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The Correlation between Physical Characteristics and Motor Skills of Female Secondary School Pupils

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A B S T R A C T

Secondary school age of female pupils, specific for intensive changes of physical characteristics, in particular for variability of motor expression, is the inspiration for numerous researches as well as of "demands" of contemporary practice of physical education within schools. We have measured physical characteristics and tested motor skills of 228 female pupils of the first grades of secondary schools from Novi Sad. The evaluation of the above-mentioned characteristics and skills has been carried out using the EUROFIT Program of measuring. By applying the canonical correlation analysis we obtained the results pointing to the existence of statistically significant correlation–out of 7 potential canonical factors 3 are statistically significant, as follows: CAN1–female pupils with higher body mass and sub-skin fat are less successful at test for static strength evaluation (MIZDR), aerobic-anaerobic endurance test (MISTR), shuttle running speed (MCUNT), and static balance test (MFLAM), CAN2–female pupils with small body mass are less successful at pliability, static force and dynamic force tests, and CAN3–female pupils with exceptional body height are more successful at tests for lower extremities explosive strength measuring. Based on the insight into the obtained structure of canonical factors it can be concluded that determined correlation of body characteristics and motor skills originate up to a significant extent from feminine gender characteristics of female pupils, who, at the studied age, represent the (un)favourable biomechanical functional basis for manifesting of skills responsible for an efficient motor behaviour.

Key words: *Physical characteristics, motor skills, female secondary school pupils*

Introduction

A high level of correlation with most motor abilities is one of the properties of pupils' body characteristics. However, depending on the survey participants age, in particular in the subsample of female pupils, the above-mentioned relation changes its direction and intensity so that at the age of 11-12 already (Malacko, 2007), and particularly after the age of 13, physical abilities (Figure 1) are "lagging behind" compared to their physical development (Ivanić, 1996). Such a trend is reflected throughout the entire adolescent period and represents the subject of interest in researches of a large number of authors (Bajrić et al., 2011; Branković et al., 2012; Milojević et al., 2014; Simić et al., 2015).

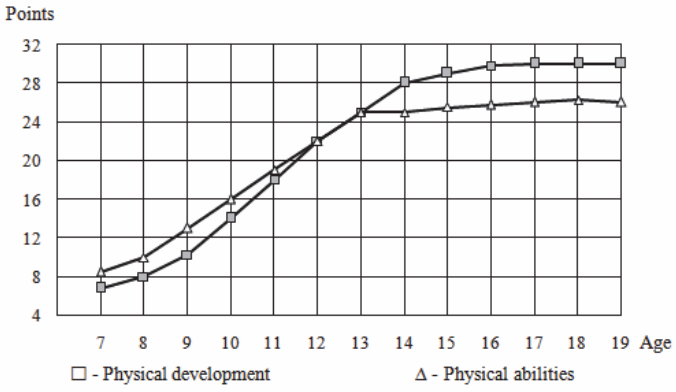

Figure 1. Has been taken over from publication by Ivanić, S. (1996)

Methods

The research has been carried out on the sample of 228 female pupils of secondary schools from Novi Sad (grammar school, medical and technical school) within the group of pupils of 15.6 years of decimal age with the aim to determine the correlation between their body characteristics and motor skills. The evaluation of the above-mentioned characteristics and skills has been carried out using the EUROFIT Program of measuring and testing (Drljačić et al., 2012). For evaluation of body characteristics we analysed the variables of AVISI – body height, AMASA - body mass, ANABC - skinfold on the upper arm biceps, ANATR

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- skinfold on the upper arm triceps, ANALE - skinfold on the back, ANABO - skinfold on the side and ANAPO - skinfold on the lower leg. The insight into motor abilities has been made via the variables of MFLAM - standing on one leg – "Flamingo", MTAPR - hand tapping, MPRET - bending in sitting position, MSKOK - standing long jump, MDINA - hand dynamometric, MLESE - torso lifting, MIZDR - body pull-up endurance, MCUNTR - 10x5 meters running and MISTR - endurance shuttle running. The evaluation of correlation of the research topics for female pupils has been carried out via canonical correlation analysis by applying Bartlett's Lambda Test and its testing by means of the corresponding h² - test.

Results

Table 1 presents the results of the correlation level between the body characteristics and motor abilities of female pupils.

Table 1. Canonical factors and their significance

	R	λ	χ^2	ss	P
1	0.63	0.39	253.13	63	0.00**
2	0.57	0.33	143.95	48	0.00**
3	0.38	0.14	56.78	35	0.01**
4	0.24	0.06	22.39	24	0.55
5	0.18	0.03	9.68	15	0.84
6	0.09	0.01	2.04	8	0.98
7	0.02	0.00	0.11	3	0.99

Legend: R – Canonical correlation, λ - Square canonical correlation, χ^2 – Hi square test, ss – degrees of freedom, P – Significance of χ test

The analysis of relation of the applied body measures and motor abilities tests has shown that in a latent area there is their statistically significant correlation. Out of 7 possible pairs of canonical factors 3 are statistically significant at the level of concluding of p=0.01.

