Ann Appl Sport Sci 10(4): e1093, 2022.
http://www.aassjournal.com; e-ISSN: 2322–4479; p-ISSN: 2476–4981. 10.52547/aassjournal.1093

ORIGINAL ARTICLE

How Judo Professionals Win and Lost in Competition: A Closer Look at Gender, Weight, Technique, and Gripping

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Submitted December 07, 2021; Accepted in final form January 27, 2022.

ABSTRACT

Background. Judo coaches and athletes must understand the relevant technical content of the competition to improve their judo skills in Taiwan. Therefore, this study intends to explore the current situation and differences in scoring techniques of outstanding judo players and the impact on the victories or defeats of scoring techniques. **Objectives.** The purpose of this study is to explore the distribution of judo players of different genders, weight divisions, scoring techniques, and gripping positions that affect the victories and defeats in the competitions. **Methods.** The research objects were a total of 185 judo players, 104 male players, and 81 female players, from Judo Competition at the 2019 Taiwan National Games that was held from October 20 to 23, 2019 in the gymnasium of Yuan Ze University Taiwan. The data was collected and analyzed by observing videos in the judo competition venues as the research samples. **Results.** The research shows that there is no significant difference between judo players' scoring techniques and various weight divisions, but it indicates a significant difference between scoring techniques and various gripping positions, as well as between gripping positions and different weight divisions. **Conclusion.** It is recommended to establish a mini-application (app) of judo tactics to provide real-time analysis during training and competitions to coaches and judo players.

KEYWORDS: ***Grip position, Judo, Weight Division, Scoring.***

INTRODUCTION

Judo is graded by weight and is an open-skill sport. In recent years, the characteristic of judo is fast-paced, emphasizing muscle strength and high cardiorespiratory ability (1) (Artioli et al., 2010). Due to the particularity of the rules, it can be victory or defeat in split second or take more than 5 to 10 minutes to end the game (1) (Artioli et al., 2010). Chinese Taipei Judo Federation (I.J.F.) announced a hundred types of techniques, and many of them were changed from 2009 to 2013; especially after London 2012 Olympic Games, active attack techniques have been promoted to get points, not the penalty of passive attack (2)(3)(4). This study compares the scoring rate and Shido in judo competitions of the Rio 2016 Olympics with the London 2012 Olympics (before and after the rules changed) and considers the weight categories and the stages of the competitions (5). Regarding the rules of judo, the men's and women's competition time have been set to four minutes, competition in the golden game time has no rule of third fouls losing the

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game, the gatame time, attack below the waist, and the penalty for the players' whose clothes are not organized by themselves; all stages of the battles are carried out, which involve open and complex skills in judo competitions since the 2016 Rio Olympics (6); the technical and tactical behaviors to have effective attacks and defensive actions (7).

Related researches point out that to win the competitions, the technical and tactical preparation from the judo athletes are the key factors (8-12); therefore, more researchers have observed, recorded, analyzed, and evaluated the process of the top competitions, and these effective researches and the statistical results can apply into the actual competitions (13). The obtained information can monitor the training plan and have further prepared the techniques and tactics of each athlete, thereby improving the efficiency of preparation for the subsequent stages of competitions (14) to improve the athletes' athletic performance. Coaches and athletes to elaborate training plans and focus on competitive strategies to increase chances of winning (15) can use current data. From the research of 2011-2012 international judo competitions, the factors (grips, attacks, defenses, techniques, and tactics) in the games, penalties (athletes or matches), and attacking types (scores or without scores) affect the outcomes (9). In competitions, the outstanding judo athletes use trunk/legs attack technical more frequently and use arms/legs attack technical more frequently, but the matches have fewer penalties, and more timeouts (16).

In this study, there are three different weight divisions for men, lightweight (-60 kg, -66 kg), middleweight (-73 kg, -81 kg), and heavyweight (-90 kg, -100 kg + 100 kg); and three weight divisions for women, lightweight (-48kg, -52kg), middleweight (-57kg, -63kg), heavyweight (-70kg, -78kg, +78kg). The minus sign (-) means that the participants are below the kilograms of the weight categories; plus (+) means that the participants are above the kilograms of the weight categories. In addition, scoring movements are divided into five categories, Te-waza, Koshi-waza, Ashi-waza, Sutemi-waza, and Osae-komi-waza, which are the scoring technique judged by the referees when judo players inflict technical attacks on their opponents in the courses of matches. Moreover, the gripping positions include the front, nape, and back. The processes of the gripping positions are based on the players' technical movements and personal habits.

The results show the differences in technologies and tactics that may contribute to home-court advantage (17). The year 2017 was the first year after the 2016 Rio Olympics, Chinese Taipei Judo Federation (I.J.F.) analyzed the various problems that have occurred in the past four years from the organization the technical dimensions and then began trial testing from January 2017 to the completion in Judo World Championship 2017 in Budapest. It will be officially implemented, until the 2020 Tokyo Olympics (18).

