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Effect of Situational Factors on the Rate of Perceived Exertion of Liga Femenina 2 Players

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Abstract

The aim of the study is to understand the impact of certain situational variables (game location, season phase, game outcome, score-line and quality of opposition) on the rate of perceived exertion (RPE) of women players of Liga Femenina 2 in competition. 24 matches played by 12 players of a team from group B of Liga Femenina 2 of the Spanish Basketball Federation during the 2019/2020 season were analysed. The RPE of the players was collected between 20 and 30 minutes after the end of the game. A multiple regression analysis was performed, considering the five situational variables as predictors of RPE. The results show that 44.61% of the RPE values are explained by these situational variables in a statistically significant way. Of the 5 situational variables analysed, the game location and the quality of opposition are dependent on the RPE. Playing away and against a weaker opponent is directly related to a higher RPE of the players in competition.

Keywords: Basketball, competition, rate of perceived exertion and situational variables.

Introduction

The quantification of the training load is a tool widely used by physical trainers and coaches to optimize sports performance, since it allows defining goals and controlling the evolution of the players (Hernández, Casamichana, & Sánchez-Sánchez, 2017) The quantification of the load is carried out taking into account two main indicators: internal and external load. Internal load can be measured using heart rate, accelerometry and rate of perceived exertion (RPE). There is scientific evidence in which a high correlation of RPE values with heart rate measurements is established, proposing the use of RPE as a means to control training intensity in absence of other resources (Boas, Arede, Vaz, & Leite, 2019; Borresen & Lambert, 2009; Fanchini et al., 2011; Fox, O'Grady, & Scanlan, 2020; Vaquera Jiménez, Suárez Iglesias, Vidania de Luis, & Calleja González, 2017).

The RPE is related to physiological factors and is considered a reliable method to assess the intensity and degree of fatigue of physical exercise (Kilpatrick, Bortzfield, & Giblin, 2012) being a useful method to monitor the internal load in basketball (Azpiroz, Feu, Jiménez, & Calleja-González, 2013; Gracia, García, Cañadas, & Ibáñez, 2014; Lupo, Tessitore, Gasperi, & Gomez, 2017). As a standardized and non-invasive method, the Borg scale (Borg, 1982) has been used to obtain the RPE of players during competition or practices (Castañer, Saüch, Camerino, Sánchez-Algarra, & Anguera, 2015).

It has been proven how different performance indicators, directly related to game variables, can affect RPE in basketball, especially during practices (Bredt et al., 2020; Curtis et al., 2020; Ferioli et al., 2020; Reina, Mancha, & Ibáñez, 2017) and in competition (Fox et al., 2020; Izquierdo & Redondo, 2020; McGown, Ball, Legg, & Mara, 2020). Research has also helped to identify which performance indicators are the most decisive for winning or losing a match (Fichman & O'Brien, 2019; M.-A. Gómez, Lorenzo, Ibañez, & Sampaio, 2013; Leicht, Gomez, & Woods, 2017) and has verified the effect of certain situational variables (for example, game location, score-line, quality of opposition) on these performance indicators and the game outcome (M. A. Gómez & Pollard, 2011; Marcelino, Mesquita, & Sampaio, 2011; Sampaio, Lago, Casais, & Leite, 2010).

Recent research has considered the score-line as a situational variable to distinguish between equal and unequal games in relation to different performance indicators and their use and/or effectiveness (Curtis et al., 2020; Fox, Stanton, Sargent, O'Grady, & Scanlan, 2019; Redwood-Brown et al., 2018; Sampaio et al., 2010), for example, in tied games, the team that wins the defensive rebound has a better chance of winning the game, while in unequal games, the winning team is more effective in the 2-point shooting, takes more defensive rebounds and gives more assists (Angel Gomez, Lorenzo, Sampaio, Jose Ibanez, & Ortega, 2008), or also in the final minutes of even games the shot selection and free throws (Gomez, Ortega, & Jones, 2016). In addition, it has been seen that there is a relationship between the time of the season (for example, pre-season, first round, second round) with the effectiveness of certain actions such as better shooting percentages during the season in relation to the pre-season or higher loads in the preseason games (Curtis et al., 2020; Redwood-Brown et al., 2018; Sampaio et al., 2010).

The factors that contribute to the resulting fatigue during and/or after a basketball game are derived not only from the physical effort, but also from the concomitant mental load (cognitive, emotional...) and the results of the task

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that is being or has been carried out (D Cárdenas, Conde-González, & Perales, 2017) .

