Factors Determining Success in Youth Judokas

by
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The aim of this study was to compare two models of determining factors for success in judo. The first model (Model A) included testing motor abilities of high-level Croatian judokas in the cadet age category. The sample in Model A consisted of 71 male and female judokas aged 16 ± 0.6 years who were divided into four subsamples according to sex and weight category. The second model (Model B) consisted of interviewing 40 top-level judo experts on the importance of motor abilities for cadets' success in judo. According to Model A, the greatest impact on the criterion variable of success in males and females of heavier weight categories were variables assessing maximum strength, coordination and jumping ability. In the lighter weight male categories, the highest correlation with the criterion variable of success was the variable assessing agility. However, in the lighter weight female categories, the greatest impact on success had the variable assessing muscular endurance. In Model B, specific endurance was crucial for success in judo, while flexibility was the least important, regardless of sex and weight category. Spearman's rank correlation coefficients showed that there were no significant correlations in the results obtained in Models A and B for all observed subsamples. Although no significant correlations between the factors for success obtained through Models A and B were found, common determinants of success, regardless of the applied model, were identified.

Key words: motor abilities, sex, weight categories, questionnaire, combat sports.

Introduction

Which factors determine person's overall success in judo, and to what extent can these factors predict their future success? Answering this question is not simple, mainly due to the complexity of judo. Competitive success is determined by a number of features and capabilities, as well as technical and tactical performance, which are only realized in direct combat against an opponent. In other words, judo is a sport discipline with great physical, technical and tactical complexity (Degoutte et al., 2003). Judo participants are divided into several weight categories, which adds to its complex structure so that each category is distinguished by its technical and tactical structure, as well as physiological demands and morphological characteristics (Drid et al., 2012). Callister et al. (1991), as far back as 1991, emphasized that the factors responsible for

successful performance were specific to each weight category. However, more recently, frequent changes in the rules of combat have, to a greater or lesser extent, caused changes in the hierarchy and level of importance of certain dimensions for judo success. In particular, changes that have occurred in recent years (e.g., ban on certain grips and throwing techniques, reducing the duration of the combat for women, etc.) have significantly influenced the combat style and intensity of top competitors (Franchini et al., 2013; Miarka et al., 2014), thus, changing the significance of individual factors for combat success. Therefore, one can conclude that factors needed for success in judo vary over time, and identifying these essential abilities can provide insightful information regarding what is needed for competitive success (Franchini et al., 2011).

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The main problem is how to determine factors of success for sports in general, including judo. Based on previous studies, two approaches/models can be incorporated to investigate this problem. The first model (Model A) represents testing judokas given a set of tests to evaluate various characteristics and compare the results with their competitive success. In the second model (Model B), respondents represent judo coaches (judo experts) who, based on their knowledge and experience through questionnaires, point to the importance of individual characteristics on success in judo (Krstulović, 2012; Krstulović and Sekulić, 2013; Van Rossum and Gagne, 1994). Both models have their advantages and disadvantages. Research using Model A has been prevalent and allows researchers and coaches to compare their results with a large number of already published findings. Many studies have presented the so-called model values of top judokas in the observed characteristics and confirmed that there are positive correlations between these features and judo combat success (Drid et al., 2013; Franchini et al., 2014; Sbriccoli et al., 2007; Zaggelidis et al., 2012).

To obtain credible results and reliable conclusions with this model of research, it is necessary to overcome certain problems, which can be characterized as shortcomings of this research model. Thus, it is desirable to test exceptional judokas who, unfortunately, are not easy to gather together and coax into testing. It is also preferable to collect a large sample of subjects for each weight category. To get a broader picture of the impact of certain abilities for success, it would be necessary to conduct a relatively large number of tests to assess different abilities. Furthermore, such testing should be carried out at a time when athletes are in their optimal form, which is amid competition periods during the annual (semi-annual) macro-cycle. In the end, the results for each subject in a particular test depend on various factors that should be considered. These factors include the metric characteristics of the measuring instrument, the quality of the evaluators and the motivation of the participants, among others.

