



THE DIFFERENCES BETWEEN MEDALISTS AND NON-MEDALISTS AT THE 2008 OLYMPIC GAMES TAEKWONDO TOURNAMENT

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ABSTRACT

Purpose. To establish the differences in some morphological characteristics and competitive efficacy parameters between the medal winners and other competitors in male and female competitions at the Olympic taekwondo tournament in China 2008. **Basic procedures.** Athlete profiles were obtained from the “Official Olympic site” which included weight category, weight, height, age, given points, received points, warnings, deduction points, defensive/offensive kicks, and punches. A total of 128 athletes competed (64 males and 64 females) in the Games. **Main findings.** In males ANOVA found significant differences in both the sub patterns between the medal winners and other competitors in: the average number of given points per fight, average number of points received per fight, and average number of given defensive kicks to the trunk. Among females, significant differences were found in all the previously specified variables together with the average number of given offensive points to the trunk, average number of given offensive points to the head, and average number of warnings per fight. **Conclusions.** The differences between male medalists and non-medalists were observed in the DK1P (average number of defensive kicks to the trunk) variable, whereas in the female competitors the largest differences were in the average number of offensive points to the trunk and head (OK1P and OK2P). The medal winners achieved better results in those variables when compared with non-winners in both male and female categories. In comparison to the last two Olympic games, certain changes in the trend in how points are given among the male and female competitors are evidenced. When compared with the 2000 and 2004 Olympic games, the Beijing games were dominated by defensive kicks among the male competitors, whereas in female athletes, greater homogeneity and changes in the style of fighting were observed.

Key words: competitive efficacy, combat sport, weight categories

Introduction

Taekwondo (TKD) can be described as a high-intensity martial art and modern Olympic sport, in which the aim is to defeat the opponent using quick and precise kicks. TKD competitions are held based on three traditional disciplines: sparring, patterns, and breaking (a power test). Currently, sparring is the only Olympic category among them. Sparring consists of three 2-minute rounds, with a 30-second interval between each of them. The fight duration and intensity primarily demand the use of anaerobic as well as aerobic capacity [1–3]. In particular, speed, agility, and muscular endurance are important during sparring [4], so that the fighters, whose above-mentioned motor abilities are more pronounced, have an advantage over their opponents with comparable technical skills. An excess of subcutaneous adipose tissue implies greater total trunk mass, leading towards being placed in a higher category,

which generally diminishes the chances for success at a competition [5, 6]. Hence, it can be concluded that TKD is a complex sport, where a considerable number of different anthropological dimensions play an important role in the final winning result.

Two major taekwondo competition systems are recognized (the WTF and ITF) and can be differentiated by the competition rules, techniques and equipment used. The WTF competition system [7] regulates full contact and kicks and strikes to the body and head as assented techniques. The following protection equipment is prescribed: trunk protector, dobok (white trousers and jacket), forearm and shin guards, head protector, groin guard and belt. ITF competitors [8], contrary to WTF, do not wear trunk protectors but have hand and feet safety equipment, while strikes are performed through light contact. The same techniques are allowed as in the WTF with the addition of the head punch. Currently, the WTF sparring discipline is the only Olympic category among them.

TKD has significantly evolved since it became an Olympic sport (in 2000). During this period, the rules have often been changed to make the competitions more

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dynamic. For example, the round duration was reduced from 3 to 2 minutes and a kick to the head now gives 2 points. In case of a tied result an extra round is provided. The fighting area is reduced to 10×10 meters and competitors are obliged to wear TKD gloves. In addition, “Win by superiority” (when a competitor scores a maximum of 12 points the match is stopped and winner declared) and “Win by point ceiling” (when a seven-point gap is reached) have been established [7].