The first two factors have approximately equal value of canonical correlation coefficient, meaning the significance in explaining the correlation of the analysed areas, while the third one has significantly lower value of this coefficient. After determining the number of statistically significant canonical factors, in the further analysis we proceeded with determining their structure in both of the studied areas.

In the area of body characteristics (Table 2), the first canonical factor is unipolar. Positive projections to this dimension were shown by body mass (0.65) and five skinfolds - skinfold on the upper arm triceps (0.93), skinfold on the upper arm biceps (0.67), skinfold on the back (0.90), skinfold on the side (0.83) and skinfold on the lower leg (0.71).

In the area of motor abilities (Table 3) the first canonical factor is bipolarly defined. The variables of body pull-up endurance (-0.82) and endurance shuttle running (-0.50) are found on the negative pole. Logical negative values but in the matrix with positive denominator have been found for "Flamingo" (0.41) and shuttle running (0.58) variables.

The insight into the correlations of the first pair of canonical factors from the system of variables of body characteristics and first canonical factor from the system of variables of motor abilities leads to the conclusion that it is of the dominant morphological structure considering more numerous and intensive projections of body characteristics variables.

The variables for evaluation of skinfolds on the belly, backs and side record the highest presence in the first canonical factor, which shows that female pupils with a higher body mass and sub-skin fat are less successful at test for static strength evaluation (MIZDR), shuttle running speed (MCUNT), aerobic-anaerobic endurance test (MISTR), and static balance test (MFLAM).

Table 2. Canonical structure of body factors

Body characteristics	CAN1	CAN2	CAN3
AMASA	0.65*	-0.57*	0.18
AVISI	-0.14	-0.08	0.68*
ANATR	0.93*	0.07	-0.17
ANABC	0.67*	-0.17	0.13
ANALE	0.90*	-0.08	0.20
ANABO	0.83*	0.22	0.06
ANAPO	0.71*	0.14	-0.29

Legend: AVISI – body height, AMASA - body mass, ANABC - skinfold on the upper arm biceps, ANATR - skinfold on the upper arm triceps, ANALE - skinfold on the back, ANABO - skinfold on the side, ANAPO - skinfold on the lower leg

The obtained results confirm up to a significant extent the findings of other authors who conclude that »exceptionally feminine constitutional type of female gender person represent in biomechanical and physiological sense, an unfavourable foundation to demonstrate the abilities responsible for an efficient motoric behaviour in complex kinesiological activities of high information and energy requirements in a time unit« (Metikoš et al., 1989)

The second canonical factor in the area of body characteristics is unipolar and defined with a high negative correlation with the body mass (-0.57). It is the matter of the survey participants with exceptionally small body mass, shorter body height and somewhat higher fat tissue in the lower body parts.

In the area of motor skills the second canonical factor is also unipolarly defined. Negative and relatively high projections to this dimension were shown for the variables used to evaluate pliability (-0.53), dominant hand static force (-0.70) and dynamic force of belly muscles and hip joint flexor (-0.52).

Hence, the above-mentioned canonical factor is dominantly motoric considering that only one variable from the system of body characteristics has significant projections while three motor variables (MPRET, MDINA, and MLESE) have statisti-

cally significant projections into this factor.

The analysis of the structure of the second pair of canonical factors shows that female pupils of smaller body mass are less successful at pliability, static force and dynamic force tests.

Starting from the projections of variables of body height and skinfolds of the lower body parts (that are not statistically significant) it can be assumed that the origin of the determined correlation is in a relatively smaller built of the survey participants and body composition of unfavourable topological and percentage ratio of the ballast and muscle tissue. Such an assumption, in a somewhat older age group, has been confirmed by the results of the research in terms of an impact of the system of body composition variables on the results of the static force evaluation test for arms and shoulder belt – »body pull-up endurance« (Korovljev et al., 2010).

Table 3. Canonical structure of motor skills factors

Motor skills tests	CAN1	CAN2	CAN3
MFLAM	0.41*	-0.25	-.02
MTAPR	-0.06	0.19	-.15
MPRET	-0.05	-0.53*	-.00
MSKOK	-0.49	-0.48	0.60*
MDINA	-0.10	-0.70*	-0.18
MLESE	-0.34	-0.52*	-0.38
MIZDR	-0.82*	-0.13	-0.38
MCUNT	0.58*	0.28	-0.17
MISTR	-0.50*	-0.10	-0.03

Legend: MFLAM - standing on one leg – "Flamingo", MTAPR - hand tapping, MPRET - bending in sitting position, MSKOK - standing long jump, MDINA - hand dynamometric, MLESE - torso lifting, MIZDR - body pull-up endurance, MČUNTR - 10x5 meters running and MISTR - endurance shuttle running

The third canonical factor in the area of body characteristics is defined unipolarly with only one variable, i.e. body height (0.68) showing high positive projection.

