

# RELATIONS BETWEEN ANTHROPOMETRIC CHARACTERISTICS AND FLEXIBILITY IN PERSONS WITH ABOVE-AVERAGE MOTOR ABILITIES

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## Abstract

The sample of 149 male aged 20.15 in decimal years ( $\pm 0.83$ ), students at the Faculty of Sport and Physical Education, underwent a battery of tests consisting of 17 anthropometric measures taken from the measures index of the International Biological Program and 3 tests designed to assess flexibility as follows: Arm invert with stick, Forward bend on a bench (the pike position) and the straddle split. The results of the canonical correlation was determined indicate that the examinees with higher values in the domains of longitudinality and skeleton transversality, with higher values with respect to the Thigh girth and the Calf girth, as well as with the higher values regarding subcutaneous fat tissue at the back also achieved better results in the tests used to assess the flexibility of the legs abductor.

**Key words:** students; legs abduction; canonical correlation.

## Introduciton

Morphological characteristics represent the most obvious area within the biopsychological and sociological status of human population. Morphology is defined by the set of characteristics such as body constitution, body system, build or structure as an organized and relatively constant entity of features which are mutually related. This set is normally made of endogenic factors (internal) and of exogenic ones (external, environment) to some lesser extent.

According to Kurelić et al. (1975) morphological characteristics can be defined as a certain system of basic morphological latent dimensions, irrespective of whether those dimensions were developed under the influence of endogenic or exogenic factors.

On the basis of the aforementioned research, and of the research carried out by Momirović, Medved, Horvat, & Pavišić-Medved (1969); Stojanović, Momirović, Vukosavljević, & Solarić (1975); Hošek, Stojanović, Momirović, Gredelj, & Vukosavljević (1980) and Hošek & Jeričević (1982), a latent structure model of morphological dimensions was formed containing four dimensions approximately interpreted as: *a factor of longitudinal skeleton dimensionality*, responsible for the bone growth in length (body height, sitting height, leg length, foot length, etc.); *a factor of transversal skeleton dimensionality* responsible for the bone growth in width (shoulder width, hips width, knee diameter, elbow diameter, etc.); *a factor of circular body dimensionality - body volume and Body weight*, responsible for the total amount of fat in the organism (triceps, biceps, abdominal and subscapular skinfold measurement, etc.).

Studying the influence of anthropometric characteristics on the flexibility in girls aged between 16 and 18 C. Krsmanović, R. Krsmanović, B. Krsmanović, & Jakonić (1995) came up with the results according to which *Forward bend on a bench* and *the Arm invert with stick* tests as the measure of flexibility in statistics terms were not significantly connected with the anthropometric variables, while the variable *the straddle split to front prone* in statistical terms is significantly connected with the anthropometric variables, especially with the variables related to the longitudinal skeleton dimensionality.

The aim of this study was to find out the relations between anthropometric characteristics and flexibility in persons with above average motor status. Also, we was try to explain what the circumstances

can degrade the results with using the applied measure instruments and to give some instructions about measurement with those battery of tests in the future.

## Method

The experimental sample consisted of the 149 male students at the Faculty of Sport and Physical Education from Novi Sad. The average age of the students was 20.15 decimal years ( $\pm 0.83$ ).

The sample of anthropometric measures consisted of 15 measures, which are part of the battery including 39 measures of the International Biological Program (IBP) (Lohman, Roche, & Martorell, 1988) and two measures which are not in the IBP. Measurements which are performed on symmetrical body parts, according to the instructions provided by the IBP, were carried out on the left side.

According to the factor-based morphological model, the following measures were used:

- For assessing the longitudinal skeleton dimensionality:
  1. Body height,
  2. Arm length,
  3. Leg length.
- For assessing the transversal skeleton dimensionality:
  1. Diameter of the ankle joint,
  2. Diameter of the knee joint,
  3. Pelvic diameter.
- For assessing the volume and body mass:
  1. Body weight,
  2. Chest girth,
  3. Biceps girth (relaxed),
  4. Biceps girth (contracted),
  5. Thigh girth,
  6. Calf girth.
- For assessing the subcutaneous adipose tissue:
  1. Subscapular skinfold,
  2. Triceps skinfold,
  3. Abdominal skinfold,
  4. Thigh skinfold<sup>1</sup>,
  5. Calf skinfold<sup>2</sup>.