In this line, controlling the training load during the competition itself provides information on its demands. Understanding these demands allows to exercise better control to make decisions, reduce risk of injury and improve performance (Fox et al., 2019). Although situational variables are considered as factors that condition performance during a game, there is little background that shows to what degree they condition the player's RPE and its effect on internal load. Basketball research has focused almost exclusively on knowing the impact of the calendar (Conte, Kolb, Scanlan, & Santolamazza, 2018; Manzi et al., 2010) on this internal load, ignoring other situational variables (game outcome, season phase, quality of opposition and score-line) that can influence RPE as recently studied in soccer (Curtis et al., 2020; Gonçalves et al., 2020)

Following this line of work and in order to provide some evidence in relation to the factors that influence the perception of fatigue of the basketball player, the goal of our work is to know the effect of certain situational variables (game location, season phase, quality of opposition, game outcome and score-line) over the RPE of Liga Femenina 2 players during the competition.

Methods

Subjects

The current analysis was carried out on a team from group B of the Liga Femenina 2 of the Spanish Basketball Federation during the 2019/2020 season. The team consisted of 12 semi-professional players aged between 18 and 45 (M ± SD: age = 25.9 ± 7.2), with heights between 166 and 194 centimetres (M ± SD: height 177.3 ± 8.7 cm) and all have at least 10 years of experience in this sport (M ± SD: years of experience = 16.2 ± 6.6 years).

The 24 games played by the team under study during the 2019/2020 season were analysed, 4 of them were pre-season and the remaining 20 were from regular season (all those that were played before the competition was suspended due to COVID-19).

Design

The study was carried out using observational methodology, which allows the necessary analyses (qualitative and quantitative) to be carried out to find the relationships of various orders existing between the different dimensions and their categories (Anguera & Mendo, 2013). The design is idiographic when analysing a single team from group B of basketball Liga Femenina 2 as a single unit. And longitudinal, since the 24 games played by this team throughout the 2019/2020 season are analysed. The variables under study are:

- RPE: The adapted Borg scale was used with values from 1 to 10 (Borg, 1982), which measures sensations of effort, discomfort and/or fatigue experienced during aerobic-anaerobic or strength training.
- Game location: Two categories are distinguished: a) local, when played at home or b) away, when played away from home, on the rival team's court or on a neutral field and therefore, entails a displacement of the usual practice place (Fox et al., 2019).
- Season phase: Period of the year in which the game is played. Three periods were considered: a) pre-season, if it is in the first 5 weeks prior to the start of the competition, b) first round, game between days 1 and 13 and c) second round, game between days 14 and 26 (Curtis et al., 2020).
- Quality of opposition: Three categories were considered to classify the competitive level of the teams: a) strongest team, when at the time of the game the rival team is 3 or more places above, b) similar team, when in the moment of the game is at most 2 places above or below, and c) weakest team, when at the time of the game it is 3 or more places below the team or is a lower league team (Curtis et al., 2020).
- Game outcome: It was considered, a) victory if the team under study is the winner of the game and b) defeat if it is the loser (Fox et al., 2019).
- Score-line: It was considered a) equal game, when the final difference between both teams is a maximum of 8 points scored or b) unequal when the final difference between both teams is more than 8 points scored (Fox et al., 2019).

Procedures

Data recording was carried out throughout the 2019/2020 season, from September to March. Divided into 3 phases: Pre-season, first phase and second phase. In the first session of the preseason, an informative meeting was held with the players in which they became familiar with the Borg scale and the post-training and post-game RPE record and the procedure to carry it out. The participants signed the corresponding informed consent.

The protocol followed to obtain the post-game RPE consisted of the players having to communicate, individually by WhatsApp, their RPE to the person in charge of the data record before leaving the gym during the 20-30 minutes after the end of the game.

All games except 1 were played on the weekend and the team had a total of 4 practice sessions on the court and 3 in the gym during the week.

In the games played at home, the players were at the court 2 hours before the start of the game for treatments with physiotherapists and pre-game warm-up. In games played away, depending on the travel plan, they travelled on the same day of competition or the day before. The players arrived at the gym 2 hours before the game.

All the data collected were stored in Microsoft Excel 2019 for subsequent statistical analysis with the IBM SPSS Statistics 21 program.

Statistical Analysis

To analyse the relationship between the RPE of the players, after the competition, with the situational variables (game location, season phase, quality of opposition, game outcome and score-line), a multiple regression analysis was proposed, considering situational factors as predictor variables and RPE as criterion variable. The level of significance is set at $p < 0.05$. The multiple regression equation is as follows:

$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + e$

Y is the RPE (criterion variable), e is the error random variable and the variables X1, X2. X3, X4 and X5 correspond to situational factors (predictor variables).

