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**Original Article**

# Training Sessions' RPE in Professional Football is Influenced by Playing Position

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**Abstract**
The aim of this study was to investigate if professional football players' RPE reported after training sessions is influenced by their playing positions.Professional football players (n = 28) from afirst division Brazilian club had RPE collected after training sessions during 10 weeks of the regular season. Athleteswere divided in groups according to their playing positions (GK, n = 3; CB, n = 4; FB, n = 5; CMF n = 5; AMF, n = 4; WMF n = 4; andFWD; n = 4).Descriptive analysis of the sample was followed by the application of the Welch's F-Test with Games-Howell post-hoc for RPE analysis of variance across positions. All playing positions reported "moderate" as mean- and mode-RPE (GK=3,19±0,64; CB=3,85±1,29; FB=3,87±1,39; CMF=3,99±1,28; AMF=3,78±1,25; WMF=3,59±1,18; FWD = 3,70±1,08), open field positions perceived effort in all intensity zones, while GKperceived sessions within a narrower range of intensities. GK reported significant lower RPE than any other playing position ($F_{GOL,\ FWD}$ = 18,61; p<0,0001), and CMF reported higher RPE than all others open-field positions, although the difference is only significant with respect to WMF (p<0,05).In conclusion,RPE is influenced by playing position and the physical activity profile performed. GK' lower RPE may be caused by the participation in open-field activities with the group of players as these activities are known to be less demanding than the position-specific training. Therefore, collecting GK' RPE also after the position-specific training block can contribute with goalkeepers' coaches in their training planning and load monitoring. Additionally, differences in RPE of CMF and WMF shed a light on the influence of running activity on perceived exertion and its relationship with tactical roles.
**Key Words:** football, training loads, RPE, playing position, goalkeeper

## Introduction

Load monitoring in professional football supports coaches' training plan with the aim to enhance performance and reduce injury risk (Borresen & Lambert, 2009; Gabbett & Whiteley, 2016; Issurin, 2010).From simple to high-end tools technologies, manytools are daily employed by professional clubs to monitor training loads during sessions and competitive matches (Akenhead & Nassis, 2016; Burgess, 2016). The Rate of Perceived Exertion (RPE) rises in this context as a practical tool for load monitoring that does not require any financial investment in order to be implemented (Alexiou & Coutts, 2008; Impellizzeri, Rampinini, Coutts, Sassi, & Marcora, 2004)since is only a number scale placed for the players as a parameter for the report of their perceived effort during certain physical activity(Foster et al., 2001). Therefore, due to its subjective essence, RPE is also considered a psychophysiological tool that can offer a broader perspective on the physical and mental stress experienced by the athlete (Borresen & Lambert, 2009; Pennebaker, 2000).

Several studies have reinforced RPE's contribution to the load monitoring process in the last years (Delecroix, McCall, Dawson, Berthoin, & Dupont, 2018; Haddad, Stylianides, Djaoui, Dellal, & Chamari, 2017). Correlations between RPE and internal load indicators such as heart rate (Coutts, Rampinini, Marcora, Castagna, & Impellizzeri, 2009; Impellizzeri et al., 2004), cortisol concentration(Caetano Júnior, Castilho, & Raniero, 2017)and blood lactate (Coutts et al., 2009) have been presented,for example. Regarding the relationship between RPE and external loads, Jaspers et al. (2018),and Gaudino et al.(2015)investigated the influence that different kinds of actions performed by the players had on their reported RPE, and from it tried to build statistical models that were capable of predicting players' RPE in real time during a given session. Additionally, Campos-Vásquez et al. (2015)analyzed the effect of different training sessions on players' RPE, and came to the conclusion that sessions including small-sided games increased the perception of effort when compared to sessions built upon tactical training and-or technical drills.

Although valid and reliable, RPE implementation can face many obstacles as a load monitoring tool. In general, the best use of self-report measures relies on players' experience and their understanding of the questions they are asked to answer (Gallo, Cormack, Gabbett, Williams, & Lorenzen, 2015; Pennebaker, 2000),ecological factors(Haddad et al., 2017), and the trust they have both on the club's professional by whom


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they are usually approached, and on the use that will be given to the data collected from them(Saw, Main, & Gastin, 2015).Furthermore, communication between coaches and staff members that collect RPE is recurrently flawed either because the importance of the work undertook by auxiliary fields is not recognized or the professionals in these fieldsusually find trouble in providing useful and meaning information (Akenhead & Nassis, 2016). These obstacles contributeto the fact that coaches plan their sessions mostly upon experience(Borresen & Lambert, 2009) hence discrepancies are often verified among players in terms of the training load each of them bore (Michel S. Brink, Frencken, Jordet, & Lemmink, 2014; Foster et al., 2001). Thereafter, there is a rise in the probability of individual loads not matching those that should be prescribed to promote adaptations in players' functional capabilities required by competition(Michel S Brink, Nederhof, Visscher, Schmikli, & Lemmink, 2010; Issurin, 2010), thus relegating some players to*undertraining*, and leading some to a non-functional *overtraining* (Halson, 2014).

It is well established that the physical activity undertaken by players during match-play in professional football is position specific(Di Salvo et al., 2007; Di Salvo, Gregson, Atkinson, Tordoff, & Drust, 2009). The tactical role assigned toplayers determine their behaviors and indicate how much of the field is available for each of them to play, therefore influencing not just on the volume and intensityof the actions performed but moreover on the way players of different positions will compose their total load at the end of the match (Dalen, Jørgen, Gertjan, Geir Havard, & Ulrik, 2016). In this sense, investigate the influence of playing position on RPE may contribute to a better interpretation of players' reported values, hence improving the load monitoring processes that relies on the perception of effort(McLaren et al., 2018).Acknowledging the relationship between position-specific physical activity in professional football and RPE may help coaches and staff members to manipulate training loads (Michel S. Brink et al., 2014), and to assess how players from the same position that are contesting for a role among starters face and respond tosimilar demands.

