

Effect of relative age in the FIFA Women's World Cup U-20 and senior elite categories: differences in playing positions and obtained results

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Abstract:

Introduction: The concept of age plays a determining role in high-performance sports, specifically in international tournaments where the participating athletes are categorized by age. An example of this is the women's under-20 world cup. Likewise, the players' ages vary among the national teams in the senior elite world cup. **Objective:** For this reason, the objective of the present study was to determine the effect of age on the results obtained by each national team and the existing differences between playing positions. **Method:** The study included 4190 players distributed as follows; U-20 category ($n:1344$) corresponding to 2014, 2016, 2018, and 2022 World Cups and the senior elite category ($n:2846$) corresponding to the World Cups between 1991-2019. Quantitative approach study, descriptive type. The statistical treatment was carried out using the program ® version 4.1.0. Univariate and bivariate analysis tests, normality tests, and the Kruskal-Wallis test. **Results:** The results indicate that, in the senior elite category World Cups, there are statistically significant differences between the teams that become champions ($p=0.03$) and the teams that finish their participation in the group stage ($p=0.00$) and occupy the fourth place ($p=0.00$) in the World Cups, being the champion teams with a higher average age. Likewise, statistically, significant differences were found between age and positions, with goalkeepers having a higher mean age compared to defenders ($p=0.00$), forwards ($p=0.00$), and midfielders ($p=0.00$). As for the U-20 World Cup, given its category, no differences were found between age and playing position. Statistically significant differences were only found between the teams that placed third, with a higher mean age than those in the groups ($p=0.00$) and quarterfinals ($p=0.02$). **Conclusion:** Thus, the variables studied in this study show that age in relation to the results achieved reflects statistically significant differences, both for the U-20 and senior elite categories. Likewise, for the senior elite category, it was found that the first, subchampion, and third place teams have a higher average age than those that finished in the group stage. Finally, also in the analysis of the senior elite category, differences were found between positions, with the goalkeepers having a higher average age than the rest of the field players.

Key Words: sport, population, age distribution, statistics.

Introduction

Women's soccer has been studied in depth in recent years (Sans & Fratarolla, 2017; Becerra Patiño, 2021; Becerra Patiño, Sarria Lozano & Palomino, 2023), from the analysis of its dimensions, emotions, physical, technical and tactical capabilities, morphological characteristics, and the game model in its relationship with the female soccer player (Becerra Patiño, 2021b), as well as the influence of emotions and their association with sports performance (Becerra Patiño, 2021c). Similarly, scientific research on women's soccer has considered the study of variables related to morphofunctional characteristics with their game positioning (Becerra Patiño, Sarria Lozano & Prada Clavijo, 2022), comparison of aerobic performance and body composition in response to game positioning in professional soccer players (Barrera et al., 2022) and variables related to strength training programs in response to set positioning (Becerra-Patiño et al., 2023).

However, and despite the growing research interest, the effects of RAE on the sport performance of female soccer players seems to be a topic of interest for sport science. Thus, the RAE phenomenon aroused the interest of sport science in the mid-1980s, when a group of researchers found significant RAE at different levels (recreational, competitive and elite) in a sample of ice hockey players, as well as in competitive level volleyball players (Grondin, Deshaies & Nault, 1984).

All this, because according to Salinero, Pérez, Burillo & Lesma (2013) the effect of the (RAE) in sport is based on the presence of athletes who are born in the last months of the year, being these almost always the most damaged having as a reference the cut-off date established by each competitive system, hence the

differences between those born in the first and last months of the year. For all the above, it is necessary to know the effects that the RAE has on the competitive results and if this in turn, responds to the positionings that underlie the tactics in soccer.

Thus, as the investigation of relative age in male soccer has been very well documented in various investigations (González Aramendi, 2007; Gutiérrez, Pastor, González Villora & Contreras, 2010; Vaeyens, Philippaerts & Malina, 2005), finding that soccer is a sport associated with significant RAE effect (Cobley, Baker, Wattie & McKenna, 2009; Musch & Grondin, 2001; Smith, Till, Romann & Cobley, 2018). However, studies of relative age in women's soccer are scarcer (Korgaokar, Farley, Fuller & Caputo, 2018). By virtue of this, and despite the exponential growth of women's soccer worldwide (FIFA Activity Report, 2017) and the growing and exponential sport science research interest in female soccer players, the number of investigations assessing this phenomenon is small (Cobley et al., 2009; Smith et al., 2018).

