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Original Article

Competitive balance using Accumulated Points Difference method in male and female roller hockey leagues.

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Abstract
The purpose of this study was to quantify the competitive balance in both men's and women's professional division roller hockey competitions (Spanish and Portugal leagues) comparing the results obtained according to the sex of participants. The sample was composed of 5,942 roller hockey games (2,044 in Spanish male league, 1,580 in Spanish female league, 1,814 in Portuguese male league and 504 in Portuguese female league) between the 2009-2010 and 2017-18 seasons. To calculate the competitive balance, it was used the Accumulated Points Difference index andthe one way ANOVA followed by Tukey Post Hoc multiple comparison test.
The results showed that male leagues are more balanced than female (71.41±11.29 vs. 79.65±5.75 for Spanish leagues and 75.56±7.54 vs. 80.16±15.01 for Portuguese leagues).
The results in relation to the sex of participants are consistent with previous studies in other sports like football. The analysis of the competitive balance could be useful for the governing body of *Roller Hockey Federations* to have quantitative data of the equality that exists in each league and to asses if it is necessary to introduce changes in the competition to make it more equalized in order to increase the audience.
Key words:competitive equilibrium, gender, performance analysis, team sports.

Introduction

The balance in sports competitions has become one of the key issues in the field of the sports economy. Contrary to what happens in other sectors, sports, and especially sports leagues, requires a competitive adversary in order to achieve maximum benefits(Lee, Kim, & Kim, 2018).

The competitive balance (CB) would be perfect when all the teams had the same probability of winning the competition(García-Unanue, Godoy, Villarrubia, Sánchez-Sánchez, & Gallardo, 2014). Thus, the study of the CB for each sport leagues is relevant because a greater balance results in greater fans' interest, which leads to better attendance and more television audience(Soebbing, 2008). So the existence of a good CB does not it only benefits the fans, but it is also profitable, from the economic point of view, for the competition itself, since the teams will have the possibility of increasing the income as the attendance grows(Levin & Bailey, 2012; Levin & Mcdonald, 2009).

Although there have been several investigations on the different variables and performance indicators related with CB in some team sports such as basketball (García-Unanue et al., 2014), ice hockey (Bowman, Lambrinos, & Ashman, 2018), handball (Hantau, Alexandru, Yannakos, & Hantau, 2014), baseball(Soebbing, 2008)or football(Naghshbandi, Yousefi, Etemad, & Moradi, 2011; Ramchandani, Plumley, Boyes, & Wilson, 2018; Triguero-Ruiz & Avila-Cano, 2018)there are few data regarding this topic about the sport of roller hockey. The CB, then, can be interpreted as the degree of uncertainty about the positions that the different teams will occupy at the end of the season. More specifically, Szymanski (2003) differentiates between 3 types of uncertainty in sports competitions. First, the uncertainty in a game, in which the two teams have a chance to win. Second, the uncertainty in a specific season, in which several teams can be in the top positions or enter the playoffs. Finally, the uncertainty in a competition or league, where the championship must be won by different teams throughout the seasons.

Scientific research has used various methods to measure competitive equilibrium, focusing mainly on the analysis of regular leagues(García-Unanue et al., 2014).Among these measurement methodsit can be find the standard deviation of the victories percentage adjusted over the standard deviation for a perfect competitiveness (Humphreys, 2002), the Gini coefficient (Schmidt, 2001), the concentration ratios of victories for the first 5 teams(Naghshbandi et al., 2011),the Hirschman-Herfindal index (Owen, Ryan, & Weatherston, 2007)or the Accumulated Points Difference index (Gasparetto & Barajas, 2016).

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Previous research in CB has mainly focused on male athletes, and few studies have been devoted to comparing this phenomenon in men's and women's competition, although some of them report a lower equilibrium in women' competition(Zambom-Ferraresi, García-Cebrián, & Lera-López, 2018).

To our knowledge, no study has yet focused on the CB in roller hockey sport. Thus, the main aim of this study was to analyse and compare the CB of male and female top division leagues of Spanish and Portuguese roller hockey using the Accumulated Points Difference method.

Methods

Sample

In order to carry out the study, 5,942 roller hockey games were analyzed belonging on the Spanish male league (2,044 matches), the Spanish female league (1,580 matches), the Portuguese male league (1,814 matches) and the Portuguese female league (504 matches). All games were played in each national league from the seasons 2009/2010 to 2017/2018 (9 seasons in total). The roller hockey leagues have a balanced schedule of games in which each team play every other once at home and once away during the season. In all games played there was a local team and a visitor since only the matches of the regular league have been included. The point system of roller hockey in the analyzed seasons uses 3 points for a win, 1 point for a draw, and 0 points for a loss. The data collection was carried out using the final standings of each game published on the Spanish Roller hockey Federation website (www.fep.es) and on the Portuguese Roller hockey Federation website(www.fpp.pt/HP/Historico/Classificacoes). Data were checked by using the independent web portal Okcat (www.okcat.cat) for match data.