However, every change in the rules has resulted in changes in the order and significance of the competitive efficacy parameters. This necessitates important modifications in the technical-tactical performance of the competitors. Hence, it is extremely important for the competitors to constantly follow the trends of the competitive efficacy parameter changes, which are decisive in the creation of training plans and programs. Studies concerning competitive efficacy parameters in sports generally as well as in TKD are very rare [9–12]. Previous investigators [9] concluded that training should be focused on offensive technique and tactics. On the other hand, Kazemi et al. [10] analyzed the data from the Sydney 2000 games, and did not obtain any statistically significant differences in any of the analyzed competitive efficacy variables between the winners and the other competitors. Furthermore, by analyzing the results from the Athens 2004 Olympic Games (OG), Kazemi et al. [11] concluded that both males and females used more frequently one-point offensive kicks to score the maximum number of points, followed by defensive kicks and offensive two-point kicks. They also concluded that the fighting style in the 2004 OG was more dynamic when compared with the 2000 OG that took place in Sydney. Therefore, it would be interesting to compare similar parameters from the data of the past 4 or 8 years, a period when TKD as a sport underwent significant changes.

The basic aim of this study is to establish the differences in a variety of morphological characteristics and competitive efficacy parameters between the medal winners and other competitors in both male and female competitions at the Olympic taekwondo tournament in China 2008.

Material and methods

The sample for this study comprised of all participants in the Olympic taekwondo tournament in Beijing 2008 (128 athletes; 64 males and 64 females) from 22 countries, who passed the demanding qualifying tests to participate in the OG, and competed in 4 male and 4 female weight categories. Taekwondo competition at the OG is carried out as a single elimination tournament

system with double repechage (among all the losers of the contestants after the final match) for 3rd place [13]. For the purpose of this research study, all the participants who participated in the Olympic taekwondo tournament (128) and all their fights (152 fights) were analyzed, and the following variables were chosen: age (AGE), body weight (WEIGHT), body height (HEIGHT), and Body mass index (BMI). The competitive efficacy variables of the participants were warnings (KJP), penalty points (GJP), offensive kicks to the trunk (OK1P), offensive kicks to the head (OK2P), defensive kicks to the trunk (DK1P), defensive kicks to the head (DK2P), given points (POPP), and received points (PRIP). According to the WTF TKD rules [7] competitors score points when contact is made to the torso (by punches and kicks) or the head (only by kicks). Penalties are divided into “Kyong-go (warning)” and “Gam-jeom (penalty point). The specified variables were obtained from the “Official Olympic site” in accordance with article 9, paragraph 2 of the IOC – Archives access rules [14].

Due to the competition system, the participants took part in different number of fights at the tournament. Hence, the competitive efficacy variables of the participants were transformed into average values per fight, that is, the relative values of the above-mentioned variables for each participant were calculated.

Based on the obtained rankings, the criterion variable of success was established. Dependant on that variable, the participants were divided into two groups: a) medal winners and b) the others.

Statistica v.7 software and ANOVA were used to determine the significant differences between the groups of winners and the others. All the results were expressed as mean (\pm SD). In all the analyses, the 5% critical level ($p < 0.05$) was considered to indicate statistical significance.

Results

From Table 1, we can conclude that male medal winners are slightly older (0.25 years), taller (almost 3 cm), and have slightly lower BMI (21.99 vs. 22.39), when compared with the non-medalists. However, differing results were obtained with female athletes (0.19 years, 2.32 cm, and 0.40 BMI). Both male and female medal winners achieved better results in all the competitive efficacy variables and the number of given and received points when compared with the non-winners, which is both logical and predictable. However, medalists had significantly different results in comparison to the others, among the variables DK1P (medalists 1.76 ± 0.82 vs. others 0.90 ± 1.06), POPP (medalists $3.07 \pm$

Table 1. Descriptive statistics (Means and Standard Deviations – SD); ANOVA statistic significance with demographic, anthropometric and competitive efficacy variables between medalists and non-medalists in male and female competitors

