Coll. Antropol. **29** (2005) 2: 697–703
UDC 796.853.23-053.6:572.087](497.5)
Original scientific paper

Anthropological Determinants of Success in Young Judoists

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A B S T R A C T

There is an evident lack of experimental studies dealing with the anthropological determinants of success in judo, especially concerning young athletes. In this paper we have attempted to establish some of the anthropological factors potentially related to judo competition achievement in 15–16 year old athletes. A set of 14 anthropometric and 12 motor-endurance variables was tested on the best young judoists in Croatia (all males, N=34). All the subjects had competed on the National Championship (NC), and the criterion was defined according to their final NC achievement. Factor analysis and discriminant canonical analysis (DISCRA) were calculated separately on the motor-endurance and anthropometric status variables. DISCRA showed the successful judoists as dominant in strength and endurance status. In contrast, there were no significant differences in the anthropometric dimensions regarding any differentiation between the more and less successful athletes. Possible explanations are discussed.

Key words: *physical fitness, antropometry, motor endurance, judo, martial arts*

Introduction

Judo is a complex sport, where a considerable number of different anthropological dimensions plays an important role in the final sport result. Therefore, if a top result is aimed at, accurate data of the characteristic anthropologic influence on the final result/outcome are required[1]. Naturally, it implies a precise and consecutive analysis of the athlete's anthropological status, which is usual in different sports and sport-related activities[2–7]. A limited number of authors, who consider the potential predictors of a judo-performance, shares the opinion that motor-endurance status strongly differentiates between the elite and the non-elite judo-athletes. For example, Franchini et al.[8] defined significant differences between the elite (Brazilian national and international medalists) and non-elite (non-medalists in the Brazilian national tournaments) competitors in a specific judo fitness test. Although well performed, and because of the representative sample of the subjects' interesting study, the results of this investigation cannot be widely generalized because the authors, apart from the specific judo fitness test (which include a great deal of the specific judo motor knowledge and skills), did not observe and study the basic motor-endurance variables. Takeuchi et al.[9] performed more complex research and described the significant relation between static strength and judo-success, on a sample of the *All Japan University Judo Weight Limit Championships.* Although performed using a stratified sample of subjects, the results are interesting and probably broadly applicable knowing the quality of the judo sport in Japan (Japanese athletes won 60% of all gold medals in the 2004 Olympic judo tournament).

Modern judo rules do not allow a passive fight. Therefore, it is not surprising that Degoutte, Jouanel and Filaire[10] with a sample of 16 top-level judoists, recently defined judo as an anaerobic, mostly lactate sport. Accordingly, the intensive training methods and high training volumes are to be applied to ensure the appropriate fitness level of the athletes, which definitely influences the morphological status of the athletes. As a result, judoists are determined as one the most mesomorphic (muscular, athletic-physique) athletes, compared to well trained (Olympic) athletes from other sports[11,12].

In this here presented brief overview, there is an evident lack of experimental data concerning the motor-endurance and morphological determinants of judo-specific success, especially in young judoists. This specific

Received for publication January 14, 2005

need and the potential sport-science objective are recognized from different authors who have investigated and recently published studies dealing with similar problems in other sports[13–16]. One of the possible reasons for the evident deficiency in the systematic information about the potential anthropological predictors of a judo performance can probably be found in the competition and scoring model of judo. Concisely, a result in judo can not be presented on the interval metric scale, which is possible in other sports (for example athletics [17] and/or swimming). Judo is a classical duel-sport, where one athlete wins (»1«), and the opponent – loses a match (»0«). Methodologically, it would not be a problem in league-sports (where each participant has to compete with all the others), but judo is an »elimination-sport« (somewhat like tennis, for example). Therefore, the problem of the objective determination of the criterion variable (success) is evident. In this paper the authors have tried to solve this problem dividing the competitors into qualitatively homogenous groups – based on the final positioning at the same competition (see Materials and Methods for a detailed explanation).

The aim of the present study can be defined in three explorative hypotheses

- To define and interpret the latent structure of the morphological and motor-endurance status in young judo competitors (judoists)
- To define and interpret the possible differences in the motor-endurance status regarding the final competition achievement in young judoists
- To define and interpret the possible differences in the morphological status regarding the final competition achievement in young judoists

In other words, we have tried to define the possible anthropological determinants of judo success in young athletes.

