




Judo mixed team event match outcome and the Judo World Ranking List

Gustavo Goulart Braga MAÇANEIRO*^{1(A,B,C,D,E,F)} , Andrés PARDO-GINÉS^{2(D,E,F)} , & Emerson FRANCHINI^{1(A,B,E,F)} 

¹ Martial Arts and Combat Sports Research Group, Sport Department, School of Physical Education and Sport, University of São Paulo (Brazil)

² Open University of Catalonia, Barcelona (Spain)

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Abstract

The Judo World Ranking List has been used to assess its predictive power regarding athletic performance. The aim of this study was to check if the ranking difference among athletes in the individual rankings could be used as a predictor for the outcome of mixed teams judo competition. We sought to verify the association between the variable “rank difference” and the probability of the higher-ranked athlete winning against that lower-ranked. This heterogeneity between athletes is a major factor in increasing or decreasing the team’s chances of winning. The higher ranked athlete’s defeat seems to have a significant negative effect on his/her teammates in subsequent bouts. These findings imply that future studies on mixed teams judo competitions should consider individual ranking differences among athletes as a predictor of performance.

Keywords: Martial arts; combat sports; judo; judo ranking; judo team competition; performance analysis.

El resultado de la competición de judo por equipos mixtos y el Ranking Mundial de Judo

Resumen

El Ranking Mundial de Judo se ha utilizado para evaluar su poder predictivo respecto al rendimiento deportivo. El objetivo de este estudio fue verificar si las diferencias de clasificación de los atletas en dicho ranking podrían usarse como predictores del resultado en las competiciones de judo por equipos mixtos. Se buscó verificar la asociación entre la variable “diferencia en el ranking” y la probabilidad de que el atleta mejor clasificado gane al aquel clasificado en posiciones inferiores. Esta heterogeneidad entre los atletas es un factor importante para aumentar o disminuir las posibilidades de triunfo del equipo. La derrota del atleta mejor clasificado parece tener un significativo efecto negativo en sus compañeros de equipo en los siguientes enfrentamientos. Estos hallazgos implican que estudios futuros sobre competiciones de judo por equipos mixtos deberían considerar las diferencias de clasificación en los rankings individuales como un predictor del rendimiento.

Palabras clave: Artes marciales; deportes de combate; judo; ranking de judo; competición de judo por equipos; análisis del rendimiento.

Resultado da disputa de judô em evento por equipes mistas e o Ranking Mundial de Judô

Resumo

O Ranking Mundial de Judô tem sido utilizado para avaliar o poder preditivo de desempenho esportivo. O objetivo deste estudo foi utilizar a diferença de ranqueamento entre os atletas nos rankings individuais como preditor do resultado de competições de judô por equipes mistas. Buscamos verificar a associação entre a variável “diferença de ranking” e a probabilidade de o atleta com classificação mais alta vencer aquele com classificação mais baixa. Essa heterogeneidade entre atletas é um fator importante para aumentar ou diminuir as chances de vitória da equipe. A derrota do atleta favorito parece ter um efeito negativo significativo sobre seus companheiros de equipe nas disputas subsequentes. Estas descobertas implicam que estudo futuros, em competições de judô por equipes mistas, devem considerar as diferenças do ranqueamento individual entre os atletas como um preditor de desempenho.

Palavras-chave: Artes marciais; esportes de combate; judô ranqueamento do judô; competição de judô por equipes; análise de desempenho.

1. Introduction

On June 11, 2017, International Judo Federation (IJF) President Mr. Marius L. Vizer announced that the Judo Mixed Team Event was selected to be part of the Olympic Games, starting with Tokyo 2020, then delayed due to COVID-19 pandemics. He stated that “The event of mixed

* Corresponding author: Gustavo Goulart Braga Maçaneiro (gugagbm@gmail.com)

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teams at the Olympic Games is a dream come true for the judo family, and the fact that it will start in Tokyo, the homeland of our sport, makes it all the more special.” (International Judo Federation, 2017). This type of competition began to be held in a world-level event at the 2017 Budapest World Judo Championship and took place again in 2018 in Baku (International Judo Federation, 2019).

