

Anthropological Analysis of Taekwondo – New Methodological Approach

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ABSTRACT

The aim of this research is to determine the order and importance of impacts of particular anthropological characteristics and technical and tactical competence on success in taekwondo according to opinions of top taekwondo instructors (experts). Partial objectives include analysis of metric characteristics of the measuring instrument, and determining differences between two disciplines (sparring and technical discipline of patterns) and two competition systems (WTF and ITF). In accordance with the aims, the research was conducted on a sample of respondents which consisted of 730 taekwondo instructors from 6 continents and from 69 countries (from which we selected 242 instructors), who are at different success levels in both taekwondo competition systems (styles) and two taekwondo disciplines. The respondents were divided into 3 qualitative subsamples (OST-USP-VRH) using the dependant variable of accomplished results of the instructor. In 6 languages, they electronically evaluated the impact in percentage value (%) of motor and functional skills (MOTFS), morphological characteristics (MORF), psychological profile of an athlete (PSIH), athletic intelligence (INTE) and technical and tactical competence – (TE-TA) on success in taekwondo. The analysis of metric characteristics of the constructed instrument showed a satisfactory degree of agreement (Iir) which is proportional to the level of respondent quality, i.e. it grows along with the increase in instructor quality in all analysed disciplines of both systems. Top instructors assigned the highest portion of impact on success to the motor and functional skills (MOTFS) variable: WTF-SPB=29.1, ITF-SPB=29.2, WTF-THN=35.0, ITF-THN=32.0). Statistically significant differences in opinions of instructors of different styles and disciplines were not recorded in any of the analysed variables. The only exception is the psychological profile of an athlete variable, which WTF instructors of sparring (AM=23.7%), on a significance level of $p<0.01$, evaluate as having a statistically significantly higher impact on success in taekwondo than WTF instructors of the technical discipline of patterns (15.4%).

Key words: expert system, success, anthropological characteristics, efficiency

Introduction

Taekwon-do as a combat sport was first developed by its founder Choi Hong Hi after the Second World War¹. According to the ideas of its founder, taekwondo was originally taught for self-defence and during the 20th century it spread all over the world in its present form. There are two competition systems in taekwondo (WTF-Olympic and ITF-non-Olympic)² which are practiced in more than 200 countries in the world³. These competition systems differ in competition rules and protective gear, and therefore in the technical and tactical approach and factors which influence the result success⁴. Competitions of the WTF system are organized in two disciplines (sparring and technical discipline of patterns-poomse), in

three age categories (cadets, juniors and seniors) and in weight categories. The competitors wear trunk protectors with wireless sensors. Scoring is performed electronically and it is relatively objective, unlike most combat sports where referees subjectively estimate points and the winner⁵. Competitions of the ITF system are also organized in three age categories, but in five disciplines⁶ sparring, technical discipline of patterns, special techniques, strength test and self-defence. As we all know, for achieving top results in a particular sport, scientific knowledge about the character of the sport is needed, as well as knowledge about the impact of particular factors on success in that sport. Generally, the success of an ath-

lete is determined by the level and structure of numerous capabilities, knowledge and characteristics, and the authors of the conducted research⁷⁻¹² concluded that top athletes of a particular sport fit into a certain anthropological profile. Equation of specification of success in taekwondo, which should refer to the hierarchical structure and mutual relations among factors which are important for achieving great sport results, has not been sufficiently researched. Due to the lack of relevant scientific research and knowledge, when planning and conducting training processes, instructors still heavily rely on their own experience and traditional methods of preparing athletes for competition, which have never been proven¹³. However, based on current knowledge^{2,14} we can conclude that all anthropological characteristics need to be at the highest level in order to achieve success in taekwondo. Nonetheless, speed and explosive strength, which are certainly used for specific technical and tactical knowledge, are the most important aspects within the field of motor skills. Taekwondo athletes are leaner than judo athletes¹⁵. Since there is a possibility of participating in several taekwondo combats in the same day⁴, it is necessary to have well developed aerobic functional capacities and a low percentage of subcutaneous adipose tissue. The dominant taekwondo athlete somatotype is proportionally built, with well-developed muscles and skeleton, as well as with a low percentage of subcutaneous adipose tissue¹⁷. Equally good performance of techniques using both sides of the body is an important factor of success in a taekwondo competition¹⁸. In order to analyse the impact of the technical and tactical component on success, research conducted in 2011⁴ included all 128 taekwondo competitors (64 male and 64 female) who competed at the Olympic Games in China in 2008. The results showed that there are no statistically significant differences in anthropometric and demographic characteristics between medallists and other participants, both male and female. In both subsamples (men and women), a statistically significant difference was determined between medallists and other competitors in the average number of: points scored by fight, points received by fight, defensive kicks to the trunk. In addition to these differences, there is a statistically significant difference in women in variables regarding the average number of: offensive points to the body, offensive points to the head and warnings by fight. In the period from the Olympic Games in 2000 to the Olympic Games in Athens in 2004, the Olympic taekwondo discipline sparring became more dynamic due to the change of rules¹⁹.

