

1 **Differences in competition statistics between winners and losers in male and female tennis players**
2 **in Olympic Games**

3
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22
23 **Abstract**

24
25 The aim of this study was to examine differences in the performance indicators between winners and
26 losers in male and female high-level tennis players. One hundred twenty-eight tennis singles matches
27 played on grass court surface of London 2012 Olympic Games were analyzed. Data were collected from
28 the official website of the Olympics and the following groups of variables were analyzed: serve variables
29 (n=7), serve return variables (n=3) and game related variables (n=5). The results showed that winners had
30 greater (p<0.05) values of second serve (%), aces, first and second serve points won (%), points won on
31 first and second serve return (%), break points played and break points won (%). Furthermore, they get
32 more, winners with both groundstrokes and net points won (%) than losers in both sexes. Furthermore,
33 losers committed more doubles faults than winners, and in male category more unforced errors, whereas
34 female winners get higher serve maximum speed (p<0.05). Performance indicators according to the result
35 of the match predicted that break points won, first serve points won (%) and first serve return points won
36 (%) are the most relevant variables in males (SC = .434; SC = .340; SC = .327), whereas it was the break
37 points won (SC = -.372) in females. Therefore, coaches should consider the variation of the competition
38 statistics by gender if they want enhance the chances of success of their players.
39

40 **Keywords:** notational analysis, match analysis, racquet sports, performance indicators.
41

Comentado [U1]: What are the most determinant variables to achieve victory in male and female tennis matches in Olympic Games?

1 INTRODUCTION

2
3 Tennis is an open-skill sport in which players constantly make tactical decisions related to specific
4 game situations (Filipic, Zecic, Reid, Crespo, Panjan, & Nejc, 2015). Players plan strategies to maximize
5 their chances of winning a match based on knowledge of their own strengths and weaknesses as well as
6 those of their opponent and taking contextual and environmental factors (climate, surface, tournament
7 round, opponent level...) into consideration (Cui, Gómez, Gonçalves, Liu, & Sampaio, 2017; Varas Caro
8 & Gómez Ruano, 2016). Thus, the ATP (Association of Tennis Professional) updates weekly information
9 about players and competition statistics (Reid, McMurtrie, & Crespo, 2010).

10
11 The examination of match statistics or performance indicators in professional tennis is attracting
12 increasing research attention (Cui, Gómez, Gonçalves, & Sampaio, 2018; Fitzpatrick, Stone, Choppin, &
13 Kelley, 2019; Klaus, Bradshaw, Young, O'Brien, & Zois, 2017; Martin, Bideau, Touzard, & Kulpa,
14 2019). These studies provide information about the way the game is played on different surfaces (Cui et
15 al., 2018), or allow us understanding the differences between players of different levels (Hizan, Whipp, &
16 Reid, 2011; Klaus et al., 2017; Söğüt, 2017) or genders (R Cross, 2014; Hizan, Whipp, & Reid, 2015;
17 Stare, Zibrat, & Filipic, 2015). Investigating the statistical analysis of game characteristics, we can
18 identify the reasons for winning or losing a game (Filipčić, Filipčić, & Berendijaš, 2008; Fitzpatrick et al.,
19 2019). In this sense, the performance indicators in Grand Slam have been fundamentally researched
20 (Martin et al., 2019; Reid, Morgan, & Whiteside, 2016). These studies observed that one of the main
21 differences is related with the service performance.

22
23 However, although there are studies that analyze competition statistics, almost have it done with
24 Grand Slam matches that are played at best of five sets and as has been shown in previous studies,
25 competition statistics change throughout the sets, so it could be possible that there are differences in
26 performances indicators between matches to the best of five sets with regard to the best of three (Martin
27 et al., 2019). In addition, there are no references – to the best of our knowledge – which focus on
28 statistical differences between winners and losers in both genders and only one did it on grass surface but
29 only in male players.

