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Differences in Grand Slam competition statistics between professional and U-18 players according to the sex

Diferencias en las estadísticas de competición de Grand Slam entre jugadores profesionales y Sub-18 según el género

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Abstract

The aim of the study was to determine the differences in competition statistics between professional and under-18 (U-18) players by sex. A total of 546 official matches of Grand Slam were selected (268 male and 278 female). The data was obtained from the official website of the tournaments. Different variables related to match time, serve, return and winners-unforced errors were analysed. Descriptive analysis and a Mann-Whitney U test to analyse the differences between professional players and U-18 players were performed. Likewise, to estimate which variables obtained the greatest significant differences was conducted a discriminant analysis. ATP players played longer sets and matches, had a better serve performance and hitting more winners than U-18 male players. Junior male players increased their return effectivity and hit fewer unforced errors than ATP players ($p< 0.001$). WTA players hit less double faults, had a better percentage of first serve-in and hit more winners than U-18 female players. Junior female hit less unforced errors than WTA players ($p< 0.001$). Moreover, the key differences between professional and junior players both males and females were the number of winners and unforced errors per set. Further, the match time and aces hitting were key factors that differentiated ATP players from U-18 male players. These data would be help coaches to design junior's trainings programs, improving their performance based on key professional stage factors.

Key Words: racket sport; performance analysis; coaching; notational analysis; strategy.

Resumen

El propósito de este estudio fue determinar las diferencias en las estadísticas de competición entre jugadores profesionales y sub-18 en tenis masculino y femenino. Se registraron un total de 546 partidos correspondientes a Grand Slam (268 masculinos y 278 femeninos). Todos los datos se obtuvieron de las páginas webs oficiales de los torneos. Se analizaron variables relacionadas con la duración del partido, servicio, resto y los golpes ganadores y errores no forzados. Se llevó a cabo un análisis descriptivo y una prueba Mann Whitney U para examinar las diferencias entre categorías, mientras que se realizó un análisis discriminante para encontrar las variables que principalmente diferencian a ambas categorías según el género. Los jugadores profesionales disputaron partidos y sets de mayor duración, además de obtener un mejor rendimiento en las variables de servicio y conseguir más golpes ganadores, mientras que los jugadores Sub-18 consiguieron más efectividad al resto y cometieron menos errores no forzados que los jugadores profesionales ($p<0.001$). Por su parte, las jugadoras profesionales cometieron menos dobles faltas, pusieron en juego un mayor porcentaje de primeros servicios y consiguieron más golpes ganadores, mientras que las Sub-18 cometieron menos errores no forzados ($p<0.001$). Sin embargo, las variables que más diferencian a ambas categorías fueron los golpes ganadores y errores no forzados por set en ambos géneros, además de la duración de los partidos y saques directos en categoría masculina. Estos datos ayudarán a los entrenadores a mejorar los programas de entrenamiento, guiando el desarrollo de jugadores Sub-18 hacia el profesionalismo.

Palabras clave: deportes de raqueta; análisis del rendimiento; coaching; análisis del juego; estrategia.

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Introduction

Tennis is one of the most practiced sports worldwide and the first among racket sports (Ferrando & Goig, 2011). It is characterised by a dynamic and complex game in which players repeatedly make decisions on positioning and shots (Filipcic et al., 2015). Players plan strategies to maximise their chances of winning based on knowledge of their own strengths and weaknesses, as well as those of their opponents and environmental factors (Varas Caro and Gómez-Ruano, 2016).

