meters from the start line we place a single medicine ball. To the right, at a 90 degree angle in relation to the direction the subject will be running, at a distance of 2.5 meters, we place a mat so that it is parallel to (alongside) the direction the subject will be running in from the start line. In the direction of the run from the start, at a distance of 2.5 meters, we place a mat across in relation to the direction the subject will be running in from the start. Left of the medicine ball we place a mat in the same fashion as to the right.

The subject stands behind the start line. At the measurers sign, he runs towards the medicine ball, goes round it on the left and runs towards the mat to the right (1), lies down at the nearest end of the mat flat on his stomach, rolls over on his back and then once again into the initial position, stands up and runs to the medicine ball which he goes round on the left and repeats the task on the mat which is at a 90 degree angle in relation to the start (2), runs to the medicine ball and goes round it on the left and runs towards the left mat (3) and does the same roll over again, then runs around the medicine ball and passing it on the left runs through the start line.

Evaluation

The time it takes for the subject to go from the start to the finish is measured in tenths of a second. The test is repeated three times and only the best score is taken into account. There are no test trials.

Equipment and props

A medicine ball, 3 mats, a stopwatch.

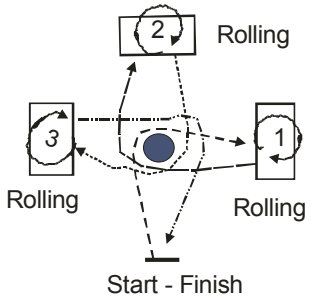

Fig. 1. A graphic representation of the subject's movement in space

Procedure

The connection between anthropometric characteristics and coordination skills was determined with the help of the canonical correlation analysis. The difference in coordination skills between the boys and girls was determined with the help of the MANOVA and ANOVA tests. The reliability of the constructed tests of running and rolling was determined by the calculation of the correlation coefficient. All of the analyses were carried out with the help of the "SPSS-8"and "Statistika-6" programs.

RESULTS

Speaking generally, no statistically significant differences in terms of anthropometric characteristics at the studied age were noted between the boys and girls. Significant differences could only be found for abdominal skin folds ($p \leq 0.06$) and thigh skin folds ($p \leq 0.07$). The girls registered higher average values in the case of abdominal skin folds and thigh skin folds.

Table 1. MANOVA for the coordination skills of the boys and girls

Wilks	F	df1	df2	p
0.92	4.81	3	172	0.003

Legend: Wilks' Lambda – value of the coefficient of the Wilk's test for the equality of group centroids; F – the value of the F-test coefficient for the significance of Wilk's Lambda; Effect df1; Error df2 – degree of freedom; p – the coefficient of the significance of the difference between the centroids;

The multivariate analysis of variance of the data gathered for coordination skills indicates that there is a statistically significant difference between the boys and girls at the p=0.003 level (Table 1). The statistically significant difference, nevertheless, exists only for spatial orientation, p=0.001 (Table 2).

Table 2. ANOVA for the coordination skills of the boys and girls

	F	p
Horizontal jump rope	1.94	0.165
20 side steps with a baton	0.29	0.593
Running and rolling	10.84	**0.001**

No statistically significant difference can be found between the anthropometric characteristics and the coordination skills for the sample of boys (Table 3), and for that reason, there is no discussion of the results.

Table 3. The canonical correlation between the anthropometric characteristics and coordination skills of the boys

	Canonical R	Canonical R^2	Chi-sqr.	df	p
0	0.53	0.28	43.72	48	0.649

Legend: Can.R – Extent of the canonical correlation; Can.R^2 - Canonical root of determination; Chi-sqr. – Barlett's Lambda test; Df – Degree of freedom; p – Significance level

There is a statistically significant connection between the anthropometric characteristics (the predictor system) and the coordination skills (the criterion system) to be found in the case of the sample of girls (Table. 4). The obtained canonical factor explains the extent of the connection between the two sets of variables in a significant way (Can.R=0.53). The influence of the anthropometric measurements on the coordination skills was explained with a 28% (Can.R^2=0.28).