Unlike the former model, Model B is rarely represented in sports, including judo. This fact is surprising given that the implementation of this experimental procedure is much faster and simpler, and a good part of the problems listed in the previous model are solved by the implementation of the questionnaire. However, this model has its flaws that can be partly removed by carefully structuring the inquiry. The primary requirement is that the questions must be understandable, simple and precise. The questionnaire itself must be short so that coaches and respondents can stay motivated and concentrate when responding. For the respondent to understand the posed question, it should be translated into their native language, including the adaptation of professional terminology. The essential precondition for obtaining relevant results by this method is interviewing the top experts who will "want" to convey their knowledge and experience with those collecting the data. Furthermore, if respondents do not have an adequate level of education, and/or specific knowledge of judo, they may not be able to adequately respond to questions. Accordingly, in the context of Model A in the present study, high-quality young judokas were tested. A relatively high number of tests for evaluation of various motor abilities, frequently used in scientific research, were also used in current research. In Model B, top judo experts were surveyed with a short, precise, and user-friendly questionnaire. Given that both of these models are used to determine factors for success in sports in general, as well as in judo, the research hypothesis was that the results, regardless of the applied model, would be similar. However, from the available data, not a single experimental procedure was conducted to confirm this assumption. Therefore, the primary objective of this study was to compare the two models of determining factors for success in judo.

Material and Methods

The Ethical Committee of the Faculty of Kinesiology, University of Split, Croatia (Chairperson Marko Erceg Ph.D.; NUMBER: 2181-205-02-05-14-002; 26 May 2014) verified that this investigation complied with all ethical standards for scientific investigations involving human participants.

Participants

In Model A, the research sample consisted of 71 male and female judokas whose parents had

agreed to their participation in the study. This sample represented 55% of the competitor population in the cadet age group (16.0 ± 0.6 years) in Croatia. The entire subject sample was divided into four subgroups according to sex and weight categories (with male judoka categories from 46–60 kg classified as lighter weight categories [LWC], and 66 kg to +90 kg as heavier weight categories [HWC]; female judokas in the category of 40–52 kg were considered in LWC, and 57 kg to +70 kg as HWC). Thus, the sample consisted of the following: 22 male LWC judokas and 20 in HWC; and 15 female LWC judokas and 14 in HWC. The average training experience of all subjects was 7.0 ± 0.9 years.

The sample in Model B consisted of 40 selectors and coaches from European cadet judo teams from a total of 22 European countries, which represented 43% of all member states of the European Judo Union and 52% of the total sent questionnaires to the available email addresses. Of these, 10 coaches had completed postgraduate studies, 6 coaches had completed graduate studies, and 24 had completed undergraduate studies. The subjects ranged between 30 and 55 years of age, and had coached and/or managed in judo for at least 8 years. During their careers, respondents, with their respective athletes, had won at least one medal in the World or European cups or championships.

Measures

In Model A, a set of predictor variables consisted of nine tests to assess motor abilities as follows: flexibility: sit and reach (FLE; cm) (Krstulović et al., 2005, 2006); agility: T test (AGI; s) (Pauole et al., 2000; Sekulić et al., 2013); coordination: agility on the ground (COO; s) (Krstulović et al., 2006); balance: stork test (BAL; s) (Landman et al., 2011); specific judo endurance: special judo fitness test (SPEC; index; the heart rate was measured with a single monitor Polar Team System, Polar Electro OY, Kempele, Finland) (Boguszevska et al., 2010; Franchini et al., 2005); jumping ability: countermovement jump (JA; cm; OptoJump Next, Microgate s.r.l, Bolzano, Italy) (Marković et al., 2004); muscular endurance: sit ups in 60 s (END; number of repetitions) (Krstulović et al., 2005; Sertić et al., 2006); maximum strength; lat machine 1-repetition maximum (MAX; kg; Lat machine MED, TechnoGym, Cesena, Italy) (Seo et al., 2012); and

speed: running 30 m from a flying start (SPE; s; Brower TC Motion Start Timer TC-Timing System, Brower Timing Systems, Draper, Utah, USA) (Krstulović et al., 2005).