Materials and Methods

Subjects

A sample of subjects (N=34) consisted of young (15.6±0.3 year old) judo competitors. All the subjects participated at the Croatian National Championship (NC) for cadets – 2004. All subjects were randomly assigned after the NC. Since NC included competition in eight weight categories (< 50, 55, 60, 66, 73, 81, 90, and > 90 kg), four to five athletes from each category was sampled in our study. Given that the sample consisted of the best young judoists in Croatia, the sample can be considered as representative for the observed sub-population. All the subjects had participated in judo for more than 5 years and had trained 4 times a week on average. Given that the study has been approved and supported by the National Judo Federation, the subjects received a complete explanation of the purpose of the examination and gave their informed consent.

Variables

The sample of the variables included: (A) independent anthropological variables divided into two sets: (1) morphological and (2) motor-endurance variables, and (B) grouping – dependent criterion variable.

The sample of the morphological variables included 14 standard anthropometric variables hypothetically aimed at defining four latent anthropometric dimensions[18,19]: Weight – body weight, WristB – wrist breadth, FemurB – femur breadth, BiacromB – biacromial breadth, BitrohB – bitrochanter breadth, ChestG – chest girth, ForearmG – forearm girth, CalfG – calf girth, SubscapSF – subscapular skinfold, ThighSF – thigh skinfold, AbdomSF – adominal skinfold, Stature – body height, LegL – leg length, ArmL – arm length. All the measuring procedures and interpretations were accomplished in accordance with the protocols suggested by Heyward and Stolarczyk.

Based on the previous studies[18,20–22] we selected 12 motor-endurance tests for the purpose of determining the basic motor abilities: Sit&Reach – sit and reach flexibility test, Coordination1 – simple 10 meters polygon test which includes backward crawling (1) over and (2) under the 35 cm high obstacles placed at (1) 3-meters and (2) 6-meters from the start line, L-Jump – power broad jump test, HandTap – 15 seconds dominant hand tapping movement frequency test, FootTap – 15 seconds dominant-foot taping movement frequency test, Sit-up – abdominal strength sit-up test (maximal number of sit-ups in 60 seconds), Push-up – chest and arm strength push-up test (maximal number of push-ups in 60 seconds), Hang – static-strength-endurance bent arm hang test (in a rigid static position), Coordination2 – simple 4-time-5-meter polygon consisting of: side rolling (5 m), backward crawling (5 m), grabing packed judo-kimono between the kness, forward crawling and backside rolling while holding judo-kimono between the knees (2 x 5 m), 30m – 30 meters dash speed test, 60m – 60 meters dash speed test, F6 – aerobic endurance 6 minute running test (one half of the standard Cooper 12-min test.

Since this study was not exclusively scientifically oriented, but intended to be of pragmatic validity in judo sport also, the authors tried to select »relative« motor-endurance tests which can be performed with no additional testing equipment apart from the equipment typically used in judo-training (mats, hanging bars, simple obstacles, kimono, etc.). The idea was to use tests where subjects' own body size (or some percent of the body size) is a certain burdening factor in test performance, and which can be used in all judo clubs regardless of the available equipment. Therefore, some testing procedures which can be seen as potentially important in judo (like maximal isometric strength, and/or VO2 values) are not included in the sample of the variables.

The criterion variable has been defined according to the final placement at the NC. For the purpose of this study the participants were divided into four qualitative categories as follows:

- The first category (C1) – finally placed from 1st to 4th position at the NC (9 athletes, Body weight: 69.5±15.2 kg, Body height: 176.4±8.6 cm)
- The second category (C2) – finally placed 5th to 7th at the NC (10 athletes, 66.6±11.4 kg, 173.8±8.0 cm)
- The third category (C3) – finally placed 8th to 10th at the NC (7 athletes, 67.8±7.0 kg, 175.4±8.4 cm)
- The fourth category (C4) – not placed at the NC (below 10th position – 8 athletes, 72.1±18.1 kg, 173.1±6.8 cm)

There are two main reasons which determined the grouping in the said categories: (A) the categorization used is logical since the 1st category consisted of the athletes directly involved in the medal duels, the 2nd category of the athletes beaten by the 1st category athletes, etc. (B) The categorization ensures equal, but also a substantial number of the subjects in each of the four groups.

