IMPACT OF ANTHROPOMETRIC VARIABLES ON JUDO PERFORMANCE FOR FEMALE JUDOKAS IN ABSOLUTE CATEGORY

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Abstract

The analysis of the impact of 17 anthropological variables on the Judo performance was carried out on the sample of elite female judokas, competitors in the absolute category. It was established that body weight, the circumference of the extremities, skinfold on the upper arm and back, and the height were most responsible for the performance.

Keywords: *judo, anthropometry, longitudinal skeletal dimensionality, volume and body mass, transversal skeletal dimensionality, quasiregression*

Zusammenfassung

EINFLUß DER ANTHROPOMETRISCHEN VARIABLEN AUF DAS RESULTAT IM JUDOKAMPF IN ALLKATEGORIE BEI FRAUEN

Auf dem Muster von Spitzenjudokas (Frauen), die Wettbewerberinnen in Allkategorie, wurde die Analyse des Einflusses von 17 Variablen auf den Erfolg in Judokampf durchgeführt. Es wurde festgestellt, daß das Körpergewicht, der Körperumfang, die Hautfaltendicke am Oberarm und auf dem Rücken, und die Körperhöhe den Erfolg in höchstem Maße beeinflußten.

Schlüsselwörter: *Judo, Anthropometrie, longitudinale Dimensionalität des Skeletts, Körperumfang und Körpermasse, transversale Dimensionalität des Skeletts, subkutanes Fettgewebe, Quasiregression*

1. The problem

In order to be able to achieve top results coaches must be conversant with the most recent scientific knowledge concerning the impact of the anthropological variables on Judo performance. One way to achieve this aim is to carry out the relevant research. The present study deals with the relationship of different anthropological characterics and the performance in Judo in the absolute category in women. The generalization of the results obtained will be applicable only to the category of the elite judokas, competitors in the absolute category. Further research will be needed for other categories of judokas.

To the author's knowledge the problem has not been dealt with in relation to this specific category. In male population the analysis of the relation between anthropological measures and the performance and technical efficiency in Judo has been studied. Thus Gartner V. (1982) established that the body weight and chest circumference played a very important role in the outcome of a judo bout. Lucić, J. (1988) stressed the impact of volume and body mass on the performance in Judo in standing position and groundwork, and Popović, A.D. (1985) pointed to the significant effect of morphological variables on the efficiency of performance of Judo technique in standing position.

2. Methods

The population the sample has been extracted from is defined as the population of elite female judokas from the Republic of Croatia, aged 16 through 31. None of them are less than the green belt, and two thirds of the subjects are brown belts and black belts. The number of subjects was reduced to 30, since the number of elite female judokas is relatively small, and consequently each correlation coefficient of .36 and up is significant at the level of .01.

The sample of variables consisted of 17 anthropological measures treated as a group of predictor variables, and one criterion variable related to Judo performance. The predictor group of variables covered four latent dimensions of the anthropometric space.

- Volume and body mass (circular skeletal dimensionality): upper leg circumference (OPSNAT), lower leg circumference (OPSPOT), upper arm circumference (OPSNAD), lower arm circumference (OPSPOD), body weight (TJETEZ);
- Longitudinal skeletal dimensionality: (body) height (TJEVIS), leg length (DULNOG), arm length (DULRUK), shoulder width (SIRRAM);
- Subcutaneous fat tissue: upper arm skinfold (NABNAD), lower arm skinfold (NABPOD), lower leg skinfold (NABPOT), back skinfold (NABLED), abdomen skinfold;
- Transversal skeletal dimensionality: elbow diameter (DIJLAK), knee diameter (DIJKOL), pelvis width (SIRZDJ).

Each variable was measured three times by calibrated measuring instruments according to the international biological programme criteria.

The criterion variable Judo performance (VICTO-

Table 1 Basic descriptive parameters of the studied anthropometric variables

	TJETEZ	TJEVIS	DULNO	DULRU	DIJLAK	DUKOL	SIRRAM	SIRZCJ	OPSNA	OPSPO	OPSNA	OPSPO	NABNA	NABPO	NABPO	NABLE	NABTR
X	66,15	156,20	93,14	71,90	6,30	8,91	37,30	30,01	57,72	36,10	29,30	23,87	1,71	0,95	1,39	1,40	1,20
S.D.	9,80	12,53	5,70	4,50	0,40	0,80	2,81	2,45	3,94	2,12	3,20	1,52	0,41	0,20	0,38	0,28	0,37