Tests were selected based on whether they met the following criteria: a) satisfying metric properties confirmed in published works; b) appropriate to the age group of the subjects; and c) by structure, to some extent, similar to specific judo situations. The placement defined the criterion variable of competition efficacy that the judoka achieved in the criterion competitions for the current year (data published in the registry of the Croatian Judo Federation).

For Model B, a new instrument - questionnaire was constructed to evaluate the impact of motor abilities for cadets' success in judo. Respondents expressed an opinion on the impact of nine motor abilities (FLE, AGI, COO, BAL, SPEC, JA, END, MAX, and SPE) for success in judo according to sex and weight categories (LWC and HWC) by entering a number from 0 to 100. The process of completing the questionnaire was conducted electronically (via the Internet) and in six languages (English, German, Russian, French, Spanish, and Italian). The questionnaire was hosted on a specialized server that enabled access controlled by a password, and automatically identified the respondents when they were completing the questionnaire based on their particular computer IP address and personal information. The respondents received personal invitations to participate in the research via email, along with an explanation, instructions and a link to access the survey.

Statistical analysis

All applied variables were subjected to standard descriptive processes for determining basic statistical variables (mean and standard deviation). The normality of distribution was assessed with the Kolmogorov-Smirnov test. In Model A, for determining the impact of certain motor abilities on the criterion variable of success in judo, multiple regression analysis was applied. Thus, values of standardized regression coefficients (β) were calculated. These coefficients, dependent on each variable's rank, were observed in the absolute sense and explicitly indicated the hierarchy of each applied predictor's impact on success in judo. In Model B, coaches, using their expert assessment, ranked the effects of

individual motor abilities for success in judo on a scale from 0 to 100. The inter-item correlation (IIR) was calculated to assess agreement among respondents (judo coaches). Spearman's rank correlation coefficients (Spearman's R) provided a measure of correlation between the listed models.

Results

Table 1 shows basic descriptive variables (Mean and Standard Deviation) of field motor tests for male and female judokas of different weight categories. Usage of the K-S test confirmed normality of distribution of all applied variables (Table 1).

As shown in Table 2, the most important factors for success in judo in HWC were identical for men and women. The greatest impact on the criterion variable of success in both subsamples had variables that estimated MAX, COO and JA. However, in the male LWC, the greatest impact on the criterion variable of success had variables that assessed AGI, SPE and SPEC. In the female LWC, the strongest correlation with the criterion had variables that assessed END, SPEC and COO.

Table 1

Descriptive statistics (Mean and Standard Deviation) of field test variables
for male and female judokas (separated by weight categories)
(Model A); data presented as means ± SD

var	Males		Females	
	HWC	LWC	HWC	LWC
END	56.7 ± 5.7	60.1 ± 6.2	51.2 ± 7.5	53.6 ± 6.8
SPEC#	14.7 ± 1.5	15.2 ± 1.7	15.8 ± 2.0	14.7 ± 2.0
COO#	14.0 ± 1.7	13.4 ± 1.3	14.5 ± 2.1	15.6 ± 3.1
MAX	70.5 ± 8.9	60.0 ± 11.9	48.2 ± 10.7	42.0 ± 6.5
JA	25.2 ± 7.0	29.8 ± 6.9	19.5 ± 4.6	22.4 ± 5.5
SPE#	4.3 ± 0.3	4.2 ± 0.3	5.0 ± 0.3	4.7 ± 0.3
AGI#	12.0 ± 0.9	11.8 ± 0.9	13.5 ± 0.8	13.1 ± 1.4
FLE	37.9 ± 7.3	34.3 ± 9.3	36.9 ± 6.1	37.7 ± 6.4
BAL	4.0 ± 2.0	4.6 ± 2.2	4.5 ± 2.7	4.7 ± 3.2

var - variables, HWC - heavier weight category, LWC - lighter weight category,
M - mean, SD - standard deviation, SPEC - specific judo endurance,
AGI - agility, SPE - speed, JA - jumping ability, FLE - flexibility,
COO - coordination, MAX maximum strength, END - muscular endurance,
BAL - balance, #reverse scaling variables