The evolution and dynamic changes in sports science records require experts to find new solutions based on specific requirements to optimize sports training in judo competitions. The coaches, athletes, and researchers have proved the necessity of training is related to judo competition activities directly (19). Judo coaches and athletes must understand the relevant technical content of the competition to improve their judo skills in Taiwan. Therefore, this study intends to explore the current situation and differences in scoring techniques of outstanding judo players and the impact on the victories or defeats of scoring techniques.

MATERIALS AND METHODS

Research Objects. The data in this study was from the 2019 Taiwan National Games, and the venue for the match was held in two places. Two observers took video records in two venues at the same time. The data was collected and analyzed by observing videos in the judo competition venues. Judo Competition in the 2019 Taiwan National Games was held from October 20 to 23, 2019 in the gymnasium of Yuan Ze University Taiwan. 104 male players and 81 female players, a total of 185 judo players as the research samples. The size of the players, technical movements, and gripping position are the scopes of this research (20).

The Reliability Verification of Observation Record. To ensure the objectivity between the observers, the researchers prepared one personal laptop, two digital cameras, one mobile phone,

and record sheets of the game scores. The inter-observer agreement is used in this study. The agreement among the three observers is 94%~96%. If an inconsistency is more than 35%, the fourth observer with international refereeing qualifications will re-observe the record to determine the decision, the formula is as follows (21): Consistency

IOA= Consistency + Inconsistency

Data Analysis. SPSS 18.0 statistical package software was used in this study and α=0.05 was used as the significant level for the statistical test.

RESULTS

The Distributions of Players' Backgrounds, Weight Divisions, Scoring Techniques, and Gripping Positions. There were 104 (56.2%) male judo players and 81 (43.8%) females participated in the competitions. In the distribution of weight divisions, 71 (38.4%) players were heavyweight champions; 58 (31.4%) players participated as middleweight champions, and 56 (30.3%) players were lightweight champions. In the scoring techniques, the judo players used Ashi-waza 116 times (37.7%), Osae-komi-waza 84 times (27.3%), Te-waza 52 times (16.9%), Sutemi-waza 36 times (11.7%), and Koshi-waza 20 times (6.5%). In the gripping positions, the judo players gripped the front 130 times (55.1%), nape 99 times (41.9%), and back 7 times (3.0%).

The differences between scoring techniques and gripping positions in different weight divisions. Chi-square distribution of scoring techniques and weight divisions. Table 2 shows there is no significant difference in the scoring techniques at different weight divisions. The research results show that there is no influential difference in technical movements in different weight divisions which enables judo players to develop comprehensively in technical movements. Each technical should strengthen the connections and collocation of different directions and attacks. Excellent judo players should possess most of the triumphant skills to respond to the ever-changing reactions of the champions.

Chi-square distribution of scoring technical movements and gripping positions. Table 3 shows the scoring techniques and gripping positions have a significant difference. The research results show that because of the gripping positions the technical movements would because of the different gripping positions affect the player's skill score which is a significant relationship between factors. The players in judo techniques are accustomed to front gripping which is the same result as Hsu et al. (21) and Yang (22). In addition, Kajmovic and Radjo (23) also pointed out that the different grips affect performance.

Table 1. The Statistical Table of Players' Backgrounds, Weight Divisions, Scoring Techniques, and Gripping Positions

Items	Times	Percentage
Male	104	56.2%
Female	81	43.8%
Total	185	100%
Lightweight	56	30.3%
Middleweight	58	31.4%
Heavyweight	71	38.4%
Total	185	100%
Te-waza	52	16.9%
Koshi-waza	20	6.5%
Ashi-waza	116	37.7%
Sutemi-waza	36	11.7%
Osae-komi-waza	84	27.3%
Total	308	100%
Front	130	55.1%
Nape	99	41.9%
Back	7	3.0%
Total	236	100%

The difference between gripping positions and weight divisions. Chi-square distribution of scoring techniques and weight divisions. Table 4 shows the judo players who participated in this competition, the differences between the scoring techniques, and the different gripping positions p.05 that show that are significantly different in the gripping positions in different weight divisions. The analysis results of this study show that the number of points obtained by the judo players using the gripping positions is the key to the victories or defeats of the competitions.

The influence of different gripping positions on victories or defeats. After the Logistic Regression model was established, it is necessary to verify whether the position of the gripping has a significant impact on the victories or defeats of the games. The test results show that the chi-square value is 150.875, which is a significant difference, shown in Table 5. Logistic

Regression is used in this study to analyze the victories or defeats of the contestants (divided into victories or defeats) because of the gripping positions to predict and understand the impacts.