Team competition events have existed in the history of judo since its foundation. Disputes between Jujutsu schools and the Kodokan were held more than once after Jigoro Kano founded judo. An example of such an important event was the Kodokan dispute against representatives of the Totsuka Jujutsu school, organized by the Japanese police. In this challenge, ten representatives from the Kodokan faced ten representatives from the mentioned school (Stevens, 2013; Watson, 2014). This challenge occurred between 1885 and 1887 (Stevens, 2013; Watson, 2014) and, while Stevens (2013) points out that there is no consensus on the exact result, Jigoro Kano states that except for two or three draws, Kodokan representatives won all matches (Watson, 2014). Regarding world competitions held by the IJF, the first event for men’s teams took place in 1994, while the first women’s event took place in 1997 (International Judo Federation, 2019).

At the Tokyo Olympic Games, the competition for mixed teams is planned to take place as follows: on an extra day of competition, after the seven days of individual matches, teams formed by six athletes (three males and three females) will face each other in six different weight categories. Regarding the above-mentioned weight categories, the teams will be formed by athletes of the following categories: -73kg, -90kg, + 90kg for males and -57kg, -70kg, + 70kg for females. The athletes who will participate in the team dispute will come from the individual competitions held in the previous days, and the format will be of repechage for the quarterfinal losers. A minimum of 12 teams will participate, each consisting of athletes qualified for the individual competition, and considering their points in the Judo World Ranking List. The team winning four bouts will be the winner of the round. The method to decide the weight category bout order was not specified in the announcement (International Judo Federation, 2017).

The IJF Senior Mixed Teams World Ranking List is dynamically updated on the IJF website and gathers the team scores considering the participation in the continental and world competitions that occurred in the two previous years (International Judo Federation, 2019). Still, the difficulty in understanding the advantage of one team over the other, in this competition format, stems from the fact that the IJF has only recently begun collecting these data. Also, the number of athletes per team, the number of bouts to win, and other factors have been modified between one competition and another. As an example of those changes, in the 2017 World Championship, the highest number of victories in six bouts decided the winning team, but in the 2018 World Championship the team first winning four bouts came out as the winner of the round (International Judo Federation, 2019). Finally, the possibility that teams may have different athletes from one competition to another would probably lead to incongruity between the team ranking position and its performance capacity. If this occurs, that is, if a team has a significant number of athletes substituted (even though the position in the team ranking remains the same), then we could say a ‘new’ team would be competing in the tournament.

The Judo World Ranking List was first published by the IJF in 2009 and has been used in studies to assess its predictive power regarding the athletes’ performance (Breviglieri et al., 2018; Courel-Ibáñez et al., 2018; Julio et al., 2013; Franchini et al., 2017; Franchini & Julio, 2015; Guilherme & Franchini, 2017; Krumer, 2017). However, no information is yet available on how the ranking position relates to the combat outcome for the case of mixed teams’ competitions. Such a study may have implications for the method with which the team ranking is evaluated, as well as for the performance prediction of these teams through the individual ranking of the athletes. Given that judo competitors depend on their ranking positions to qualify for the most important competitions such as the Olympic Games (International Judo Federation, 2019), it is necessary to explore the consequences of using this performance rating format in relationship with their competitive results.

In terms of relevant variables influencing sport performance, Gómez et al. (2013) consider the following “situational variables”: type of competition, game period, game location, game status and the quality of the opponent. Studies focused on judo competitions have also used as variables weight categories (Krumer, 2017), place of competition and the advantage of competing at home



(Julio et al., 2013; Krumer, 2017), and performance by ranking (Breviglieri et al., 2018; Courel-Ibáñez et al., 2018; Franchini et al. 2017; Franchini & Julio, 2015; Guilherme & Franchini, 2017; Krumer, 2017).

Within the variables mentioned above, the type of competition, i.e. the format of the dispute may, according to studies, influence the athletes' performance (Jordet & Elferink-Gemse, 2012; Gómez et al., 2013). As pointed out by Hernández and Torres (2009), it is necessary to consider the type of competition when training an athlete. The work of these authors highlights the importance of understanding the differences in structure in individual and team competitions for judo athletes.

Although the IJF has created a specific ranking for mixed teams, the ranking of a team does not change even if all its athletes are replaced by others for the next competition. As that is a real possibility, the hypothesis of this study was that the individual ranking of the athletes taking part in the teams can assess the likelihood of victory of those teams in competition. Following that idea, the conjecture is that a team with a better-ranked set of athletes, concerning their individual ranking position, is stronger than a team with a worst-ranked set of athletes.