In this way, the analysis of competition in tennis has increased research attention in the last decade (Fitzpatrick et al., 2019; Reid et al., 2016), focusing mainly in the following aspects; (i) assessing physical and physiological demands; and (ii) analysing technical-tactical performance during match-play. First, some studies have examined rally length in seconds (Mendez-Villanueva et al., 2007), number of shots per point (Fernandez-Fernandez et al., 2008), ratios work-rest (Mendez-Villanueva et al., 2007), distance covered during match-play (Cui et al., 2018) or cluster of players in relation to their anthropometric characteristics (Cui et al., 2019a). The second aspect seeks to provide information about performance indicators, which can determine the match result. In this line, court positioning or variables related with stroke efficacy, such as speed or landing locations have been previously studied (Hizan et al., 2015; Martínez-Gallego et al., 2013; Kolman et al., 2018). Thus, technological advances have allowed sport science to access an enormous quantity of data almost instantly. For example, there are in tennis several studies that used "Hawk-Eye" (Reid et al., 2016), racket smart sensors (Giménez-Egido et al., 2020) or notational data (Grambow et al., 2020; Escudero-Tena et al., 2020). All of them help to study objectively players behaviour enhancing competitive performance, as well as providing coaches useful information to optimise training processes (Gomez-Ruano, 2017; Klaus et al., 2017). Specifically, the International Tennis Federation (ITF), the Association of Tennis Professionals (ATP) and Women's Tennis Association (WTA) update weekly the players and competition statistics of the main tournaments in their websites. Hence, it is well known that Grand Slams are the most relevant tournaments in tennis because bring together the best players in both professional and under-18 (U-18) categories (Cui et al., 2017, 2019b; ITF, 2020).

On the other hand, previous studies indicated that men's and women's game patterns have developed towards aggressive style, characterised by a more offensive baseline in "all court", trying to put more pressure on the opponent (Stare et al., 2015). Regarding with most of notational analysis studies in tennis, have been focused on the technical-tactical actions of serve and serve-return because of their greater influence on the game (Filipcic et al., 2015; Katić et al., 2011), besides "winners" and "unforced errors" (Reid et al., 2016). Moreover, other studies analysed competition statistics according to sex (Brown & O'Donoghue, 2008; Hizan et al., 2011), court surface (Gillet & Leroy, 2009; Söğüt, 2019), play style (Martínez-Gallego et al., 2019), tournament round (Cui et al., 2017) or player performance (Filipcic et al., 2015). Most studies were carried out in professional players, however, there is little research about junior tennis players and even less that examine both sex. This lack of studies can be also observed at U-18 stage even though it is the previous step to professionalism (Alfermann & Stambulova, 2012; Celda & Dualde, 2017). In addition, should be developed scientific evidence due to physical and technical-tactical differences between senior and junior players (Klaus et al., 2017). Differences in competition statistics between professional and U-18 players may improve the coaches' knowledge of key technical-tactical aspects to be improved in U-18 players to make them more likely to become professionals.

Therefore, the aim of the study was to determine the differences in competition statistics between professional and U-18 players in both sex.

Method

Sample

Data of 546 Grand Slam matches were collected, 268 from male players and 278 from female players. Table 1 shows the matches distribution according to the different events. Matches from the "second round" until the final in professional players were analysed, while for U-18 players were analysed from third round (match statistics in previous rounds were not available in this category). On the other hand, matches with early retirement, disqualification of any player or no IBM system (IBM: Armonk, NY, U.S.A) in the court were excluded. Twelve matches could be not analysed because the situation described above (matches of ATP players = 10, matches of WTA players = 1, and matches of U-18 male players = 1).

Table 1. Number of matches analysed by category and sex

	Male (n=268)		Female (n=278)		Total
	Senior	U-18	Senior	U-18	
Australian Open	59	31	62	31	183
Roland Garros	60	31	62	31	184
Wimbledon	57	30	61	31	179
Total	176	92	185	93	546

Procedures

The data were gathered from the official website of each Grand Slam: Australian Open (www.ausopen.com), Roland Garros (www.rolandgarros.com) and Wimbledon (www.wimbledon.com). All the matches were played to the best of three sets except in ATP players, who played to the best of five sets as stated in the official regulation (ITF, 2017).

The variables analysed were divided into four groups: temporary variables, serve performance variables, return performance variables and variables related to "winners" and "unforced errors" (Table 2). Data collection were notated in a specifically designed spreadsheet (Microsoft Excel). To control data quality, an exploratory analysis was done to find possible errors and anomalies during the data recording. To control their quality, the data were recorded by two researchers in two separate searches. In order to control the quality of the data during the analysis of the different variables, a control of 10% of the cases was carried out, for which both the expert observer and the responsible observer analysed all those works (Losada and Manolov, 2015). Considering the Kappa concordance coefficient, a minimum concordance of 0.94 was obtained.

