

Relations Between Anthropometric Dimensions and Overcome Resistance in Recurring Motion

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Abstract 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 recurring motion. The evaluation of resistance in motion was based on conducting motion with 75% of the maximum achieved, overcome weight, repetitive motion is carried out until the maximum number of correctly executed repetitions. 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 recurring motion from anthropometric body characteristics. High cohesion of variables of the overcome resistance in recurring motion with anthropometric body characteristics indicates that a part of the resistance variable in motion is expectedly significant. 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.

Keywords: *multiple regressive analysis, relations, anthropometric dimensions, overcome maximum resistance in recurring motion*

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1. Introduction

The human organism has the feature of generating and releasing energy with the goal of overcoming resistance on a certain path at a certain time, within a given kinetic outlet [4,6]. Taking into consideration the qualitative and quantitative diversity of expression in terms of overcoming resistance within one global kinetic outlet, the possibility of forming an entire series of relations within the space of anthropometric body characteristics [1,2,5,8,9] is enabled. Preferring a certain role of anthropometric dimensions in the realization of motion where overcoming resistance is dominant, their contribution within the source of variability resistance in motion [7,10,12,13,14] is a legitimate expectation. It is to be expected that the body with the larger volume and larger mass, as well as larger transversal skeletal dimensionality have a stronger impact in motions that are defined by measures of maximum resistance. The amplitude of motion is realized in recurring motion presenting the exceeded path in motion, which is defined as successive repetition of individual motion, while limited by the mechanism for generating intensity and the duration of releasing energy, what will influence the decrease of the impact of lever length. Hence,

a positive impact of the volume dimension, body mass and transversal skeletal dimensionality regarding motion outcome is to be expected, where it is necessary to overcome some maximum external resistance in recurring motion.

Such a predominantly theoretical concept of the variance part of resistance will significantly be explained through parallel anthropometric dimensions determined by longitudinal, transversal, and circular dimensions of the skeleton as well as the subcutaneous adipose tissue factor. The main purpose and objective of this study is aimed towards the direction of researching mutual relationships and relations of overcome resistance in motion with anthropometric body dimensions.

2. 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 overcome resistance in recurring motion;

1. lifting with legs from squat (ESDNKG), 2. Pushing with hands from lying position (ESDRKG), 3. arms pulling up from lying position (EPPRKG)

(ESDRKG), 3. pulling weight with arms from lying position (ESPRKG). Evaluation of resistance in motion was based on execution of motion with 75% of maximum achieved weight, repetitive motion is carried out until the maximally correct executed repetition.

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).

3. Results

Variables of anthropometric characteristics in relation to resistance in motion, lifting with legs in repetitive motion (ESDNKG) Table 1, significantly contributes to the prediction.

Table 1. Multiple regression of variable (ESDNKG) resistance in motion, lifting legs in recurring motion in the system of anthropometric variables

VARIABLES		R	BETA	SIGMA-B	T(BETA)
1	AVT	-0.01	-1.49	0.95	-1.56
2	AT	-0.13	-0.35	1.13	-0.31
3	ADN	-0.15	-1.50	1.13	-1.32
4	ADR	0.11	3.49	2.15	1.62
5	ASK	0.03	-4.64	7.93	-0.58
6	ADL	0.05	0.88	5.53	0.15
7	ADRZ	0.04	-6.34	5.50	-1.15
8	ADK	0.16	1.77	1.12	1.57
9	AOG	0.24	1.14	0.95	1.19
10	AON	0.22	0.76	3.51	0.21
11	AONK	0.26	-0.19	2.84	-0.06
12	AOP	0.17	-0.83	1.94	-0.42
13	AKNL	0.12	1.15	1.14	1.00
14	AKNT	0.01	-1.63	0.89	-1.83
15	AKNP	-0.01	-0.62	0.88	-0.70
DELTA	RO	SIGMA-D	F	P	Q
0.25	0.50	270.99	2.41	14.76%	0.05

Key: ATV – body height, ADN – leg length, ADR – arm length, ASK – biacromial 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

The following variables have significant cohesion in treated space: (AOG, AON, AONK, AOP) which measure body volume. And besides a small number of significant coefficients of correlation the linear combination of predictor variables forms a regressive function which ensures a satisfactory level of multiple correlation (0.50) and a coefficient of determination (0.25). Based on the obtained results in the analysis of the variance and the obtained F – test on the level of significance of 0.95 reliability, it is possible to conduct predictions of the criterion variable on the basis of a variable group of anthropometric characteristics. In this process, the fraction

of the explained variance, to which the variable system of anthropometric characteristics contributes towards, amounts to 14.76% of the total amount of variability which can be ascribed to multiple regression. This enables acceptance of the statement that anthropometric characteristics are a significant factor in solving repetitive motions in leg lifting with a load, as well as the fact that subjects with the aforementioned characteristics in principle achieve better results in overcoming resistance in motion. Observing the obtained results within the space of variables of anthropometric characteristics in relation to the resistance in motion, lifting with arms in repetitive motion (ESDRKG), Table 2, a significant impact is noticed.