Due to the complexity of taekwondo⁴ and numerous objective problems, it is very difficult to define the precise equation of specification in each combat sport, and the same can be said for taekwondo. If we want to get results by measuring taekwondo athletes, we must pay attention to the following restraining factors: a) a relatively large sample of respondents – top athletes is necessary; b) the problem of a large number of weight categories (fighters in lighter weight categories are significantly an-

thropologically different from the ones in heavier categories); c) the sample of respondents should be tested using many tests for estimating different dimensions in very short annual training cycle periods; d) often changes of rules surely, whether to a greater or a lesser extent, affect the change of order and importance of particular dimensions on success in taekwondo and e) the problem of the dependant variable, i.e. objective estimate of athlete's success etc.

In this paper, the authors wanted to overcome the majority of the mentioned objective deficiencies and they have decided to use a somewhat different methodological approach than the standard one, which includes measuring athletes–competitors in order to establish the impact of anthropological characteristics on success in taekwondo²⁰⁻²². Therefore, a measuring instrument was constructed for this study (questionnaire)²³ the results of which (after processing and interpretation) should provide an answer to the question (according to the opinions of the respondents) regarding the impact of particular anthropological dimensions on success in taekwondo. From available studies of similar topics two methodological approaches can be identified: a) Research of athletes' opinions – as participants of activities and training processes²⁴, b) Research of instructors' opinions – as creators and direct applicants of training processes and activities²⁵⁻²⁷. Establishing a hierarchy of anthropological dimensions important for success in a particular sport using questionnaires is well known²⁸, but according to available data, no one has ever researched a similar sport topic in such a specific and global way, especially not in taekwondo.

The main or global aim of this research is to determine the order and importance of impact of particular anthropological characteristics and technical and tactical competence on success in taekwondo according to opinions of top taekwondo instructors (experts). Partial objectives refer to determining metric characteristics as well as differences between the two disciplines (sparring and technical discipline of patterns) and two competition systems (WTF and ITF) in analysed variables of anthropologic space.

Subjects and Methods

Subject sample

The sample of respondents (instructors) was comprised of 730 respondents – taekwondo instructors from 6 continents and 69 countries, of various levels of education and competitive success, of two taekwondo disciplines (sparring and the technical discipline of patterns) and from both taekwondo competition systems currently in place on the international level (WTF and ITF). The choice of instructors for the purposes of this study was made according to very strict criteria which required a correctly filled-out questionnaire and a precise identification via IP address and personal information (name, surname, address and e-mail address).

Variable sample

Based on the analysis of papers with a similar methodological approach^{25,26}, we included a total of 15 variables in this study, which were divided into two groups depending on their role:

a) Instructor identification and classification variables (N=9): IP address, name and surname, e-mail address, country, taekwondo rank, taekwondo style (WTF/ITF), sparring or patterns instructor, level of education and highest instructor achievement (TREZ) as a criterion variable of qualitative division of respondents within a particular style and discipline.

b) Predictor variables of anthropological characteristics and technical and tactical competence (N=5): motor and functional skills – (MOTFS), morphological characteristics – (MORF), psychological profile of the athlete – (PSIH), athletic intelligence – (INTE) and technical and tactical competence – (TE-TA).

Procedure

Following the analysis of the collected data and for the purposes of this study, 242 respondents-instructors (training male senior taekwondo athletes in the sparring and patterns disciplines) out of a total of 730 respondents were successfully identified and chosen for further analysis. A division of respondents into 3 qualitative subsamples according to particular style (WTF and ITF) and discipline (SPB – sparring and THN – technical discipline of patterns) was set out: 1. (VRH) – a subsample comprised of top instructors awarded medals at continental and world championships and the Olympic Games; 2. (USP) – a subsample comprised of successful instructors awarded medals at national championships and international competitions; 3. (OST) – a subsample comprised of the rest of the instructors, who have had no competitive success or have achieved results in local competitions.

For the purposes of this study, a measuring instrument-questionnaire was created for the identification of respondents (instructors) and the evaluation of the impact of some anthropological characteristics on success in taekwondo. The questionnaire contained a large number of questions, but for the purposes of this paper, the respondents (instructors) were asked, based on their own observations and experience, to rank in order of importance and assign percentile values of impact on success in taekwondo to the aforementioned predictor variables (the sum total of all 5 fields had to be 100%). The process of filling out the questionnaire was conducted electronically (over the Internet), in 6 world languages (English, German, Russian, French and Croatian). The questionnaire was hosted on a specialised server which enabled access control by password and automatic respondent identification when filling out of the questionnaire from a particular computer defined by an IP address and personal information. The respondents received personal invitations to participate in the research via e-mail (through national taekwondo associations and clubs), along with explanatory information and a link to access the survey.

Data analysis

All applied variables were subjected to standard descriptive processes for determining basic statistical parameters. To achieve the aim of this study, a measuring instrument (questionnaire) was created²³. The metrical characteristics of the questionnaire's variables were determined for each subsample and separate variable group by calculating: *sensitivity* – Kolmogorov-Smirnov test (KS), objectivity – Cronbach's alpha coefficient (α) and degree of agreement among the respondents – inter-item correlation (Iir). For the purposes of determining the differences between styles (WTF-ITF) and disciplines (SPB-THN) with regard to opinions about the impact of anthropological characteristics on success in taekwondo, the method of univariate variance analysis (ANOVA) was used. The subsample of respondents of the highest available quality based on the criterion variable of the highest instructor achievement was used as representative of each discipline in a particular style for the creation of an expert model of the impact of certain variables on the rate of success in taekwondo.