The team event in judo has its outcome as a result of individual disputes. While emotional responses, such as anxiety, provoked by waiting phases and other variables, can modify the chance of victory in combat, and even though there is the influence of these variables in team events, the expected results for this research was that the highest-ranked athlete still had a higher probability of winning a lower-ranked athlete as shown in studies dealing with individual disputes.

2. Materials

To develop this research, it was verified the association between the position in the Judo World Ranking List of the athletes that make up the teams, the result of the combats in mixed team events, as well as influences throughout the different stages of the competition. Data from the following mixed team format competitions were retrieved: Judo World Championship Mixed Teams 2017, Judo World Championship Mixed Teams 2018, Judo World Championship Mixed Teams 2019, European Championship Mixed Teams 2018, Asian Games Mixed Team 2018, and Asian-Pacific Judo Championships 2019, all available on the IJF website. It is worth noting that the weight category order for the bouts, in the competition rounds, varied between competitions and, in some cases, it also changed during the same competition.

The information described above was obtained from the IJF website (www.ijf.org). This content is freely accessible and, since it was not obtained through experimentation, but secondarily, there are no ethical questions regarding its analysis (Morley & Thomas, 2005). To preserve the anonymity of the athletes throughout the process, names were not used in the data analysis. Instead, participants were represented by numerical variables.

3. Methods

The analysis was performed based on data from the six competitions cited above, using bouts results and the ranking of athletes according to the Judo World Ranking List (closest and previous to each competition). The dates were established as follows: for the 2017 World Championship, held on 09/03/17, the ranking used was from 08/14/17; for the 2018 World Championship, held on 09/27/18, the ranking from 09/17/18; for the 2019 World Championship, held on 01/09/19, the ranking from 19/08/2019; for the 2018 European Championship, held on 07/18/18, the ranking from 07/16/18; for the 2018 Asian Games, held on 09/01/18, the ranking from 08/20/18; and for Asia Pacific 2019, held on 04/23/19, the ranking from 04/08/19.

For each bout, the athletes' information available in the rankings cited above was used. These rankings consider the score for each athlete in competitions in the two years before the publication date. In some cases, the ranking information of the athlete was not provided by the IJF website and thus some bouts could not be used in the analysis due to lack of information.

From a total sample of 603 bouts, those in which there were not enough data were discarded. Specifically, (1) those in which there was no ranking information for one or both athletes; (2) bouts in which there was no actual match (W.O.); and, (3) those in which the ranking of



the two athletes was the same, as the ranking difference does not exist (athletes of different weight division in the individual tournament could be in the same division in the team event). Finally, up to 539 bouts (89% of the total) were included in the analysis.

Regarding the sample characteristics by weight category, the category with the largest sample was -73kg with 101 bouts (18.73% of the total sample). In turn, the +90kg category had the smallest sample, with 73 bouts (13.54% of the total). The categories -90kg, -70kg and -57kg had over 90 bouts, being distributed with 99 (18.36%), 97 (18%) and 94 (17.43%) bouts, respectively. Finally, the +70kg category reached 75 bouts (13.9% of the total).

The competition with the greatest number of bouts was the 2017 World Championship with 128 bouts, followed by the 2018 European Championship with 123 bout and the 2018 and 2019 World Championships with 99 and 97 bouts, respectively. The competitions with the lowest number of bouts were the 2019 Asia Pacific Cup with 43 bouts, and the 2018 Asian Games with 49 bouts.

Regarding the competition stages, the number of bouts analyzed in male and female first and second rounds was similar, with 53 and 56, respectively, for each sex. A total of 110 bouts were analyzed for the quarterfinals. Semi-Finals and repechages had the same number of bouts analyzed, with 61 bouts each. In the dispute for the bronze medal, the numbers of bouts were 31 bouts for males and 26 for females. Lastly, there were 16 bouts for each sex category in the finals, totaling 32 bouts.

In terms of wins for the favorite athlete, the results were 65.9% for males, 71% for females and 68% for the total of bouts. Regarding the variables of the results by team wins, it can be observed the distribution of 61.9% for male bouts, 65.4% for females bouts and 63% for the total.