Table 4. The canonical correlation between the anthropometric characteristics and the coordination skills of the girls

	Can. R	Can. R^2	Chi-sqr.	df	p
0	0.53	0.28	73.26	48	0.011

Legend: Can.R – Extent of the canonical correlation; Can.R^2 - Canonical root of determination; Chi-sqr. – Barlett's Lambda test; Df – Degree of freedom; p – Significance level

By reviewing the structure of the canonical factor (Table 5), we can come to the conclusion that the area of anthropometric characteristics is defined by the measurements for the evaluation of transversal dimensionality, circular dimensionality, body mass and subcutaneous fatty tissue and that it is not defined by the measurements of longitudinal dimensionality. The obtained factor can be defined as the factor of transversal and circular dimensionality and subcutaneous fatty tissue.

Table 5. The canonical factor of the anthropometric characteristics of the girls

Anthropometric characteristics	Root 1
Body height	0.03
Leg length	0.10
Arm length	-0.04
Shoulder width	0.32
Pelvic width	0.46
Hip width	0.35
Body mass	0.46
Thorax volume	0.27
Upper arm volume	0.33
Thigh volume	0.15
Calf volume	0.40
Triceps skin folds	0.49
Subscapular skin folds	0.31
Abdominal skin folds	0.49
Thigh skin folds	0.42
Medial calf skin folds	0.45

The canonical factor for the coordination skills is defined by all three coordination skills in a significant manner (Table 6), and so can be defined as the general factor of coordination.

Table 6. The canonical factor of coordination skills of the girls

Coordination	Root 1
Horizontal jump rope	-0.68
20 sidesteps with a baton	0.67
Running and rolling	0.74

DISCUSSION

We embarked on this study with the assumption that knowledge of the nature of the relations between anthropometric measurements and coordination skills of a sample of children aged 7 is important for the organization of physical education classes and the choice of physical activities which the children will be involved in. The aim of this research was to determine the significance of the relations between the anthropometric characteristics and coordination skills of boys and girls aged seven.

On the basis of the insights we gained into the statistical indicators, we can conclude that for the sample of boys, there is no statistically significant connection between the anthropometric characteristics and coordination skills. Nevertheless, on the other hand, for the sample of girls, there is a statistically significant connection between anthropometric characteristics and coordination skills. For this reason, we compared anthropometric characteristics between the samples. The values we obtained have indicated that there are no statistically significant differences in the studied area between the girls and boys.

The multivariate analysis of variance has shown that there is a statistically significant difference between the boys and girls in terms of coordination skills. Similar results can be found in the work done by Zurc, Pišot, and Stojnik (2005) who showed that there is a difference in coordination skills between boys and girls aged 6,5. On the other hand, in the research done by Quan, Hu, Yian, Huang, Pan, Xu, Lu, Guo Zhao, and Zhang (2000) no statistically significant difference was found between the coordination of boys and girls, but on a sample of subjects aged 11. On the basis of the ANOVA results, it was concluded that a special contribution to the overall difference in coordination skills came from spatial orientation, which was studied with the help of the running and rolling test. The numeric values for the means of that test for the boys are greater than those for the girls. Considering the fact that the better result is the numerically smaller one can lead us to the conclusion that the girls were faster when completing the task. On the other hand, Kambas, Fatouros, Aggeloussis, Gourgoulis, and Taxildaris (2003) have shown that gender and age did not affect the performance of the coordination task among children aged 8 to 10. But this was not confirmed on sub-samples of children aged 4 to 7.

Spatial orientation as part of coordination skills was studied by Ljah & Sokolkina (1997), Juras, Waskiewicz, and Raczek (1998). They concluded that spatial orientation belongs to the specific coordination skills and that it manifests a complex inner structure, including precision and speed, as its most significant factors, which has also been shown in this research.

Another contribution made to the statistically significant relations between the two studied factors in the area of anthropometric characteristics was made by the measurements for the evaluation transversal dimensionality, circular dimensionality, body mass and subcutaneous fatty tissue. In this area only the measurements for longitudinal dimensionality did not take part in defining the significant relations. The obtained factor was defined as the factor of transversal and circular dimensionality and subcutaneous fatty tissue. In the research carried out by Katić, Srhoj, and Pašanin (2005) on a sample of children aged 6,5, the best predictors for the polygon backwards test (a test of coordination) were body weight, longitudinal dimensionality of the skeleton and subcutaneous fatty tissue in a negative sense.