Table 2. Dependent variables analysed

Variable	Description
Temporary variables	
Match time	Total match time in minutes
Set time	Total set time in minutes
Serve performance variables	
Aces	Number of direct serves
Aces per set	Number of direct serves ÷ Sets of the match
Double faults	Number of doubles faults
Double faults per set	Number of doubles faults ÷ Sets of the match
First serve in (%)	Number of first serve in ÷ Number of points play at 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
Return performance variables	
Return points won (%)	Number of points won on return ÷ Number of points play at return
Break points per set	Total break points ÷ Sets of the match
Breaks per set	Break points won ÷ Sets of the match
Break points won (%)	Break points won ÷ Break points played
Variables related to winners and unforced errors	
Winners per set	Total winners ÷ Sets of the match
Unforced errors per set	Unforced errors ÷ Sets of the match

Statistical analysis

Data analysis was performed using the statistical package IBM SPSS version 25.0 (IBM Corp., Armonk. NY. USA). First, a descriptive analysis of the data (mean and standard deviation) was done. Second, the Mann-Whitney U test (non-parametric test) was conducted analysing the differences between categories (professional *versus* U-18), because the normality assumptions were not satisfied (Kolmogorov-Smirnov test). Finally, to find those statistical variables that best differentiate the two groups (senior and junior), a discriminant analysis (Berry, 2002) was conducted. For interpreting the linear vectors, a Structural Coefficient (SC) >0.30 was considered relevant. The alpha level was set at $p< 0.05$.

Results

The differences between professionals and U-18 players in both sex are shown in Table 3.

Table 3. Differences between professionals and U-18 players

	Male							Female						
	Senior	U-18	P value	Z value	Cohen's	CV% senior	CV% junior	Senior	U-18	P value	Z value	Cohen	CV% senior	CV% junior
Temporary variables														
Match time (min)	150.10 ± 52.26	81.63 ± 28.78	<0.001	-15.183	0.1494	34.97	37.63	98.10 ± 30.72	88.98 ± 31.09	0.001	-3.420	0.292	31.30	38.85
Set time (min)	40.59 ± 7.47	35.94 ± 9.26	<0.001	-6.423	0.566	18.53	24.93	41.77 ± 9.28	37.37 ± 8.25	<0.001	-5.107	0.480	22.36	22.30
Serve performance variables														
Aces	9.22 ± 6.41	2.95 ± 2.95	<0.001	-12.430	1.137	69.86	147.5	2.63 ± 2.73	2.32 ± 2.25	0.053	-0.628	0.117	103.8	112.5
Aces per set	2.55 ± 1.75	1.31 ± 1.32	<0.001	-9.230	0.788	68.5	131	1.12 ± 1.14	1.00 ± 0.96	0.619	-0.497	0.106	102.7	143.9
Double faults	3.20 ± 2.49	2.70 ± 2.14	0.009	-2.604	0.216	77.57	105.5	3.13 ± 2.44	3.98 ± 2.41	<0.001	-4.410	-0.356	78.21	60.25
Double faults per set	0.88 ± 0.63	1.21 ± 0.94	<0.001	-3.530	-0.436	71.59	92	1.35 ± 1.02	1.72 ± 1.04	<0.001	-4.323	-0.364	75.37	69.33
First serve in (%)	63.71 ± 6.82	59.98 ± 7.45	<0.001	-5.932	0.527	10.69	12.22	63.46 ± 8.47	59.78 ± 7.98	<0.001	-4.369	0.449	13.35	13.28
First serve points won (%)	71.94 ± 9.86	66.99 ± 12.00	<0.001	-4.911	0.475	13.83	17.82	62.00 ± 12.24	62.42 ± 11.02	0.832	-0.212	-0.041	19.82	17.48
Second serve points won (%)	51.60 ± 11.75	49.15 ± 11.90	<0.001	-2.388	0.206	22.71	24.56	45.36 ± 11.76	45.70 ± 11.60	0.660	-0.440	-0.034	25.98	25.22
Return performance variables														
Return points won (%)	35.94 ± 22.99	40.14 ± 10.07	<0.001	-5.232	-0.537	24.49	24.67	43.98 ± 9.53	44.37 ± 9.07	0.630	-0.481	-0.034	21.73	20.38
Break points per set	2.52 ± 1.43	3.12 ± 2.04	0.001	-3.366	-0.363	56.34	67.33	3.55 ± 1.68	3.67 ± 1.85	0.518	-0.646	-0.072	47.04	51.40
Breaks per set	0.94 ± 0.68	1.39 ± 1.21	<0.001	-5.021	-0.507	72.82	90.23	1.65± 0.88	1.69 ± 0.90	0.673	-0.422	-0.036	53.01	54.22
Break points won (%)	35.28 ± 8.63	44.51 ± 28.07	<0.001	-3.904	-0.367	64.03	63.73	47.46 ± 22.85	47.31 ± 22.16	1.000	-0.001	0.015	47.99	47.13
Variables related to winners and unforced errors														
Winners per set	10.46 ± 3.54	4.06 ± 4.58	<0.001	-13.439	1.662	33.93	321	9.29 ± 3.91	3.59 ± 4.43	<0.001	-12.756	13.849	42.22	442
Unforced errors per set	8.77 ± 4.23	3.72 ± 3.94	<0.001	-12.195	1.249	48.18	233	10.54 ± 4.90	4.71 ± 4.81	<0.001	-11.798	11.961	46.49	192.4