For each bout, the performance was defined by victory or defeat using as reference the best-ranked athlete between the two, which was defined as the favorite of the dispute. A victory of the best-ranked athlete means, therefore, a defeat of the worst-ranked athlete (the underdog) and vice versa. For the statistical analysis, the dependent variable (bout result) received the value 1 when the favorite athlete won, and 0 otherwise. This variable is therefore categorical and binary. Additionally, the logistic regression model was used to verify the covariation between variables.

Following the line of Krumer's (2017) and Koning's (2011) works, covariants that were common to both athletes (date, time, place, etc.) should not be used for the analysis of major events. However, it is possible to use differences such as ranking position as a variable for the analysis, as stated by these authors.

The observation unit was each bout. The analysis was then developed using logistic regression as proposed by Krumer (2017). Using the binary category dependent variable, where the victory of the favorite athlete in the ranking was described by number 1, and the defeat by number 0, with the favorite being the athlete with the higher position in the World Ranking List, and the underdog being his/her opponent. Based on Krumer's (2017) study, the level of heterogeneity (difference in ranking) between athletes in each bout was calculated as the difference between the ranking positions. This difference between ranking positions was used as an individual-specific variable, where $Rank_F$ is the Favorite's Ranking and $Rank_U$ is the Underdog's Ranking. From these considerations, $RankDif_{FU}$ was then calculated using the equation: $RankDif_{FU} = \log^2(Rank_U) - \log^2(Rank_F)$.

The result of the analysis showed the association between heterogeneity and probability of victory, using the model-based used by Krumer (2017) based on Koning (2011) for the probability of the favorite winning the bout through the formula:

$$Pr(\text{FavoriteWins}) = \frac{1}{1 + e^{-\beta * RankDif_{FU}}}$$

Through this model, we sought to explore the association between the $RankDif_{FU}$ variable and the probability of the better-ranked athlete to win against the underdog. Data were collected also considering the following variables: sex, weight category, and team performance. The



categorical team performance variable was based on the performance of the favorite's athlete team according to the individual performance analysis, being assigned the number 1 when the favorite's athlete team won and 0 when the favorite's athlete team lost (for each round). With this last variable, it was possible to observe the association between individual performance and collective performance, i.e., if, when the favorite athlete won his/her team also won, meaning that there was a correlation between the two results. Since competition for mixed teams involves different weight categories for males and females, it is reasonable to test whether the odds of winning vary between these categories. For this, the logistic regression was performed using the individual result as the dependent variable and heterogeneity in ranking as a predictor. The logistic regression analysis was developed in the programming language R (version 3.5.1.) through the IDE RStudio (version 1.1.456). The library readxl was used to read the spreadsheet data.

Regarding team performance, Chi-Square tests were used to identify the dependence between individual and team outcome variables with an association higher than expected by chance. For this, a table of expected values was developed using the expected distribution considering the total values of the real distribution of the sample. That is, the total number of victories of the favorite and the victories of his/her team (VV); the favorite won but his/her team lost (VD); the favorite lost but his/her team won (DV); The favorite was defeated, and his/her team was also defeated (DD).

To elaborate on the expected value table, the percentage of the team's victory and defeat values in relation to the total were used, which represent the values of 64% and 36% of the total. This was done by using the distribution of the outcome of the team (victory or defeat) multiplied by the numbers of defeat or individual victory. For example, the expected value of VV is the percentage of wins per team of the total, at 64%, multiplied by the number of individual wins of 36%, and so on. Expected value is a form of weighted average, summing up the ideas of future expectations, and the weight of probabilities, that is, how we expect data to behave under some assumption. In this case, we used the total number of victories and defeats of the team and athletes to formulate an expected distribution of the data. From this data crossing, the expected results of VV, VD, DV, and DD were obtained. For the Chi-Square test, the expected value and real value tables were then developed, and the Excel software was used to return the p-value.

4. Results

Table 1 shows the average results of the overall RankDif_{FU}, by sex and by weight category. A lower average level of heterogeneity indicates categories where the median difference between individual rankings is smaller, thus the favorite's ranking is closer to the underdog's ranking. The lowest average of the RankDif_{FU} variable result for male's weight categories is -73kg. It is also the category with the largest amount of data available, 101 records. In the case of the female categories, the lowest average is that of the -57kg weight category, followed by the -70kg weight category. Both categories had more data available for the study than the 70kg category.

Table 1. Average heterogeneity level between favorites and underdogs.