Simple regression analyses were performed with each of the predictor variables, to see how they individually influence the criterion variable. All data are expressed as mean ± standard deviation, to determine the differences between the dimensions of each variable.

Results

Once the multiple regression analysis has been carried out between the situational variables and the criterion variable, the analysis of the variance of this is presented below (Table 1):

Table 1

Analysis of variance table in multiple regression.

	Degrees of freedom	Sum of squares	Average of the squares	F	Critical value of F
Regression	5	1,6172	0,3234	2,8992	0,0432
Waste	18	2,0081	0,1116		
Total	23	3,6253			

Since the critical value of F = 0.0432 is less than the significance level $\alpha = 0.05$, the null hypothesis is rejected, that is, it is true that there is a dependency relationship between the predictor variables (situational) and the variable criterion (RPE). The coefficient of determination R^2 is 0.44608, this means that the model thus adjusted allows to explain 44.61% of the RPE in a statistically significant way.

The data from each of the simple regression analyses performed for each predictor variable are shown below (Table 2). The critical value of F and the coefficient of determination R^2 are shown:

Table 2

Critical value of F and coefficient of determination R^2 of each of the simple regression analyses.

Variable	Critical value of F	Coefficient of determination R^2
Game location	0,0287	0,19941
Season phase	0,6977	0,00699
Quality of opposition	0,0386	0,18026
Game outcome	0,2109	0,07017
Score-line	0,1422	0,09528

Of the five variables analysed, the critical value of F for both the game location and the quality of the opposition is lower than the significance level $\alpha = 0.05$, therefore the null hypothesis is rejected, and it is true that there is a dependency relationship of these predictor variables with the RPE. And according to the coefficient of determination R^2, the game location allows explaining 19.94% of the RPE in a statistically significant way and the quality of the opposition 18.03%.

For the rest of the variables, having a critical value of F higher than the significance level, the null hypothesis is not rejected and the dependency relationship of these variables with the RPE is not fulfilled, independently. The results obtained to determine the differences between dimensions of each situational variable are presented in Table 3, expressed as means ± standard deviation.

Table 3

RPE (M ± SD) depending on the game location, season phase, quality of the opposition, game outcome and score-line.

Variable	Local	Away	
Game location	7,35 ± 0,36	7,7 ± 0,37	
	Preseason	First round	Second round
Season phase	7,8 ± 0,68	7,42 ± 0,3	7,62 ± 0,33
	Stronger	Similar	Weaker
Quality of opposition	7,42 ± 0,41	7,55 ± 0,32	7,98 ± 0,32
	Win	Lose	
Game outcome	7,41 ± 0,49	7,62 ± 0,32	
	Equal game	Unequal game	
Score-line	7,67 ± 0,42	7,43 ± 0,35	

Discussion

The goal of the research has been to determine the effects of various situational factors on the RPE as a quantifier of the load in competition in basketball, specifically for the game location, the season phase, the quality of the opposition, game outcome and the score-line in players of Liga Femenina 2.

The multiple regression shows how the studied situational variables explain 44.61% of the RPE obtained with statistical significance of $p < 0.05$. Curtis et al. (2020), in NCAA soccer players, found similar results, (differences in RPE between 0.75-1.71 units between some dimensions and others). The authors check how situational variables directly influence RPE beyond performance indicators or variables directly related to the game. Along the same lines, the RPE values obtained for the sample under study can be explained by 44.61% by the situational variables analysed, which means that 55.39% would be explained by variables not included in work, such as, for example, types and number of attacks, effective or failed individual actions, or types of defense and/or defensive pressure exerted by the rival, among others (Bredt et al., 2020).

The results show that the game location (home or away) is significantly related to the RPE of the players after the competition. The average RPE in the games played as away games is 0.35 units higher than the games played at home. Fox et al. (2019), for a male semi-professional team, found higher RPE values in games played as visitors; in these, the

number of jumps, high intensity actions, total and relative slowdowns, also presented higher values. Gonçalves et al. (2020), for semi-professional soccer players, obtain higher RPE values in games played away from home. Regardless of the factors directly related to the game, the fact of having higher RPE values when playing as a visitor can be associated with the "unsuitable" travel conditions of semi-professional teams that influence fatigue in competition. Add to this fact that, due to a low budget, not all players can travel, having a direct impact on the number of minutes of play of those who do travel, it could partly explain the higher values of RPE in away games, as indicated by Fox et al. (2019).

