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Relations between Anthropometric Dimensions and Overcome Resistance in Individual Motion

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RELATIONSBETWEENANTHROPOMETRICDIMENSIONSANDOVERCOMERESISTANCEININDIVIDUALMOTION

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Relations between Anthropometric Dimensions and Overcome Resistance in Individual Motion

Miroslav Dodig

Summary- The research was carried out on a sample of 124 subjects, 15-16 year old males. An analysis was performed of the relations of anthropometric body characteristics and overcome resistance in individual motion. Obtained information was submitted for mathematical analysis, the MULTREG program, from the statistical program "STAT – PACK" (Gauss – Jordan, 1954, Cooley – Lohnes, 1962). On the basis of maximum cohesion and regressive coefficients, variables that measured body volume, transversal skeletal dimension and longitudinal skeletal dimension have the highest cohesion with the overcome maximum resistance in individual motion from anthropometric body characteristics. The weakest contribution to predicting resistance lies within the variables that measured subcutaneous adipose tissue. High cohesion of variables of the overcome maximum resistance in individual motion with anthropometric body characteristics indicates that a part of the resistance variable in motion is conditioned by mutable flexible anthropometric values. As the overcome maximum resistance in motion is mainly conditioned by the structure for generating intensity and duration of energy release, thus the anthropometric dimensions, especially in the volume segment, body volume and transversal skeletal dimensionality, present a factor that significantly participates in the realization of motion with increased requirements for overcoming maximum resistance in motion.

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I. Problem

Since functional structures of the biological system form an organized and integrated system, and relatively simple relations of resistance in motion and anthropometric dimensions depend on them (4,5,6). This complexity is conditioned firstly with anatomical body structures and physiological mechanisms for motion regulation. Such mechanisms have simple physiological regulatory mechanisms in their structures, which are responsible for the realization of the kinetic structure. There is no doubt, that overcome resistance in motion is a comprehensive part of the musculoskeletal system, and it is thus presumed that certain anthropometric dimensions (the longitudinal, transversal and circular skeletal dimensions and subcutaneous fat factor) have a serious role in the exploitation of resistance in motion (1,2,7,12,13,14).

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Long limbs, thus long levers, due to their length produce a larger possibility of realizing the amplitude of motion in individual motion. Because of long extremities, the resistance required to overcome motion in space must be described by significantly longer trajectories throughout the process of motion so as to ensure optimal biomechanical functioning of the kinetic chain, than it is the case of the short level system (8, 9, 10). It can be expected that subjects with a larger volume and body bulk, and larger transversal skeletal dimensionality have a bigger impact in motions that are defined with maximum resistance measures. It can be presumed that the positive influence of the volume dimension, body bulk and transversal skeletal dimensionality influence the outcome of motion, where it is necessary to overcome some maximum external resistance, realized in individual motion.

II. Methods

The sample of subjects for this research study amounted to 124 subjects, of male gender ranging from 15 to 16 years of age. The planned sample of 124 Subjects, represents the effect sufficient for any correlation coefficient equal to or larger than .23, consider different from zero with a margin of error lesser than 0.1 or a .99 degree of reliability.

Pursuant to the goal and purpose of the research measuring instruments that have already been validated in the author's prior researches were used (M. Dodig, 2010), and were selected in a manner so as to cover all dimensions of the hypothetical model. Variables for the evaluation of anthropometric characteristics

- Longitudinal skeletal dimensionality; 1.body height (ATV), 2.leg length (ADN), 3.arm length (ADR), 4.biacromial range (ASK).
- Transversal skeletal dimensionality; 1.elbow diameter (ADL), 2.wrist diameter (ADRZ), 3.knee diameter (ADK).
- Body volume and bulk; 1.body weight (AT), 2.mid-range of chest (AOG), 3.upper arm magnitude – extended (AON), 4.upper arm magnitude – bent (AONK), 5.shin magnitude (AOP).]
- Subcutaneous tissue; 1.cutaneous back fold (AKNL), 2.cutaneous stomach fold (AKNT), 3.cutaneous shin fold (AKNP).