With regard to male players, the temporary variables for the ATP players had higher values of match [Z=-15.183, p < 0.001] and set time [Z=-6.423, p < 0.001]. For the serve performance variables, significant differences were found for all variables. The ATP players obtained higher values in aces [Z=-12.430, p < 0.001], aces per set [Z=-9.230, p < 0.001], first serve in (%) [Z=-5.932, p < 0.001], first serve points won (%) [Z=--4.911, p < 0.001] and second serve points won (%) [Z=-2.388, p < 0.001]; while U-18 players hit more doubles faults per match [Z=-2.604, p < 0.01] and set [Z=-3.530, p < 0.001]. By contrast, the return performance variables is higher in U-18 players. They had significantly higher mean values for return points won (%) [Z=-5.232, p < 0.001], break points per set [Z=-3.366, p < 0.005], breaks per set [Z=-5.021, p < 0.001] and break points won (%) [Z=-3.904, p < 0.001]. Finally, the ATP players hit more winners per set [Z=-13.439, p < 0.001], although committed more unforced errors per set [Z=-12.195, p < 0.001] than U-18 players.

Concerning female players, the WTA players had significantly higher mean values for both "temporary" variables, match time [Z=-3.420, p < 0.005] and set time [Z=-5.107, p < 0.001]. The serve performance variables in the WTA players showed higher percentage of first serve-in and U-18 players hit more double faults per match [Z=-4.410, p < 0.001] and set [Z=-4.369, p < 0.001]. Finally, the WTA players hit more winners strokes per set [Z=-12756, p < 0.001], while U-18 players committed fewer errors per set [Z=-11.798, p < 0.001].

Tables 4 and 5 show the discriminant function analysis (p < 0.001), both for sex and categories, correctly classifying 92.2% of male players (ATP and U-18) and 83.4% of female players (WTA and U-18). The most powerful discriminators among male players were the "winners per set" (SC=.597), match time (SC=.548), unforced errors per set (SC=.446) and aces (SC=.418), while in female tennis only were the winners per set (SC=.778) and unforced errors per set (SC=.668).

Table 4. Standardised coefficients from the discriminant analysis of the game statistics betwen ATP and U-18 male players

	Male
	Senior - U-18
Winners per set	.597
Match duration (min)	.548
Unforced errors per set	.446
Aces	.418
Aces per set	.280
Set duration (min)	.209
Return points won (%)	-.194
First serves in (%)	.194
Breaks per set	-.181
First serve points won (%)	.170
Double faults per set	-.160
Break points per set	-.132
Break points won (%)	-.126
Double faults	.076
Second serve points won (%)	.076
Eigenvalue	1.677

Wilks´Lambda	0.373
Canonical correlation	.792
Chi-square	508.684
Significance	<0.001
Reclassification	92.2%

*SC discriminant value >0.30

Table 5. Standardised coefficients from the discriminant analysis of the game statistics betwenn WTA and U-18 female players.