Variables	Medalists (males) mean ± SD	Others (males) AS ± SD	F-test	Medalists (females) AS ± SD	Others (females) AS ± SD	F-test
AGE	25.44 ± 3.67	25.19 ± 4.29	0.04	23.00 ± 2.63	23.19 ± 4.62	0.02
HEIGHT	182.73 ± 8.99	179.74 ± 8.50	1.44	169.41 ± 7.86	171.72 ± 6.18	1.45
WEIGHT	73.99 ± 13.88	72.78 ± 12.10	0.11	60.81 ± 9.17	62.13 ± 8.16	0.30
BMI	21.99 ± 2.47	22.39 ± 2.25	0.36	21.10 ± 2.22	21.00 ± 1.93	0.03
KJP	1.09 ± 0.48	1.02 ± 0.81	0.11	1.24 ± 0.61	0.80 ± 1.02	2.68
GJP	0.23 ± 0.23	0.29 ± 0.36	0.37	0.36 ± 0.29	0.13 ± 0.30	7.13^b
OK1P	1.16 ± 0.92	0.83 ± 1.10	1.16	1.17 ± 0.51	0.55 ± 0.58	1.79^b
OK2P	0.19 ± 0.25	0.10 ± 0.34	0.89	0.14 ± 0.27	0.03 ± 0.11	4.95^a
DK1P	1.76 ± 0.82	0.90 ± 1.06	8.56^b	1.54 ± 0.84	0.77 ± 0.78	11.32^b
DK2P	0.05 ± 0.10	0.01 ± 0.07	2.49	0.08 ± 0.15	0.03 ± 0.12	1.67
POPP	3.07 ± 1.01	1.71 ± 1.80	8.13^b	2.90 ± 0.91	1.38 ± 1.01	20.95^b
PRIPP	1.78 ± 0.91	3.00 ± 2.09	5.09^a	1.41 ± 0.73	2.66 ± 1.21	9.61^b

* F-test – univariate test results; ^a $p < 0.05$; ^b $p < 0.01$

Abbreviations used: (AGE) age, (HEIGHT) body height, (WEIGHT) body weight, (BMI) Body mass index, (KJP) warnings, (GJP) penalty points, (OK1P) offensive kicks to the trunk, (OK2P) offensive kicks to the head, (DK1P) defensive kicks to the trunk, (DK2P) defensive kicks to the head, (POPP) given points, (PRIPP) points received

1.01, vs. others 1.71 ± 1.80) and PRIPP (medalists 1.78 ± 0.91 vs. others 3.00 ± 2.09) in the male competitors, whereas in the female competitors, the variables GJP (medalists 0.36 ± 0.29 , vs. others 0.13 ± 0.30), OK1P (medalists 1.17 ± 0.51 , vs. others 0.55 ± 0.58), OK2P (medalists 0.14 ± 0.27 , vs. others 0.03 ± 0.11), DK1P (medalists 1.54 ± 0.84 , vs. others 0.77 ± 0.78), POPP (medalists 2.90 ± 0.91 , vs. others 1.38 ± 1.01), and PRIPP (medalists 1.41 ± 0.73 , vs. others 2.66 ± 1.21) showed statistically significant differences. Furthermore and what was quite interesting, the female medal winners, on average, had more warnings (KJP). They also had significantly more penalty points (GJP) when compared with the non-medalists. Among the male medal winners, we noticed a slightly higher number of warnings, which, however, were not statistically significant (0.23 vs. 0.29). Nevertheless, both the male and female medalists scored most of their points by giving defensive kicks to the trunk (DK1P).

Discussion

The results from Table 1 show that the BMI values of top male and female TKD athletes were in the normal range (18.5 – 24.9) and probably in the lower part of the normal range, because this sample population comprised of the elite athletes who have higher muscle mass when compared with the general population [15]. In general, the average BMI of male medalists was lower than that of male non-medalists, but did not show any statistical significance. This may suggest that the me-

dalists had a leaner body than the non-medalists, and lower body fat content, as observed by Chan et al. [16], who showed that the dominant somatotype (endo-mesecto) for males (4.2 – 4.7 – 2.9) and females (6.3 – 4.2 – 2.0) was a well-proportioned stature, well-developed muscles and skeletons, and low subcutaneous fat. The BMI values in female athletes were almost identical among both the medalist and non-medalist groups, and the values in the non-medalists were even slightly lower.