Variables for evaluation of resistance in individual motion are defined with overcome maximal

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resistance in realized motion, expressed by the unit of measure for mass – kilogram (kg) 1.lifting with legs from squat (EPDNKG), 2.Pushing with hands from lying position (EPDRKG), 3.arms pulling up from lying position (EPPRKG)

Methods for transformation, condensation and mathematical data analysis are selected according to data analysis requirements. Obtained data are subject to analysis.

Relations of variables which measured resistance in motion and the variable of anthropometric body characteristics are solved with a multiple regression analysis, the MULTREG program, from the statistic program "STAT – PACK" (Gauss – Jordan, 1954, Cooley – Lohnes, 1962). For the purpose of determining relations between predictor variables and criterion variables, the correlation coefficients between each predictor variable and criteria variable (R) were calculated, as were the regressive coefficient of predictor variables (BETA), the standard error of regressive coefficients (SIGMA-D), the T-values of the regressive coefficient of determination of criterion variables (DELTA) and coefficients of regression T (BETA). Furthermore, the coefficients of determination of criteria variables were also calculated, as well as coefficients of multiple correlations between predictor variables and criterion variables (RO) that are derived from a routine evaluation prognosis (SIGMA-D). The analysis of variance tested the hypothesis that the population to which the sample belongs to, the coefficient of determination of criteria variables is equal to zero. For this purpose quadrant sums were calculated, degrees of freedom and middle quadrant, which belong to the linear regression and deviation from the linear regression. In addition, sums of middle quadrants were also calculated for the total variance source. The hypothesis about the nullity of coefficients of determination was tested with an F – test. The percentage of contribution of predictor variables explains the total variances of the criterion variable (P) and (Q) significance of F – test at a reliability level of .99 and .95 along with DF1 and DF2 degrees of freedom, if the real value of the coefficient of determination is zero (Cooley, W. W., Lohnes, P. H., 1971).

III. Results

With analysis of obtained results in the space of variables of anthropometric characteristics in relation to resistance in motion, lifting with legs in individual motion (EPDNKG), table 1, a significant influence is discerned.

Table 1 : Multiple regression of variable (EPDNKG) resistance in motion, lifting legs in individual motion in the system of anthropometric variables

Variables	R	Beta	Sigma-B	T(Beta)
1. AVT	0.12	-0.01	0.02	-0.45
2. AT	0.08	-0.01	0.03	-0.30
3. ADN	0.08	-0.01	0.03	-0.31
4. ADR	0.11	-0.04	0.06	-0.63
5. ASK	0.31	0.22	0.24	0.92
6. ADL	0.20	-0.00	0.17	-0.01
7. ADRZ	0.32	0.04	0.17	0.26
8. ADK	0.39	0.03	0.03	0.99
9. AOG	0.38	-0.00	0.02	-0.12
10. AON	0.45	0.03	0.10	0.32
11. AONK	0.49	0.09	0.08	1.08
12. AOP	0.38	-0.00	0.06	-0.09
13. AKNL	0.19	0.01	0.03	0.53
14. AKNT	0.11	-0.00	0.02	-0.34
15. AKNP	0.06	0.04	0.02	-1.73

DELTA	RO	SIGMA-D	F	P	Q
0.31	0.56	8.42	3.29	21.88%	0.01

Key: ATV – body height, ADN – leg length, ADR – arm length, ASK - bioacromial range, ADL – elbow diameter, ADRZ – wrist diameter, ADK – knee diameter, AT – body weight, AOG – middle range of chest, AON – upper arm range – extended, AONK - upper arm range – bent, AOP – shin range, AKNL - cutaneous back fold, AKNT - - cutaneous stomach fold, AKNP - - cutaneous shin fold.