Results

By analysing Figure 1, which shows the geographical position of respondents participating in this study, we can conclude that by continent the highest response rate to the study was recorded in Europe (N=499 or 68.3% of all respondents). A somewhat lower response rate to the study was recorded in North America (N=113 or 15.5%), followed by Asia (n=47 or 6.4%), South America (N=30 or 4.1%), Africa (N=28 or 3.8%) and Australia (N=13 or 1.7%). From the analysis of the results by country it can be observed that the response rate was highest in the United States of America (N=49 or 6.7%), followed by Canada (N=45 or 6.2%), the Netherlands (N=35 or 4.8%), the United Kingdom (N=34 or 4.6%) and Belgium (N=25 or 3.4%).

By inspecting the results (Table 1) which, among other things, show respondent frequency with regards to level of education, it can be observed that 42 Doctors of Science participated in the study, which amounts to 17.3% of the total number of respondents. Higher, university or postgraduate qualification (VŠ+VS+PHD=183) is held by 75.6% of the respondents, as opposed to only (N=4) 2% of respondents who only have the most basic education i.e. have finished primary school. From the parameters describing the respondents with regard to taekwondo rank (belt), which are also shown in Table 1, it can be observed that 23 holders (9.5%) of the higher taekwondo ranks of 7th, 8th and 9th Dan (title of grand master) participated in the study, nine of whom (3.7%) were instructors of the WTF style and fourteen of whom (5.85%) were instructors of the ITF style. The holders of lower taekwondo instructor ranks (1st, 2nd and 3rd Dan, N=116) amounted to 47.9% of the total number of study respondents, and 103 (42.6%) respondents were holders of the 5th, 6th and 7th Dan ranks.

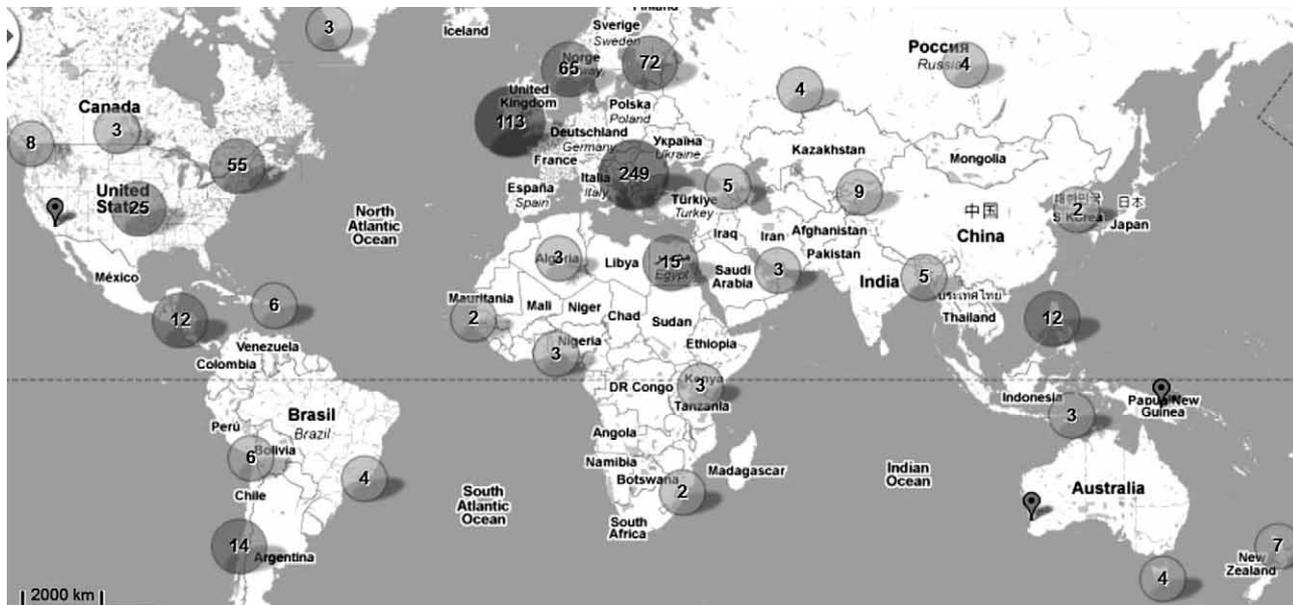


Fig. 1. Representation of the geographical position of the respondents (number of respondents-instructors N=730).

TABLE 1
RESPONDENTS ACCORDING TO THE LEVEL OF EDUCATION AND TAEKWONDO QUALIFICATION

N=242	Level of education								TKD qualification			
	N	OŠ	ŠŠ	ST	VŠ	VS	PHD	123	456	789		
WTF n=142	OST N=65	SPB	48	–	9	4	12	15	8	6	5	1
		THN	17	1	2	1	7	2	4	10	5	2
	USP N=65	SPB	52	–	8	4	19	12	9	25	23	4
		THN	13	1	4	1	3	4	–	4	8	1
	VRH N=12	SPB	12	1	3	–	1	4	3	29	18	1
		THN	0	–	–	–	–	–	–	–	–	–
	UKU WTF 142		3	26	10	42	37	24	74	59	9	
ITF n=100	OST N=35	SPB	21	–	3	1	10	4	3	13	8	–
		THN	14	–	1	1	6	5	1	6	5	3
	USP N=41	SPB	37	–	4	2	10	5	6	11	15	1
		THN	14	–	5	1	4	–	4	8	3	3
	VRH N=24	SPB	13	1	–	–	9	2	1	3	7	3
		THN	11	–	1	–	3	4	3	1	6	4
	UKU ITF 100		1	14	5	42	20	18	42	44	14	
SVUK				4	40	15	84	57	42	116	103	23