Likewise, existing studies on the effect of relative age show discrepancies in their findings (Delorme, Boiche & Raspaud, 2010; Goldschmied, 2011). Thus, the results found by Delorme Boiche & Raspaud (2010) show that there is an effect of RAE in French female youth and elite soccer players, while Goldschmied (2011) found no effect of RAE in professional players who participated in the 2002-2003 season of the Women's United Soccer Association.

Similarly, the systematic review and meta-analysis developed by Smith et al. (2018) on RAE in female athletes indicated a small RAE in various sport contexts.

In the same sense, the study of age has been considered in other sports, through the effect of RAE in basketball as an indicator to select successful players (Maciel et al., 2021), effect of RAE in handball players (Gómez-López, Angosto, Ruiz & Pérez, 2017) and evidence of the effect of RAE in Canadian women's ice hockey (Weir, Smith, Paterson, Ch & Horton, 2010). Similarly, there are studies that relate the effect of RAE and game positioning. One such study was developed by Bozděch, Agrícola & Zháněl (2019) in which they sought to determine the effect of RAE on men's ice hockey through the analysis of positions and anthropometric characteristics. Similarly, the effect of RAE and how it may affect the perceived market value in the professional soccer league in Spain has been studied (Pérez-González, Fernández-Luna, Vega & Burillo, 2018).

On the other hand, there are several studies aimed at assessing the relative effect of age in invasion team sports, mainly in youth sports (Romann, Rüeger, Hintermann, Kern & Faude, 2020; Silva, Leonardo, Rodrigues & Krahenbühl, 2022), the effect of RAE in professional soccer in relation with the influence of the competitive level and playing position (López-del-Rio, Radabán, Redondo & Sedano, 2019), being most of these studies in men's soccer (González-Villora, Pastor-Vicedo & Cordente, 2015; Helsen, Van Winckel & Williams, 2005; Prieto-Ayuso, Pastor-Vicedo, Serra-Olivares & González-Villora, 2015; Sedano, Vaeyens & Redondo, 2015).

Another study developed by Baker, Schorer, Cobley, Bräutigam & Büsch (2009) determined the relationships between gender, depth of competition and RAE in team sports. Similarly, Cobley et al. (2009) studied the effects of RAE in sport, seeking to determine the relationships that exist in the annual groupings by age and the development of athletes.

Likewise, it was found that some studies aimed at determining the effect of RAE in youth soccer from the analysis of the FIFA U-17 World Cup, as well as research aimed at determining the influences of nationality, playing position, and height of players on the effects of RAE in the FIFA U-17 Women's World Cup (Romann & Fuchslocher, 2012). However, studies have not been found to date investigating the effect of RAE in elite women's World Cups since its inception in 1991, nor have the study of the last four U-20 women's World Cups.

According to the study developed by Sierra-Díaz, González-Villora, Pastor-Vicedo & Serra-Olivares (2017), the hypothesis that the effect of the RAE has been increasing in recent years in elite youth category competition is confirmed, although, no significant effects of elite soccer teams were found as a result of the physical advantages that tend to disappear in older players. In the same way, it is confirmed that the RAE is influenced by a series of processes related to physical variables, positioning on the field of play and the process of talent detection and selection, among others (Sierra-Díaz et al., 2017).

Likewise, it is necessary to continue evidencing variables related to the playing position and other performance factors exhibited by the athletes, given that, a study evidenced that the differences between athletes by quarters of the year were inconsistent, making it necessary to continue developing research that helps to explain the relationship of the RAE with behavioral variables, coach criteria, training and competition environment, as well as the culture of the sport in each country (Figueiredo, Coelho-E-Silva, Cumming & Malina, 2019).

For all these reasons, the need arises since soccer is characterized by variability in its playing positions and sporting results. The studies of the RAE should be aimed at analyzing this relationship between the age positioning in the game and the position of the teams in tournaments.