Furthermore, the results given in Table 1 show a contradictory fact, according to which, female non-medalists are, on average, taller than female medalists, although no statistical significance could be observed. Earlier research has shown that taller athletes have a significant biomechanical advantage over their shorter competitors. Taller athletes have longer upper and lower limbs, which translates into longer levers, providing them with greater ability to cover a larger area with less energy [10]. Nevertheless, it is presumed that female medalists compensated this “handicap” with greater dynamics, speed, agility, and better attack timing, which, according to certain authors, is considered to be the most important factor for success in TKD [10]. However, these assumptions should be proven in future studies.

The finding that there were no significant differences in the weight between medalists and non-medalists among both male and female athletes is completely logical, as all the fighters are categorized on their weights, and the competitors are generally recommended to maintain the upper limit weight of their weight category [5, 6].

Interestingly, no major differences in the BMI, AGE

Table 2. Comparison of the results from the last three Olympic Games with anthropometric and demographic variables

Variables	Sydney 2000	Athens 2004	Beijing 2008
BMI (M) medals	21.9 ± 2.4	22.4 ± 2.3	22.0 ± 2.5
BMI (M) no medal	22.8 ± 3.3	22.5 ± 2.5	22.4 ± 2.3
BMI (F) medals	20.8 ± 2.3	20.4 ± 2.5	21.1 ± 2.2
BMI (F) no medal	21.3 ± 2.7	21.1 ± 2.2	21.0 ± 1.9
HEIGHT (M) medals	183 ± 0.1	183 ± 0.1	183 ± 9.0
HEIGHT (M) no medal	179 ± 0.1	181 ± 0.1	180 ± 8.5
HEIGHT (F) medals	170 ± 0.1	173 ± 0.1	169 ± 8.0
HEIGHT (F) no medal	169 ± 0.1	169 ± 0.1	172 ± 6.2
WEIGHT (M) medals	73.4 ± 12.1	75.8 ± 16.1	74.0 ± 13.9
WEIGHT (M) no medal	73.7 ± 14.3	74.1 ± 13.0	72.8 ± 12.1
WEIGHT (F) medals	60.3 ± 9.1	61.3 ± 10.5	60.8 ± 9.2
WEIGHT (F) no medal	61.3 ± 10.9	60.9 ± 9.4	62.1 ± 8.2
AGE (M) medals	24.4 ± 3.3	26.1 ± 4.6	25.4 ± 3.7
AGE (M) no medal	25.2 ± 4.3	26.0 ± 4.3	25.2 ± 4.3
AGE (F) medals	23.1 ± 3.9	24.3 ± 4.9	23.0 ± 2.6
AGE (F) no medal	24.9 ± 4.7	24.5 ± 4.7	23.2 ± 4.6

Abbreviations used: (AGE) age, (HEIGHT) body height, (WEIGHT) body weight, (BMI) Body mass index, (M) males, (F) females

and HEIGHT variables could be observed between the medalists and non-medalists among both male and female competitors when the results from the last three OG were compared (Tab. 2). The competitors who took part in the Athens Olympics were slightly older than those competing in the Beijing and Sydney Olympics.

Unfortunately, we were unable to compare the completely competitive efficacy variables from the last three OG for the following reasons:

a) Although the analyzed variables from the Sydney 2000 OG [10] and the Athens 2004 OG [11] gave useful data, they presented absolute values, which, according to their authors, may result in a doubtful interpretation of the results because participants took part in a different number of fights. In other words, taking into consideration the specific type of competition, in which all the participants do not take part in the same number of fights, it is necessary to consider the total number of fights in relation to the observed parameters, which allow for the calculation of the relative values for each fighter, as was done in this study.

b) When compared with the research carried out by Kazemi et al. [10] using data obtained from the Sydney OG or that carried out by Kazemi et al. [11] using data from the Athens OG, a greater number of fights were analyzed.

c) Numerous changes in the competition rules have occurred in the meantime, in addition to other changes