123 – number of holders of 1st, 2nd, 3rd Dan taekwondo qualification, 456 – holders of 4th, 5th, 6th Dan taekwondo qualification, 789 – number of holders of 7th, 8th, 9th Dan taekwondo qualification, OŠ – number of respondents with completed primary school, ŠŠ – number of respondents with a high school diploma, ST – number of students, VŠ – number of respondents with a higher education degree, VS – number of respondents with a college degree, PHD – number of respondents with completed postgraduate studies, SVUK – total

The values of the Cronbach’s alpha objectivity coefficient – (α) in the anthropological characteristics variables (ANT.KAR) shown in Table 2 ranged from relatively high values in the subsample comprised of the rest of the patterns instructors of the ITF style (ITF-THN-

-OST $\alpha = 0.71$) to very high values in the subsample comprised of successful sparring instructors of the WTF style (WTF-SPB-USP $\alpha = 0.96$). The highest degree of agreement in opinions about the order and importance of anthropological characteristics (Iir=0.61) for success in

TABLE 2
METRIC CHARACTERISTICS OF THE QUESTIONNAIRE FOR THE ESTIMATE OF THE ORDER AND IMPORTANCE OF IMPACT OF ANTHROPOLOGICAL CHARACTERISTICS AND TECHNICAL AND TACTICAL COMPETENCE ON SUCCES IN TAEKWONDO

WTF (n=142)								
Instructors	SPB (N=112)				THN (N=30)			
	Iir	α	K-S	D-max	Iir	α	K-S	D-max
OST	0.39	0.92	0.17–0.18	0.19	0.39	0.87	0.20–0.30	0.31
USP	0.59	0.96	0.16–0.18	0.19	0.61	0.90	0.13–0.31	0.36
VRH	0.61	0.88	0.18–0.36	0.37	–	–	–	–

ITF (n=100)								
Instructors	SPB (N=61)				THN (N=39)			
	Iir	α	K-S	D-max	Iir	α	K-S	D-max
OST	0.23	0.71	0.16–0.20	0.29	0.28	0.76	0.22–0.35	0.35
USP	0.37	0.90	0.15–0.23	0.25	0.41	0.78	0.17–0.24	0.35
VRH	0.51	0.85	0.15–0.23	0.36	0.50	0.85	0.15–0.28	0.39

Iir – inter-item correlation, α – Cronbach's alfa, WTF – World Taekwondo Federation; ITF – International Taekwondo Federation, SPB – sparring, THN – technique, OST – other instructors, USP – successful instructors, VRH – top instructors, K-S – value of the Kolmogorov-Smirnov test for the estimate of normal distribution, D-Max – maximum deviation of relative empirical cumulative distribution from relative cumulative Gaussian distribution with regard to the number of respondents

taekwondo was shown by top sparring instructors of the WTF style (WTF-SPB-VRH). The lowest degree of agreement in opinions (Iir=0.23) can be observed on the subsample comprised of the rest of the sparring instructors of the ITF style (ITF-SPB-OST). The shown indicators of metrical characteristics of the created measuring instrument point to the existence of a satisfactory connection between opinions of instructors belonging to high-quality subsamples. The values of the Kolmogorov-Smirnov test for all the variables and subsamples are within the D-max limit value and confirm the satisfactory sensitivity of the questionnaire used. The values obtained show no statistically significant deviations from normal distribution, which is why the parametrical method of variance analysis (ANOVA) can be used for analysing the differences.

By inspecting the results from Table 3 of the univariate analysis of variance (ANOVA) in opinions on the order and importance of the impact of anthropological characteristics and factors of technical and tactical competence on success in taekwondo, no statistically relevant differences were noted between instructors of different styles and disciplines in any of the analysed variables, except for the psychological profile of an athlete variable which WTF sparring instructors (AM=23.7%), on a significance level of $p < 0.01$, evaluate as having a statistically more significant impact on the success in taekwondo than WTF technical discipline instructors (15.4%).

Discussion

Methodologically, available research most similar to this one was conducted in 1994, 1996 and 2012^{25–27}. The first research project²⁵ was conducted on a sample of 50

respondents, all representative instructors of judo (N=11), speed skating (N=9), swimming (N=24) and table tennis (N=6), who were asked in a survey to rank eight general factors of success in a given sport. As a measure of instructor agreement in expressed opinions, Kendall's coefficient was calculated for each sport individually (judo=0.36, speed skating=0.86, swimming=0.60, table tennis=0.30). In another research²⁶ conducted in 1996, the authors asked 65 respondents, all successful Dutch field hockey (N=27), golf (N=19) and athletics (N=19) instructors, to determine a precise percentage value of impact of each factor on the success in their sport. Two additional factors (cooperation with the instructor and cooperation with team members) were added to the eight factors from the previous research. As a measure of instructor agreement in opinions, Kendall's coefficient was once again calculated for each sport individually (field hockey = 0.56, golf = 0.86, swimming = 0.48, explosive athletic disciplines = 0.66, athletic endurance disciplines = 0.52). The authors of the latest available research²⁷ wanted to establish a hierarchy of individual anthropological characteristics on the success in judo according to weight groups. For that purpose, they conducted a survey questionnaire on a sample of 27 European top instructors and selectors for women's judo national teams. Kendall's coefficient of agreement between instructors was 0.56. The results of the degree of respondent agreement in said research^{25–27} were very similar to the results of top ITF and WTF taekwondo instructors included in this research, which is logical given the fact that the previous survey also included top instructors and national team selectors. In all three research projects^{25–27}, the authors used the so-called Kendall's tau coefficient (τ) as a measure of the degree of respondent agreement. The cal-