For flexibility assessment a battery of three motor flexibility tests was used, which proved to be quite reliable on the examinees of similar age and similar lifestyle in previous researches. The applied battery is part of the complex battery by Metikoš, Prot, Hofman, Pintar, & Oreb (1989), the standardization of which served as the basis for measuring carried out by the qualified measurers.

The battery consisted of the following measuring instruments for assessing flexibility:

1. Arm invert with stick,
2. Forward bend on a bench,
3. Straddle split.

In order to determine the relations between two sets of variables canonical correlation analysis was used, which was implemented in the QCCR program (Knežević & Momirović, 1996).

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<sup>1</sup> Not included in the IBP.

<sup>2</sup> Not included in the IBP

## Results

Tables 1 and 2 show the basic descriptive statistics of variables.

**Table 1.** DESCRIPTIVE STATISTICS OF ANTHROPOMETRIC VARIABLES

VARIABLE	M	SD	MIN	MAX	SKE	KUR
Body height (mm)	1816.26	62.99	1670	1975	.05	-.62
Arm length (mm)	798.32	36.17	717	899	.03	-.30
Leg length (mm)	1022.36	44.14	894	1134	-.06	-.01
Diameter of the ankle joint (mm)	70.99	3.89	62	85	.69	1.13
Diameter of the knee joint (mm)	100.22	4.32	91	113	.16	-.20
Pelvic width (mm)	286.68	16.60	255	345	.50	.53
Body weight (kg)	77.900	9.331	54.6	123.8	.89	3.22
Chest girth (cm)	96.71	5.44	80	118	.39	1.76
Biceps girth (relaxed)(cm)	28.13	2.61	22	36	.67	.89
Biceps girth (contracted) (cm)	31.89	2.78	24	40	.46	.60
Thigh girth (cm)	56.23	4.35	45	74	.40	1.31
Calf girth (cm)	36.74	2.40	32	44	.26	.09
Subscapular skinfold (mm)	118.56	33.33	68	254	1.37	2.77
Triceps skinfold (mm)	91.02	32.10	28	190	.60	.09
Abdominal skinfold (mm)	131.31	51.24	52	300	.69	-.06
Thigh skinfold (mm)	157.95	47.49	50	300	.19	-.28
Calf skinfold (mm)	96.82	39.94	40	240	1.08	1.05

Legend: M – mean, SD – standard deviation, MIN – minimal result, MAX – maximal result, SKE – skewness, KUR – kurtosis

**Table 2.** DESCRIPTIVE STATISTICS OF FLEXIBILITY VARIABLES

VARIABLE	M	SD	MIN	MAX	SKE	KUR
Arm invert with stick (cm)	70.72	15.56	25	104	-.30	-.02
Forward bend on a bench (cm)	52.54	7.90	30	70	-.31	-.13
Straddle split (cm)	188.44	10.83	153	220	-.11	.45

Based on the results given in the tables 1 and 2 it is possible to ascertain that the sample is homogenous. Only the value of skewness in the case of the variable Subscapular skinfold is slightly higher, which leads us to the conclusion that distribution moves slightly to the left. This comes as no surprise as it is widely known that in general, subcutaneous adipose tissue is not a normally distributed anthropometric characteristic, especially not in the case of young men (e.g. Momirović, Hošek, Prot, & Bosnar, 2003).

In the flexibility realm and on the basis of the skewness and kurtosis results, it is possible to say that the results appear to be almost ideal, which can mean that the battery used for the assessment of this latent dimension was appropriate.

Table 3 contains the results of canonical correlation analysis calculated by QCCR algorithm.

**Table 3.** THE RESULTS OF THE CANONICAL CORRELATION ANALYSIS

<i>Flexibility variable</i>	CV1f	CV2f
Arm invert with stick	-.20	.03
Forward bend on a bench	.17	<b>.93</b>
Straddle split	<b>-.82</b>	.34
<i>Anthropometric variable</i>	CV1a	CV2a
Body height	<b>-.70</b>	<b>-.31</b>
Arm length	<b>-.63</b>	<b>-.46</b>
Leg length	<b>-.84</b>	-.05
Diameter of the ankle joint	<b>-.43</b>	<b>-.41</b>
Diameter of the knee joint	<b>-.61</b>	-.22
Pelvic width	-.29	<b>-.52</b>
Body weight	<b>-.69</b>	<b>-.32</b>
Chest girth	<b>-.55</b>	<b>-.46</b>
Biceps girth (relaxed)	-.21	<b>-.30</b>
Biceps girth (contracted)	-.25	<b>-.32</b>
Thigh girth	<b>-.43</b>	-.11
Calf girth	<b>-.49</b>	-.13
Subscapular skinfold	<b>-.42</b>	.20
Triceps skinfold	<b>-.30</b>	<b>.31</b>
Abdominal skinfold	<b>-.37</b>	.29
Thigh skinfold	-.23	.25
Calf skinfold	-.28	.10
<b><math>\rho</math></b>	.70	.46
<b><math>\rho^2</math></b>	.50	.21
<b>p</b>	.00	.03