In this sense, differentiating the needs of female athletes in response to their positioning within the playing field and how this influences the result is a topic of research interest for sports science. For this reason, the objective of the present research was to analyze the effect of age on the results obtained by each team, as well as the existing differences between playing positions.

Material & methods

Participants

Retrospective study that analyzed the effect of relative age in response to positioning and results obtained in the FIFA U-20 Women's World Cup and the FIFA senior elite World Cup.

The dates of birth were analyzed for each of the national teams. The U-20 and elite categories, corresponding to 4190 players distributed as follows: U-20 category (n:1344) through the analysis of 2014, 2016, 2018, and 2022 World Cups, and for the senior elite category (n:2846) the World Cups from 1991 to the 2019 World Cup were studied. Six U-20 women's World Cups were excluded from the study because the date of birth for each of the participating teams was not available, so the excluded World Cups were from 2002 to 2012. Likewise, the decision to analyze only these World Cups without counting the FIFA U-17 Women's World Cup responds to no access to the variables under study, mainly the date of birth. The dates of birth, playing position, results obtained, and position in the competition were analyzed for each tournament. The inclusion criteria for each women's world cup under 20 and above categories were the following: i) to have the date of birth (day/month/year) corresponding to each player participating in it, ii) that each team had a minimum of 20 players and iii) to obtain the results of each of the matches played in each women's world cup.

Thus, each data was obtained through the livefutbol.com and FIFA websites. Thus, the registration of the data was systematized as follows: i) create a database in Microsoft Excel, ii) create in each sheet the consignment of data for the U-20 category and another for the senior elite category, iii) fill in the date of birth for each of the selections and iv) record the results obtained.

Statistical analysis

To perform the statistical analysis, version 4.1.0 of the ® software was used. Absolute and relative frequency tables were made for each of the variables, which were divided into the total population, the U20 category and the senior elite category. Then, a bivariate analysis was performed for each of these variables with the age of the players. Finally, a boxplot was made for each of these bivariate analyses, to begin to get an idea of where this study will go. After that, the players were separated by each category, then the normality analysis was performed by means of the Shapiro-Wilk test to the age of the players, where a hypothesis system is assumed, where it is intended to prove that this distribution is normal. Finally, since age was not normally distributed in any of the categories, a Kruskal-Wallis test was performed as a non-parametric multiple comparison test. In the cases in which differences were found in the previous tests, a Tukey test was performed to determine differences in each of the pairs.

Results

Table 1 shows the absolute and relative representation of the athletes evaluated in the U-20 (n:1344), senior elite (n:2846), and all players (n:4190) categories in response to their positioning on the field and the results obtained for the groups of goalkeepers, and defenders, midfielders and forwards, and the position reached in the U-20 and senior elite women's world cups.

Table 1. Absolute and relative representation of the number of athletes evaluated in the U-20 and senior elite women's soccer cups organized by FIFA.

Category	All		U20		Senior Elite	
<i>Game positioning</i>	Absolute	Relative	Absolute	Relative	Absolute	Relative
<i>Goalkeepers</i>	544	12.98%	192	14.29%	352	12.37%
<i>Defenders</i>	1400	33.41%	448	33.33%	952	33.45%
<i>Midfielders</i>	1360	32.46%	448	33.33%	912	32.04%
<i>Forwards</i>	886	21.15%	256	19.05%	630	22.14%
TOTAL	4190		1344		2846	
Category	All		U20		Senior Elite	
<i>Position in the tournament</i>	Absolute	Relative	Absolute	Relative	Absolute	Relative
<i>Champion</i>	247	5.89%	84	6.25%	163	5.73%
<i>Subchampion</i>	248	5.92%	84	6.25%	164	5.76%
<i>Third place</i>	249	5.94%	84	6.25%	165	5.80%
<i>Fourth place</i>	248	5.92%	84	6.25%	164	5.76%
<i>Quarterfinals</i>	993	23.70%	336	25.00%	657	23.09%
<i>Round of 16</i>	368	8.78%	0	0.00%	368	12.93%
<i>Groups</i>	1837	43.84%	672	50.00%	1165	40.93%
TOTAL	4190		1344		2846	

Figure 1 shows the births for each player evaluated in the year's four quarters for U-20, senior elite, and both groups. The quarterly distribution of the birth dates observed confirms that there is a higher percentage of players born in the first six months of the year. For the senior elite category, 54.37% of the players participating in the women's World Cups organized by FIFA are born between January and March (1st quarter), with 27.02% and 27.35% corresponding to players born between April and June (2nd quarter). Finally, players born between July and September (3rd quarter) have the lowest percentage, with 22.03%.