In the area of coordination skills, all three studied skills (leg coordination, body coordination and spatial orientation) make a statistically significant contribution to the ob-

tained significant relations. The results for the running and rolling test make the greatest contribution to the canonical factor of coordination for girls. The assumption is that this result is connected to the displayed significant difference in the speed of task completion in favor of the girls. Nevertheless, in the case of a sample of girls, we might be dealing with a general factor of coordination at this age.

The results of the performance of complex motor tasks are mainly connected to the speed with is genetically condition to a great extent. The only way to "fix" coordination is by means of precision in performance, which is in correlation with the number of repetitions of certain structures of motion and movement. The results published by Chicu (2006) indicate that the implementation of concrete study methods and exercise methods improves the index for the development of coordination skills among younger students.

CONCLUSION

Our research has shown that for the sample of girls aged seven a statistically significant difference can be found between anthropometric characteristics and coordination skills. The greatest contribution to the significant relations was made by the transversal and circular dimensionality and subcutaneous fatty tissue one the one hand, and all of the coordination skills on the other. The studied relations for the sample of boys were not statistically significant, whereby the initial hypothesis was partially confirmed.

Acknowledgment *This research was part of the project of the Faculty of Sport and Physical Education in Niš entitled "The constitutional characteristics, functional and motor skills as factors of health and sport selection" approved in 2008, which is being realized with the help of the Sports Association of the city of Niš (head researchers: professor Radmila Kostić and professor Ratomir Đurašković).*

REFERENCES

1. Chicu, V. (2006). *The development of coordination abilities at the middle school pupils through the application of moving games during the Physical Education lessons*. National Institute of Physical Training and Sports, Retrieved 15.11.2006 at: http://www.cnaa.acad.md/en/thesis/5497/
2. Ivanović, M. (2008). Canonical relations between morphological-motor features in first grade students. *Sport Science* 1(2), 65-71.
3. Juras, G., Waskiewicz, Z., & Raczek, J. (1998). Space Orientation-Identification, Inner Structure and Diagnosis. *Antropomotoryka*, (17). Retrieved 29.11.2006. at: http://www.awf.krakow.pl/wydaw/ant17_98.htm
4. Kambas A., Fatouros J., Aggeloussis N., Gourgoulis V., & Taxildaris K.(2003). Effect of age and sex on the coordination abilities in childhood. *Inquiries in Sport and Physical Education*, 1, 152-158.
5. Katić, R., Srhoj, Lj., & Pašanin, R. (2005). Integration of coordination into the morphological-motor system in male children aged 7-11 years. *Collegium antropologicum*, 29(2), 711-716.
6. Kostić, R., Miletić, Đ., Jocić, D., & Uzunović, S. (2002). The influence of dance structures on the motor abilities of preschool children. *Facta Universitatis, Series Physical Education and Sport*, 1(9), 83-90.
7. Kostić, R. (1996). Trening plesača (Dancers training). Niš: Individual publication of the author.
8. Kurelić, N., Momirović, K., Stojanović, M., Šturm, J., Radojević, Đ., & Viskić-Štalec, N. (1975). *Struktura i razvoj motoričkih dimenzija omladine (The structure and development of morphological and motor dimensions of young people)*. Belgrade: The Institute for Scientific Research of the Faculty of Physical Education of the University of Belgrade.
9. Ljah, V.I., & Sokolkina, V.A. (1997). *K vaprosu o prirode mežindividualjnoj variativnosti nekatorih koordinacionih sposobnostej detej 7-9 let (Questions of the nature of inter-individual variations of certain coordination skills of children aged 7 to 9)*. Retrieved 15.10.2005. at http://lib.sportedu.ru/press/fkvot/1997N2/P2-7.htm