	Female
	Absolut-Junior
Winners per set	.778
Unforced errors per set	.668
Set duration (min)	.275
First serves in (%)	.247
Doubles faults per set	-.201
Doubles faults	-.197
Match duration (min)	.165
Aces	.065
Aces por set	.063
Break points per set	-.039
Return points won (%)	-.023
Breaks per set	-.022
First serve points won (%)	-.019
Second serve points won (%)	-.016
Break points won (%)	.004
Eigenvalue	.718
Wilks´Lambda	.582
Canonical correlation	.647
Chi-square	294.706
Significance	<0.001
Reclassification	83.4%

*SC discriminant value >0.30

Discussion

The main findings of the present study were: (i) the ATP players played longer matches and sets, achieved higher performance serving and hitting more winners per set, while U-18 players had better results at “return” and commit less unforced errors; (ii) the WTA players played longer matches and sets, get higher first serve percentage and commit fewer doubles faults than U-18 female players; (iii) the variables that represent the main difference between professional and U-18 players were “winners” and unforced errors per set in both sex, and only the match duration and aces in male tennis showed significant differences.

The results showed more differences between male than female categories. The temporary variables in WTA and ATP players had longer times in match-play and set duration than U-18 players ($p<0.001$). These results agree with the conclusions obtained by Blanca-Torres et al. (2019). In the case of total match duration, the higher values in the male professional players can be explained by the differences in the match format between categories, as ATP Grand Slam matches are played to the best of five sets, while U-18 category is played to the best of three (ITF, 2020). This fact should be taking into account by coaches and trainers because male professional cover a distance per set of 572 m (Reid et al., 2016), which will imply a greater physical demand when U-18 players go to professional category and play matches with more sets. In the case of females, longer match duration could be associated with closer matches, with a greater average of sets played as previous studies have shown (Blanca-Torres et al., 2019). Further, according to the data obtained by Cui et al. (2018), professionals run between 558 and 608 m per set and 9.14 and 10.18 m per points depending on the playing surface, so it can be expected that the physical demand may also be higher as in female professionals by playing closer matches. The fact that male professional players have a better serve, get fewer break opportunities and break per set, besides win a lower percentage of break points, could be associated with a closer sets with more games played. Thus, Cross (2014) showed that between 2000 and 2014, one tie-break was played of each seven sets and the mean of games per set was 10 in males. Hence, there was one break each five games, so future studies should analyse these variables in U-18 players. In females, longer set durations could be explained by other factors such as number of strokes per point, point duration or games per set, although more detailed study is needed to compare these results in a similar context.

Regarding serve and return variables, those are the most determining variables in Grand Slam (Cui et al., 2017, 2018; Filipcic et al., 2015). These differences in the serve performance between categories may be due to some factors such as anthropometric characteristics, since, as previous studies have shown, the players height have a significant influence on serving performance and speed (Bonato et al., 2015; Rod Cross and Pollard, 2009; Cui et al., 2019). Ball velocity distinguished high-performing players from lower-performing players (Kolman et al., 2018). Regarding, high-level junior players who are advanced in chronological and biological age are taller and serve faster than younger and less maturing players in both sex (Fernandez-Fernandez et al., 2014; Myburgh et al., 2016). In this way, Fernandez-Fernandez et al. (2014) found a mean height of 181.5 and 171.5 cm respectively in males and females U-18 players, while Söğüt (2019) and Vaverka and Cernosek (2013) registered a mean stature of 187 and 173 cm for males and females professional, respectively. Likewise, biological and chronological age are also related with a higher physical performance (Fernandez-Fernandez et al., 2014; Myburgh et al., 2016), which is directly related to the serve speed. Fernandez-Fernandez et al. (2014) find maximum serve speeds of 176.9 and 150.9 km/h in male and females U-18 players, while Reid et al. (2016) obtained an average of first serve speed of 184.3 and 152.1 km/h respectively. Furthermore, Reid et al. (2016) found that the peak serves speeds of male and female professional players were 206.3 and 171.8 km/h respectively. Regarding, it is difficult to stablish clear conclusions about the relationship between shot accuracy and performance level. In young players, it seems that those with more experience scored higher than less experienced in ball velocity and accuracy (Kolman et al., 2017; Vergauwen et al., 2004). Nevertheless, as the systematic review of Kolman et al. (2018) concluded, future studies should focus on investigating the relationship between ball velocity and accuracy and whether more experienced players are able to maintain accurate strokes under conditions of increasing demands in tennis (Kolman et al., 2018).