Table 2. Multiple regression of variable (ESDRKG) resistance in motion, raising arms in recurring motion within the system of anthropometric variables

VARIABLES	R	BETA	SIGMA-B	T(BETA)	
16	AVT	0.15	0.57	0.64	0.87
17	AT	0.12	0.00	0.76	0.00
18	ADN	0.08	-0.49	0.76	-0.64
19	ADR	0.06	-1.59	1.45	-1.09
20	ASK	0.22	3.64	5.37	0.67
21	ADL	0.15	-0.22	3.75	-0.06
22	ADRZ	0.22	-1.86	3.72	-0.49
23	ADK	0.32	-0.49	0.76	-0.65
24	AOG	0.38	1.30	0.65	2.01
25	AON	0.40	2.74	2.37	1.15
26	AONK	0.39	0.73	1.92	0.38
27	AOP	0.30	-0.23	1.31	-0.17
28	AKNL	0.10	-0.56	0.77	-0.73
29	AKNT	0.11	-0.20	0.60	-0.33
30	AKNP	0.10	-0.10	0.60	-0.18
DELTA	RO	SIGMA-D	F	P	Q
0.24	0.49	183.59	2.26	13.39%	0.05

Key (see Table 1)

Significant correlations in analyzed space are conditioned by variables (AOP, AONK, AON, AOG) that measured body volume and variables (ADK, ADRZ, ASK) that measured the skeletal transversal dimensionality.

The linear combination of variables produced a significant coefficient of multiple correlation (0.49) and a coefficient of determination (0.24). Obtained values ensure adequate data in order to accept the statement that the joint reproduces common variances to such a degree based on which a prediction of the stated motion can be carried out – resistance in motion by lifting arms (ESDRKG), with anthropometric characteristics.

This was also confirmed in the variance analysis where the F – test holds a statistical significance of 0.95 reliability level. It can be confirmed that anthropometric characteristics significantly contribute to the prediction of the stated motion. This is supported by the fraction of the explained variance which covers 13.39% of the total variability, and which can be ascribed to multiple regression.

The system of anthropometric characteristics variables in relation to resistance in motion, pulling with arms in repetitive motion (ESPRKG), Table 3, ensures a sufficient level of influence.

Table 3. Multiple regression of variable (ESPRKG) resistance in motion, pulling with arms in recurring motion within the system of anthropometric variables

VARIABLES	R	BETA	SIGMA-B	T(BETA)	
31	AVT	0.31	-0.49	0.64	-0.76
32	AT	0.30	0.89	0.75	1.17
33	ADN	0.28	0.61	0.76	0.81
34	ADR	0.14	-2.29	1.44	-1.59
35	ASK	0.40	5.70	5.32	1.07
36	ADL	0.26	-1.27	3.71	-0.34
37	ADRZ	0.40	-0.36	3.69	-0.10
38	ADK	0.48	0.41	0.75	0.54
39	AOG	0.45	0.32	0.64	0.51
40	AON	0.50	5.28	2.35	2.24
41	AONK	0.50	-1.15	1.90	-0.60
42	AOP	0.46	0.81	1.30	0.62
43	AKNL	0.12	0.26	0.76	0.34
44	AKNT	0.07	-0.99	0.59	-1.65
45	AKNP	0.08	-0.59	0.59	-0.99
DELTA	RO	SIGMA-D	F	P	Q
0.42	0.65	181.86	5.22	34.01%	0.01

Legend (see Table 1)

The largest and most positive connection in the space of predictors have the following variables (AOP, AONK, AON, AOG, AT) which measure body volume, variables (ADK, ADRZ, ADL, ASK) which measure transversal skeletal dimensionality and variables (AVT, ADN) which measure the longitudinal skeletal dimensionality.

The linear combination of variables produced a multiple correlation which is satisfactory and significant (0.65). It is clear that in the process of forming the regression function, the stated variables contributed the most. The obtained results especially the satisfactory coefficient of determination – 0.42, determined on the basis of the anthropometric characteristics system, validate the evaluation that resistance in motion, pulling with arms in repetitive motion is dependent on anthropometric characteristics.

The analysis of variance and the obtained F – test which is statistically significant on a level of 0.99 reliability, ensures a significant evaluation of the fraction which can be ascribed to multiple regression. A part of the variance that can be explained by the system of predictor variables amounts to 34.01% of the total variability, ensuring the statement that resistance in motion, pulling with arms in repetitive motion is dependent on anthropometric characteristics.

4. Discussion

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 recurring motion. The evaluation of resistance in motion was based on conducting motion with 75% of the maximum achieved, overcome weight, repetitive motion is carried out until the maximum number of correctly executed repetitions. 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 recurring motion from anthropometric body characteristics. High cohesion of variables of the overcome maximum resistance in recurring 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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