THE RELATIVE AGE EFFECT IN TOP 100 FEMALE TENNIS PLAYERS (2014-2018)

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ABSTRACT

The theory of Relative Age Effect (RAE) works on the assumption that athletes born at the beginning of a calendar year are more successful than athletes born in the end of the year. The athletes born early have a significant probability of a higher level of physiological, morphological and psychological abilities than later born athletes. Several studies show that the RAE was not found in females or it was significantly lower than in males. The research objective was to find out the influence of RAE in WTA Tour TOP100 female professional tennis players (n=500) in 2014–2018. Cohen's effect size (ES) *w* was calculated to assess the level of the influence of RAE. To assess the differences between the observed and the expected relative age quarter distribution, Chi-Square test (χ^2) was used. In terms of effect size (ES), a medium influence of RAE has been proven in 2016 and 2017 ($w = 0.33$, resp. $w = 0.30$); a small influence has been proven in years 2014, 2015, 2018 and in the whole observed period 2014–2018. Based on statistical analysis, the influence of RAE cannot be rejected in years 2016 ($p < 0.05$) and 2017 ($p < 0.05$) and also in the whole period of 2014–2018 ($p < 0.01$). The influence of RAE can be rejected in 2014, 2015 and 2018 ($p > 0.05$). The next step was to assess the influence of RAE on the final WTA ranking in 2014–2018. Players have been divided into four intervals: 1–25, 26–50, 51–75 and 76–100 positions. ES has showed the medium influence of RAE in 76–100 positions ($w = 0.34$); only small influence of RAE was found in other positions. Statistical analysis showed that the influence of RAE cannot be rejected in 1–25, 26–50 and 76–100 positions ($p < 0.05$): it can be rejected in 54–75 positions. The results of the research have shown the medium influence of RAE in 2016 and 2017: in the recent years (and in the whole observed period of 2014–2018), the influence of RAE was small. The influence of RAE on the final WTA ranking is also small, except the 76–100 positions.

Keywords: Women´s Tennis Association; date of birth; chronological age; talent; rankings

Introduction

Researches emerged in the mid-1980s pointing to an unusually high representation of individuals born at the beginning of calendar years in various sports selections. This phenomenon, later referred to as Relative Age Effect (RAE), still permeates through various age categories, various performance levels both in collective and individual sports (Agricola, Zháněl & Hubáček, 2013; Helsen, Van Winckel & Williams, 2004).

The issue of RAE (Musch & Grondin, 2001), also referred to as Birth Date Effect (Karcher, Ahmaidi & Buchheit, 2014) or Birth Quarter (Larouche et al., 2010), points to a deviation in the frequency distribution of birth dates of selected groups of athletes from normal frequency distribution in the general population (Agricola et al., 2013). This deviation is probably caused by the fact that, especially in pupil and youth categories, the individuals born earlier are more successful than individuals born in the later months of the year (Parent-Harvey, Desjardins & Harvey, 2014). Higher success is mainly caused by developmental lead which can be almost 12 months within one category. This developmental lead is a considerable advantage mainly in the area of physiological, psychological and morphological preconditions (Gibbs, Jarvis & Duffur, 2012). There are even two-year categories in some sports, i.e. the difference between team mates can be as much as 24 months (Lames et al., 2009). As a result, individuals born in the later months of the year often have much less chance to compete successfully with the biological older athletes (Andrade-Souza, Moniz & Teoldo, 2015). A number of studies have reported that this developmental advantage is lost over time (Bjerke, Pedersen, Aune & Lorås, 2017; Ford P & Williams, 2011) and the 'talented' individuals from the past become only average athletes (Lames et al., 2009). Biologically younger – and perhaps truly talented individuals – have often terminated their sports career by then (so called burnout effect), because they have not got time or space to develop their talents (Abbot & Collins, 2004; Arrieta, Torres-Unda, Gil & Irazusta, 2015).