	Male & Female	Male	Female
Global	1.6859	1.6781	1.70368
-90kg		1.7419	
-73kg		1.55800	
+90kg		1.71049	
-70kg			1.6630
-57kg			1.65468
+70kg			2.0000

An increase in the RankDif_{FU} variable made it more likely that the highest-ranked athlete would win and is statistically significant at the significance level of $p < 0.001$ for males at $1.15e-07$ and females at $9.73e-10$. Logistic regression outputs (estimator, standard error, deviance) can be seen in Table 2. A smaller estimator indicates a smaller influence from the heterogeneity level in the favorite's individual victory chances. According to the estimation results in Table 2, for example,

the overall probability of an athlete ranked in the eighth position winning against a ranked athlete in the twenty-second position is 62.8%.

$$0.628 = \frac{1}{1 + e^{-0.359 * (\text{Log}_2^{(22)} - \text{Log}_2^{(8)})}}$$

Table 2. Logistic regression outputs for individual bouts by rank difference function.

	Global Results	Male Results	Female Results
Estimator	0.3594***	0.3209***	0.4012***
Standard error	(0.0444)	(0.0605)	(0.0656)
Log Likelihood	-333.4371	-172.7934	-160.2365
Deviance	666.8742	345.5868	320.4731
Numb. observations	539	273	266

Note: ***p < 0.001, **p < 0.01, *p < 0.05

Table 3 presents the estimators obtained through logistic regression in the different weight and sex categories studied. These values are used in the previously established logit model to verify the probability of the favorite winning, considering the difference between the ranking of athletes in each bout.

Table 3. Logistic regression results (estimators).

	-90kg	-73kg	+90kg	+70kg	+57kg	-70
Male	0.24704 **	0.3871***	0.3495**			
Female				0.4848 ***	0.3595***	0.3738***

Note: ***p < 0.001; **p < 0.01

Table 4 represents the distribution of matches when verifying individual and team performance results from the favorite's point of view.

Table 4. Relationship between victory of the favorite and victory of the team of the favorite.

	WC2018	WC2017	EC2018	AP2019	AG2018	WC2019
VV	52 (52.52%)	71 (55.46%)	62 (50.40%)	23 (53.49%)	28 (57.14%)	52 (53.61%)
VD	15 (15.15%)	16 (12.50%)	20 (16.26%)	6 (13.95%)	9 (18.37%)	15 (15.46%)
DV	8 (8.08%)	17 (13.28%)	11 (8.94%)	3 (6.98%)	1 (2.04%)	15 (15.46%)
DD	24 (24.24%)	24 (18.75%)	30 (24.39%)	11 (25.58%)	11 (22.45%)	15 (15.46%)
Total	99	128	123	43	49	97

Note: VV = Victory of the favorite and victory of the team; VD = Victory of the favorite and defeat of the team; DV = Defeat of the favorite and victory of the team; DD = Defeat of the favorite and defeat of the team.

Tables 5 and 6 represent the values used for the Chi-Square test. There was a significant association between variables on p < 0.01 (9.45234E-25). Thus, the variables are associated above the level of chance.

Table 5. Chi-Square test expected values.

	Victory of the favorite	Defeat of the favorite	Total
Victory of the team	236.16	108.8	343
Defeat of the team	132.84	61.2	196
Total	369	170	539

Table 6. Actual values used in the Chi-Square test.

	Victory of the favorite	Defeat of the favorite	Total
Victory of the team	288	55	343
Defeat of the team	81	115	196
Total	369	170	539

The results of the logistic regressions, using the variable team result as the dependent value and RankDif_{FU} as independent (Table 7), showed for the female, male and global models the same

high levels of significance as for the previous models targeting individual result, but there was a reduction in the value of the estimators obtained. For example, the global estimator decreased from 0.35935 to 0.24976, expressing a reduction in the influence of the favorite's rank in the global results compared to their own following the expected results. In the same way, in males, the estimator went down from 0.32086 to 0.23815, and in females from 0.40121 to 0.26139.

Table 7. Logistic regression's output for team bouts by rank difference function (estimators).

	Global	+90	-90	-73	70	-70	-53
Global	0.24976 ***						
Male	0.23815 ***	0.1921ns	0.2237*	0.2940**			
Female	0.26139 ***				0.13968 #	0.3351 **	0.3346 **

Note: ***p < 0.001; **p < 0.01; *p < 0.05; #p < 0.1; "ns" indicates a result is not significant.