In the area of motor skills this factor is also unipolar and it is defined by high positive projection of standing long jump variable (0.60).

The analysis of significant projections of body characteristics and motor skills, as well as into those that are not statistically significant shows that female pupils with exceptional body height are more successful at tests for lower extremities explosive strength measuring. High results in the standing long jump reflect an explosive leg power and lower extremities length, which we logically come to know via female pupils' body height.

Similar findings that confirm the impact of longitudinal skeletal dimension on explosive power demonstration can also be found at other authors (Kurelić et al., 1975; Korovljev et al., 2010). Kurelić emphasises that "increased longitudinal measures with constant body volume and quantity of fat tissues are accompanied, primarily, by relative reduction in the ballast mass, which creates better potentials for successful executing of motion tasks, primarily of locomotion type", and later on that "the skeleton longitudinal dimensionality factor affects positively the excitation intensity regulation factor".

Discussion

The conducted study of correlation between body characteristics and motor skills of female pupils of secondary schools lead to isolating of three canonical factors. The first canonical factor is determined by higher correlation between the body mass of female pupils, which originates from the sub-skin fat tissue and lower success rate at energy regulation evaluation tests - static strength evaluation (MIZDR), shuttle running speed (MCUNT), aerobic-anaerobic endurance test (MISTR), and static balance test (MFLAM). In practice of physical education in schools we "see" such examples among obese and less physically active female pupils, which at the same time through diet culture and exercising is also the way of educational acting.

The second canonical factor is determined by characteristics of female pupils with smaller body mass – increased fat tissue in lower body parts and their poorer results at pliability (MPRET), static force (MDINA), and dynamic force (MLESE) tests. The challenge of physical education in schools can be recognised in a new diet culture and exercising aimed at establishing of a higher level of motor skills and body composition of a balanced topological and active-ballast ratio.

The third canonical factor expressed in relatively lowest correlation coefficient, is manifested via high and positive projections of body height and standing long jump (MSKOK) – female pupils with exceptional body height are more successful at tests for lower extremities explosive strength measuring. It is justified to expect, in particular in relation of out-curricula involvement of teachers of physical education, that such female pupils need to be "directed", more than others, towards the sports disciplines (basketball, volleyball, athletics, swimming, etc.) where they can valorise their potential talent and "natural" morphological-motoric dispositions.

In addition to the learning value of objectivization of correlation between body characteristics and motor skills and female pupils of secondary school, the obtained results of the study contribute significantly to creating "guidelines" for effective and humane professional-pedagogical acting of all stakeholders in educational process.

R E F E R E N C E S

Bajrić, O, Bajrić, S., & Jovanović, M. (2011). Kanonička povezanost morfoloških karakteristika i bazičnih motoričkih sposobnosti kod učenika srednje škole, *Sportske nauke i zdravlje, 1*(2), 157-163.

Branković, N., Milanović, S., Pavlović, R., & Simonović, Z. (2012). Kanoničke relacije morfoloških dimenzija i repetitivne snage kod učenica srednjih škola, *Glasnik Antropološkog društva Srbije*, *47*, 35-40.

Drljačić, D., Arsić, K., & Arsić, D. (2012). Primena Eurofit baterije testova u praćenju fizičkih sposobnosti i zdravstvenog statusa dece, *PONS, Medicinski časopis, 9*(4), 158-164.

Ivanić, S. (1996). *Metodologija praćenja fizičkog razvoja i fizičkih sposobnosti dece i omladine*. Gradski sekretarijat za sport i omladinu Grada Beograda, Beograd.

Korovljev, D., Mikalački, M., & Čokorilo, R. (2010). Uticaj telesne kompozicije na performanse snage kod žena starih 19 godina, *Glasnik Antropološkog društva Srbije*, *45*, 483-489.

Kurelić, N., Momirović, K., Stojanović, M., Šturm, J., Radojević, D., & Viskić-Štalec, N. (1975). *Struktura i razvoj morfoloških i motoričkih dimenzija omladine SFRJ*. Institut za naučna istraživanja Fakulteta za fizičko vaspitanje, Beograd.

Malacko, J. (2007). Relacije između varijabli voluminoznosti tijela i motoričkih sposobnosti kod djevojčica osnovne škole, *Acta Kinesiologica 1*(2), 76-80

Metikoš, D., Mišigoj-Duraković, M., & Hofman, E. (1989). Kanoničke relacije između morfoloških karakteristika i motoričkih sposobnosti žena, *Kineziologija, 2,* 123-132.

Milojević, A., Marković, E., Gadžić, A., & Stanković, V. (2014). Developmental characteristics of motor abilities of high school girls. *Facta Universitatis Physical Education and Sport, 13*(3), 261-273.

Simić, M., Vuković, J., Marković, S., & Vukadinović, M. (2015). Morphological characteristics and motor abilities of physically active and inactive female high-school students. *Sport Logia, 11*(1), 27-35.

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