As mentioned in the introduction, RAE influence has been proven in various sports. A number of researches has also aimed at the differences of RAE influence between the sexes, resp. directly at RAE in girls (Delorme, Boiché & Raspaud, 2010; Hancock, 2017; Molenaar, et al., 2015; Sofia, Barreiros & Fonseca, 2016; Stenling & Holmström, 2014; Weir et al., 2010). Based on the presented results, it is possible to say that the RAE influence is not as dominant in girls in junior categories as it is in boys: the main reason the authors state is that during the period when the selection pressure is at its strongest in most sports, the puberty period of girls is often over and the differences caused by different stages of ontogenetic development are not so distinct. Another reason is possibly the fact that girls are not so much interested in physically demanding sports (where the RAE influence appears most) as boys are. Therefore, the competition is smaller and the selection pressure is not so strong (Cobley, Baker, Wattie & McKenna, 2009).

The issue of RAE in tennis appears in scientific studies approximately since the late 1990s and focuses mainly on youth and junior categories. Recent studies include Pacharoni, Aoki, Costa, Moreira, & Massa (2014), Romann & Fuchslocher (2014), or Ulbricht, Fernandez-Fernandez, Mendez-Villanueva, & Ferrauti (2016). With regard to the issue we are dealing with, some important studies include also the results of RAE influence in girls/women. Giacomini (1999) found in young male and female US tennis players that the RAE influence is significantly weaker in categories over 16 years than in U16, resp. U14 categories. Results of research have also shown a significantly weaker influence of RAE in girls. Study by Filipcic (2001), which focuses on the best Slovenian male and female tennis players in U12 – U18 categories, has confirmed RAE influence in tennis players in the U12, U14 and U16 categories, but not in the U18 category. There has been a significant RAE influence found in female tennis players in the U12 and U14 categories, but not in the U16 and U18 categories. Pacharoni et al. (2014) report that there is almost no evidence of RAE influence in adult male and female professional tennis players in Brazilian and South American tennis leagues. The RAE influence in female professional tennis players at Grand Slam tennis tournaments in 2002–2003 (Edgar & O'Donoghue, 2005), resp. in 2008–2009 (O'Donoghue, 2009) was proven in both studies in terms of material significance, but not in terms of effect size (ES).

Based on the results of these studies, it could be assumed that RAE influence will not be significant in senior female categories. The aim of this research was to find if the influence of RAE is demonstrable in female professional players, who took 1–100 positions (TOP 100) in the WTA Rankings in 2014–2018.

Methods

The best 100 female tennis players (TOP 100) in 2014–2018 (n=500) were chosen for the analysis of RAE influence. Research data were obtained from public Internet sources at the official WTA website https://www.wtatennis.com/rankings. The division of players into individual quarters was performed according to their date of birth as follows: Q_1 (January to March), Q_2 (April to June), Q_3 (July to September), Q_4 (October to December). With respect to the research problem to be solved, we formulated two research questions:

1. Is it possible to prove the influence of RAE in female tennis players in individual years, resp. during the whole observed period?
2. Is it possible to prove the influence of RAE on the positions of female tennis players in individual quarters of the WTA rankings during the whole observed period?

To assess the match of the theoretical (expected) distribution of frequencies and the empirical (observed) distribution of frequencies, Chi-Square (χ^2) test in the Goodness of Fit variant was used. The expected frequency distribution was based on assumptions of equal distribution for each of the four quarters (Q_i = 25%). With regard to the deliberate selection of the elements of the research set, we assessed the material significance (effect size, ES) of the results using the Cohen´s *w* coefficient (Cohen, 1988); it can be interpreted as small (*w* = 0.10), medium (*w* = 0.30) or large (*w* = 0.50). The research data were processed using STATISTICA 10 software and Microsoft Office Excel.

Results

RAE influence in individual years and in the whole monitored period

Figure 1 shows an overview of the distribution of relative frequencies of birth dates in individual quarters (Q_1–Q_4) in individual years.