Table 2

*Values of beta coefficients in multiple regression and associated rank
of motor abilities for male and female judokas
(separated by weight categories) (Model A)*

| | Males | | | | Females | | | |
| | HWC | | LWC | | HWC | | LWC | |
var	β	Rank	β	Rank	β	Rank	β	Rank
END	0.07	5	0.05	5	-0.65	9	0.56	1
SPEC#	-0.05	6	-0.24	3	-0.14	5	-0.52	2
COO#	-0.38	2	-0.15	4	-0.47	2	-0.25	3
MAX	0.60	1	0.00	7	0.53	1	0.05	4
JA	0.35	3	0.01	6	0.28	3	0.03	5
SPE#	0.41	9	-0.33	2	0.02	7	-0.02	6
AGI#	0.36	8	-0.38	1	-0.18	4	-0.01	7
FLE	0.25	4	-0.02	8	0.00	6	0.00	8
BAL	0.02	7	-0.28	9	-0.16	8	-0.20	9

*var - variables, HWC - heavier weight class, LWC - lighter weight class,
SPEC - specific endurance, AGI - agility, SPE - speed, JA - jumping ability,
FLE - flexibility, COO - coordination, MAX - maximum strength,
END - muscular endurance, BAL - balance, β - the value of standardized regression coefficients,
Rank - variable rank, #reverse scaling variables*

*Descriptive statistics (Mean and Standard Deviation) and associated rank
of motor abilities according to coaches for male and female judokas
(separated by weight categories) (Model B); data presented as means ± SD*

	Males				Females			
var	HWC		LWC		HWC		LWC	
	M ± SD	Rank	M ± SD	Rank	M ± SD	Rank	M ± SD	Rank
END	81.7 ± 12.1	3	71.1 ± 17.0	7	76.3 ± 12.0	3	73.3 ± 15.8	5
SPEC	78.7 ± 14.1	2	78.2 ± 14.0	3	76.4 ± 13.5	2	79.8 ± 15.0	2
COO	77.6 ± 16.5	6	77.9 ± 15.3	4	71.3 ± 17.3	5	72.4 ± 21.5	6
MAX	76.9 ± 11.7	1	63.6 ± 17.2	8	81.4 ± 11.6	1	61.7 ± 16.0	9
JA	72.1 ± 14.4	4	78.7 ± 12.8	2	75.8 ± 13.8	4	74.7 ± 13.6	4
SPE	70.6 ± 14.0	5	82.2 ± 10.9	1	70.7 ± 14.8	6	81.3 ± 13.5	1
AGI	70.4 ± 19.0	8	75.7 ± 15.7	5	67.9 ± 16.0	8	75.9 ± 14.7	3
FLE	63.1 ± 16.9	9	61.7 ± 16.9	9	60.3 ± 15.4	9	70.4 ± 17.2	8
BAL	58.0 ± 19.8	7	71.7 ± 21.5	6	68.6 ± 18.3	7	71.7 ± 18.9	7

*var - variables, HWC - heavier weight category, LWC - lighter weight category,
M - mean, SD - standard deviation, SPEC specific endurance, AGI - agility,
SPE - speed, JA - jumping ability, FLE - flexibility, COO - coordination,
MAX maximum strength, END - muscular endurance,
BAL - balance, Rank - variable ranking*

