

CANONICAL RELATIONS BETWEEN MORPHOLOGICAL DIMENSIONS AND THE RESULTS OF REPETITIVE STRENGTH AMONG FEMALE STUDENTS PARTICIPATING IN SPORTS RECREATIONAL EXERCISE

UDC: 796.012.-057.075-055.2
(Original scientific paper)

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Abstract

The aim of the research was to primarily determine the canonical between the systems, on the one hand, of predictor anthropometric measures of longitudinal dimensionality of the skeleton, circular dimensionality and body mass and subcutaneous fatty tissue and on the other the system of criterion variables of repetitive strength, followed by the univariate and multivariate influence of predictor variables on individual characteristics of variables of repetitive strength, in order to determine the predictor validity and the construction of the battery of tests for the diagnosis of the relevant abilities of morphological dimensions, which directly or indirectly make the greatest contribution to the manifestation and development of repetitive strength. Female students about two years engaged in the recreational exercises. The sample consisted of 55 female students from East Sarajevo, aged 20 - 23 ± 6 month, and a system of nine anthropometric measurements, three for longitudinal dimensionality of the skeleton (body height, AVIST, leg length, ADNOC and arm length, ADUŽR), three for circular dimensionality and body mass (average thorax volume, AOGRK, upper leg volume, AONKT, lower leg volume, AOPTK and body mass, ATEŽT) and three for subcutaneous fatty tissue (abdominal skinfolds, ANTRB, upper leg skinfolds ANNTK, lower leg skinfolds, ANPTK). Repetitive strength consisted of three tests: torso lifts of a vaulting box (MDTK), mixed pull-ups (MMZG) and squats (MČUČ). The results of the research indicate that between the anthropometric measurements as the predictor system and the results for repetitive strength, as the criterion, there is a statistically significant connection $p = .001$, which also indicates a high projection of the measures of morphological dimensions and tests of repetitive strength on the canonical factor.

Keywords: *longitudinal dimensionality of skeleton, circular dimensionality, body mass, subcutaneous fatty tissue, motor tests, cross-correlation, canonical correlation analysis*

INTRODUCTION

It is well-known (Malacko, 2002) that there is almost no human motor structure which consists of cyclical movements (for instance, sports recreation), without it being under the strong influence of complex mechanisms for regulation and duration of excitation, which is responsible for the realization of motor structures of moderate intensity over a longer period of time, at

the basis of which we find the mechanisms for regulation and creation of energy.

Thus, it is thought that repetitive strength is one of very important motor skills which can be influenced through certain physical exercise, which at the same time is still insufficiently studied in the female student population.

In the relevant literature (Kurelić, Momirović, Stojanović, Šturm, Radojević, & Viskiće-Štalec,

1975; Pržulj, 2012), what has been considered to be as repetitive strength, is the ability to perform a certain movement without the decrease in effectiveness, that is, prolonged activity without a decrease in intensity. Considering that the coefficient of the innate nature of this dimension is .50, the possibility for development is great, and so it is recommended that it is developed with the remaining of the motor-functional abilities, but at an early age (Drabik, 1996; Gajić, 1986; Pržulj, 2006).

The subject matter of this research is the determination of statistically significant relations between the individual latent dimensions of appropriate morphological characteristics and the repetitive strength. These relations are significant in sports recreational exercise, in order to, on the one hand, check and maintain the desired anthropological harmony among female students of this age, and on the other, to realize the desired sports recreational technology and the actualization of the program content of recreational exercise.

The aim of the research was to primarily determine the canonical between the system of predictor anthropometric measures of longitudinal dimensionality of the skeleton, circular dimensionality, body mass and subcutaneous fatty tissue on the one hand, and on the other, the system of criterion variables of repetitive strength, then the univariate and multivariate influence of predictor variables on the individual criterion variables of repetitive strength, in order to determine the predictor validity and construction of tests battery for the diagnosis of those abilities relevant to morphological dimensions, which directly or indirectly contribute to the manifestation and development of repetitive strength among female students aged 20-23.