(in training technology, the character of the game, etc.). Thus, it is interesting to observe the way the above-mentioned changes influenced the characteristics of TKD sparring. For example, on analyzing the data from the OG held in Sydney in 2000, Kazemi et al. [10] found no statistically significant differences in any of the analyzed variables between the winners and the other competitors. It is obvious that a period of 8 years (two Olympic cycles) brought considerable differences in the way point are awarded among the world's top TKD athletes. This probably might have been caused by certain changes in the rules during that period (as mentioned, the round duration was reduced from 3 to 2 minutes and the kick to the head gives 2 points). In addition, the results obtained from the Athens 2004 OG [11] were also significantly different from those presented here. In other words, offensive kicks in both male and female competitors were still dominant at those games, which was not observed in the Beijing 2008 OG (especially among male competitors) (Tab. 1). Interestingly, this was already remarked by the Koreans in the Sydney 2000 OG [10], where they had considerably more points than their opponents. A comparison of the results of male and female competitors (Tab. 1) revealed that the differences in the analyzed competitive efficacy variables between the medalists and non-medalists were considerably more pronounced in female athletes. Thus, only the variable defensive kicks to the trunk (DK1P) distinguished successful competitors from the less successful ones, while in female athletes, the medal winners, on average, used considerably more offensive kicks (OK1P and OK2P) and even had more penalty points (GJP) when compared with the non-medalists. According to the authors, such results were primarily conditioned by a great homogeneity of male athletes in all weight categories, when compared with the female competitors. Kazemi et al. [10] confirmed this notion by concluding that female Taekwondo athletes participating in competitions and generally in the sport started much later than male athletes. In addition, the number of female Taekwondo athletes in the world is lower than that of male athletes. In some countries, such as Iran, the participation of female Taekwondo athletes in international competitions is banned owing to religious beliefs. This may affect the amount of emphasis put on developing elite international female Taekwondo athletes in different countries, thus explaining the large difference in scoring between female winners and non-winners. However, it seems that gender differences in that segment are not as pronounced today. In particular, in the Sydney 2000 and Athens 2004 OG, there was a considerably greater number of fights won by superiority among female com-

petitors when compared with males (even up to 8 times), which points to considerable differences in quality of fighting between the winners and the other female athletes. For example, in the Beijing 2008 OG, there were practically no differences between males and females in that parameter, and only 5 fights in the female category and 3 fights in the male category ended that way.

It is also evident that in the last OG, the fighting style of female athletes changed when compared with male athletes, which is indicated by two facts:

- a) Female medalists had, on average, more warnings and penalty points when compared with male medalists (1.24 and 0.36 when compared with 1.09 and 0.23).
- b) Female medalists obtained a higher number of warnings and a considerably greater number of penalty points when compared with the non-medalists.

Such results significantly differ from those obtained from the Athens 2004 OG [11], and based on the way the competitors used to win (a greater number of offensive kicks and knock downs), it was concluded that male athletes had a more dynamic fighting style than female athletes. The importance of the fighting dynamics is observed in other combat sports such as judo [17]. It is obvious that in Beijing, the successful female competitors often attacked and took more risks, but also made more mistakes in their fights. For more accurate conclusions, future research should include round analysis between the medalists and non-winners.

Male medalists achieved higher results than male non-medalists only in the number of defensive kicks to the trunk. Thus, it can be concluded that male athletes were very uniform, and, according to their technical and tactical characteristics, more homogeneous than female athletes. Thus, male athletes “maneuvered” more and waited for a wrong move by their opponent, without taking too many risks, and to launch a counter-attack at the right moment in order to gain the advantage. It is known that defensive techniques result in “cleaner and more impressive” points [18], and hence, it is not surprising that those techniques clearly distinguished medalists from non-medalists. However, the obtained results are partially contradictory to the conclusions of Yujin and Zeng [9] who suggested that TKD training should be based on offensive techniques. Nevertheless, according to the presented results, this statement is not valid any more, especially with regard to male competitors. It is interesting to note that during the analyzed TKD tournament, the competitors did not obtain any points through punches to the trunk (hence, that variable was not used in the research). As no effective punches

were recorded at the Athens OG as well, we can conclude that it is a trend in modern TKD. Thus, it can be stated that these techniques should be practiced only in trainings with the purpose of improving conditioning and tactics, and certainly not as a direct technique instrumental in being awarded points.