Meanwhile, for the U-20 category, the percentage of players born in the first six months of the year (1st and 2nd quarter) represents 54.76% of the total number of players evaluated. Here, it is also determined that the third quarter has the lowest percentage of births for players participating in the FIFA U-20 Women's World Cup, with 21.06%. This information can be contrasted and deepened on the number of players born in each of the year's quarters, with a total of 2278 players born in the first six months of the year versus 1912 players born in the last six months of the year for the U-20 and older categories (see table 2).

Figure 1. The quarterly distribution of births for each player evaluated at the FIFA Women's World Cups in the U-20, senior elite, and total player categories.

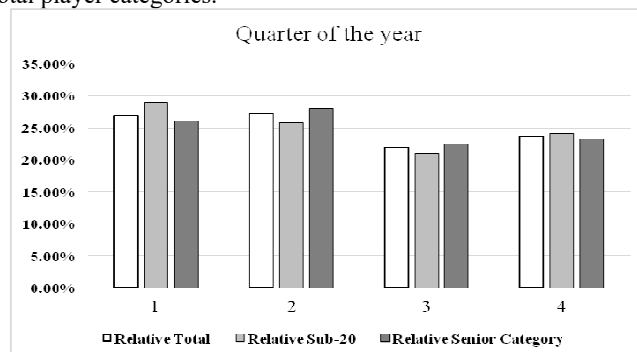


Table 2. Each of the quarters' absolute and relative representation corresponding to the total number of athletes evaluated in the U-20 and senior elite women's soccer cups organized by FIFA.

Categorized in the U 20 and Senior elite women's soccer cups organized by FIFA						
Category	All		U20		Senior Elite	
Quarter of the year	absolute total	relative total	absolute	relative	absolute	relative
1	1132	27.02%	389	28.94%	743	26.11%
2	1146	27.35%	347	25.82%	799	28.07%
3	923	22.03%	283	21.06%	640	22.49%
4	989	23.60%	325	24.18%	664	23.33%
TOTAL	4190		1344		2846	

Analysis U-20 category

In first place, it is worth mentioning that for the U-20 category, there is no round of 16, given that 16 teams participate in each competition. Thus, concerning the analysis of the RAE, figure 2 shows the statistically significant differences in response to the position achieved in the FIFA U-20 Women's World Cup. These differences were found between the teams that finished in third place and those that finished in the group stage and reached the quarterfinals. Finally, no statistically significant differences were found in the RAE vs. game positioning. This may be because, being a category with a specific age, most of the teams have players close to the age limit for the U-20 category (see Figure 3).

Figure 2. Boxplot age and its relationship with the position achieved in the FIFA Women's World Cup.

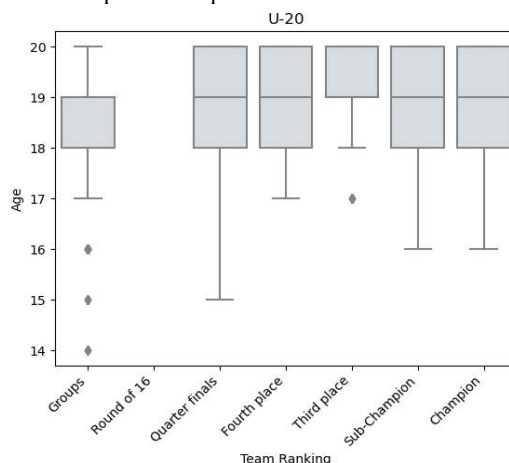
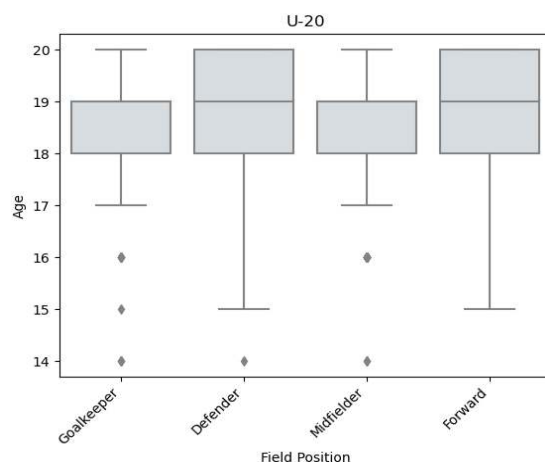