METHODS

Using a sample of 55 female students from East Sarajevo, aged 20 – 23 ± 6 months, a sys-

tem of nine anthropological measurements was used, three of which were for the longitudinal dimensionality of the skeleton (body height, AVIST, leg length, ADNOG) and arm length, ADUŽR), three for circular dimensionality and body mass (average thorax volume, AOGRK, upper leg volume, AONKT, lower leg volume, AOPTK and body mass, ATEŽT) and three for subcutaneous fatty tissue (abdominal skinfolds, ANTRB), upper leg skinfold ANNTK, lower leg skinfold, ANPTK). The proposed model for the sample of measurements for the evaluation of morphological characteristics was used on the basis of the recommendation of the International Biological Program (Lohman, Roche & Martorell, 1988). Repetitive strength was made up of three tests: torso lifts on a vaulting box (MDTK), mixed pull-ups (MMZG) and squats (MČUČ). The measuring instruments for the evaluation of repetitive strength were taken from the research of Kurelić et al., 1975.

In order to determine the relations between morphological characteristics and repetitive strength, the data were processed by a canonical correlation analysis using the SPSS 12.0 and Statistika 5.0 program.

RESULTS

The results of the canonical correlation analysis indicate that (table 1.) in the relations between the system of predictors, made up of the anthropometric measurements for the evaluation of morphological characteristics, and the criterion system, which is made up by the variable for the evaluation of repetitive strength, a single statistically significant canonical factor was obtained, Can R which significantly explains the level of connection between the set of predictor variables and the criterion. The determinant coefficient (Can R²) indicates that the percentage of the common variance for both groups of

Table 1. The canonical correlation analysis of morphological characteristics and repetitive strength

	Can R	R ² %	Chi-sqr.	df	p
0	.70	.49	87.48	50	.001

variables is 49%. The canonical factor is statistically significant at the P = .001 level, which is confirmed by the Chi-square test (Chi-sqr.) and the high coefficient (87.48).

Considering the extent of the canonical

correlation coefficient, and the common variance, it can be concluded that repetitive strength of the participants will be manifested to a great extent depending on their morphological characteristics.

Table 2. The canonical factors of anthropological measurements

Anthropological measurements	Canonical factor
AVIST	0.27
ADNOG	0.18
ADUŽR	0.01
AOGRK	0.47
AONKT	0.50
AOPTK	0.68
ATEŽT	0.55
ANTRB	0.24
ANNTK	0.35
ANPTK	0.28

Table 2. shows that the greatest projections on the canonical factor have the following anthropological measures of circular dimensionality of the skeleton and body mass: lower leg volume (0.68), upper leg volume (0.50) thorax volume (0.47) and body mass (0.55), and thus mostly conditioned the results of all the tests of repetitive strength. The smallest and thus most insignificant projection on the canonical factor was determined by the longitudinal dimensionality of the skeleton and subcutaneous fatty tissue.

Table 3. The canonical factors of the criterion variables of repetitive strength

Motor variables	Canonical factors
MDTK	0.40
MMZG	0.58
MČUČ	0.52

Table 3. shows the obtained results which indicate that the greatest projection on the canonical factor was determined by the mixed pull-ups test ($r = 0.58$), and somewhat smaller one for the squats ($r = 0.52$) and torso lifts on the vaulting box ($r = 0.40$).

From the cross-correlation matrix of anthropometric measurements of the morphological dimensions and the variables of success of the dimensions of repetitive strength (table 4.), in the case of the female participants, we can determine a different level of the correlation coefficients. What significantly contributes to success in repetitive strength are the anthropometric measures of circular dimensionality and body mass as well as the individual measures of subcutaneous fatty tissue.

DISCUSSION

By determining the influence of the predictor system of anthropometric measurements

Table 4. A cross-correlation analysis of the morphological characteristics and repetitive strength

Anthropometric measurements	MDTK	MMZG	MČUČ
AVIST	0.10	-0.10	0.08
ADNOG	-0.02	-0.12	0.04
ADUŽR	-0.03	-0.10	0.15
AOGRK	0.50	-0.52	0.51
AONKT	-0.39	0.34	0.42
AOPTK	-0.48	-0.42	-0.37
ATEŽT	0.55	0.57	0.48
ANTRB	-0.24	0.25	0.35
ANNTK	0.25	-0.24	0.25
ANPTK	0.28	-0.25	0.24

(body height, leg length, arm length, average thorax volume, upper leg volume, lower leg volume, and body mass), on the individual criterion variables of repetitive strength (torso lifts on a vaulting box, mixed pull-ups, and squats), shown in tables 1. to 4., we can reach the expected conclusion that the predictor system of

female participants has a multivariate and statistically significant influence on all the individual criterion variables of repetitive strength at the .001 level ($p=0.001$).