TABLE 3
UNIVARIANTE ANALYSIS OF VARIANCE (ANOVA) RESULTS

ANT. KAR.	X±SD	AS±SD	F-test	p
	WTF-SPB-VRH	ITF-SPB-VRH		
MOTFS	29.1 ± 9.73	29.2 ± 9.54	0.00	0.99
MORF	11.7 ± 4.43	12.4 ± 6.65	0.08	0.78
TE-TA	20.4 ± 4.5	26.9 ± 12.3	2.96	0.10
PSIH	23.7 ± 8.0	21.2 ± 15.4	0.27	0.61
INTE	15.0 ± 7.7	10.4 ± 4.8	3.31	0.08
	WTF-SPB-VRH	WTF-THN-USP		
MOTFS	29.1 ± 9.7	35.0 ± 9.8	2.2	0.15
MORF	11.6 ± 4.4	15.4 ± 10.1	1.4	0.25
TE-TA	20.4 ± 4.5	21.2 ± 11.8	0.0	0.84
PSIH	23.7 ± 8.0	15.4 ± 7.5	7.3	0.01
INTE	15.0 ± 7.6	13.1 ± 4.8	0.6	0.46
	ITF-SPB-VRH	ITF-THN-VRH		
MOTFS	29.2 ± 9.5	32.0 ± 13.2	0.35	0.56
MORF	12.3 ± 6.7	11.8 ± 5.1	0.04	0.84
TE-TA	26.9 ± 12.3	22.1 ± 7.2	1.30	0.27
PSIH	21.2 ± 15.4	19.1 ± 7.7	0.16	0.69
INTE	10.4 ± 4.8	15.0 ± 7.7	3.20	0.09
	WTF-THN-USP	ITF-THN-VRH		
MOTFS	35.0 ± 9.8	32.0 ± 13.2	0.4	0.53
MORF	15.4 ± 10.1	11.8 ± 5.3	1.1	0.30
TE-TA	21.1 ± 11.7	22.1 ± 7.2	0.1	0.82
PSIH	15.4 ± 7.5	19.1 ± 7.7	1.4	0.25
INTE	13.1 ± 4.8	15.0 ± 7.7	0.6	0.47

MOTFS – motor and functional skills, MORF – morphological characteristics, TE-TA – technical and tactical competence, PSIH – psychological profile of an athlete, INTE – athletic intelligence WTF – WTF competition system; ITF – ITF competition system, THN – technical disciplines of patterns, USP – successful instructors, VRH – top instructors, F-test – analysis of variance, p – significance level

ulation method for this coefficient comes from the area of nonparametric statistics and is applied for ranking the objects of measurement when the obtained results are statistically very different from normal result distribution. Since the results obtained in this research and shown in Table 2 do not present significant statistical deviations from the Gaussian distribution in any of the variables or subsamples on a significance level of $p < 0.05$, a Cronbach's alpha coefficient calculation was applied for the calculation of the measuring instrument objectivity, whereas the inter-item correlation (Iir) calculation method was used to measure the degree of agreement between respondents within a particular qualitative subsample. However, unlike all other aforementioned research projects, this research was conducted on a higher global level (in six languages) and it included as many as 730 instructors of all result success categories and education levels from 69 countries and all six continents. All respondents filled their surveys individually. Therefore, they could in no way influence the opinions of other instructors and the »halo effect« was prevented. A satisfactory level of respondent education shown in Table 1, as well as the electronic possibility of preventing errors

when filling in the survey (the sum of anthropological characteristic percentages had to be 100%) were a prerequisite for realising the idea of using respondents as measuring instruments and for the purpose of achieving the goals of this research.

The analysis of trends in the degree of respondent agreement (Figure 2) shows that the degree of agreement (Iir) is proportional to the respondent quality level, i.e. it grows with the increase of instructor quality in all analysed disciplines of both competition systems. The respondent opinion results for instructors of WTF and the ITF sparring discipline ranged from 0.39 to 0.59 and 0.61; i.e. from 0.23 to 0.37 and 0.51). The opinion results for instructors of the technical discipline of patterns of both competition systems ranged from 0.39 to 0.61; i.e. from 0.28 to 0.41 and 0.50). As can be noticed, the research plan called for the creation of a total of 12 subsamples (3 per each style and discipline), but after analysing the obtained data (Table 2), we managed to create a total of 11 subsamples (5 WTF 5 and 6 ITF subsamples). The reason for not creating a subsample of top WTF instructors of the technical discipline of patterns lies in the fact that we were not able to identify, within