Table 2 Correlation of predictor anthropometric variables

	TJETEZ	TJEVIS	DULNO	DULRU	DIJLAK	DUKOL	SIRRA	SIRZCJ	OPSNA	OPSPO	OPSNA	OPSPO	NABNA	NABPO	NABPO	NABLE	NABTR
TJETEZ	.0000																
TJEVIS	.7491	.0000															
DULNOG	.6493	.9117	.0000														
DULRUK	.4012	.6462	.6663	.0000													
DIJLAK	.0591	.2057	.1950	.1292	.0000												
DUKOL	.6235	.5935	.5303	.4723	.2528	.0000											
SIRRAM	.5741	.5459	.5111	.6108	.0163	.5260	.0000										
SIRZCJ	.1179	.2552	.1421	.2319	.0754	.1245	.4817	.0000									
OPSNA	.8502	.5023	.4230	.1761	.1249	.5132	.3417	-.0205	.0000								
OPSPOT	.6936	.4541	.4054	.1898	.2466	.3796	.3058	.1603	.7544	.0000							
OPSNA	.6578	.4002	.2765	.2202	.1158	.3591	.4448	.4275	.6831	.7691	.0000						
OPSPOD	.7234	.4977	.3629	.3347	.1452	.4023	.5498	.3874	.7048	.7612	.8628	.0000					
NABNAD	.7640	.4058	.3520	-.0024	.0964	.5451	.4546	.2564	.7468	.5636	.5804	.5557	.0000				
NABPOD	.6494	.3173	.2062	.1993	.2196	.2834	.1927	-.2392	.7235	.5606	.4158	.5553	.4282	.0000			
NABPOT	.4190	.3870	.4658	.2261	.1512	.2711	.1830	-.1570	.4681	.4220	.1130	.1557	.3916	.3205	.0000		
NABLE	.5940	.2146	.1588	-.0789	.3661	.3416	.2579	.1334	.7146	.6697	.71(?)	.6763	.6527	.6224	.1269	.0000	
NABTR	.4485	.3137	.2560	-.0146	.2786	.1303	.0090	-.3844	.4939	.2557	.1144	.2548	.2835	.6542	.4425	.4058	.0000

Each r >than 0.36 is significant at the level of 0.01

RIES) was based on the total number of points collected in 29 Judo competitions that the subjects gained over a longer period during training sessions, competitions and preparations. Each victory brought a point, and defeat brought zero points. Judo was performed according to international rules.

Having in mind a small number of examinees, regression analysis was considered the most suitable method for data processing, i. e. the regression analysis that maximizes the covariance of linear composite formed of the standardized predictor variables and standardized criterion variable. This SRA model of regression analysis does not test the significance of the multiple correlation directly, but indirectly through testing the significance of the predictor variables and criteria.

3. Results and Discussion

On the basis of the data displayed in Table 1 it might be concluded that the sample of subjects was slightly different from the usual population (Momirović, 1969) owing to the group selection and the heavy weight category of subjects. The volume measures and body mass were consequently slightly higher.

Further, the relationship between anthropometric measures and the performance in Judo was analyzed by the intercorrelation matrix of the predictor group of anthropometric variables. This matrix (Table 2) showed essentially medium high and high correlation coefficients and markedly less low and zero correlation. The values of the achieved coefficients of the anthropometric variables were not significantly different from the similar values obtained in other studies (Mekić, 1974; Kurelić et al., 1975; Momirović, 1969;) on the female population.

The highest correlation values between anthropometric variables were achieved among variables belonging to the same hypothetical latent dimension. Most highly correlated were the measures of circular skeletal dimensionality and subcutaneous fat tissue, and of the longitudinal dimensionality and transversal and circular dimensionality. The lowest correlation was established between transversal skeletal dimensionality and subcutaneous fat tissue. The low negative correlation between the pelvis width and the skinfold on the lower arm, lower leg and the abdomen were quite interesting, since they were probably the result of the specific stature of judokas in the absolute category.

The correlation of the predictor group and the criterion defined as Judo performance were displayed in Table 3. The data showed a great number of medium high and high coefficient correlation values and only six of them were not statistically significant. The highest numerical values of the correlation coefficients were those of circular skeletal dimensionality and the performance. The upper arm skinfold, body weight, the upper arm circumference and the upper leg circumference were highly

Table 3 Correlation of the predictors and the criterion

	VICTORIES
TJETEZ	.7038
TJEVIS	.3741
DULNOG	.3351
DULRUK	.1693
DIJLAK	-.0673
DIJKOL	.5107
SIRRAM	.4626
SIRZDJ	.4239
OPSNAT	.6947
OPSPOT	.5863
OPSNAD	.7056
OPSPOD	.6226
NABNAD	.8036
NABPOD	.3224
NABPOT	.2304
NABLED	.6064
NABTRB	-.0109

Each r>36 is significant at the .01 level

Table 4 Quasiregression coefficients

	VICTORIES
TJETEZ	.3398
TJEVIS	.1801
DULNOG	.1613
DULRUK	.0815
DIJLAK	-.0324
DIJKOL	.2458
SIRRAM	.2226
SIRZDJ	.2040
OPSNAT	.3343
OPSPOT	.2821
OPSNAD	.3395
OPSPOD	.2996
NABNAD	.3867*
NABPOD	.1552
NABPOT	.1109
NABLED	.2918
NABTRB	-.0053