In the relevant literature (Kurelić et al.; Malacko, 2002; Przulj, 2007) morphological characteristics can be defined as a group of

manifest anthropometric measurements relevant for research in physical education, transformed, through factor procedures into latent morphological dimensions. The same authors indicate that on the basis of the determined extents of anthropometric measurements diagnosed on athletes of both genders it is possible to set the goals and tasks for training and plan the program of management activities in certain cycles for the increase in the level of anthropometric measurements which we would like to influence through the training.

Considering that the coefficient of the innate origin of longitudinal dimensionality of the skeleton ranges between .98 - 100 %, the possibility for development exists, but to a very small extent, and thus it is recommended that it should be developed along with the remaining morphological characteristics, on the earliest possible age (Malacko, 2002). Subcutaneous fatty tissue, in almost all sports activities represents a parasite factor with a .50% chance of transformation.

Repetitive strength can be defined as an ability of muscles to manifest force during a cyclical work regime (Przulj, 2006). What is characteristic for this type of strength is the ability for prolonged work on the basis of alternative contractions and the relaxation of the muscles of the torso, in almost all sports activities, depending on age and/or gender, and is mostly used in the athletic running disciplines of longer duration and walking, since they are marked as typical cyclical training or competitive work.

According to some researchers (Kurelić et al. 1975; Brown, Ferrigno, & Santana, 2000; Bompa, 2006; Milanović, 2007) the regulation factor of the intensity of excitation most probably depends on the device for the control of excitation in the primary motor centers and those subcortical nuclei which have the role of amplifiers or modulators. Other researchers agree (Heimar & Medved, 1997; Ward et al., 2006; Duraković, 2008), indicating in their studies the approximately same parameters for the effective realization of repetitive strength, considering the fact that flexibility also has a significant influence on this dimension, along with the quality of the sports technique and biochemical situation on the periphery of the locomotor system.

CONCLUSION

The research results indicate that between the anthropometric measurements as the predictor system and the results of repetitive strength, as the criterion system, there is a statistically significant connection, which indicates high projections of the measures of morphological dimensions and tests of repetitive strength on the canonical factor. The obtained research results will contribute to the work with students in East Sarajevo, as a special attention will now be paid toward the development of the morphological dimensions of circular dimensionality of the skeleton and body mass during the process of sports recreational exercise, since they give the greatest explanation of the achieved results in repetitive strength, and this will contribute to the achievement of better results in sports recreation. In addition, the results of the morphological dimensions and repetitive strength will contribute to the individualization of sports recreational exercise, by adjusting the planning, programming and control of the work to suit the individual abilities and features of the students which are taking part in sports the recreational activities.

REFERENCES

- Bompa, T. (2006). *Teorija i metodologija treninga* [Theory and methodology of training. In Croatian.] Zagreb: Nacionalna i sveučilišna knjižnica.
- Brown, L., Ferrigno, V., & Santana, C. (2000). *Training for speed, agility and quickness*. Champaign IL: Human Kinetics.
- Drabik, J. (1996). *Children and sports training: How your future champions should exercise to be healthy, fit and happy*. Island Pond, Vermont: Stadion Publ.
- Duraković, M. (2008). *Kinantropologija, Biološki aspekti tjelesnog vježbanja*. Kinanthropology, Biological aspects of physical exercise Zagreb: Kineziološki fakultet Sveučilišta u Zagrebu.
- Gajić M. (1986). *Struktura i razvoj koordinacije kod učenika osnovne škole* [Structure and development of co-ordination of primary school students. In Serbian.] Novi Sad: Fakultet fizičke kulture.
- Heimar, S. & Medved, R. (1997). Funkcionalna dijagnostika treniranosti sportaša [Functional diagnostics of their fitness athletes. In Croatian.] *International conference, Proceedings* (pp. 23-44). *International conference* Zagreb: Fakultet za fizičku kulturu, Sveučilišta u Zagrebu.