Experimental design

All the anthropological variables were measured during the National Judo Camp, organized by the National Judo Federation, four weeks after the NC. Since all the NC participants, regardless of their NC achievement, were invited to the Camp, the sample of the subjects can be considered as randomized. During the first day of testing, the anthropometric variables were collected. On the second day, movement frequency, flexibility and strength tests were performed, and on the third day, coordination, speed, power and aerobic-endurance tests were carried out, all after appropriate 10–15 minute warm up (including jogging, foot/ankle rotation, extensions and flexions, knee rotation and squats, leg kicks and rotation of the hips, trunk/waist rotation, shoulder/arm rotation and double crossing, neck rotation, and light stretching).

All morphological and motor tests (excepting Sit-up, Push-up, Hang, and F6) were performed three times, with appropriate rest in between. Cronbach Alpha ranged from the 0.76 (AbdomSF) to 0.99 (Weight) in morphological, and 0.75 (Coordination2) to 0.93 (Sit&Reach) for motor tests, all defining acceptable to high reliability. For all multiple-item tests the average result of all test-items is used as the final result.

As a methodological remark, the authors are aware that the conclusions reached by this research are somewhat limited by the fact that the subjects were tested 4 weeks after the NC, but objectively the time consuming and physically demanding test procedures used in this research, could not be performed during and/or immediately before/after the NC (coaches and athletes would not agree and/or test-results would not be reliable). But, physical fitness and/or morphological differences and changes are hardly possible to occur during a next 4-week period given that: (1) all subjects were relatively well trained and on the season's highest fitness level during the NC, (2) all subjects had a 2-week active break after the NC (3–4 recreational trainings weekly including sport games, swimming, light jogging,…), and (3) after the active break all of them did light training (start of the season) for the next two weeks before the camp. Finally, if some changes in the morphological and/or motor-endurance status even occured, it can be supposed that it will be similar for all athletes. Therefore, we are of the opinion that the testing delay did not have any significant influence on our considerations.

Data processing

Apart from the descriptive statistics (mean, standard deviation, minimum and maximum), we defined the normality of the distributions for all the measured variables using the Kolmogorov-Smirnov test.

The latent structure of the applied independent anthropological variables was defined using factor analysis' Varimax normalized rotation, under Gutman-Kaiser criterion of the extraction of the significant factors[23,24].

Discriminant canonical analysis[2] was used for the purpose of defining the significance and the character of the differences between the four categories of the young judoists, separately in the anthropometric, as well as in the motor-endurance status.

All coefficients considered significant at the 95% level (p=0.05). Statsoft's Statistica (version 5.5) was used for all the calculations and statistical procedures.

Results and Discussion

Since none KS test overreached defined maximum value (0.22), all variables should be considered normally distributed (Table 1). However, higher SD values in some, mostly motor-endurance tests (F6, Hang, L-Jump, Push-up, Sit-up), can be attributed to already studied differences in the motor-endurance status of the pubescent boys[25].

When comparing the here observed results with those of age-related Croatian non trained boys[26] we can observe that young judoists are clearly dominant in motor status, especially for the Sit&Reach (60 vs. 50 cm), Coordination1 (9 vs. 12 s), L-Jump (233 vs. 200 cm) and Sit-up (50 vs. 38 repetitions), for the judoists and non trained boys respectively.

The factor analysis calculated on twelve motor-endurance variables extracted three significant factors (Table 2), characterized by the equivalent percentage of the common variance explained (from 31 to 20%, Table 2), meaning that the motor-endurance system was logically and objectively explained by the measures used, all justifying the selection of the motor-endurance variables in this study. The first factor (F1 – STR/END) can be identified as a strength-endurance factor, because of the obvious projections of all strength and endurance variables. It seems that the second test of the coordination (Coordination2) in this sample of subjects requires some endurance (Table 1, test is up to 50% longer in duration than the Coordination1) and strength (see Variables, 2nd and 3rd movement pattern includes forward