Figure 3. Boxplot age and its relationship to game positioning in the FIFA Women's World Cup.



Analysis senior elite category

It is worth mentioning that the FIFA senior elite Women's World Cup has been undergoing considerable changes in the number of teams, going from 12 participating teams in 1991 and 1995 to 16 teams between the 1999 and 2011 World Cups. In 2015, the number of teams increased to 24 for the 2015 and 2019 World Cups. Thus, in Figure 4, the boxplot shows the differences between the RAE and the position achieved in the FIFA Women's World Cup senior elite category. These differences were found in most of the analyses, the most representative being those established between the teams that reached the quarterfinals and group stage and the teams that were champions of the competition (see Figure 4). Likewise, differences were also found between age and playing positions, with goalkeepers being the oldest players compared to the rest of the positions (see fig 5).

Figure 4. Boxplot age with the position achieved in the FIFA Women's World Cup

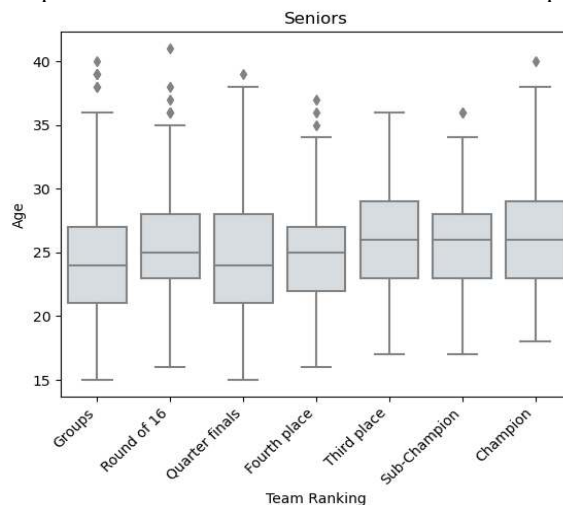


Figure 5. Boxplot age with game positioning in the FIFA Women's World Cup.

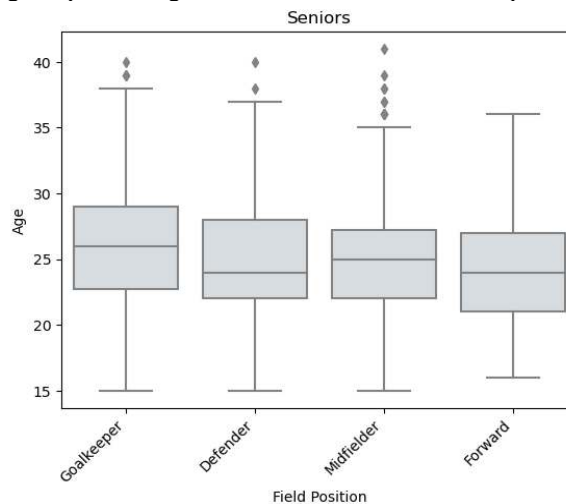


Table 3 shows the statistically significant differences established for each category. There, they determined that for the U-20 category, the average age of the teams that remained in the quarterfinals was higher than the average age of those in the quarterfinals ($p=0.02$). The average age of the teams that remained in the quarterfinals is higher than that of those in the groups ($p=0.00$).

Meanwhile, for the senior elite category, the statistically significant differences show that the average age of the teams that remained in the quarterfinals is lower than the average age of the teams that remained in the round of 16 ($p=0.02$), the teams that were champions ($p=0.00$) and of those that took third place ($p=0.00$). Similarly, the average age of the championed teams is higher than that of the teams that placed fourth ($p=0.03$) and group stage ($p=0.00$). Finally, the average age of the teams that finished in the group stage is lower than those that placed subchampion ($p=0.00$) and third ($p=0.00$).