The decrease in estimator values shows a degradation in the influence of the ranking difference between a favorite and an underdog on overall results compared to individual results, but the influence is still significant and positive for the main models (global, male, female) and for four of the individual categories. It is important to note that the outputs of the 70kg category and +90 kg category were not significant enough to be taken into consideration for this analysis, the overall results in Table 7 show a similar pattern to that followed by the main models. To sum up, a favorite with a greater ranking difference over the underdog athlete in a bout positively influences the victory in this individual bout and the team's victory as well, but the latter to a lesser degree.

To analyze the covariance between categorical variables of individual outcome and team performance, a logistic regression model was constructed in which the favorite team performance variable was used as the dependent variable, and the individual performance variable as an independent predictor variable (Table 8).

Table 8. Logistic Regression output for team results by the individual result.

	Global	Male	Female
Favorite's victory estimator	1.2685***	1.2852***	1.2528***
Favorite's defeat estimator	-0.7376***	-0.8422***	-0.6162**
Probability of team victory when the favorite wins	0.7804	0.7833	0.7777
Probability of team defeat when the favorite loses	0.3235	0.3010	0.35064

Note: ***p < 0.001; **p < 0.01

According to the estimation results of the model, shown in Table 8, a victory of the favorite for males or females puts the team winning chances at around 78% and a defeat at just 32.35% on average. That is, we can observe that there is a covariance between the individual outcome variables as a predictor and the team outcome as the dependent variable.

To obtain the results showcased in Figure 1, a logistic regression model as the one shown in Table 8 was built per bout. The favorite team performance variable was used as the dependent variable and the individual performance variable was used as an independent predictor. The following estimators and p-values were found for each bout: first bout = 1.3669 (p < 0.001); second bout = 1.3863 (p < 0.001); third bout = 1.086 (p < 0.001); fourth bout = 1.2164 (p < 0.001); fifth bout = 0.7621 (p < 0.05); sixth bout = 1.9741 (p < 0.001). Figure 1 represents the variation of the team winning probability in each bout of the team dispute considering the result of a win by the favorite fighter. For the first bout, the favorite's victory means that his/her team's probability of winning reaches 79.6% and 80% for the second one. A positive result for the favorite athlete in the first and second bouts significantly increases the chances of winning for his/her team, whereas that influence drops on the third, fourth and fifth bouts. As individual bouts follow one another the probability of overcoming an individual loss decreases through the dispute. In reaching the fifth bout, the individual performance has a lower probability of deciding the outcome of the team dispute (68.1%). On the contrary, the favorite athlete's win in the sixth bout might make the biggest difference between his/her team's or defeat (87.8%), in the case that the team dispute does not end in the sixth bout.