Variables

As an indicator of competitive equilibrium, the Accumulated Point Difference (APD) method was used. The APDproposed forGasparetto & Barajas (2016), calculates the sum of the points'differences among the participants. These differences are computed by decreasing from the total points of the champion what has achieved second place. It is repeated successively until the point difference between the penultimate team and the last of the classification table.

Thus, the calculation of the maximum imbalance would be the following:

$Unbalance_{max} = 6 * (N - 1)$

Consequently, the formula created from the APD is presented below:

$$APD = \left(\frac{\sum_{i=1}^{N} (TP_{i=1})}{Unbalance_{max}} \right) * 100$$

Where N is the number of participating teams and TP is Total points of each club at the end of the tournament.

Statistical analysis

The Kolmogorov-Smirnov test was used to confirm the data were normally distributed to confirm the use of parametric techniques. Descriptive statistics methods were used to calculate mean and frequencies. The comparison of the four groups was performed by analysis of variance (ANOVA) with two factors (gender and APD), followed by Tukey Post Hoc multiple comparison test.

Statistical analysis was accomplished using SPSS (Version 20 for Mac; SPSS Inc., Chicago, IL, USA) and statistical significance was set at $p < 0.05$.

Results

There was not found a significant main effect of gender and league on APD index [$F_{(3,32)} = 1.355$ $p = 0.274$].Table 1shows descriptive statistics and percentages of APD from all the matches in the different leagues between the 2009-2010 and 2017-2018 seasons.As it can see, men leagues have a lower APD index than women for both national leagues. Althoughthis difference was not statistically significant ($p > 0.05$) the difference was almost 9% for Spanish leagues (males/females: 71.41±11.29 vs. 79.65±5.75, p= 0.354**)** and almost 5% for Portuguese leagues (males/females: 75.56±7.54 vs. 80.16±15.01, p= 0.791).

Table I. Descriptive analysis of APD values for each league and season. Total values are expressed in mean ± SD.

Season	Spain		Portugal	
	Men	**Women**	**Men**	**Women**
2009-2010	70.00	79.49	72.22	78.57
2010-2011	57.69	81.94	71.11	54.76
2011-2012	70.51	78.21	79.76	80.95
2012-2013	70.00	79.49	77.78	61.90
2013-2014	91.11	93.59	64.44	76.19
2014-2015	85.56	70.83	83.33	80.95
2015-2016	63.33	85.90	75.64	97.62
2016-2017	58.89	79.49	75,00	100
2017-2018	75.56	67.95	80.77	90.48
TOTAL	**71.41±11.29**	**79.65±5.75**	**75.56±7.54**	**80.16±15.01**

For the 9 seasons studied, it seems that APD remains more stable in men's league than in women's league (Figure 1).

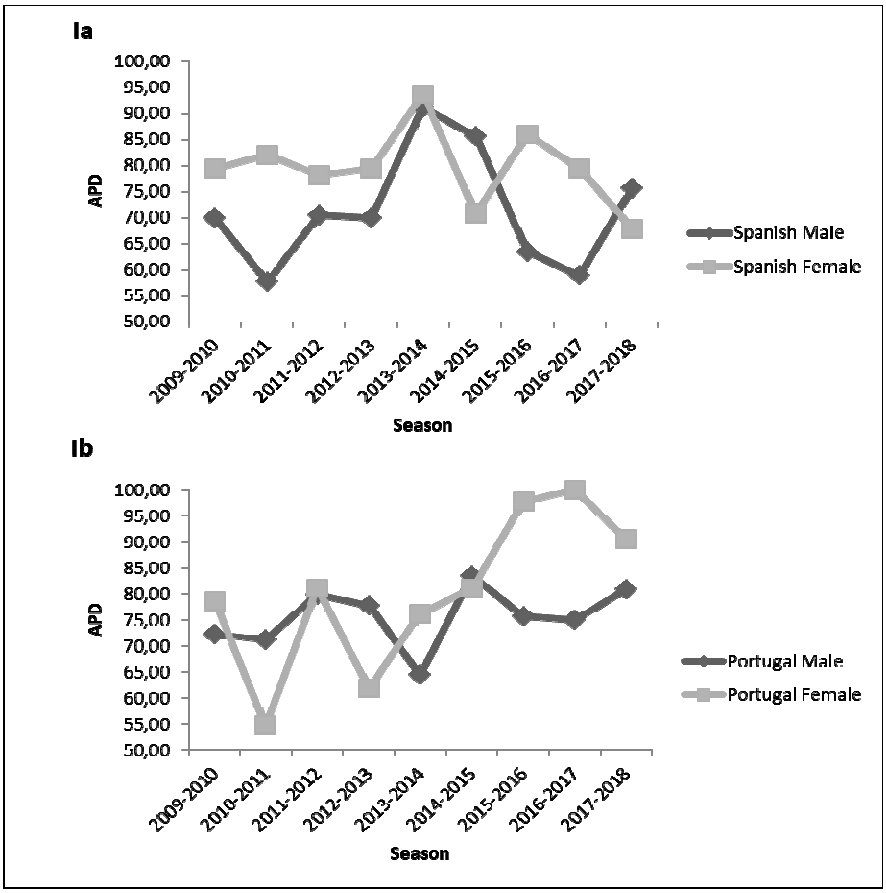

Figure I. Comparison ofAPD over time according to the league and gender. The figure Ia shows APD in Spanish league and Figure Ib shows APDin Portuguese league.