Table 2. Judo Players' Scoring Technical Movements and the Chi-Square Distribution

Technical Movements	Weight Divisions			Chi-Squared	P-Value
	Lightweight	Middleweight	Heavyweight		
Te-waza				13.186[a]	0.106
Numbers	22	25	16		
Percentage	34.9%	39.7%	25.4%		
Koshi-waza				13.186[a]	0.106
Numbers	6	4	9		
Percentage	31.6%	21.1%	47.3%		
Ashi-waza				13.186[a]	0.106
Numbers	35	42	49		
Percentage	27.8%	33.3%	38.9%		
Sutemi-waza				13.186[a]	0.106
Numbers	9	8	23		
Percentage	22.5%	20.0%	57.5%		
Osae-komi-waza				13.186[a]	0.106
Numbers	30	24	33		
Percentage	34.5%	27.6%	37.9%		

Table 3. Chi-Square Distribution of Scoring Technical Movements and Gripping Positions

Technical Movements	Gripping Positions			Chi-Squared	P-Value
	Front	Nape	Back		
Te-waza				43.322[a]	0.000*
Number	46	4	1		
Percentage	90.2%	7.8%	2.0%		
Koshi-waza				43.322[a]	0.000*
Number	11	5	2		
Percentage	61.1%	27.8%	11.1%		
Ashi-waza				43.322[a]	0.000*
Number	54	63	2		
Percentage	45.4%	52.9%	1.7%		
Sutemi-waza				43.322[a]	0.000*
Number	14	22	1		
Percentage	37.8%	59.5%	2.7%		
Osae-komi-waza				43.322[a]	0.000*
Number	5	4	1		
Percentage	50.0%	40.0%	10.0%		

*P<0.05

Table 4. Chi-Square Distribution of Scoring Techniques and Weight Divisions

Gripping Positions	Weight Divisions			Chi-Squared	P-Value
	Lightweight	Middleweight	Heavyweight		
Front				15.555[a]	0.004*
Number	55	32	43		
Percentage	42.3%	24.6%	33.1%		
Nape				15.555[a]	0.004*
Number	19	35	44		
Percentage	19.4%	35.7%	44.9%		
Back				15.555[a]	0.004*
Number	4	2	1		
Percentage	57.1%	28.6%	14.3%		

*P<0.05

Table 5. Omnibus Tests of Model Coefficients

	Chi-Square	Sig.
Step 1		
Step	150.875	0.000*
Block	150.875	0.000*
Model	150.875	0.000*

*P<0.05

The setting of logistic regression model. Assuming that the scores of gripping positions of front, nape, and back are E1, E2, E3, and the probability of winning the game is P_1, and the probability of losing the game is 1- P_1. The formula for data fits logistic regression model is

$$\ln\frac{P_1}{1-P_1} = \alpha + \sum_{i=1}^{3}\beta_i E_i$$

Verification of logistic regression model. After the logistic regression model is established, it is necessary to check whether the positions of the gripping have a significant impact on the outcomes of the games. The test results show that the chi-square value is 150.875, which is a significant difference (P< 0.05). The summary of regression coefficients is shown in Table 6.

According to the results in Table 6, the gripping position is based on the back, and the gripping positions of front and nape have significant effects on the victories or defeats of the competitions in the regression model. The regression coefficient (β) are 38.141 and 33.638 which present the judo players use the nape gripping position in the competition, the winning rate is 38.141 times higher than that of using the back; using the front gripping position in the competition is 33.638 times higher than using the back. It is obvious that the gripping position in the nape has a higher chance of winning, the next gripping position is the front. Therefore, the position has a positive impact on the victories or defeats of the judo players.

According to the results in Table 6, attacking the neck is more critical to victories and defeats which is the key to victories or defeats, and which is a strong and fast gripping position in the competitions.

The impact of scoring technical movements on victories or defeats. Table 7 shows the chi-square value is 146.862, which is a significant difference. Logistic Regression is used to analyze the judo players' victories or defeats (divided into wins and losses), whether the variables of players' scoring technical movements to predict the impact.

Table 6. Variables in the Equation

	Sig.	Exp (β)
Step 1[a]		
Back	0.000*	38.141
Front	0.006*	33.638
Constant	0.000*	0.001

*P<0.05

Table 7. Omnibus Tests of Model Coefficients

	Chi-Square	Sig.
Step 1 [a]		
Step	149.862	0.000*
Block	149.862	0.000*
Model	149.862	0.000*

*P<0.05

Table 8. Variables in the equation

	Sig.	Exp(β)
1[a] Step 1[a]		
Te-waza	0.000*	12.481
Koshi-waza	0.998	1.367E9
Ashi-waza	0.000*	25.808
Sutemi-waza	0.001*	33.000
Constant	0.000	0.000

*P<0.05

Setting the logistic regression model. Assuming the judo players' technical movements, Te-waza, Koshi- waza, Ashi-waza, Sutemi-waza, Osae-komi-waza, score F_1, F_2, F_3, F_4, F_5, the probability of victories in competitions is P_1, the probability of defeats in competitions is 1-P_1, the logistic regression model is

$$\ln\frac{P_1}{1-P_1} = \alpha + \sum_{i=1}^{5}\beta_i F_i$$

The verification of the logistic regression model. After the logistic regression model is established, it is necessary to verify whether the technical movement has a significant impact. The test result shows that the chi-square value is 149.862, which is a significant difference (P<0.05). The regression coefficients are shown in Table 8.