R – coefficients of correlation between every predictor variable and criterion variable

BETA – regression coefficients of predictor variables

SIGMA-B – standard error of regression coefficients

T (BETA) – values of regression coefficient

DELTA – coefficients of determination of criterion variables

RO – coefficients of multiple correlations between predictor variables and criterion variables
SIGMA-D – standard evaluation of prognosis
F – test
P – percentage of contribution of predictor variables towards the explanation of the total variance criterion variable
Q – reliability

In the region of predictor variables, the variables that measured the transversal dimensionality of the skeleton have the biggest connection with the criterion (ASK, ADL, ADRZ, ADK) as well as variables that measured body volume (AOG, AON, AONK, AOP). A regressive function ensuring a satisfactory level of multiple regression (0.56) was formed with a linear combination of variables, with a significant coefficient of determination (0.31). The largest contribution towards forming regressive functions have body volume variables (AON, AONK, AOP) and transversal dimensionality variables (ADRZ, ADK, ASK, ADL). Obtained results indicate that for realization of resistance in motion of legs in individual motion, anthropometric characteristics play an important part, manifested as body volume and transversal skeletal dimensionality i.e. larger volume and bone density enable overcoming stronger resistance in motion.

This is also confirmed by the analysis of the variance where the F – test is statistically significant on a level of .99 reliability. Evaluation of the fraction of resistance in motion that can be attributed to multiple regression (the ratio of the average quadrant) in the space of variables with anthropometric characteristics amounts to 78.12%. Their complementary part amounts to 21.88% and evaluates the fraction of variance that is explained by the system of variables of anthropometric body characteristics.

Observing the space of variables of anthropometric body characteristics in relation to resistance in motion, raising arms individual motion (EPDRKG), table 2, a significant impact can be discerned.

Table 2 : Multiple regression of variable (EPDRKG) resistance in motion, raising arms in individual motion within the system of anthropometric variables

Variables		R	Beta	Sigma-B	T (Beta)
16.	AVT	0.16	-0.03	0.01	-1.69
17.	AT	0.17	0.03	0.02	1.82
18.	ADN	0.09	-0.04	0.02	-1.90
19.	ADR	0.18	-0.02	0.04	-0.65
20.	ASK	0.40	0.20	0.15	1.33
21.	ADL	0.35	0.12	0.10	1.17
22.	ADRZ	0.41	-0.01	0.10	-0.10
23.	ADK	0.54	0.01	0.02	0.58
24.	AOG	0.61	0.05	0.01	2.93
25.	AON	0.66	0.05	0.06	0.86
26.	AONK	0.72	0.14	0.05	2.56
27.	AOP	0.50	-0.04	0.03	-1.09
28.	AKNL	0.23	0.00	0.02	0.27
29.	AKNT	0.16	-0.03	0.01	-1.76
30.	AKNP	0.11	-0.02	0.01	-1.75
DELTA	RO	SIGMA-D	F	P	Q
0.67	0.82	5.22	14.77	62.69%	0.01

Key (see Table 1)

In the region of predictor variables, variables that have the strongest connection to the criteria (AONK, AON, AOG, AOP) are the ones that measured body volume. A somewhat lesser connection have those variables (ADK, ASK, ADL, ADRZ) that measured transversal dimensionality of the skeleton. A significantly lesser connection which is borderline significant have variables (AT, ADR, AKNT, AKNL) that measured the longitudinal dimensionality of the skeleton and adipose tissue.

Through linear combination of predictor variables a regressive function was formed which ensures a satisfactory level of multiple correlation (0.82) and a coefficient of determination (0.67). The morphological characteristics of transversal dimensionality and body volume gave the biggest contribution to the process of forming the regressive function. Deviation of the predictor from the line of regression ensures enough degrees of freedom which is further confirmed by the regressive prediction, which moves in the range of 5 kg/100. Thus, based on the anthropometric body characteristics it is possible to conduct a prediction of resistance in motion. This is confirmed by the obtained F – test. The evaluation of the variance part that can be ascribed to anthropometric body characteristics based on multiple regression amounts to 62.69% of the total variability, while the smaller part of 37.31% cannot be ascribed to anthropometric body characteristics. A significantly larger fraction of the variance that can be explained through the impact of the system of anthropometric body characteristics, indicates that the larger part of the criterion variance is conditioned by anthropometric characteristics. A distinct significance of variables is noticed in regard to the anthropometric body characteristics in relation to resistance in motion regarding pulling with arms in individual motion (EPPRKG), table 3, what points to a significant impact.