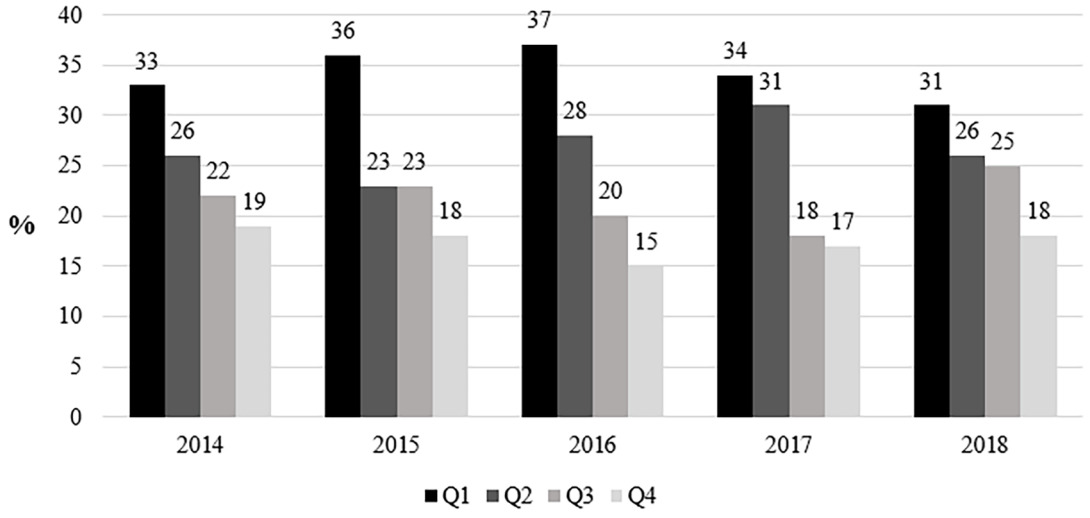

Figure 1 *Distribution of relative frequencies in individual quarters (Q_i) in 2014–2018*

The number of female players born in the first quarter (Q_1) prevails in each of the monitored years; on the other hand, the least female players were born in the last quarter of the year (Q_4). Except for 2015, where the frequencies are same in Q_2 and Q_3, it is possible to see a typical manifestation of RAE influence in each of the monitored years – frequencies in individual quarters have a clearly decreasing tendency from Q_1 to Q_4.

Table 1 shows the relative frequencies (%) in individual quarters Q_i for each year and throughout the whole observed period (2014–2018).

Table 1 *Influence of date of birth in TOP 100 female tennis players in 2014–2018*

Year	Q_1 [%]	Q_2 [%]	Q_3 [%]	Q_4 [%]	χ^2	p	w	ES
2014	33.0	26.0	22.0	19.0	4.40	0.22	0.21	Small
2015	36.0	23.0	23.0	18.0	7.12	0.69	0.27	Small
2016	37.0	28.0	20.0	15.0	11.12	0.01	0.33	Medium
2017	34.0	31.0	18.0	17.0	9.20	0.03	0.30	Medium
2018	31.0	26.0	25.0	18.0	3.44	0.33	0.19	Small
2014–2018	34.2	26.8	21.6	17.4	31.44	0.00	0.25	Small

Note: Q_i = quarter of the year, χ^2 = Chi-square test, p = p value, w = Cohen's w test, ES = verbal interpretation of effect size.

In terms of material significance (ES) (Tab.1), a medium influence of RAE was demonstrated in 2016 and 2017 (w=0.33, resp. w=0.30), but only a small influence of RAE in 2014, 2015, 2018 and in the whole period of 2014–2018. Due to the deliberate selection of elements of the research group, we prefer the assessment with the use of effect size; however, the assessment of RAE through statistical significance has shown similar results. The impact of RAE influence cannot be rejected in the years 2016, 2017 ($p<0.05$) and during the whole period of 2014–2018 ($p<0.01$), which is probably influenced by the large size of the sample (n=500); the RAE influence is rejected in 2014, 2015 and 2018 ($p>0.05$).

RAE influence on WTA Rankings during the whole monitored period

The assessment of RAE influence within the WTA ranking is shown graphically in Figure 2. The positions of 100 best female players in the WTA Rankings were divided into four intervals: 1–25, 26–50, 51–75, 76–100 position.