Technical movements based on Osae-komi-waza, Te-waza, Ashi-waza, and Sutemi-waza have significant impacts on the victories or defeats of competitions. The regression coefficient (β) are 12.481, 25.808, and 33.000, which shows the winning rate of using Te-waza in the competition is 12.481 times higher than using Osae-komi-waza; the winning rate of using Ashi-waza in the competition is 25.808 times higher than Osae-komi-waza; the winning rate of using Sutemi-waza in the competition is 33.000 times higher than Osae-komi-waza. It is obvious that the players who use Sutemi-waza have higher chances of winning in the competition, and the next one is using Ashi-waza. Therefore, judo players' scoring technique has a positive impact on victories or defeats.

DISCUSSION

The purposes of this research are to explore the influence of judo players' technical movements

on victories or defeats to understand the current situations of judo players in different backgrounds and the differences in technical movements at different levels and positions. After data analysis, conclusions and suggestions are provided to coaches and related workers for future engagement reference for related research.

The current situation of judo players' background. The research objects are judo players who participated in the 2019 National Athletic Games in Taiwan. 104 male players (56.2%), 81 female players (43.8%), and 245 games in total, even weight ranks. In the distribution of weight divisions, heavyweight is the most, followed by middleweight and lightweight. In the distribution of scoring techniques, Ashi-waza is the most, followed by the Osae-komi-waza, Te-waza, Sutemi-waza, and Koshi-waza, which is the same research results with Brito et al. (16), Miller et al. (10) and Gardasevic and Stankovic (24); therefore, Taiwan judo players use Ashi-waza Te-waza more frequently than other skills, In the distribution of gripping positions, the front is the most, followed by nape and back.

The differences in scoring techniques in different weight divisions and gripping positions

The score techniques in different weight divisions show no significant difference, but score techniques in different gripping positions have significant differences. The technique of gripping positions affects the scores in the nape. Both Kajmovic and Radjo (23) and Kajmovic et al. (25) pointed out that different grips affect sports performance.

There is a significant difference between the gripping position and different weight divisions.

The gripping position that heavyweight judo players tend to grip is napes, but lightweight judo players tend to grip is fronts, which is the same research results with Ito et al. (26). Judo players should develop different angles of gripping to accommodate different players' techniques.

The impact of different gripping positions on victories or defeats

The gripping positions have significant impacts on the victories or defeats of the competitions which is the same research result as Miarka et al. (9). The gripping position in the nape has a higher chance of winning, and the second is to grab the front position.

The impact of scoring techniques on victories or defeats. The scoring techniques have a significant difference in the victories or defeats of the competitions. Judo players have a higher chance of winning when they use Sutemi-waza, and the next is Ashi-waza which is different from the research results from Stankovic et al. (27) that may be different from the technology level of international elite players. Sutemi-waza was used less by Taiwanese judo players; therefore, the successful score rate may be higher.

CONCLUSION

At present, there is still no research on analyzing the technical and tactical analysis of judo players by applying artificial intelligence machine learning. Therefore, it is necessary to more carefully collect literature to support the research feasibility, including selecting the input parameters, setting the network parameter values, etc. It is also recommended to establish a mini-application (app) of judo tactics to provide real-time analysis during training and competitions to coaches and judo players.

APPLICABLE REMARKS

- The scoring techniques in judo training is mostly used Ashi-waza; therefore, it is recommended that coaches and judo players have more movements of Ashi-waza as a part of the warm-up during the training, such as De-Ashi-Harai, Okuri-Ashi-Harai, and Sasae-Tsurikomi-Ashi.
- Osae-komi-waza is the second most that judo players got points from the games and it takes up a certain proportion of the whole game. It is recommended that coaches and judo players can strengthen the training, such as suppressing one judo player with two to three players to improve the training intensity. Coaches and judo players can try from different angles in Shime waza and Kansetsu waza to increase the training weight.
- Sutemi-waza which has a higher score or wins the games was used less by Taiwanese judo players. To face the diversity of international judo players' techniques, it is suggested that coaches and judo players should increase the proportion of Sutemi-waza training in their usual training and competitions.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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