Table 3 : Multiple regression of variable (EPPRKG) resistance in motion, pulling with arms in individual motion within the system of anthropometric variables

	VARIABLES	R	BETA	SIGMA-B	T(BETA)
31.	AVT	0.24	-0.01	0.01	-0.53
32.	AT	0.18	-0.02	0.02	-0.92
33.	ADN	0.19	-0.01	0.02	-0.46
34.	ADR	0.23	-0.05	0.04	-1.23
35.	ASK	0.41	0.20	0.15	1.28
36.	ADL	0.27	0.04	0.10	0.43
37.	ADRZ	0.41	-0.02	0.10	-0.21
38.	ADK	0.57	0.05	0.02	2.30
39.	AOG	0.59	0.03	0.01	1.94
40.	AON	0.58	-0.05	0.06	-0.83
41.	AONK	0.63	0.11	0.05	1.96
42.	AOP	0.48	-0.06	0.03	-1.81
43.	AKNL	0.23	-0.01	0.02	-0.74
44.	AKNT	0.20	-0.00	0.01	-0.46
45.	AKNP	0.17	-0.01	0.01	-1.10

DELTA	RO	SIGMA-D	F	P	Q
0.53	0.72	5.33	7.73	45.10	0.01

Key (see Table 1)

In the region of predictor variables the strongest connection with the criterion have those variables (AONK, AOG, AON, AOP, AT) that measure the body volume, variables (ASK, ADL, ADRZ, ADK) that measure the transversal skeleton dimensionality, a somewhat lesser connection those variables (ATV, ADN, ADR) which measure the longitudinal dimensionality of the skeleton and the weakest variables (AKNL, AKNT, AKNP) that measure adipose tissue. a regressive function which ensures a satisfactory level of multiple correlations (0.72) is formed through the linear combination of predictor variables. Variables that measured body volume and transversal dimensionality of the skeleton had the biggest contribution towards forming the regressive function. Deviations in view of the predictor variables from the regressive line ensures adequate degrees of cohesion what is confirmed by the average regressive prediction which moves in the range of 5.33 kg/100.

The obtained results, and to an extent the coefficient of determination of 0.52 is determined on the basis of a system of anthropometric characteristics, thus justifying the evaluation on the grounds that resistance in motion, pulling by arms in individual motion is dependent on anthropometric characteristics. The evaluation of a partial variability also emphasizes this point, and can be ascribed to anthropometric characteristics based on multiple regression (the ratio of an average quadrant of deviation and an original average quandrant) and amounts to 45.10% of the total variability. However, the larger part that amounts to 54.90 % of the total variability cannot be ascribed to multiple regression.

IV. Conclusion

The research was carried out on a sample of 124 subjects, 15-16 year old males. An analysis was performed of the relations of anthropometric body characteristics and overcome resistance in individual motion. Obtained information was submitted for mathematical analysis, the MULTREG program, from the statistical program “STAT – PACK” (Gauss – Jordan, 1954, Cooley – Lohnes, 1962). On the basis of maximum cohesion and regressive coefficients, calculated T-values of regressive coefficients between predictor variables and criterion variables, confirmed the significance of the prediction. The Nullity Hypothesis of coefficient determination was tested with the F – test. The percentage of contribution predictor variables explain the total variances of the criterion variable (P) and (Q) the significance of the F – test on a level of reliability of .99 and .95 along with DF1 and DF2 degrees of freedom, confirmed the stated significance. Variables that measured body volume, transversal skeletal dimension and longitudinal skeletal dimension proved to have the highest cohesion with the overcome maximum resistance in individual motion from anthropometric body characteristics. The weakest contribution to predicting resistance lies within the variables that measured subcutaneous adipose tissue. High cohesion of variables of the overcome maximum resistance in individual motion with anthropometric body characteristics indicates that a part of the resistance variable in motion is conditioned by mutable flexible anthropometric values. As the overcome maximum resistance in motion is mainly conditioned by the structure for generating intensity and duration of energy release, thus the anthropometric dimensions, especially in the volume segment, body volume and transversal skeletal dimensionality, present a factor that significantly participates in the realization of motion with increased requirements for overcoming maximum resistance in motion.

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