Legend:  $\rho$  – variance,  $\rho^2$  - coefficient of determination, p – significance of  $\rho$

The canonic correlation analysis determined two statistically significant canonic correlations.

Thus, the first distinguished canonic correlation (given in the Table 3), based on which it is possible to observe that in case of the realm of the variables assessing flexibility it was presented by the variable used for assessing the lower extremities – Straddle split, while among the variables belonging to the right set those were the ones covering longitudinality, transversality and Calf girth, Thigh girth, body volume and Body weight.

The other distinguished canonic correlation in case of the left set was defined by means of the variable - Forward bend on a bench, while in case of the right set the following variables were determined: mostly with - Pelvic width, Arm length, Chest girth and Diameter of ankle joint, and the little bit less with: Body weight, Biceps girth (contracted), Triceps skinfold and Biceps girth (relaxed). The variable of the left set is in negative correlation with the anthropometric, except in the case of the variable - Triceps skinfold, which is in positive correlation with the variable of the left set.

## Discussion

Therefore, the structures of the first canonical factor of the system of anthropometric variables and the first canonical factor of the system of flexibility variables shows that those examinees who had higher values of longitudinal and transversal dimensionality, Body weight and body volume achieved better results in the Straddle split test. The reverse relation is also true, i.e. the examinees with lower values of longitudinal, transversal dimensionality, Body weight and body volume achieved poorer results in the straddle split test.

Leg length and Body height were the ones most closely related to this type of test. The measures of longitudinal skeleton dimensionality were expected to have influence on the result in the Straddle split test. The examinees with long lower extremities achieve better results on average, i.e. the movement range of lower extremities is wider in their case, which makes this test quite imprecise, unless pubic bone height were measured from the ground while standing legs set apart instead of the movement range in order to get the flexibility value in lower extremities (Krsmanović et al., 1995). Another option is to partialize the influence of height and leg length.

The third option which was nowhere to be found in the books or related papers to the matter up until now would be taking the relative results value. The relative value in the case of the Straddle split tests would be presented as the relationship between the obtained value during the test performance and the measured Body height or, which is maybe better, Sitting height which has smaller variability than Body height. This way, methodological shortcomings occurring during the manifestations of abductors flexibility would be successfully eliminated.

Another statistically significant canonical correlation shows that those examinees who had lower values in case of longitudinal, transversal dimensionality of the upper extremities and Body weight, while they had higher values in case of Triceps skinfold achieved better results in Forward bend on a bench test. In other words, the examinees who were shorter with smaller Body weight and proportions of the upper extremities, but physically less fit (which is evident based on the values of Triceps skinfold as an indicator of physical fitness) achieved better results in the forward bend test, which estimates the body flexibility. This confirms the mechanism for synergic regulation and tonus regulation manifested by means of seated forward bends, significantly predetermined kinesiological activator and genetics. The very structure of a directed kinesiological activity can diminish genetically predetermined flaws but only to a certain degree. Physical exercise, done with great caution, under professional guidance, gradually and in a timely manner can significantly improve muscles elasticity. Similarly, people who are subject to that kind of treatment after terminating the kinesiological programs, are not able to maintain the trained elasticity for a long time, as intramuscular abilities, muscles characteristics, bring the muscle back to the initial position. Unfortunately, as we can see, even in population which is in some kind of training, it is not true. For this reason, genetic disposition, mostly related to the osseous and ligament systems, knee cap depth, is the thing which is permanent and unchanging and is the true carrier of flexibility and therefore, in some researches (Bala, Nićin, & Popović, 1997) the question rightfully arises – is flexibility actually a motor ability or morphological characteristic?

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## **PART 6.**

### **Top-level sports**