Table 4

Correlations of ranks between the results of the two applied models

	Males				Females			
	HWC		LWC		HWC		LWC	
	R	*p*	R	*p*	R	*p*	R	*p*
	0.35	0.35	0.60	0.08	0.31	0.40	0.20	0.60

HWC - heavier weight category, LWC - lighter weight category,
R - Spearman's correlation coefficient, p - level of significance

The level of agreement among coaches (IIR) was in range of 0.20 to 0.41. There was an extremely small range of average values for the impact of certain motor abilities on success in judo (only 20 percentage points from the least to most important abilities for success in judo) (Table 3). SPEC was crucial for judo success, while FLE was the least necessary, regardless of sex and weight category. Furthermore, MAX was the most necessary element for success in males and females in HWC, and the least significant in males and females in LWC. However, for males and females in LWC, SPE was the most important motor ability (Table 3).

The results of correlation analysis (Table 4) show that there was no significant correlation of results obtained by Models A and B for all observed subsamples of respondents (Spearman's R ranges from 0.20 to 0.60).

Discussion

The degree of agreement between responding judo experts was, on average, lower (in the range of 0.20 to 0.41) than the numerical results of previous research that interviewed judo coaches (Krstulović, 2012; Krstulović and Sekulić, 2013; Van Rossum and Gagne, 1994). Although they were top quality judo experts, a larger number of discussed variables, in relation to aforementioned studies, probably contributed to the increased difference in answers given on the impact of individual abilities on success in judo. The relatively large measuring scale of the impact of certain capabilities (0–100) probably caused the large dispersion in our results, as well as the fact that respondents had to enter specific values, especially for lighter and heavier weight categories in men's and women's competitions (four issues).

The results shown in Table 2 suggest that in Model A, the test for assessing MAX (lat machine) had the greatest impact on the success of male and female judoka cadets in HWC. These results were expected and remained consistent with previous findings (Bonitch-Góngora et al., 2012; Krstulović et al., 2006; Sterkowicz et al., 2011). The combat in HWC is less dynamic compared to LWC (Sterkovicz et al., 2013), thus, the dominance and control over the opponent are mainly achieved through a solid grip, for which a high level of MAX is necessary. The test for assessing COO (agility on the ground) in HWC in both sexes, according to the Beta coefficient (β), ranked second in importance. Coordination is a motor ability believed to be important in the

general motor development. It has been proven that it is a valuable indicator of athlete's potential for progression and as such, it is an important talent characteristic in skill-based sports like combat sports for example (Sadowski, 2005). Sekulic et al. (2006) indicated that judo elements were considered as highly effective in the development of coordination. Given the technical complexity and speed of execution required in judo, it can be assumed that coordination plays an important role in that sport. A highly developed coordination allows young judokas to learn better and improve a larger number of complex judo techniques, which implies better results in competition (Miletić et al., 2004). Thus, Đapić-Caput et al. (2013) defined coordination as one of the most significant predictors of judo success in young judokas. Moreover, Krstulović et al. (2006) reported that coordination was better developed in elite judo athletes compared to the non-elite ones. It is interesting that the most significant predictors of success in male and female cadets in LWC differed somewhat. Common to both is relatively high importance of specific judo fitness tests on the criterion variable of success (third place in importance for LWC males and second place for LWC females). It is the most commonly applied test for assessing SPEC in judokas and has proven successful in distinguishing between higher and lower quality judokas (Detanico et al., 2012). Tests for evaluating AGI and SPE in LWC males and END in LWC females ranked highly and were consistent with a role in which the first abilities had a significant impact on judo success (Ratamess, 2011). LWC athletes are shorter and, consequently, quicker and more agile than their counterparts competing in HWC (Almansba et al., 2008). Speed and agility allow not only for faster arrival in the optimal position to throw, but also provide a greater ability to avoid attacks and perform counter-attacks. END is of great importance in judo competitions, especially after the introduction of new rules (in 2013) that penalize passive combat and inactivity, thus, requiring a constant high combat pace and a large number of attacks.