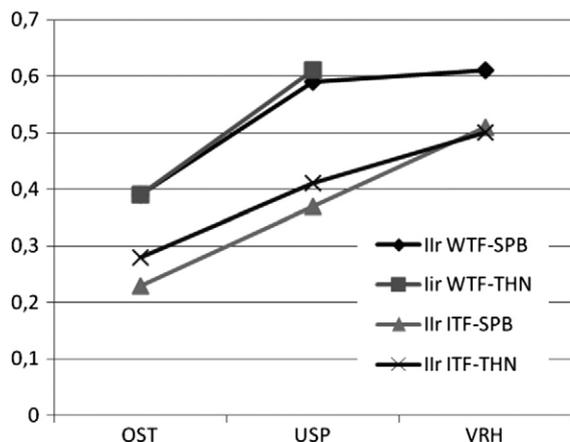


Fig. 2. Trend of degree of agreement among taekwondo instructors (Iir- inter-item correlation). WTF – World Taekwondo Federation, ITF – International Taekwondo Federation, OST – other instructors, USP – successful instructors, VRH – top instructors, SPB – sparring; THN – technique.

the sample, a number of top instructors for the aforementioned speciality which would be sufficient for statistical processing and obtaining interpretable results. Seeing that the WTF sparring discipline is an Olympic discipline, we can presume that most Olympic style instructors would consider it primary. For this reason, the instructors who were technically obliged to choose a discipline in the electronic questionnaire opted for sparring although they instruct and achieve results in the technical discipline of patterns. Since there was a high degree of agreement within the subsample of successful WTF instructors (USP) in the technical discipline of patterns, (Iir=0.61), this group was used in further analyses as the sample of highest quality. Consequently, it can be concluded that such research (as well as most other research) does not require a large respondent sample as long as the respondents are top experts in the analysed area.

The analysed competition systems (WTF and ITF) belong to the family of contact combat sports, which are dominated by kicking techniques. In both systems, sparring occurs between two opponents on an identical mat, with more or less similar duration and time for rest between rounds. The fighters are divided into weight categories, and awarded points are scored according to a similar principle. Neither of the two systems allows grabbing the opponent by the leg, avoiding combat, falling on the floor or stepping out of the fighting area. It remains clear that the differences in protective equipment worn by WTF (trunk protector) and ITF contestants (gloves and kick shoes), as well as the permitted light contact punch to the head on ITF competitions, did not have a crucial impact in relation to all other previously stated similarities between the two competition systems.

By inspecting the results (Table 3) of the univariate analysis of variance in opinions on the order and importance of the impact of certain anthropological characteristics and factors of technical and tactical competence on

success in taekwondo between instructors who represent the two different WTF (WTF-THN-USP) and ITF (ITF-THN-VRH) competition styles in the technical discipline of patterns, it has been noted that on a significance level of $p < 0.05$ there are no statistically relevant differences in any of the analysed variables, which was expected due to similarity in content, performance and judging method between the two disciplines.

Statistically significant differences in the psychological profile of an athlete variable, which WTF sparring instructors (AM=23.7%), on a significance level of $p < 0.01$, evaluate as having a statistically more significant impact on the success in taekwondo than WTF technical discipline instructors (AM=15.4), were expected due to the nature of the two disciplines. As it is known, sparring is a combat discipline in which opponents directly confront each other. The differences between the two disciplines are characterized by the existence of an evident possibility to injure an opponent or to be injured, as well as different approaches to combat with an imaginary (technique) as opposed to a real (sparring) opponent. The obtained results confirm the conclusions of many authors^{30–34} which emphasise the importance and the need to integrate psychological training into the training process of all athletes, especially those who practice combat sports.

It was interesting and expected² that instructors of both competition systems (WTF and ITF) of the sparring discipline as well as the technical discipline of patterns, regarding the field of anthropological characteristics and technical and tactical competence, as representatives of all four top subsamples (WTF-SPB-VRH, WTF-THN-USP, ITF-SPB-VRH and ITF-THN-VRH) chose motor and functional skills as the most important factor which influences competitor results. They assigned the variable a value of 29.1% to 32.0% (Table 4) of impact on success in taekwondo, which was expected since taekwondo is a multi-structural activity filled with complex techniques for which the person needs to have a relatively high level of motor and functional skills^{35,36}. Furthermore, all instructors generally agreed with the claim that technical and tactical competence (from 20.45% to 26.9%), as well as the psychological profile of an athlete (from 15.4% to 23.7%), are important for all disciplines of both systems. They ranked the former as the second and the latter as the third most important factor for achieving good results in taekwondo. The instructors believe that least impact across all disciplines in relation to all 5 offered factors can be assigned to athletic intelligence (from 10.4% to 15.0%) and morphological characteristics (from 11.6% to 15.4%). This conclusion regarding the impact of morphological characteristics was also expected, since competitions in both systems (WTF and ITF) are organized according to weight categories in order to minimize the impact of morphological dimensions. Numerous authors^{8–12,16–17,37–39} were in agreement when they concluded that having particular morphological characteristics does not guarantee winning a gold medal. Success is related to a combination of numerous factors, which unfor-

TABLE 4
ORDER OF IMPACT OF ANTHROPOLOGICAL CHARACTERISTICS ON SUCCESS IN TAEKWONDO

Rang	WTF-SPB	ITF-SPB	WTF-THN	ITF-THN
1.	MOTFS (AS=29.1%)	MOTFS (AS=29.2%)	MOTFS (AS=35.0%)	MOTFS (AS=32.0%)
2.	PSIH (AS=23.7%)	TE-TA (AS=26.9%)	TE-TA (AS=21.2%)	TE-TA (AS=22.1%)
3.	TE-TA (AS=20.4%)	PSIH (AS=21.2%)	PSIH (AS=15.4%)	PSIH (AS=19.1%)
4.	INTE (AS=15.0%)	MORF (AS=12.3%)	MORF (AS=15.4%)	INTE (AS=15.0%)
5.	MORF (AS=11.6%)	INTE (AS=10.4%)	INTE (AS=13.1%)	MORF (AS=11.8%)

MOTFS – motor and functional skills, MORF – morphological characteristics, TE-TA – technical and tactical competence, PSIH – psychological profile of an athlete, INTE – athletic intelligence WTF – World Taekwondo Federation; ITF – International Taekwondo Federation, USP – successful instructors, VRH – top instructors, SPB – sparring; THN – technique

tunately, are still insufficiently researched in the field of taekwondo².