Finally, the differences found between age and playing position reveal that goalkeepers have a higher average age compared to defenders ($p=0.00$), midfielders ($p=0.00$), and forwards ($p=0.00$).

Table 3. Statistically significant differences for the variables under study, elite category age VS position reached in the tournament, age VS game positioning and for U-20 category between age and position reached in the tournament.

Senior Elite Category (Age VS team position)						
group1	group2	meandiff	p-adj	lower	upper	reject
Quarterfinals	Round of 16	0.8729	0.0237	0.0673	1.6786	True
Quarterfinals	Champion	1.7004	0.0001	0.6177	2.7832	True
Quarterfinals	Third place	1.44	0.0016	0.3625	2.5175	True
Round of 16	Groups	-1.2714	0	-2.0113	-0.5314	True
Champion	Fourth place	-1.4449	0.0306	-2.8135	-0.0763	True
Champion	Groups	-2.0989	0	-3.1336	-1.0641	True
Groups	Subchampion	1.3212	0.0031	0.2892	2.3532	True
Groups	Third place	1.8384	0	0.8092	2.8677	True
Senior Elite category (Age VS position among players)						
group1	group2	Meandiff	P-adj	Lower	Upper	Reject
Defenders	Goalkeepers	1.2865	0	0.6102	1.9627	True
Forwards	Goalkeepers	1.7433	0	1.0219	2.4647	True
Midfielders	Goalkeepers	1.2848	0	0.6046	1.9651	True
U-20 Category (Age VS team position)						
group1	group2	meandiff	p-adj	lower	upper	reject
Quarterfinals	Third place	0.4149	0.0254	0.0309	0.7989	True
Groups	Third place	0.479	0.0025	0.1147	0.8432	True

Discussion

The effect of RAE continues to be a topic of research interest, mainly when studied in the female gender. Thus, the study developed by Korgaokar et al. (2018) is one of the few studies in which strong effects of RAE have been found in elite female youth soccer players. The aforementioned findings, are confirmed by the findings found in the present research, which reveal that if there is the effect of RAE for youth players U-20 category participants of the women's world cup organized by FIFA. However, the results of the research developed by Baro Zamorano (2017) with players of the Iberdrola League of Spain, evidence few effects of the RAE. Similarly, the study developed by Sedano et al. (2015) found RAE among Spanish female soccer players who represented national and regional level national teams. However, there are other studies in which the effect found for RAE in women's soccer has been minimal ((Nakata & Sakamoto, 2012; Romann & Fuchslocher, 2012; Vincent & Glamser, 2006; Van den Honert, 2012).

On the other hand, the results found are more related to research conducted in male soccer players (Lesma, Pérez-González & Salinero, 2011; Martín Barrero & Martínez Cabrera, 2021; Salinero, Pérez, Burillo, Lesma & Herrero, 2014), especially, when relating the effect of RAE to game positioning.

In another instance, the study developed by López-del-Rio et al. (2019) determined that, if there is an effect of the RAE, there is an overprovision of athletes born in the first six months of the year, being the national teams where this phenomenon mainly occurs. This is corroborated by the present research results when it was found that female national team players are predominant, both for the U-20 category and for the senior elite category. The study developed by Delorme et al. (2010), in which 15,285 players belonging to the French soccer federation corresponding to the U-10, U-14, and U-17 categories were analyzed, found an overestimation of players born in the first six months. However, this effect decreases in the higher categories. Nevertheless, these results are separate from those of the present study. The effect of the RAE is maintained for female soccer players in the world's most important national team tournament, both for the U-20 and senior elite categories.

Likewise, inverse SARs have been reported among older women, being a disadvantaged cohort (Goldschmied, 2011; Till et al., 2010), however, the findings of the present study evidence that the teams that are older, are the ones that achieve better positions in the tournaments, compared to teams that remain in the group stage.