30
31 These type of analyses are interesting for two main reasons, on the one hand, the Olympic Games
32 is the most important world competition and the best of three sets is played. On the other, male and
33 female professional tennis have technical-tactical differences (Rod Cross, 2014; Filipčić et al., 2008;
34 Hizan et al., 2011; Reid et al., 2016) due in part to the physical players profiles of both genders
35 (Munivrana, Filipčić, & Filipčić, 2015; Myburgh, Cumming, Coelho E Silva, Cooke, & Malina, 2016).
36 Therefore, the competition analysis provides valuable information which allows defining the technical-
37 tactical demands of the game for the players (O'Donoghue & Ingram, 2001). In this way, the main
38 purpose of the present study is to identify the performance indicators in relation to gender during the full
39 matches of London 2012 Olympic Games played in grass surface.

40 METHOD

41 *Sample*

42
43 Data of 176 players performing of 128 London Olympic Games matches were collected, 64 from
44 male and 64 from female players. All of them were played in grass court surface and proceeded from the
45 first round until the final. The matches which had an early retirement, disqualification of some player or
46 without IBM system (IBM: Armonk, NY, U.S.A) in the court were excluded. This occurred in a total of
47 two times, both in female players.

48 *Procedure*

49
50 The data were collected from the official website of London Olympic Games
51 (<https://www.olympic.org/london-2012>) . All the matches were played at the best of three sets in
52 accordance with ITF (International Tennis Federation) rules (ITF, 2017). Intra-rater reliability was
53 calculated through observer registering the same values of play (two game) on two occasions separated
54 by a four-week period. Cohen's Kappa was used and 0.95 was obtained for observer. The value was
55 considered as very good (>0.80) (Landis & Koch, 1977).

1 The variables analyzed were divided into five groups: temporary variables, variables related with
 2 serve performance, variables related with the return-serve performance, variables related with net play
 3 performance and variables related with winners and unforced errors (Table 1).
 4
 5

Table 1. Dependent variables analyzed

Variable	Description
<i>Temporary variables</i>	
Match time	Total match time in minutes
<i>Variables related to serve</i>	
Aces	Number of direct serves
Doubles faults	Number of doubles faults
First serve in (%)	Number of first serve in ÷ Number of points play at first serve
Second serve in (%)	Number of second serve in ÷ Number of points play at second serve
First serve points won (%)	Number of points won with first serve ÷ Number of points play with first serve
Second serve points won (%)	Number of points won with second serve ÷ Number of points play with second serve
Serve Maximum Speed	The highest serve velocity
<i>Variables related to returns</i>	
Return of first serve points won (%)	Number of points won on first serve return ÷ Number of points play at first serve return
Return of second serve points won (%)	Number of points won on second serve return ÷ Number of points play at second serve return
Break points	Total break points
Breaks	Break points won
Break points won (%)	Break points won ÷ Break points played
<i>Variables related with net play performance</i>	
Net points won (%)	Number of points won at the net ÷ Number of points play at the net
<i>Variables related to winners and unforced errors</i>	
Winners	Total winners
Forehand winners	Total forehand winners
Backhand winners	Total backhand winners
Unforced errors	Total unforced errors

6
 7 The data were collected in a specifically designed spreadsheet (Microsoft Excel) and were the exported to
 8 the SPSS 22.0 statistical program for analysis. Data were analysed by set.
 9

10 11 12 **Statistical Analysis**

13
 14 IBM SPSS version 22.0 (IBM Corp., Armonk, NY, USA) statistical program for analysis was
 15 used. A descriptive analysis of the data (means and standard deviation) in male and female independently
 16 was conducted. A univariate (Mann Whitney U) test (non-parametric) was carried out analyzing the
 17 differences between winning and losing players, because the assumptions of normality and homogeneity
 18 of variances were not satisfied. To identify those statistical variables that best differentiate the two groups
 19 (winning and losing players), a discriminant analysis (Ntoumanis, 2001) was conducted. For the
 20 interpretation of the linear vectors, a Structural Coefficient (SC) >0.30 was considered relevant.
 21 Significance was set at p<0.05.

22 **RESULTS**

23
 24 The differences between winning and losing male and female gender are shown in table 2.