As we have previously mentioned, taekwondo is an extremely complex and complicated combat sport with a wide range of factors of success, which, among other things, significantly depend on the opponent, draw, age and weight category. In the process of writing his doctoral dissertation⁴⁰, during the analysis of previous research, the author has found that most researchers in previous research in the field of taekwondo have not paid enough attention to defining the name of the research subject (taekwondo or taekwon-do) and choosing key

words which they have used in their publications. Such an approach to searching databases and such methodological settings pose problems when comparing research results, since it has not been defined to which taekwondo style the respondents belong to. Therefore, we can suggest that as a rule in future research the term taekwondo should be used for the WTF system and taekwon-do for the ITF system, considering definitions of the name of the competing style which are used by parent World Federations in their documents. These facts make searching and comparing previous research and experimental procedures, which include situational measuring, extremely

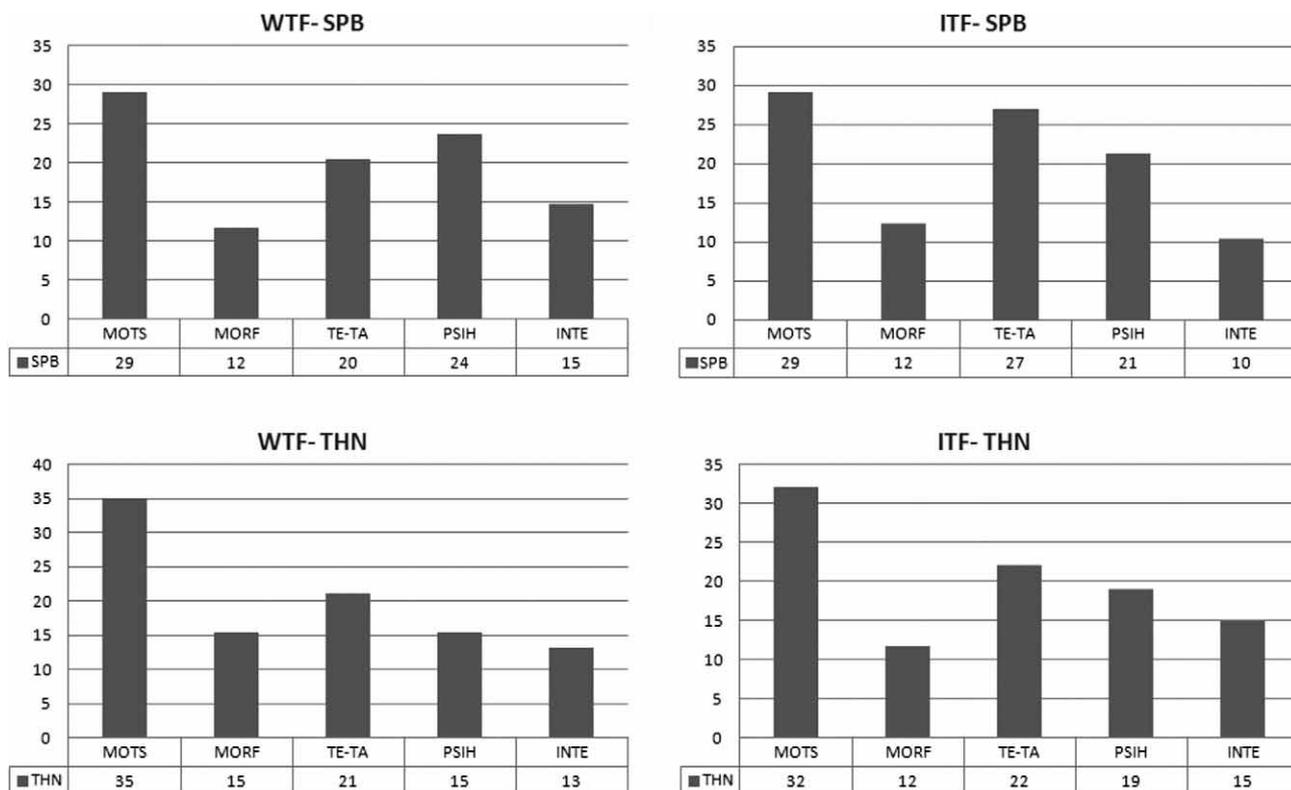


Fig. 3. Importance of impact of particular anthropological characteristics and technical and tactical competence on success in taekwondo. MOTFS – motor and functional skills, MORF – morphological characteristics, TE-TA – technical and tactical competence, PSIH – psychological profile of an athlete, INTE – athletic intelligence WTF – World Taekwondo Federation; ITF – International Taekwondo Federation, USP – successful instructors, VRH – top instructors, SPB – sparring; THN – technique.