Another study developed by Salinero et al. (2013) that related the effect of the RAE and the game positioning determined that the goalkeeper and defense positions are the most susceptible to be influenced by the effect of the RAE, a case that is reaffirmed in the present research only for the goalkeeper position.

The results provided by the study developed by Romann et al. (2020) reveal that the RAE has a minimal but constant effect on the participation of children's soccer. They concluded that the biases derived from the RAE are analyzed and eliminated in the stages of sports participation. This could contribute to the fact that players born in the last six months, belonging to a percentage lower than 50% of the population evaluated in the present study, may have more options to participate in the national teams. In other words, the scope of research focused on the effect of the RAE seeks, in one way or another, to reorient how athletes who have a specific advantage of being born in the first six months of the year are selected.

Another conclusion derived from a study conducted at the U-17 Women's World Cup with senior elite women's youth soccer players found that there are considerable effects of SAR and that these links are also related to playing positions (Romann & Fuchslocher, 2012). However, the present research findings for the U-20 category do not show significant relationships between RAE and playing position.

Finally, another research evidenced when analyzing the final stages of the competitions (quarterfinals, semifinals and finals), that the RAE did not have an evident impact in the professional senior elite category, however it did exist in the lower categories: U-21, U-19 and U-17 (González-Villora et al., 2015), data that do not contrast with those evidenced in the present research where the effect of relative age was found with the results obtained in the U-20 and senior elite categories.

Conclusions

According to the objective set for this research, the variables under study show that age with the results achieved reflects statistically significant differences, both for the U-20 category and the senior elite category. The main differences show that the teams that reach first place in the women's soccer tournaments organized by FIFA have a higher average age than those that do not make it past the group stage.

Likewise, for the senior elite category, it was found that there are statistically significant differences between age and the relationship that exists with the positioning of the game. There, goalkeepers are the ones with a higher average age compared to the rest of the positions. This may be due to the experience that must be had to guard the goal of each team. For the senior elite category, it has been found that the first, runner-up and third-placed teams have a higher average age than those that finished in the group stage.

This research sought to determine the relationships between the RAE with the game positioning and the position reached in the women's soccer world championships. There, it was found that for the U-20 category, only differences were found between the positions, with the teams that came in third place being the most homogeneous. At the same time, the teams that occupied the first four positions had a higher average age than those eliminated in the quarterfinals or did not advance past the group stage. This raises the question of whether the U-20 teams have the best players. Therefore, it is still necessary to know the effects of the RAE in women's soccer, thus seeking to generate an awareness process for coaches and all the actors of the performance system to avoid sport abandonment and, at the same time, guarantee equal opportunities for players to demonstrate their performance in the different international championships in response to the age established by each championship. According to the analysis for both the U-20 and senior elite categories, of the 4190 players who participated in the women's soccer World Cups analyzed, 544 were goalkeepers, 1400 central defenders, 1360 midfielders, and 886 forwards. Four thousand one hundred ninety players, it is observed that, for both categories analyzed, players born in the first six months of the year prevail, with 54.37% and 54.76% for the senior elite and U-20 categories, respectively. Likewise, it is found that, for both categories, the lowest percentage of players who participated in the analyzed competitions was in the third trimester, with 22.03% in the senior elite category and 21.06% in the U-20 category. The findings of the present research ratify the need to review the organization of the categories by year of birth, given that there is still a tendency for players born in the first months of the year to have a greater chance of being chosen to represent their countries in the most important competition in women's soccer.

Future prospects

It would be necessary to establish the effect of the RAE, comparing the men's and women's U-20 World Cups, as well as the senior elite World Cup as the highest performance category. There, it would be possible to show the trend of the SAR effect according to the highest competition organized by FIFA, both for men's and women's soccer. And, at the same time, this effect could be evidenced according to the game positioning, which could help to understand the needs of each position.

Limitations The study's main limitations are not finding the database of the U-17 World Cup and, thus, being able to perform a much deeper analysis of the effect of age on the game positioning and the position achieved by each team.

Recommendations

The results of this research should be considered, especially when considering the training of youth players who will participate in the U-20 championships, given that a higher percentage of selected players born in the first two quarters of the year continue to prevail.

Conflicts of interest

The authors have no conflict of interest

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