10. Nazarenko, D.L. (2001). *Mesto i značenie točnosti kak dvigateljno-koordinacionogo kačestva (The position and significance of precision as a motion-coordination skill)*. Retrieved 15.11.2006. at: http://www.lib.sportedu.ru/press/fkvot/2001N2/p30-35.htm
11. Petković, E. (2004). The relation of situational-motor coordination to the competitive success of female gymnasts. *Facta Universitatis, Series Physical Education and Sport*, 2(1), 25-33.
12. Popović, R. (1998). *Antropološke determinante uspeha u ritmičko-sportskoj gimnastici (The anthropological determinants of success in rhythmic-sports gymnastics)*. Niš: Individual publication of the author.
13. Starosta, V., Hirtc, P., & Pavlova-Starosta , T. (2000). *Sensitivnie i kritičeskie periodi v razvitij dvigateljnih koordinacionnih sposobnostej u junih sportsmenov (The sensitive and critical periods in the development of the motion-coordination skills of young athletes).* Retrieved 15.11.2006. at: http://www.lib.sportedu.ru/press/fkvot/2000N2/p28-29.htm
14. Stanišić, I., Kostić, R.,Uzunović, S., Marković, J. (2008). The significance of the relations between the quality of the performance of dance structures and the motor coordination skills of preschool children. *Facta Universitatis, Series Physical Education and Sport*, 1(9), 83-90.
15. Quan, D.Q., Xu, C.G., Yian, B.T., Huang, H., Pan, T.T., Xu, Z., Lu, D.J., Guo, X., Zhao, Y.H., & Zhang, Y. (2000). *The research on developmental-law of motor coordination ability of children in 7-12 years*. Retrieved 21.11.2006. at: http://www.ausport.gov.ou/fulltext/2000/preoby/abs075a.htm
16. Waskiewicz, G., Juras, J., & Raczek, J. (1998). The motor Adjustment – Inner Structure and Place Among Other Coordinational Abilities. *Antropomotoryka*, (17), Retrieved 29.11.2006 at: http://www.awf.krakow.pl/wydaw/ant17_98.htm
17. Weiner, S., & Lourie, A. (1981). *Practical Human Biology*. New York: Academic Press.
18. Zurc, J., Pišot, R., & Stojnik, V. (2005). Gender differences in motor performance in 6.5 year old children. *Kinesiologia Slovenica*, 11(1), 90-104.

RELACIJE ANTROPOMETRIJSKIH KARAKTERISTIKA I KOORDINACIONIH SPOSOBNOSTI

Radmila Kostić, Ratomir Đurašković, Saša Pantelić, Dobrica Živković, Slavoljub Uzunović, Mladen Živković

Cilj istraživanja je bio da se utvrdi kakve su relacije između antropometrijskih karakteristika i koordinacionih sposobnosti na uzorcima devojčica i dečaka. 91 dečak i 85 devojčica je činilo uzorke ispitanika. Svi oni pohađaju prvi razred osnovnih škola grada Niša. Primenjene su tri mere za procenu longitudinalne dimenzionalnosti (body height, leg lenght, arm lenght), tri mere za procenu transverzalne dimenzionalnosti (shoulder width, pelvic width i hip width), pet mera za procenu cirkularne dimenzionalnosti i mase tela (body weight, thorax volume, upper arm volume, thigh volume i calf volume) i pet mera za procenu potkožnog masnog tkiva (triceps skinfolds, subscapular skinfolds, abdominal skinfolds, thigh skinfolds i medial calf skinfolds). Za procenu koordinacionih sposobnosti primenjeni su merni instrumenti Preskakanje horizontalne vijače, 20 iskoraka sa provlačenjem palice i Trčanje i valjanje (novokonstruisani test). Multivarijantna analiza varijance je pokazala da postoji statistički značajna razlika u koordinacionim sposobnostima između dečaka i devojčica na nivou p=0.003. Između antropometrijskih karakteristika i koordinacionih sposobnosti ne postoji statistički značajna povezanost na uzorku dečaka, dok na uzorku devojčica postoji. Dobijeni kanonički faktor antropometrijskih karakteristika je definisan kao faktor transverzalne, cirkularne dimenzionalnosti i potkožnog masnog tkiva, a kanonički faktor koordinacionih sposobnosti je definisan kao generalni faktor koordinacije.

Ključne reči: *antropometrija, koordinacija, relacije, sposobnosti, deca*