TABLE 1
DESCRIPTIVE STATISTICS

Variables	X	SD	MIN	MAX	KS (d)
Weight (kg)	68.9	13.2	52.0	105.0	0.14
WristB (cm)	5.7	0.4	5.2	6.9	0.21
FemurB (cm)	9.9	0.5	9.0	11.0	0.10
BiacromB (cm)	38.7	2.6	32.5	43.0	0.15
BitrohB (cm)	27.9	2.5	24.0	36.5	0.13
ChestG (cm)	90.7	7.6	80.7	109.5	0.14
ForearmG (cm)	26.5	1.9	23.3	30.3	0.13
CalfG (cm)	36.3	2.7	32.0	44.0	0.12
SubscapSF (mm)	8.2	3.1	4.6	18.9	0.22
ThighSF (mm)	8.1	2.6	3.8	15.4	0.18
AbdomSF (mm)	8.0	4.5	3.9	24.4	0.21
Stature (cm)	174.8	7.7	159.0	189.9	0.10
LegL (cm)	101.2	5.7	90.2	114.4	0.06
ArmL (cm)	78.6	4.0	70.5	87.7	0.09
Sit&Reach (cm)	60.2	10.4	34.0	85.0	0.16
Coordination1 (s)	9.4	1.7	6.4	12.6	0.10
L-Jump (cm)	233.7	23.1	175.0	290.0	0.13
HandTap (repet)	36.2	4.4	26.0	45.0	0.10
FootTap (repet)	41.9	4.1	32.0	50.0	0.18
Push-up (repet)	32.5	12.4	12.0	60.0	0.14
Hang (s)	53.8	24.4	5.8	99.6	0.07
Coordination2 (s)	11.7	2.0	8.8	17.1	0.17
30m (s)	4.8	0.2	4.4	5.2	0.11
60m (s)	8.9	0.4	8.2	9.7	0.10
F6 (m)	1419.6	108.0	1240.0	1660.0	0.14

KS (d) – Kolmogorov-Smirnov test considered significant for d> 0.22, MIN – minimum, MAX – maximum, Variables: Weight – body weight, WristB – wrist breadth, FemurB – femur breadth, BiacromB – biacromial breadth, BitrohB – bitrochanter breadth, ChestG – chest girth, ForearmG – forearm girth, CalfG – calf girth, SubscapSF – subscapular skinfold, ThighSF – thigh skinfold, AbdomSF – abdominal skinfold, Stature – body height, LegL – leg length, ArmL – arm length, Sit&Reach – sit and reach flexibility test, Coordination1 – coordination 1st polygon test, L-Jump – power broad jump test, HandTap – frequency hand tapping test, FootTap – frequency foot tapping test, Sit-up – abdominal strength sit-up test, Push-up – chest and arm strength push-up test, Hang – static strength endurance bent arm hang test, Coordination2 – coordination 2nd polygon test, 30m – speed test 30 meters dash, 60m – speed test 60 meters dash, F6 – aerobic endurance 6 minute running test

crawling and backward rolling while holding judo-kimono between the knees), and therefore is moderately projected on the first factor. The second factor (F2 – COORD/ FREQ) can be defined as a shared factor of the coordination and the frequency of the simple movements.The third factor (F3: LEX/SPEED/POWER) is evidently calculated as the linear combination of the flexibility, sprint variables (30 m and 60 m) and power test (L-JUMP). Therefore, F3 can be identified as a combined factor of flexibility, speed & power. The negative projections of some variables can be explained knowing the reverse scaling of several variables (Table 2).

TABLE 2
FACTOR ANALYSIS OF THE MOTOR-ENDURANCE STATUS VARIABLES

Variables	F1	F2	F3
Sit&Reach	0.07	–0.01	0.82
Coordination1*	–0.46	–0.79	–0.18
L-Jump	0.44	0.20	0.75
HandTap	0.02	0.77	0.20
FootTap	0.01	0.93	0.02
Push-up	0.89	0.10	0.08
Hang	0.80	0.06	0.20
Coordination2*	–0.61	–0.26	–0.45
30m*	–0.48	–0.46	–0.59
60m*	–0.46	–0.42	–0.68
F6	0.72	0.36	–0.09
EXPL.VAR.	3.67	2.73	2.40
PRP.TOTL.	0.31	0.23	0.20

*denotes reversely scaled variables, F1–3 – factor structure, EXPL.VAR – single factor variance, PRP.TOTL – percentage of the total variance explained, Variables: Sit&Reach – sit and reach flexibility test, Coordination1 – coordination 1st polygon test, L-Jump – power broad jump test, HandTap – frequency hand tapping test, FootTap – frequency foot tapping test, Sit-up – abdominal strength sit-up test, Push-up – chest and arm strength push-up test, Hang – static strength endurance bent arm hang test, Coordination2 – coordination 2nd polygon test, 30m – speed test 30 meters dash, 60m – speed test 60 meters dash, F6 – aerobic endurance 6 minute running test