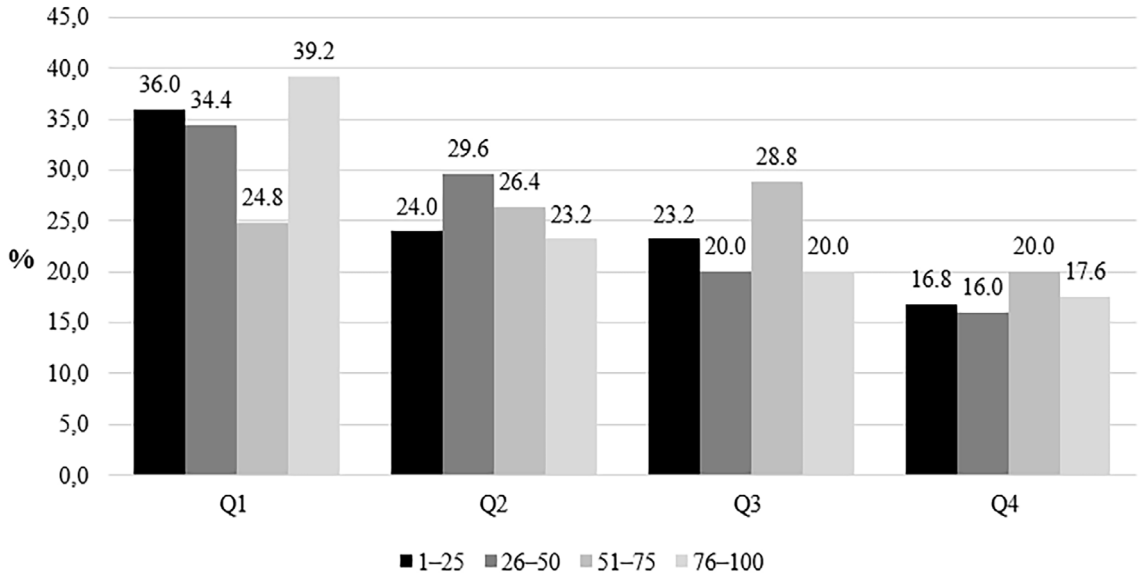

Figure 2 *Distribution of frequencies (%) in individual quarters (Q_i) according to positions in the WTA Rankings (TOP100) for the whole monitored period (2014–2018)*

It is clear from the graphical representation in Figure 2 that of the players placed in positions 1–25 in the WTA rankings in 2014–2018, the highest number is in the Q_1 quarter (36%), then in Q_2 (24%), Q_3 (23.2%), and least in Q_4 (16.8%). A similarly decreasing tendency of relative frequencies can also be seen in players in 26–50 positions and in players in 76–100 positions. A different tendency of frequencies in Q_1–Q_4 was found in female players in 51–76 positions (24.8%, 26.4%, 28.8%, 20.0%).

Table 2 shows the results of statistical analysis of the influence of date of birth on the WTA ranking in 2014–2018.

Table 2 *Influence of date of birth on WTA ranking in 2014–2018*

Ranking	Q_1 [%]	Q_2 [%]	Q_3 [%]	Q_4 [%]	χ^2	p	w	ES
1–25	36.0	24.0	23.2	16.8	9.62	0.02	0.28	Small
26–50	34.4	29.6	20.0	16.0	10.78	0.01	0.29	Small
51–75	24.8	26.4	28.8	20.0	2.07	0.56	0.13	Small
76–100	39.2	23.2	20.0	17.6	14.23	0.00	0.34	Medium

Note: Q_i = quarter of the year, χ^2 = Chi-square test, p = p value, w = Cohen's w test, ES = verbal interpretation of effect size.