* *marks regression coefficient with the highest value of F-test
defining the significance of multiple correlation.*
R)=0.7845 (multiple correlation)
F-test = 58.3380 (the highest F-test value)
Q=0.003 (F-test significance)
F 0.003 (df1=1; df2=28) = 5.61

Table 5 The structure of the quasiregression factors

	VICTORIES
TJETEZ	.9241
TJEVIS	.6937
DULNOG	.6001
DULRUK	.3987
DIJLAK	.1994
DIJKOL	.6520
SIRRAM	.6392
SIRZDJ	.3218
OPSNAT	.8699
OPSPOT	.8120
OPSNAD	.8230
OPSPOD	.8583
NABNAD	.8044
NABPOD	.6136
NABPOT	.4067
NABLED	.7325
NABTRB	.3477

ALPHA = 0.8575 (reliability)

of the strength of the arms which was crucial for breaking the opponent's balance, making contact and throwing (*kutsushi, tsukuri, kake*). If *tori* is incapable of performing these actions in a standing position, which is the fundamental fighting posture, the actions cannot be successful. The arm strength is to a large extent responsible for groundwork, and particularly in holds and releases from the holds (*osaekomi, osaekomi toketa*). In these terms the relationship between the upper arm circumference and the performance in Judo fight should be explained.

The body weight is extremely important for Judo performance since it forces the lighter judokas, when throwing or holding the opponent or releasing from the hold, to use muscular strength. The heavier judoka when competing with a lighter one is more stable and acts with absolute force in all actions and particularly when performing sutemi waza. Logical interrelationship of this variable and the success in performance in Judo is the reason that male and female judokas are categorized into weight categories at competitions, and the consequence being that winners in absolute categories are usually the heaviest contestants. The competitions in absolute category are held notwithstanding this fact, with the aim to, in harmony with Judo principles and its definition, point to the possibility of overpowering the strength by using proper technique, and breaking balance by quick and coordinated body movements.

The circumference of the upper leg (and the lower leg too) obviously measures the strength of legs. It is extremely important for Judo performance and the Japanese (Draeger &Inokuma, 1970, pp. 138-140) consider it most responsiblefor the success. In any case it is responsible for the final stage of all throwings (except some sutemi wazas) and for the defensive and good balance position.

correlated with the performance in Judo in the absolute category.

The relationship of the upper arm skinfold and the upper arm circumference with the performance was easy to explain. These two measures were the indirect indicators

The subcutaneous fat tissue in athletes is usually considered a ballast and is rarely positively correlated to success in sport. Therefore, we find it difficult to explain the relationship of the back skinfold and the performance, except as the contribution to the whole body mass which is positively correlated with the performance in Judo.

Table 4 displays the quasiregression coefficients and quasimultiple correlation (RO). The regression analysis using SRA model shows a high multiple correlation coefficient of .78, significant at the 0.5 level. *Per analogiam* it might be claimed that the selected group of anthropometric variables can predict the success in Judo in the absolute category in women. The vector analysis of quasiregression coefficients shows its identity with the vector of anthropometric correlation and the performance in Judo. The same measures that have the highest correlation with the criterion also have the greatest impact on it, and consequently the assumption on the relationship of the predictor group and the criterion holds, with the qualification that the following variables have the greatest impact on the success in Judo in the absolute female category: upper arm skinfold, body weight, upper arm circumference, upper leg circumference, lower arm skinfold, lower leg skinfold and back skinfold.

The structure of quasiregression factors (Table 5) the reliability of which (ALPHA) estimated by the Cronbach procedure is .86, shows that it is best defined by measures of circular body dimensionality (body weight and measure of circumference). It is less strictly defined by measures of subcutaneous fat tissue and longitudinal body dimensionality (upper arm skinfold, back skinfold and the height), whereas the measures of transversal skeletal dimensionality have the least impact. The obtained structure of quasiregression factors implies that women who are heavier, who have more body mass and partly more subcutaneous fat tissue, and who are also taller will perform better in the absolute female category in Judo.

4. Conclusion

The research on the relationship of 17 anthropometric measures and the performance in Judo in the absolute female category has been carried out on the sample of 30 elite female judokas aged 16 through 31, competitors carring not less than a green belt. High degree of correlation of the predictor group of anthropometric variables and the performance in Judo has been established. The multiple correlation coefficient amounted to .78 (p), and the following measures had the dominant impact on the performance circular dimensionality, subcutaneous fat tissue and longitudinal dimensionality. The measures of transversal skeletal dimensionality showed the lowest correlation with the criterion variable. The structure of the quasiregression factor showed that heavier and taller women with more muscular mass and some subcutaneous fat tissue will perform better in the absolute female category in Judo.

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