Table 2 compares the average position of teams that have achieved a championship during the nine seasons analysed. Likewise, it shows the dominance of some clubs in their national leagues. The fact that a club has presented a position close to 1 or 2, recognizes that although has not won the league, was always close to the top positions.

Table II. Champion teams, number of championships and average position from 2009-2010 to 2017-2018 seasons.

Spain						Portugal					
Men			Women			Men			Women		
Club	C	AP	Club	C	AP	Club	C	AP	Club	C	AP
F.C.Barcelona	7	1.33	C.P. Voltregà	5	1.66	FC Porto	4	1.77	SL Benfica	6	1
Liceo H.C	1	2.11	Gijón H.C	2	2.66	SL Benfica	3	2	Turquel	1	2.87
Reus Deportiu	1	3.55	H.C Palau	1	5.14	Sporting CP	1	3.88	GDR OsLobinhos	1	2
			Cerdanyola H.C	1	8.43	AD Valongo	1	5.22	F. Nortecope	1	1

C = Championships' achieved; AP = Average Position

Discussion

The present study aimed to examine the CB in both men's and women's Spanish and Portuguese professional division roller hockey leagues using the APD method and to compare the results obtained according to gender.

The comparison between the men's and women's leagues provided evidence of greater CB in men's league. As this was the first comparative study on CB in roller hockey, there are no previous studies to interpret these findings. However, these results were not unexpected as the available literature in other sports also shows evidence of greater CB values in men's leagues, as in football, where Zambom-Ferraresi et al. (2018)analysed the CB effect in Spanish First Division football leagues (*Liga Santander* vs. *LigaIberdrola*) reporting higher male values.

There are several possible explanations for the differences found between genders according to some of the factors allegedly related to the competition characteristics. One of them, as it happens with other sports, is that the female clubs' sections which have a professional male team,are benefitted by the infrastructure and staff of the male section. This phenomenon could be called "drag effect"(Zambom-Ferraresi et al., 2018), and provides a great advantage for some female clubs respect to the others which don't have a male section. Another aspect that should be taking into account would be the tradition and story of a club, normally related to the male section. Roller hockey clubs with a large tradition used to have higher support provided by institutions and membership base.Bothfacts could be the main reasons why in Spanish and in Portuguese female's leagues the same two teams have won five and six championships respectively in the last nine seasons (C.P.Voltregà for Spanish league and SL Benfica for Portuguese league).

Regarding the evolution of CB values over time,it should be noted that in men's league seems to remain more stable while in the female league shows a higher variability. As it happens with other sports, the professionalization process has not been so generalized in female teams with respect to the professionalization process of male teams (Brito, Miarka, de Durana, & Fukuda, 2017). For this reason, in the female competitions, there are some teams with many resources competing against others with very different potential in the same league. This fact could explain the high variability of CB values between seasons in women's roller hockey competitions, like in the Portuguese female league where the APD value ranges from 54.76% to 100%.

The present investigation has some limitations that have to be acknowledged and should be addressed in further research. Firstly the present study has the limitation of being only focused on two countries. In order to generalise our findings, it would be necessary to consider male and female leagues in other countries with a great tradition in roller hockey (e.g. Italy, France, Argentina, etc.).Secondly, further research could study the CB in other roller hockey competitive contexts like divisions (1st Division, 2nd Division, etc.) to contrasting them with the present results and to know if have different values.

Conclusions

The results of this study reveal the CB valuein another sport, roller hockey. According to the results obtained, the CB using APD method in the Spanish men and women's leagues are 71.41% and 79.65% respectively; for the Portuguese roller hockey is 75.56% for the men's league and 80.16% for the women's league.Therefore, this investigation provides new knowledge for a better understanding of the CB effect in general, and the sport of roller hockey in particular.In this way, it is expected that the present research contributes to the theoretical and methodological development of the subject.

The analysis of the CB could be useful to help roller hockey teams toplan the training loads according to whether the game is played against. Apart from that, it could also be useful for the governing body of *Roller Hockey Federations* to have quantitative data of the equality that exists in each league and to asses if it is necessary to introduce changes in the competition to make it more equalized (e.g.change the regular league forplayoff system, establish a cap salary, etc.) and increase the audience.

Disclosure statement

No potential conflict of interest was reported by the authors

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