Using the varimax normalized factor analysis, 14 manifest anthropometric variables are structured in three significant latent dimensions – factors. The equal percentage of the common anthropometric variance explained (from 24 to 31%, Table 3) defines the variable system used as well balanced for the purpose of the description of the anthropometric structure in young judoists. In Table 3, relatively simple factor structures can be observed and explained. As in some previous studies[18,19] the first factor (F1 – LENGTH) can be identified as the factor of the longitudinal dimensionality observing the positive projections of all the body-length measures. The second one (F2 – VOL) is characterized by the significant positive projections of all the skinfolds and most of the girth-measures. Since the body weight is also highly correlated with F2, the factor can be identified as the factor of the absolute voluminosity. Because of moderate to high correlations of the breadth measures, the third factor (F3 – TRANSV) can be identified as a factor of the transversal dimensionality[27].

Since a relatively large number of the variables in this study does not allow us to calculate a discriminant analysis using the manifest measures, for further analysis, the motor-endurance and anthropometric factor results (factor scores) of the subjects are calculated.

Using the discriminant canonical analysis (DISCRA), we calculated the significance and the character of the differences between the four qualitative categories of

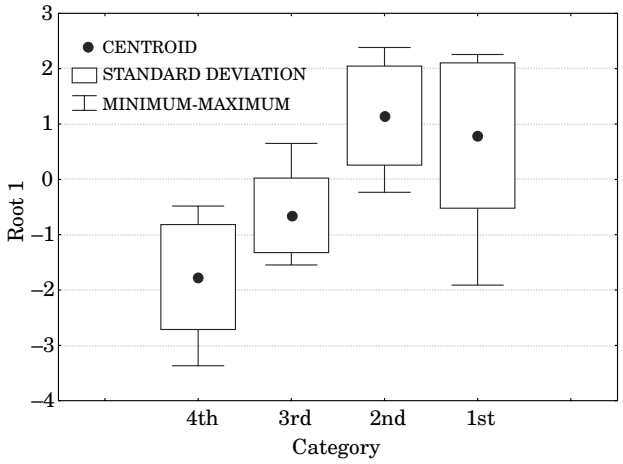

Fig. 1. Distribution and positioning of the category groups on the significant motor-endurance discriminant function (Root 1).

young judoists in the latent motor-endurance status (Table 4, Figure 1). Only one discriminant function reached an acceptable level of significance (p = 0.05). Generally, it denotes the significant motor-endurance differences between the achievement criterion groups. Significant discriminant function is characterized by the positive projections of all three motor-endurance factors (latent variables). However, it is obvious that the first factor (F1: STR/END), because of the high correlation with a significant Root (0.83), defines the specific structure and the character of the group differences. According to the Root's structure (correlations of the latent motor-endurance variables and discriminant factor) and centroid positioning (the groups' Means in the multivariate discriminant system), group 1 (G1) and group 2 (G2) can be defined as dominant in the pre-defined and explained motor-endurance latent variables (Table 2). The clear dominancy of these two groups (G1 and G2) is evident in the strength-endurance status. In other words, the subjects (young judo athletes) who performed better at the NC were dominant in the strength-endurance status, compared to their rivals. All this stated defines the strength-endurance status as the most significant overall fitness factor discriminating between the successful and unsuccessful young judoists. Knowing the pre-defined structure of the latent strength-endurance factor (see previous text and Table 2), we can define the successful judo-athletes as dominant in dynamic and static strength endurance, and aerobic-endurance. The graphical presentation (Figure 1) explains the interdependence of the motor-endurance status and judo-efficacy even better. The four categorized groups are precisely distributed on the significant discriminant root (Root 1). It is very interesting that the entirely of G4 is placed on the negative pole of the significant discriminant root, meaning that all the G4 subjects performed less than average in the strength-endurance variables. G3 is positioned neutrally, while G1 and G2 are positively projected on the significant discriminant-root (Root 1).