The fact that the males categories had greater differences than females, could be affected by an early maturation of the women, which allows them to arrive before the men to their physical and physiological development and begin a serious strength training in neuromuscular power (Grosser and Schonborn, 2002; Meylan et al., 2014; Munivrana et al., 2015; Myburgh et al., 2016). Furthermore, the age and level of players is directly related to the experience and practice training volume (Sánchez-Muñoz et al., 2007; Söğüt, 2017) and it could be affect to their better technical capabilities (Hizan et al., 2011; Stare et al., 2015). Moreover, the study of Cui et al. (2017), showed that even in the professional category, high-experienced players outperformed other players in the serve and return variables. Regarding junior categories, Klaus et al. (2017) concluded that they based their serve performance on an "in-percentage" strategy and minimising errors on the server player's first shot rather than scoring points directly.

On the other hand, return performance is highly influenced by serve performance and professional players serve more efficacy than junior players. In our study, U-18 male players performed better on all return variables than ATP players, whereas no differences were found in the female categories. The worst performance in the serve variables of the U-18 male players may explain this fact. In the case of females, although WTA players committed fewer doubles faults and obtained a higher percentage of first serves in, there were no differences in the percentage of points won with first and second serve, so this could explain the absence of differences. Thereby, Hizan et al. (2011) found that professional players performed worse return first serve than U-16, but obtained a higher percentage of points won returning opponent second serve. Future studies should consider the differences between the points won by first serve and second serve return in U-18 players.

One of the main finding of the study indicated that ATP and WTA players, hit more winners per match, although they committed more unforced errors than U-18 players. It could be related with a more offensive play style in professional categories, because of greater technical-tactical skills (Filipcic et al., 2015; Whiteside & Reid, 2017) and better physical performance (Murray & Hunfalvay, 2017). Moreover, Martínez-Gallego et al. (2013, 2019) concluded that the most successful professional players spent more time in offensive zones, pushing their opponents to hit the ball further from the baseline. Also, O'Donoghue and Brown (2008) showed that the tactical advantage of the first serve was in points with a rally length below 5 shots, however with second serve, this advantage keeps until the rally length reached a third shot. WTA players lost the tactical advantage in first serve after two shots, but there was no significant serve advantage whit second serve. Furthermore, Fitzpatrick et al. (2019) identified the percentage of points won with a rally length from 0 to 4 shots, and found that this rally length were strongly associated with success. In short, professional players try to play a more offensive style because this strategy increases their chances of winning, however, these variables have been less studied in U-18 players. For these reasons, future studies should be encouraged to increase the knowledge of key technical-tactical aspects to develop in U-18 tennis players. In future research, the data on this topic should be complemented by measuring the influence of mental skills on playing performance.

Conclusion

Professional players (ATP and WTA) play longer matches, hit more winners and commit more unforced errors than U-18 players. On other hand, male professional players have higher serve performance, while U-18 players have a better performance returning serves. However, between female categories there are not so many differences, WTA players commit fewer double faults and have higher percentage of first serve in. Despite these results, further studies on this topic are needed to reach new goals in player development, especially in the female category.

Practical Applications

The results of our study allow coaches and sports organisations to design training programs for U-18 players, based on professional tennis performance indicators, in order to develop and increase the chances of U-18 players achieving professionalism.

Although the differences were greater between male categories, serve-related variables were shown to be a key performance indicator, so more practices of serve-return should be prioritized. Furthermore, given their greater number of winners, it seems that professional players play more aggressive than U-18, so technical and tactical skills as playing in offensive zones, hitting deeper and faster or practise change of ball directions should be implemented with special attention in young players development. Finally, the longer duration of professional matches, require a better physical performance than U-18 tennis competition, and therefore physical preparation should be a fundamental aspect in training.

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