Curtis et al. (2020) in their study show that the load borne by players in the pre-season is higher than that borne during the season due to the type of practice carried out and its concentration. The results obtained for our sample reflect that the mean RPE during the preseason (7.8 ± 0.68) is higher than in the first (7.42 ± 0.3) or second round (7.62 ± 0.33). However, the standard deviation of the RPE during the preseason (0.68) is much higher, which means that this difference is not significant and therefore it cannot be said that the moment of the season, for the analysed sample, it directly influences the RPE of the players. It would take more pre-season games to have a greater amount of data and to be able to compare with season games.

Regarding the quality of the opposition, previous studies in soccer such as that of Curtis et al. (2020) found no relationship with the internal load of the players. Although, other works, also in semi-professional soccer, obtain results that allow them to conclude that the effect of the quality of the opposition on the load is greater when the level of the rival is similar to that of the analysed team (Brito, Hertzog, & Nassis, 2016). However, the results obtained by Gonçalves et al. (2020) show that the load of the players is greater when they face weaker opponents compared to when they play against teams of their level and decreases even more against stronger opponents. The results obtained for the sample analysed in our study present values that support the conclusions of Gonçalves et al. (2020). The quality of the opposition has a significant relationship with the RPE, being clearly higher when playing against a weaker opponent (7.98 ± 0.32) than when playing against a rival of similar level (7.55 ± 0, 32) or higher (7.42 ± 0.41). Without having objective data with which to discuss, we can venture to think that there may be an additional emotional component that supposes a greater mental load for the players due to the fact of not being able to fail against opponents in theory worse classified, a mental load that affects a greater feeling of fatigue and therefore, greater RPE (D Cárdenas et al., 2017).

Fox et al. (2019), in men's semi-professional basketball, do not find differences in the volume of the players' workload during victories and defeats, which is consistent with previous research in soccer, in which no differences are seen in the distances covered according to the result of the match (Bradley & Noakes, 2013). Our results do not significantly relate the game outcome with the RPE, although in defeats (7.62 ± 0.32), its value is higher than when it is won (7.41 ± 0.49), although the standard deviation in the victories is greater (0.49), which means that the difference is not important. Gonçalves et al. (2020) also obtain higher RPE values in losses. Even so, the fact that the RPE in defeats is higher is related to a greater number of high intensity accelerations and total decelerations (Fox et al., 2019), which can be explained by the physical and mental effort that a team has to make to overcome a losing game, which implies greater fatigue (D Cárdenas et al., 2017) and therefore also a greater RPE. It would be interesting for future researches to associate in the RPE values to the partials on the scoreboard as a function of match time to get a better idea of what happens to the RPE in wins and losses.

Regarding the score-line, our results show that the RPE values are higher when the game result is equal (7.67 ± 0.42) compared to when it is unequal (7.43 ± 0.35). In matched games, the number of total and high intensity accelerations is higher, as well as decelerations and RPE according to the results found by Fox et al. (2019). It may be related to the fact that in matched matches, coaches tend to reduce team rotation and keep the starting players more minutes on the court to increase the chances of winning, so the load and RPE tend to increase (Curtis et al., 2020; Fox et al., 2019), it can even be understood that an even match requires greater concentration to avoid mistake, more cognitive and/or emotional involvement and this results in a greater mental load, than together with the physical load conditions higher RPE values (D Cárdenas et al., 2017; David Cárdenas et al., 2013). However, our work does not present enough differences to consider that the score-line has a significant influence on the RPE of the players in competition.

Conclusions

After analysing the results, it can be concluded, for the sample studied, that:

a) Situational variables can explain the value of RPE in competition by 44.6%. The remaining percentage could be explained by the influence of other variables not taken into account in this work.
b) Game location and the quality of the opposition are situational variables that significantly influence the RPE of the players in competition. While the season phase, the game outcome and the score-line, despite also showing differences in the RPE between their dimensions, are not found to be important enough to claim that their influence is significant. Therefore, playing away from home and against a weaker opponent is directly related to a higher RPE in competition.

Limitations

Although the present study has tried to explore what effect the situation variables may have on RPE, it would have led to more valid research outcomes if the study had used a sample greater than the 24 games analysed and to analyse more than one team. Furthermore, the current researcher is well-aware of the need to incorporate additional situational variables as partial markers every five minutes to explain the behaviour of the RPE in certain circumstances.

Practical Applications

In light of the results obtained, this study can help coaches to plan weekly workloads based on variables such as game location and the quality of the opponent, which we know, for the sample under study, can potentially influence the RPE.

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