The results presented and discussed here are comparable to the conclusions from the limited number of previous studies which have dealt with the potential predictors of success in judo. For example, Sertić[28,29]

TABLE 3
FACTOR ANALYSIS OF THE ANTHROPOMETRIC STATUS VARIABLES

Variables	F1	F2	F3
Weight	0.39	0.69	0.57
WristB	0.21	–0.18	0.83
FemurB	0.39	0.37	0.55
BiacromB	0.30	0.27	0.38
BitrohB	0.35	0.15	0.67
ChestG	0.36	0.72	0.43
ForearmG	0.16	0.46	0.79
CalfG	0.07	0.73	0.58
SubscapSF	0.18	0.91	0.19
ThighSF	0.04	0.83	–0.11
AbdomSF	0.17	0.90	0.14
Stature	0.86	0.16	0.42
LegL	0.94	0.15	0.18
ArmL	0.94	0.16	0.22
EXPL.VAR.	3.29	4.39	3.37
PRP.TOTL.	0.24	0.31	0.24

F – factor structure, Expl.Var – single factor variance, Prp. Totl – percentage of the total variance explained), Variables: Weight – body weight, WristB – wrist breadth, FemurB – femur breadth, BiacromB – biacromial breadth, BitrohB – bitrochanter breadth, ChestG – chest girth, ForearmG – forearm girth, CalfG – calf girth, SubscapSF – subscapular skinfold, ThighSF – thigh skinfold, AbdomSF – abdominal skinfold, Stature – body height, LegL – leg length, ArmL – arm length

TABLE 4
DISCRIMINANT CANONICAL ANALYSIS CALCULATED BETWEEN FOUR JUDO-QUALITATIVE CATEGORIES ON THE LATENT MOTOR-ENDURANCE VARIABLES

	ROOT 1
F1: STR/END	0.83
F2: COORD/FREQ	0.17
F3: FLEX/SPEED/POWER	0.20
C: G1	0.79
C: G2	1.15
C: G3	–0.65
C: G4	–1.76
WIILKS LAMBDA	0.35
CAN R	0.78
p	0.00

ROOT 1 – structure of the significant discriminant root, C – centroid positioning of qualitative groups 1–4, CAN R – canonical correlation, F1: STR/END – factor of the strength and aerobic endurance, F2: COORD/FREQ – factor of the coordination and frequency, F3: FLEX/SPEED/POWER – factor of the flexibility, speed and power

defined coordination as the most significant predictor of success in judo in very young judoists (up to 11 years of age). Off course, it is not surprising because high level of the coordination allows youngsters and novices to learn and improve in a great number of the complex judo--skills, which implies better results in the early sport--phases[30]. But, in the latter phases, when a significant quantity of sport elements is learned and performed skillfully, strength[9] and endurance capacities[10] significantly influence on the success of judo. The structure and the characteristics of the judo elements, duels and competition system confirm all the discussed even more specifically. A judo duel lasts 3–5 minutes (depending on the age category, in this study – 4 minutes). Briefly, during this particular period, the opponents are continuously in contact and at grip, actively trying to »pull« and/or »push-out« the rival from a balanced stable position. In those specific judo maneuvers the requirements in dynamic strength (pushing and pulling the rival) and static strength endurance (mostly typical kimono-gripping) are evident. Meanwhile, since the lactate production during the judo match is pronounced[10], endurance capacity (in this study measured by F6) ensures the possibility of rapid and effective recovery[18], allowing one to repeatedly perform at a high efficacy level, and finally – to achieve a better result. Of course, one can argue about known performance-differences between boys of the same chronological age, but contrasting maturity status, most apparent between 13 and 16 years of age[31]. Definitely, it seems a very logical problem if the concrete definition of the relationship between the motor-endurance-status and any kind of sport performance in young athletes is aimed at. However, the authors are of the opinion that these problems are not attributed to this study mainly because: (A) most studies that have been focused on comparisons of boys of different maturity status, showed that the differences in the functional (motor-endurance) capacities between boys of contrasting maturity status within a chronological age group, or within a narrow age range, are reduced when body size is statistically controlled in the analysis[31], and (B) the judo-competition is organized in weight categories. Therefore, although not »directly statistically controlled«, body size was evidently »pragmatically statistically controlled« by the competition system (weight categories), which we additionally ensured keeping the body sizes (e.g. body height and body weight) in each qualitative category equal (see Variables where we explained the clustering of the four observed qualitative categories and where average body weight and body height values for each qualitative category are presented).