- Kurelić N., Momirović, K., Stojanović, M., Radojević, Ž., & Viskiće-Štaleb, N. (1975). *Struktura i razvoj morfoloških i motoričkih dimenzija omladine*. Structure and development of morphological and motor dimensions of youth. In Serbian.] Beograd: Institut za naučna istraživanja Fakulteta za fizičko vaspitanje Univerziteta u Beogradu.
- Lohman, T.G., Roche, A.F., & Martorell, R. (1988). *Antropometric standardization reference manual*. Chicago: Human Kinetics Books.
- Malacko, J. (2002). *Osnove sportskog treninga – kibernetički pristup* [Fundamentals of sports training - cybernetic approach. In Serbian.] Beograd: IGRO „Sportska knjiga“.
- Milanović, L. (2007). *Metodika treninga brzinsko-eksplozivnih svojstava kod djece i mladih, Kondiciona priprema sportaša*. [Training Methods of speed and explosive characteristics of children and youth fitness preparation of athletes. In Croatian.] Zagreb: Kineziološki fakultet Sveučilišta u Zagrebu.
- Pržulj, D. (2006). *Antropomotorika* [Anthropometrics. In Serbian.] Pale: Fakultet fizičke kulture.
- Pržulj, D. (2007). *Kondiciona priprema sportista* [Fitness preparation of athletes. In Serbian.] Pale: Fakultet fizičke kulture.
- Pržulj, D. (2012). *Dijagnoza antropoloških obeležja i treniranosti sportista* [Diagnosis of anthropological traits and their fitness of athletes. In Serbian.] Istočno Sarajevo: Fakultet fizičkog vaspitanja i sporta.
- Ward, S.D., Saunders, R., Felton, M.G., Williams, E., Epping, N.J. i Pate, R.R. (2006). Implementation of a school environment intervention to increase physical activity in high school girls. *Health Education Research*, 21(6), 896-910.

КАНОНИЧКИ РЕЛАЦИИ НА МОРФОЛОШКИТЕ ДИМЕНЗИИ СО РЕЗУЛТАТИТЕ НА НЕКОИ ТЕСТОВИ ЗА РЕПЕТИТИВНА СНАГА КАЈ СТУДЕНТКИТЕ ОПФАТЕНИ СО СПОРТСКО РЕКРЕАТИВНО ВЕЖБАЊЕ

УДК: 796.012.-057.075-055.2
(Оригинален научен труд)

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Апстракт

Целата на истражувањето беше да се утврди каноничката корелација на мулти-варијантно и униваријантно ниво, меѓу одреден систем на антропометриски мерки (предиктори) за проценување на: лонгитудиналната димензионалност на скелетот, циркуларната димензионалност и масата на телото, како и поткожното масно ткиво, со друг систем на моторни тестови (критериуми) за проценување на репетитивната снага кај студентките по физичко воспитување и спорт. Целта беше насочена кон утврдување на предикторската валидност и изборот на релевантните варијабли кои непосредно придонесуваат за изразување на репетитивната снага кај примерок на студентки од Источно Сарајево, на возраст од 20 до 23 години (± 6 месеци). Студентките, во период од околу две години, беа опфатени и со рекреативно вежбање. Врз студентките беа применети девет антропометриски мерки. Од мерките, по три беа применети за проценување на: лонгитудиналната димензионалност на скелетот (висина на телото - AVIST, должина на нозете - ADNOG и должина на рацете - ADUŽR); циркуларната димензионалност и маса на телото (среден обем на градниот кош - AOGRK, обем на надколеницата - AONKT, обем на потколеницата - AOPTK и маса на телото - ATEŽT); поткожното масно ткиво (кожен набор на стомакот - ANTRB, кожен набор на надколеницата - ANNTK и кожен набор на подколеницата - ANPTK). За проценување на репетитивната снага беа применети тестовите: подигнување на трупот на шверска клупа - MDTK, мешани згибови - MMZG, и чучнувања - MČUČ. Резултатите

од истражувањата покажаа дека меѓу антропометриските мерки и моторните тестови, постои статистички значајна поврзаност ($p=0.01$).

Клучни зборови: *лонџитудинална димензионалност на скелето, циркуларна димензионалност, маса на телото, појкожно масно ткиво, моторни тестови, кроскорелации, каноничка корелациона анализа,*

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