Table 2. Differences between winning and losing male and female players

	Male (n = 64)				Female (n = 62)			
	Winning players	Losing players	P value	Z value	Winning players	Losing players	P value	Z value
<i>Temporary variables</i>								
Match time (min)	101.27 ± 43.44	101.71 ± 42.86	-	-	94.10 ± 30.75	94.10 ± 30.75	-	-
<i>Variables related to serve</i>								
Aces	9.00 ± 6.56	5.71 ± 4.20	0.001	-3.179	5.77 ± 4.71	2.77 ± 2.88	0.002	-3.088
Doubles faults	1.12 ± 1.36	2.12 ± 1.72	0.002	-3.142	2.74 ± 2.97	3.55 ± 2.14	0.025	-2.247
First serve in (%)	66.54 ± 7.19	63.23 ± 8.03	0.254	-1.142	67.88 ± 7.55	64.84 ± 7.70	0.077	-1.767
Second serve in (%)	95.59 ± 6.59	91.92 ± 6.68	0.002	-3.087	88.81 ± 9.04	85.09 ± 7.98	0.046	-1.998
First serve points won (%)	79.50 ± 6.68	67.53 ± 7.87	0.000	-6.643	73.11 ± 7.75	59.17 ± 11.97	0.000	-7.022
Second serve points won (%)	59.01 ± 7.22	48.14 ± 11.67	0.000	-5.255	53.20 ± 11.56	38.89 ± 10.78	0.000	-5.506
Serve Maximum Speed	208.39 ± 8.28	204.09 ± 10.54	0.078	-1.760	177.81 ± 11.32	171.26 ± 8.99	0.048	-1.981
<i>Variables related to returns</i>								
Return of first serve points won (%)	32.33 ± 7.95	20.73 ± 6.72	0.000	-6.651	40.83 ± 11.97	26.89 ± 7.75	0.000	-7.017
Return of second serve points won (%)	51.72 ± 11.82	41.33 ± 7.38	0.000	-5.267	61.11 ± 10.78	46.80 ± 11.56	0.000	-5.496
Break points	7.52 ± 3.32	3.62 ± 2.79	0.000	-5.962	8.16 ± 2.91	4.71 ± 3.30	0.000	-5.499
Breaks	3.09 ± 1.23	0.79 ± 0.95	0.000	-8.192	4.45 ± 1.41	1.71 ± 1.47	0.000	-7.381
Break points won (%)	48.19 ± 23.33	20.99 ± 27.98	0.000	-4.617	57.75 ± 19.12	32.23 ± 23.43	0.000	-4.965
<i>Variables related with net play performance</i>								
Net points won (%)	71.54 ± 10.41	63.96 ± 11.07	0.000	-4.278	67.25 ± 17.71	66.05 ± 17.87	0.007	-2.687
<i>Variables related to winners and unforced errors</i>								
Winners	28.79 ± 11.63	22.03 ± 12.78	0.000	-3.666	26.45 ± 9.64	16.77 ± 10.27	0.000	-4.362
Forehand winners	9.73 ± 4.71	7.35 ± 4.85	0.007	-2.714	10.71 ± 5.03	7.29 ± 5.39	0.008	-2.664
Backhand winners	4.12 ± 2.62	3.41 ± 2.32	0.043	-2.021	6.55 ± 2.77	3.84 ± 2.96	0.008	-3.969
Unforced errors	15.15 ± 7.64	18.94 ± 7.66	0.001	-3.377	17.55 ± 8.94	19.68 ± 9.66	0.065	-1.849

2 The results showed that in both genders, winners had higher values in aces ($p < 0.005$), points won
3 with first and second serve (%) ($p < 0.001$), percentage of second serve in ($p < 0.05$) and committed less
4 doubles faults ($p < 0.05$). On other hand, with the return, winner players won more points with their second
5 serve (%), have more break points, get more breaks and won more break points (%) ($p < 0.001$) and net
6 points (%) ($p < 0.05$). Furthermore, they get more overall winners ($p < 0.001$) than losing players and get
7 more winners with their forehand ($p < 0.001$) and backhand ($p < 0.05$) too. Furthermore, males have lower
8 value of unforced errors than losing players ($p < 0.005$) while female winners have a greater values of
9 maximum serve speed ($p < 0.05$).