Contrary to the motor-endurance status, the four achievement criterion groups of young judoists are not significantly discriminated in the anthropometric latent status (Wilks Lambda = 0.75, $p>0.05$). Briefly, it leads us to the conclusion that the morphological structure does not contribute to success in 15–16 year old judo athletes. The authors are of the opinion that the stated can be explained as follows. (A) The first possible reason for an absence of the significant anthropometric differentiation between the achievement criterion groups (qualitative categories) of the young judoists can be found in the very similar anthropometric structure of all the subjects, resulting in a relatively small variability of the anthropometric results. This reason can be confirmed by the fact that all the anthropometric variables' distribution, although normal, are peaked and relatively low in variance, meaning that: $SD > (MAX–MIN)/6$, for all the anthropometric variables (Table 1). Further, since the discriminant canonical analysis is a specific type of correlation analysis, in this case – we attempted to estimate the criterion (judo achievement) using the anthropometric predictors. But, in judo, the athletes are divided into weight-categories, implying that the variance of the anthropometric status in the single weight category is particularly contracted. It does not allow for any calculation of the significant correlation between the anthropometric latent structure and judo achievement, and therefore – does not allow significant differentiation of the successful and less-successful young judoists in the anthropometric latent status. (B) In this study, because of the achievement criteria problem (explained in the Introduction section) we had to formulate a grouping variable (qualitative category: from 1^{st} to 4^{th} according to NC results). In other words, an equivalent number of the different-weight-category-athletes has been sampled in each criterion/category (from 1^{st} to 4^{th}). It unquestionably results in the anthropometric similarity between the different criterion-groups, not allowing us to define the anthropometric differentiation between the four qualitative categories (achievement criterion groups).

These particular explanations can be supported in some previous studies. In short, the significant correlation between anthropometrics and the results in judo is confirmed only in the absolute weight category[1], not surprising knowing some specifics of the weight management technologies in judo. As stated before, judo competitions are organized in weight categories. Naturally, each athlete is very concerned about the weight limit, trying to sustain his/her body weight as close as possible to the upper weight limit. It keeps the anthropometric variance in the single weight category very narrow. But the same approach is not characteristic for the absolute weight category athletes. Quite the opposite, in the absolute category there is no upper weight limit. Mostly, it means that the absolute category athletes try to increase their lean-body-mass as much as possible. Therefore, the anthropometric variance in absolute weight category is wide (or at least considerably wider than in the other weight-categories). Finally, it allows one to calculate and confirm the significant correlation between the anthropometrics and judo success in an absolute-category, something not possible in other weight categories.

Conclusion

According to the results presented and discussed here, the following conclusions can be drawn: 1) Strength and aerobic endurance status are probably two of the most important anthropological determinants of competitive successfulness in judo in young 15–16 year old

athletes. Most likely, dynamic-strength-endurance allows one to efficiently perform the specific dynamic judo patterns and tasks, while static strength endurance ensures the effectiveness of the »gripping« techniques. Given that judo tournaments and competitions are exceptionally time concentrated, aerobic-endurance is directly related to recovery, allowing an athlete to perform repeatedly at a high level of efficacy. 2) In the young judoists observed and studied here, the morphological anthropometric characteristics are not directly related to success in judo. Two possible reasons can be suggested. (A) The relatively small variability of the anthropometric results did not allow us to define any significant correlation between anthropometrics and judo-efficacy, and (B) the criterion-variable used here (judo-success according to the final NC placement) is not appropriate if the morphological-anthropometric influence on the judo-achievement is studied. Our opinion is that for this particular purpose, the investigators should study each judo weight category separately, and/or to sample the subjects more variable in morphological structure than those sampled in this investigation (high National level).

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ANTROPOLOŠKE ODREDNICE USPJEŠNOSTI KOD MLADIH JUDAŠA

SAŽETAK

Očit je nedostatak eksperimentalnih studija koje su se bavile antropološkim odrednicama uspješnosti u judo sportu, posebno na uzorku mladih judaša. U ovom radu pokušalo se utvrditi antropološke faktore koji su potencijalno povezani sa uspjehom u judo borbi kod 15–16 godišnjih judaša. Ispitanici (muškarci, najbolji mladi judaši Hrvatske, N=34) testirani su na 14 antropometrijskih i 12 motoričko-funkcionalnih varijabli. Svi ispitanici nastupali su na državnom prvenstvu, te je kriterij uspješnosti određen prema konačnom plasmanu na tom natjecanju. Faktorska i diskriminativna analiza primijenjene su zasebno na uzorku antropometrijskih i motoričko-funkcionalnih varijabli. Diskriminativnom analizom utvrđeno je kako su uspješni judaši dominantni u snazi i funkcionalnim sposobnostima u odnosu na njihove manje uspješne kolege. Međutim, u antropometrijskim mjerama nisu utvrđene značajne razlike između uspješnih i manje uspješnih judaša. Diskutira se o mogućim objašnjenjima dobivenih rezultata.