In terms of material significance (ES) (Tab.2), a medium influence of RAE was shown only in female players in 76–100 positions (*w* = 0.34); a small influence of RAE was found in female players in 26–50 positions (*w* = 0.29), 1–25 positions (*w* = 0.28) and 51–75 positions (*w* = 0.13). Assessment of RAE influence by statistical significance gives a somewhat different evaluation; it has been proven that some influence of RAE cannot be rejected for players placed in 1–25, 26–50, 76–100 positions ($p < 0.05$), while RAE influence is rejected for players in 51–75 positions. Due to the deliberate selection of elements of the research group, we prefer the assessment with the use of effect size (methodologically more appropriate); it can therefore be stated that the influence of RAE on the position of female players in the ranking is small and, with the exception of the players in 76–100 places (medium RAE influence), materially insignificant.

Discussion

Most studies devoted to RAE issue focus on team sports, especially ice hockey and football (soccer). However, there are also numerous studies devoted to individual sports such as gymnastics (Hancock, Starkes & Ste-Marie, 2015), swimming (Costa, Marques, Louro & Marinho, 2013) or skiing and figure skating (Baker, Janning, Wong, Cobley & Schorer, 2014). Research works aimed at tennis (for instance Agricola et al., 2013; Edgar, & O'Donoghue 2005; Filipcic, 2001; Giacomini, 1999; O'Donoghue, 2009; Pacharoni et al., 2014, Romann & Fuchslocher, 2014) are mainly devoted to junior tennis; the influence of RAE in senior tennis is paid much less attention. The results of our research showed that a medium RAE influence in terms of effect size was found in female professional tennis players (n=500) only in 2016 (37% in Q_1) and 2017 (34% in Q_1); it was small in other years and in the whole observed period. A study by Edgar and O'Donoghue (2005) dealing with the RAE influence in female players in Grand Slam tournaments (n=211) in 2002–2003 showed that most players were born in Q_1 (33.1%) and, according to the authors, the significance of RAE influence cannot be rejected ($\chi^2 = 12.9$, $p < 0.01$). However, when calculating the Cohen ´s w value (w = 0.25), we have to state only a small material significance (ES) of RAE influence (Tab.1). A similar study by O'Donoghue (2009) on female players in Grand Slam tournaments (n=193) in 2008–2009 found that most players were born in Q_1 (29.0%) and in Q_2 (29.5%) and, according to the author, the significance of RAE influence cannot be rejected ($\chi^2 = 12.9$, $p < 0.05$). However, when calculating the Cohen ´s w value (*w* = 0.22), we have to state again only a small material significance (ES) of

RAE influence. It can be concluded from these findings that, in accordance with the results of some of the above mentioned studies suggesting decreasing, resp. no RAE influence in senior female age categories, as well as in accordance with the results of our research, only medium, resp. small RAE influence was proven in female professional tennis players.

In assessing RAE influence on positions in individual quarters of WTA rankings in 2014–2018 (Tab.2), it was found that of the female players placed in WTA rankings in 1–25 positions, the highest number is in the Q_1 quarter (36%); similar situation can also be seen for players in 26–50 positions (in Q_1 = 34.4%) and for players in 76–100 positions (in Q_1 = 39.2%), but not for players in 51–76 positions (in Q_1 only 24.8%). The influence of RAE on the position of the players in the ranking is small, with the exception of the players in 76–100 positions (medium RAE influence) materially insignificant.

Conclusion

The aim of this research was to determine the incidence of RAE influence in female professional tennis players (WTA Rankings, TOP 100) in 2014–2018. In assessing RAE influence in terms of material significance (ES), a medium influence of RAE was only proven in 2016 a 2017; the RAE influence was small in other years and during the whole monitored period. When investigating the influence of RAE on rankings in individual quarters of the year in the WTA Rankings (TOP 100) in the whole observed period, it was proven that RAE influence on the ranking of players is small, and, with the exception of players in 76–100 position (medium RAE influence), materially insignificant.

Even though some authors have suggested some ways how to eliminate the influence of RAE, none of them is currently universally applicable. It is therefore important to respect developmental patterns and the knowledge of RAE influence especially in junior categories, persistently attempting to carefully and rationally assess the future potential of athletes. Therefore, it is important for coaches, officials as well as parents to be familiar with the issue, to respect the laws of development of young athletes and to assist to eliminate RAE influence in sports selections.

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