10
11 Table 3 and 4 shown the discriminant analysis from both genders for winning and losing players.
12 The obtained function was significant for both genders ($p < 0.001$) and classify correctly the 98.5% of the
13 cases in male tennis and the 96.8% in female tennis.

14 Table 3. Standardised coefficients from the discriminant analysis of the game statistics between winning and losing male players

	Male
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	Winning-Losing
Break points won (%)	.434
First serve points won (%)	.340
Serve return of first serve points won (%)	.327
Break points	.264
Second serve points won (%)	.231
Serve return of second serve points won (%)	.219
Break points won (%)	.219
Net points won (%)	.146
Doubles faults	-.133
Aces	.124
Winners	.115
Second serve in (%)	.114
Forehand winners	.103
Unforced errors	-.103
Serve Maximum Speed	.094
First serve in (%)	.090
Backhand winners	.059
Match time (min)	-.002
Eigenvalue	5.995
Wilks' Lambda	.143
Canonical correlation	.926
Chi-square	101.149
Significance	<.001
Reclassification	98.5%

*SC: Structural Coefficient. discriminant value ≥ 0.30

As can be seen in the results, the most powerful discriminators between winning and losing in male were break points won (%) (SC=.434), first serve points won (%) (SC=.340) and serve return of first serve points won (%) (SC=.327).

Table 4. Standardised coefficients from the discriminant analysis of the game statistics between winning and losing female players

	Female Winning-Losing
Break points won (%)	-.372
First serve points won (%)	-.270
Serve return of first serve points won (%)	-.270
Second serve points won (%)	-.250
Serve return of second serve points won (%)	-.250
Break points won (%)	-.233
Break points	-.216
Winners	-.189
Backhand winners	-.185
Aces	-.150
Forehand winners	-.128
Serve Maximum Speed	-.125
Second serve in (%)	-.085
First serve in (%)	-.078
Doubles faults	.061
Unforced errors	.045
Net points won (%)	-.013
Match time (min)	<.001
Eigenvalue	6.792
Wilks' Lambda	.128
Canonical correlation	.934
Chi-square	96.496
Significance	<.001
Reclassification	96.8%

*SC: Structural Coefficient. discriminant value ≥ 0.30

1
2 As can be seen in the results, the most powerful discriminators between winning and losing in
3 female were break points won (%) (SC= -372).

4 5 **DISCUSSION**

6
7 Match statistics aid improving the quality of tennis training programs (Kovacs, 2007; Lago-Peñas,
8 Lago-Ballesteros, Dellal, & Gómez, 2010; Ortega, Villarejo, & Palao, 2009). They allow to know what
9 happens specifically in the competition and help coaches to adjust specific training goals according to
10 factors like gender, surface, category of players or moment of the match (Cui et al., 2018; Meffert,
11 O'Shannessy, Born, Grambow, & Vogt, 2018; Reid et al., 2016; Stare et al., 2015; Varas Caro & Gómez
12 Ruano, 2016). Nevertheless, nowadays there was no criterion about the variables that differentiate
13 winners and losers in grass courts surface in both genders in matched played to the best of three sets. In
14 this sense, this study shows how in male players the indicators that differentiate winner than loser are the
15 break points won, percentage of points scored with the first service and points scored with the serve
16 return after opponent first service, while in female players, the determinant are the break points.

17
18 As previous studies concluded, serve and return are the most determinant skills in tennis
19 performance (Gillet, Leroy, Thouwarecq, & Stein, 2009). Our study show that independent of gender,
20 winners have better values in almost of these variables like aces, points won with first and second serve
21 (%), less doubles faults and get higher percentage of second serve in (%) in grass court surface. It could
22 be associated with a better control of serve effects and direction (Gillet et al., 2009). In male tennis, these
23 results are in accordance with Katić, Milat, Zagorac, and Đurović (2011) for the same surface, although
24 this study found in addition higher percentages of first serves in. Other studies support our finding but
25 find better performance of first serve in (%) in winner players too, although their sample were played on
26 clay surface (Filipčić et al., 2008) or the data provided of all Grand Slams (Ma, Liu, Tan, & Ma, 2013). In
27 female tennis, the results are in accordance with Filipčić et al. (2008) in almost variables except, aces and
28 percentage of first serve in, in which they don't found any differences between winners and losers.
29 However, previous results were founded in clay surface, so it should be considered because surface
30 affects match statistics (Cui et al., 2018; Reid et al., 2016).