difficult, which is why the researchers face many organizational and methodological problems. We tried to solve some of these problems with the application of the model and methodology used in this research. Since there are very few scientific research projects which deal with issues of the impact of particular factors on success in taekwondo², we believe that this paper, on a hypothetical level, definitely contributes to understanding relations and defining the impact of particular factors on results in taekwondo. Given that participation coefficients and relations among particular factors in the equation of specification of success in taekwondo have been discussed only hypothetically, the research in that field provided useful information which contribute to the reduction of the hypothetical part. In accordance with set aims, (according to available literature) research was conducted for the first time on such a large and representative sample of taekwondo instructors with the aim of determining the impact of factors on success, and the existence of similarities and/or differences between two disciplines (sparring and technical discipline of patterns) and two systems (WTF and ITF) of taekwondo competition on a global level. The results of the conducted research help us understand the order and amount of impact of particular anthropological characteristics and the technical and tactical competence on success in taekwondo, and they set realistic limits and provide guidance which should be used for future experimental research in the field of determining factors and their mutual relations necessary for success in taekwondo. Generally, the acquired knowledge enables relatively better planning and programming of trainings, i.e. during practice, emphasizing those factors which are important for success in taekwondo.

Conclusion

The analysis of metric characteristics of the constructed instrument showed a satisfactory degree of agreement (Iir) which is proportional to the level of respondent quality, i.e. it grows with the increase of instructor quality in all analysed disciplines of both systems. The top instructors assigned the highest portion of impact on success to the motor and functional skills

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(MOTFS) variable: WTF-SPB=29.1, ITF-SPB=29.2, WTF-THN=35.0, ITF-THN=32.0). Furthermore, all instructors generally agreed with the claim that technical and tactical competence (from 20.45% to 26.9%), as well as the psychological profile of an athlete (from 15.4% to 23.7%), are important for all disciplines of both systems. They ranked the former as the second and the latter as the third most important factor for achieving good results in taekwondo. The instructors believe that least impact across all disciplines in relation to all 5 offered factors can be assigned to athletic intelligence (from 10.4% to 15.0%) and morphological characteristics (from 11.6% to 15.4%). Statistically significant differences in opinions of instructors of different styles and disciplines were not recorded in any of the analysed variables. The only exception is the psychological profile of an athlete variable, which WTF instructors of sparring (AM= 23.7%), on a significance level of $P < 0.01$, evaluate as having a statistically significantly higher impact on success in taekwondo than WTF instructors of technical discipline of patterns (15.4%).

Finally, the results obtained and the conclusions drawn definitely do not present a final solution to the problem of evaluating the impact of different factors on success in taekwondo. However, they should be accepted primarily as a starting point with a scientific foundation of good quality for future empirical research. On such a basis, the obtained models of impact and relations between particular factors of success will be improved and upgraded in order to define an equation of specification of success in taekwondo which would be as precise as possible. In future research it would be interesting to conduct a more detailed research of the impact on success of all 5 anthropological characteristics, which were the subject of this research.

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ANTROPOLOŠKA ANALIZA TAEKWONDOA – NOVI METODOLOŠKI PRISTUP

SAŽETAK

Cilj je ovog istraživanja utvrđivanje redosljeda te važnosti utjecaja pojedinih antropoloških karakteristika i tehničko-taktičke pripremljenosti na uspješnost u taekwondo sportu prema stavovima vrhunskih taekwondo trenera (eksperata). Parcijalni ciljevi obuhvaćaju provjeru metrijskih karakteristika mjernog instrumenta i utvrđivanje razlika između dvaju disciplina (sportske borbe i tehničke discipline izvođenja formi) i dvaju sustava natjecanja (WTF i ITF). U skladu s ciljevima istraživanje je provedeno na uzorku od 730 ispitanika taekwondo trenera sa 6 kontinenata iz 69 država, različite razine rezultatskog uspjeha obaju taekwondo sistema (stilova) natjecanja i dviju taekwondo disciplina. Ispitanici, kriterijskom varijablom postignutog trenerskog rezultata, podijeljeni u 3 kvalitativna subuzorka (OST-USP-VRH) su na 6 svjetskih jezika elektroničkim putem vrednovali postotni (%) utjecaj motoričko-funkcionalnih sposobnosti (MOTFS), morfoloških karakteristika (MORF), psihološkog profila sportaša (PSIH), sportske inteligencije (INTE) i tehničko-taktičke pripremljenosti – (TE-TA) na uspješnost u taekwondou. Analiza metrijskih karakteristika konstruiranog instrumenta pokazala je zadovoljavajući stupanj slaganja (IIR) proporcionalan razini kvalitete ispitanika, odnosno isti raste sa porastom kvalitete trenera u svim analiziranim disciplinama obaju sustava natjecanja. Vrhunski treneri najviši udio utjecaja na uspješnost dodijelili su varijabli motoričko-funkcionalnih sposobnosti (MOTFS): WTF-SPB=29,1, ITF-SPB=29,2, WTF-THN=35,0, ITF-THN=32,0). Statistički značajne razlike u stavovima trenera različitim stilova i disciplina nisu zabilježene ni u jednoj analiziranoj varijabli, izuzev u varijabli psihološkog profila sportaša kojoj treneri WTF sportske borbe (AS=23,7%) na razini značajnosti $p<0,01$, dodjeljuju statistički značajno veći utjecaj na uspješnost u taekwondou od trenera WTF tehničkih disciplina izvođenja formi (15,4%).