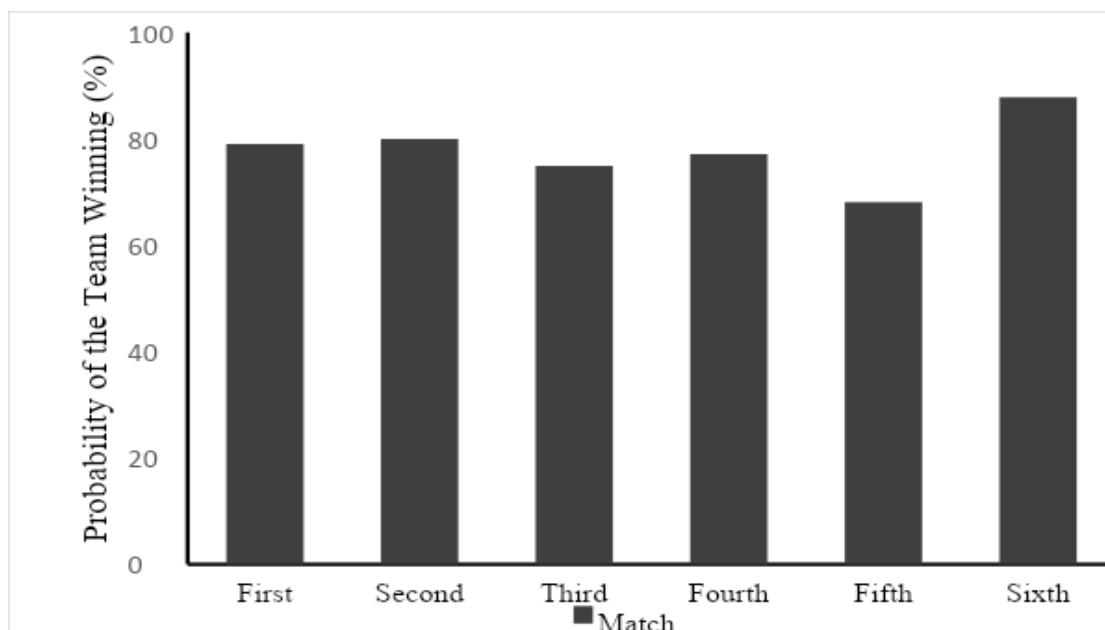


Figure 1. Team winning probability when the favorite wins by bout.

5. Discussion

In this research, the results of 273 bouts between male athletes and 266 bouts between female athletes in six different mixed teams judo competitions between 2017 and 2019 were studied. Using each bout as a sample unit, it was observed that in the team competition model, as well as in the individual competitions, the favorite athlete's greater probability of victory remains and that the heterogeneity between athletes in this format has significant predictive power in the outcome of the bouts.

Using the results shown in Table 3, and following the example in Krumer (2017), the probability for a judo athlete ranked 8 to win against a judo athlete ranked 22 was 62% in the +90kg category, 58.9% in the -90kg, 63% in the -73kg, 66.9% in the +70kg, 63% in the -70kg and, lastly, 62% to -57kg. These predictions were not validated in an independent set of data. As the heterogeneity level has bigger importance in the +70kg bout, it might be important for teams to pay attention to the athlete's ranking in this category when looking for increased chances of victory. While the competitiveness of the category may influence the results (number of athletes, variability in rankings of the same athlete in different competitions, etc.), this study is out of the scope of this article.

When comparing the results on male and female probabilities of winning on the study of Krumer (2017) with the individual competition, the favorites have fewer winning chances in the mixed team events format. In Krumer's study, the example where the underdog is ranked 22 and the favorite is ranked 8, the favorite male athletes had a 67.7% of chance of winning, whereas female athletes had a 68.5% of chance of winning. In our study, the results were 61.4% for favorite male athletes and 64.2% for female athletes. A possible explanation for this is that the difference in format could provoke higher psychological stress, which may affect higher-ranked athlete's performance. In other words, watching the bout results of their teammates, and considering the effects of his/her performance for the collective outcome, could add an extra emotional response that is not present when the athletes are competing individually. Judo is a sport with high psychological demands, being anxiety an important factor of study (Morales, et al., 2012). Just as different anxiety levels are observed in judo competitions of different importance (official and non-official) and between national and international-level athletes (Morales, et al., 2012), the difference in format from individual to team competition could induce similar effects. While this study did not investigate psychological parameters, further investigation may help better understand the effects of anxiety levels on the judo mixed teams event. The difference in results shows that male athletes suffer a higher decrease in their winning chances, with a 6.3% less probability of winning in team events bouts for the case and ranks used above.

The Chi-Square test of independence showed that the variables were associated above the level of chance. That is, in a dispute between teams of similar strengths, it was the performance of the favorite athlete that determined the difference in the outcome. This is evident in Table 4, where the correlation between the favorite win and the team win (VV) is presented. These two results combined in the proportion of 53.43% of all bouts observed. Favorite defeats coincided with team defeats (DD) in 21.33% of the cases. We can observe through this distribution that the individual result of the favorite seemed to have a positive or negative effect on the team result in 74.76% of the studied cases. In the 2019 World Championship, the negative effect did not seem decisive as the proportion of the result (15.46%) was the same as when there was no correlation between the win or loss of the favorite and the team's result. Still, in this competition, the correlation between favorite victory and team victory (VV) was greater than fifty per cent.

In the logistic regression model where the dependent value was the variable by team outcome and the independent value was the individual outcome, for both male and female, a favorite winning his/her bout positively influenced the outcome of the team in the two cases already mentioned. When the favorite won his/her bout, his/her team had a higher probability of winning the round, between 77 and 78%. In case of defeat, this percentage dropped to 30% for males and 35% for females, indicating a larger negative impact for males of 5%.