Conclusions

According to the results presented and discussed herein, the following conclusions can be drawn:

- Diverse results were found in the male and female population: male medalists and non-medalists differ in defensive scoring (medalists having higher values) and female in offensive scoring (medalists having higher values).
- Remarkable changes were found in the trends in obtaining points with regard to the last two OG (defensive kicks were dominant among male athletes, while there was a noticeable homogeneity and change in the style of fighting among the female athletes).
- Future studies should analyze the relationships between the variables of competitive efficacy and other anthropological characteristics variables and also a round analysis between medalists and non-medalists.

References

1. Melhim A.F., Aerobic and anaerobic power responses to the practice of taekwondo. *Br J Sports Med*, 2001, 35, 231–234, doi:10.1136/bjism.35.4.231.
2. Lin W.-L., Yen K.-T., Lu C.-Y.D., Huang Y.-H., Chang C.-K., Anaerobic capacity of elite Taiwanese Taekwondo athletes. *Sci Sport*, 2006, 21, 291–293, doi:10.1016/j.scispo.2006.04.005.
3. Markovic G., Vucetic V., Cardinale M., Heart rate and lactate responses to taekwondo fight in elite women performers. *Biol Sport*, 2008, 25, 135–146.
4. Heller J., Peric T., Dlouhá R., Kohlíková E., Melichna J., Nováková H., Physiological profiles of male and female taekwondo (ITF) black belts. *J Sports Sci*, 1998, 16, 243–249, doi: 10.1080/026404198366768.
5. Pieter W., Bercades L.T., Heijmans J., Injuries in young and adult taekwondo athletes. *Kinesiology*, 1998, 30, 22–30.
6. Marković G., Misigoj-Duraković M., Trninić S., Fitness profile of elite Croatian female Taekwondo athletes. *Coll Antropol*, 2005, 29, 93–99.
7. Rules and regulations. Published by the World Taekwondo Federation 2010. Available from: <http://www.wtf.org>
8. I.T.F. World junior and senior tournament rules, Version 10, May 2010, International TaeKwon-do Federation (I.T.F.).
9. Yujin Z., Zeng Y.J., An analysis of Chinese taekwondo team participation of men’s 14th and women’s 7th World Championships. *Journal of Wuahu Institute of Physical Education*, 1999, 33, 37–39.
10. Kazemi M., Waalen J., Morgan C., White A.R., A profile of olympic taekwondo competitors. *J Sport Sci Med*, 2006, CSSJ, 114–121.

11. Kazemi M., Casella C., Perri G., 2004 Olympic Tae Kwon Do Athlete Profile. *J Can Chiropr Assoc*, 2009, 53, 144–152.
12. Szwarc A., The efficiency model of soccer player's actions in cooperation with other team players at the FIFA World cup. *Hum Mov*, 2008, 9, 56–61, doi: 10.2478/v10038-008-0002-y.
13. Standing procedures taekwondo competition at Olympic games in force as of may 5. Published by the World Taekwondo Federation 2008. Available from: http://www.wtf.org/wtf_eng/site/rules/file/SOP_for_taekwondo_at_Olympic_Games_%28as_of_Beijing_2008%29.pdf
14. International Olympic Committee, IOC Archives Access Rules, 1997. Available from: URL: http://www.olympic.org/Documents/Reports/EN/en_report_1014.pdf
15. Bickley L.F., Szilagy P.G., Bates' Guide to Physical Examination and History Taking. Lippincott Williams & Wilkins. Philadelphia 2003.
16. Chan K., Pieter W., Moloney K., Kinanthropometric profile of recreational taekwondo athletes. *Biol Sport*, 2003, 20, 175–179.
17. Boguszewski D., Fight Dynamics of the Double Olympic Champion in Judo (1988, 1992). *J Hum Kinet*, 2006, 16, 97–105.
18. Kim S.H., Chung K.H., Lee K.M., Textbook Taekwondo Kyorugi Olympic style sparring. Turtle Press, Wethersfield 1999.

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