31
32 Regarding with serve maximum speed, although O'Donoghue and Ballantyne (2004) found a
33 strong relationship between serve speed and the probability of winning the point in male tennis, it is
34 seems that these variable it is not determinant for the match final outcome in neither of two genders.
35 Katić et al. (2011) obtained the same results for men in grass court surfaces but furthermore, they did not
36 appreciate differences in the average speed of first and second serve. No studies have been found to
37 compare our results of female players.

38
39 With regard to the return variables, winners have better results than losers, highlighting the great
40 role of this stroke in the modern professional tennis (Ma et al., 2013). These values are also similar with
41 the obtained by other studies in males for grass courts (Katić et al., 2011) and for all surfaces (Ma et al.,
42 2013). On the other hand Filipčić et al. (2008) arrived to the same conclusion for both genders in clay
43 surface. As it seems to happen with our results, other studies find better performance with the return
44 stroke in female than male players and Reid et al. (2016) conclude that women contacted the ball closer to
45 the net when they returned in hard court surface, so it could be associated with a more offensive strategy
46 when they returned. On other hand, Gillet et al. (2009) found that in male tennis, the most beneficial zone
47 for place the serve return it is the central zone for the first and second serve in clay court surface, so it
48 would be interesting to study it in grass courts in both genders. In addition, both men and women
49 winners, get better values of break points won (%) like others researchers in grass (Katić et al., 2011) and
50 all Grand Slam surfaces for men (Ma et al., 2013) and in clay for women (Filipčić et al., 2008).
51 Nevertheless, although the study of Filipčić et al. (2008) was develop on clay court surfaces, it seems to
52 be surprising that they did not find differences in men for break points won between winners and losers.

53
54 With net points, winners have better performances, but it is surprising that only men losers
55 committed more unforced errors than winners, whereas the rest of studies get differences in this variable
56 between winners and losers independent of surface and gender (Filipčić et al., 2008; Hizan et al., 2011;
57 Katić et al., 2011).

1 According with our results it could be affirmed that winners seem to be more offensive (get more
2 aces and winners) and safer (less doubles faults) than losers. Considering all the variables studied, break
3 points won (%) was the most determinant variable to win the match in both genders. Probably, it could be
4 because winners have a stronger mentality than losers in the most decisive moments of a match and as
5 Meffert et al. (2018) concluded for Wimbledon tournaments in male category, winning players keep up
6 their first serve in percentage of points at break points, while losing players serve a lower percentage. It is
7 worth mentioning that these results show the situation on a grass surface and in matches to the best of
8 three sets, therefore future studies are needed to increase the knowledge of tennis performance, especially
9 in female tennis, as well as to extend to another categories and surfaces.

10 11 12 13 **CONCLUSIONS**

14
15 This study demonstrated that players had different performance statistic depending on gender in
16 grass court surface in a best of three matches. Furthermore winners being more offensive and safer than
17 losers, and independent of gender, the most determinant variable to win the match was break points won
18 (%) and also first serve points won (%) and return of first serve points won (%) in males. These results
19 could be used as a reference by coaches to improve training programs for competitive players.

20 21 **PRACTICAL APPLICATION**

22
23 Get and analyze match statistics could be useful for coaches to set specific training goals and enhance
24 competitive performance. Nonetheless, very few players have an analyst in their staffs or have a coach
25 who records the competition data. Probably, it could seem a hard and complex task, but nowadays there
26 are lots of easy apps with which to obtain the results automatically without statistical analysis, just
27 entering the data. In addition to improve trainings programs, it can let to know the own and opponent
28 weaknesses and strengths.

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