As observed in Figure 1, having a favorite athlete win the first or second bout significantly increased the chances for his/her team winning the round. That influence dropped in the following bouts as the probability of overcoming an individual defeat decreased through the team dispute. As teams balance the ranking of athletes in individual disputes, the influence of having the favorite athlete on later bouts for the team's outcome increases in the sixth bout. As favorite athletes have a higher chance of winning and a bigger influence on the team victory for the first bouts of a dispute, that may shorten the round thus favoring the recovery between disputes during the pause for the next round, or even preserve athletes that did not have to compete.

A defeat by the favorite in the first bout reflects a negative difference of 42.5% in the team's chance of winning early in the round. While the data cannot confirm the reasons behind this, the poor performance of a team's favorite athlete, that is, one of his/her best athletes, appears to have an important negative effect on his/her teammates in subsequent bouts. Conversely, in the sixth bout, which is a decisive bout to conclude a balanced round, as having a favorite winning increase the winning chance to 87.8%, it might show that favorites have a lower anxiety level in decisive moments when compared to underdogs. As shown by the study of Jordet and Elferink-Gemser (2012) with soccer's penalty shootout, a series of stressors occur during this type of dispute, anxiety being the most common emotion reported by the athletes. As the study of these authors showed, confidence was expressed by athletes as dependent on teammate's performance or the series of outcomes. This might explain the results as the judo mixed team events competition have a similar format to the soccer penalties shootout.

When considering competitions for mixed teams, it is interesting to note that, for a team, understanding the position of their athletes in the world rankings is an efficient way to predict the odds of a positive outcome in this competition format. Since there is a significant influence between the favorite athlete's individual victory on the team result, this study shows that the performance of the favorite athletes tends to increase the probability of victory of their teams, this value is 79% when the favorite wins the first combat of the team dispute. Conversely, a defeat from the favorite athlete significantly impairs his/her team's chances of winning, a loss of the favorite in the first bout reduces the team's chances of winning to 37%.

6. Conclusion

The influence of favorite athletes' individual victories on their teams' results is stronger in the first two bouts, reaching the lowest point on the fifth bout. Higher rank difference among athletes appears to have a great influence on the contest outcome.

Athletes in each team can be freely changed between competitions, while the Team Rank remains unchanged. In this study we showcased the relationship between individual athletes' rankings and global team victories. A team that improves the position of its athletes in the world rankings, between team competitions, should increase their chances of victory.



Since the favorite's victory in the first two bouts has a greater impact on the outcome than subsequent bouts, the favorite's performance in these bouts seems to have positive or negative effects on his/her teammates. Also, compared with the results in the study by Krumer (2017), the heterogeneity level in mixed events is smaller for both male and female athletes. It is important to better understand if psychological factors, such as anxiety, could be influencing individual performance in the team competition format.

These findings imply that future studies on mixed team events should consider the differences among athletes in individual rankings as a predictor of performance. The prediction model presented in this paper, could be used in future works, to develop a model capable of predicting the outcome of the judo mixed team round, using the ranking of athletes in individual disputes through conditional probabilities.

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Author's biographical data

Gustavo Maçaneiro (Brazil) has a bachelor's degree in Physical Education by Universidade Federal de Santa Catarina, Florianópolis, Brazil. He is a member of the Martial Arts and Combat Sports Research Group, Sport Department, School of Physical Education and Sport, of the University of São Paulo, Brazil. He achieved the rank of black belt in judo by the Kodokan Judo institute in Tokyo, Japan. E-mail: gugagbm@gmail.com

Andres Pardo Gines (Spain) has a bachelor's degree in Computer Systems Engineering by the University of Barcelona. Master of Science in Data Science by the Open University of Catalonia, Faculty of Computer Science, Multimedia and Telecommunications, Barcelona, Spain. He is currently working in a R&D center focused on Deep Learning. E-mail: apardogi@uoc.edu

Dr. **Emerson Franchini** (Brazil) is an associate professor at the Sport Department, School of Physical Education and Sport, University of São Paulo, where he is the coordinator of the Martial Arts and Combat Sports Research Group. He investigates martial arts and combat sports, especially judo, in different scientific fields. He has published papers in several sport sciences journals, as well as served as editorial member and reviewer in martial arts and combat sports and sport sciences journals. E-mail: efranchini@usp.br