Interestingly enough, variables that assess FLE and BAL for all subsamples of respondents had the least impact on the criterion variable for judo success. Although judo combat practically consists of constant attempts to disrupt opponent's balance, that allows for the efficient application of throwing techniques as observed in the analyzed sample, this ability did not have much significance. Previous research suggests there is relatively small balance variability between judokas (Krstulović and Sekulić, 2013), which significantly reduces the possibility to obtain a more direct correlation of that skill with success in judo. Flexibility in judo, unlike some other martial arts (Marković et al., 2005), is not highly correlated with success, but still plays a significant role in injury prevention (Pocecco et al., 2013).

The relatively small range of results, from least to most important abilities, in Model B (Table 3) indicates a significant effect of a vast number of different motor abilities on cadets' judo success according to the responses of judo experts. In other words, respondents estimated that all the discussed motor variables had significant and equal importance for success in judo.

It should be also noted that respondents assessed SPEC as one of the most important, and FLE as one of the least important skills regardless of sex and weight category. The importance of END, especially SPEC in judo combat, has been already discussed as a probable result of significant rules changes, which were further emphasized in judo experts' opinions on the importance of these abilities. It is interesting that MAX was perceived as most critical ability in HWC males and females, and least significant for LWC males and females, which is identical to the results gathered by Krstulović and Sekulić (2013) in women and by Krstulović (2012) in men. In the previously mentioned studies, senior judokas were observed, so it is possible to conclude that MAX, according to the experts, has stable and prognostic impact in all age categories. Common to LWC males and females was that SPE was the most important ability for judo success, which is not surprising with regard to the characteristics presented above and peculiarities of the fighting style in LWC judokas of both sexes.

Table 4 shows that there was no significant correlation between the results of Models A and B for any of the analyzed subsamples. Despite the fact that the global level did not reach statistical significance, it is still possible to observe certain principles common to both applied models. Analysis of the partial

results of motor abilities testing and the results of the survey revealed that the most important factors for judo success, considering sex and weight categories, regardless of the applied model, were: a) SPE, which ranked second in Model A and first in Model B, and was a common determinant of success from the analyzed variables in LWC males; b) SPEC, ranked second in both models, was a common determinant of success from the analyzed variables in LWC females; and c) MAX, that was first in both models, was a common determinant of success from the analyzed variables in HWC males and females.

The importance of the other analyzed variables, to a greater or lesser extent, differed in the models. These differences were probably due to different factors and deficiencies of the applied research models. In Model A, the sample of respondents was relatively small and testing did not cover the best European male and female judokas. Moreover, for practical reasons, only nine tests were applied, one test assessing each latent motor dimension (ability). Model B included experts from 22 European countries with successful coaching careers and high levels of education. However, one should take into account the so-called "compensatory phenomenon" as a limiting factor when interpreting the results of Model B (Vaeyens et al., 2008). Different athletes can reach superior levels of performance in different ways as small flaws in certain characteristics can be compensated for by excelling in other characteristics. Therefore, surveyed judo experts evaluated values of particular abilities according to the specific features of their respective top competitors, which might have caused some differences in the results.

Conclusions

The results reaffirmed the appropriateness of classification of judokas into LWC and HWC, irrespective of the model applied, as factors of success differed with regard to weight categories. Although no statistically significant correlation between the two applied research models was found, certain common determinants of success in both models could be identified. An important predictor of success in LWC males was SPE, while in LWC females, SPEC was more important. However, in HWC males and females, MAX played the most vital role. It is difficult to determine which of the two applied models is more reliable in identifying factors for judo success. It would be better to say that both models have their advantages and disadvantages, and it is for researchers to decide which to use in their work. It is also important to point out that the scientific basis of obtained results by any model is of great importance in the daily work of judo coaches, as it contributes to the quality of planning and carrying out training programs, all with the goal of achieving best results. Since the predictors for success in cadets were analyzed in this research, future studies should include samples of elite judokas in the senior age category.

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