Therefore, the aim of this study was to investigate if professional football players' RPE reported after training sessions is influenced by their playing positions.

## Material & methods

### *Subjects and sample*

This study was conducted with 29 professional football players from a first division club during 10-week period in the second half of the regular season. Players were divided in subgroups according to their playing position in order to enable RPE comparison: Goal-Keepers (GK) (*players* = 4, *session*s = 182); Center-backs (CB) ($n$ = 4, $n$ = 200); Full-Backs (FB) ($n$ = 5, $n$ = 202); Center Midfielders (CMF)($n$ = 5, $n$ = 202); Attacking Midfielders (AMF) ($n$ = 4, $n$ = 203);Wide Midfielders (WMF) ($n$ = 4;$n$ = 199) e Forwards (FWD) ($n$ = 4, $n$ = 202).

### *Procedure*

RPE was collected 15 to 30 minutes after the end of every training session using CR-10 scale modified by Foster et al. (2001) (Table 1). In favor of players adherence, and consistency in their answers (Eston, 2012; Saw et al., 2015), players were approached every occasion by the same staff member. Values collected were then inputted into an Excel 2016 (Microsoft, USA) worksheet for further analysis.

**Table1 – RPE Scale proposed by Foster et al. (2001)**

| Value | PerceivedExertion |
|---|---|
| 0 | Nenhum esforço |
| 1 | Veryeasy |
| 2 | Easy |
| 3 | Moderate |
| 4 | - |
| 5 | Hard |
| 6 | - |
| 7 | Very hard |
| 8 | - |
| 9 | - |
| 10 | - |

This study obtained ethical approval from the São Judas Tadeu University's Research and Ethics Committee under the file nº 80575617.4.0000.0089, and voluntary informed consent was collected from all subjects prior to survey completion in accordance with the Declaration of Helsinki.

***Statistical analysis***

Descriptive analysis of the sample was followed by the application of the Welch's F-Test with Games-Howell post-hoc for RPE analysis of variance across positions.All statistical procedures were performed with SPSS Statistics, 23.0, manufactured by IBM (USA).

**Results**

Descriptive analysis of the sample presented that all playing positions reported "moderate" as a mean-RPE during the in-season period analyzed by this study (GK=3,19±0,64; CB=3,85±1,29; FB=3,87±1,39; CMF=3,99±1,28; AMF=3,78±1,25; WMF=3,59±1,18; FWD = 3,70±1,08) (Table 2).

**Table 2 – Descriptive analysis of RPE by Playing Position**

| Position | n | Range | Min. | Max. | Mean | SD |
|---|---|---|---|---|---|---|
| GK | 182 | 4 | 2 | 6 | 3,19 | 0,641 |
| CB | 200 | 7 | 1 | 8 | 3,85 | 1,291 |
| FB | 212 | 8 | 1 | 9 | 3,87 | 1,391 |
| CMF | 202 | 8 | 1 | 9 | 3,99 | 1,279 |
| AMF | 203 | 9 | 0 | 9 | 3,78 | 1,249 |
| WMF | 199 | 7 | 1 | 8 | 3,59 | 1,181 |
| FWD | 202 | 7 | 1 | 8 | 3,70 | 1,076 |

Additionally, open-field positions perceived effort in all intensity zones (CB = 1-8, "very easy" to "very hard"; FB = 1-9, "very easy" to "very hard"; CMF = 1-9, "very easy" to "very hard"; AMF = 0-9, "no effort" to "very hard"; WMF = 1-8, "very easy" to "very hard"; FWD = 1-8, "very easy" to "very hard"), while the goal-keepers perceived their sessions within a narrower range of intensities (GK = 2-6, "easy" to "difficult"). Nevertheless, "moderate" was the mode for the RPE reported across all playing positions as presented in Figures 1 to 7.

**Fig. 1 – RPE histogram (GK)**

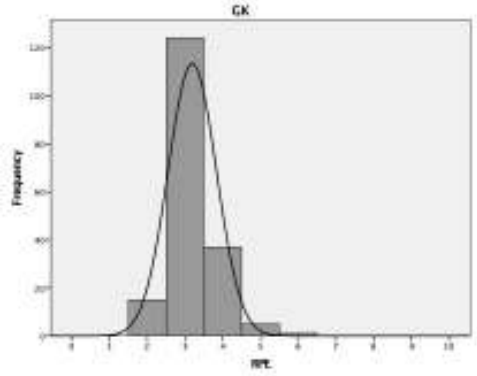



**Fig. 2 – RPE histogram (CB)**

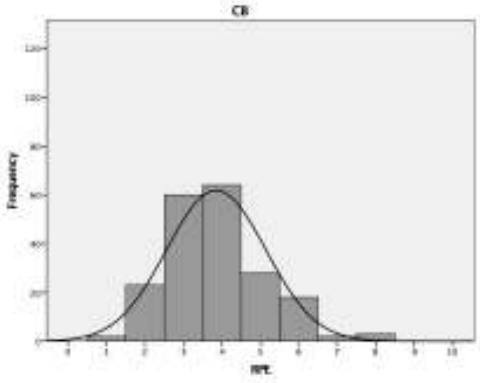



**Fig. 3 – RPE histogram (FB)**

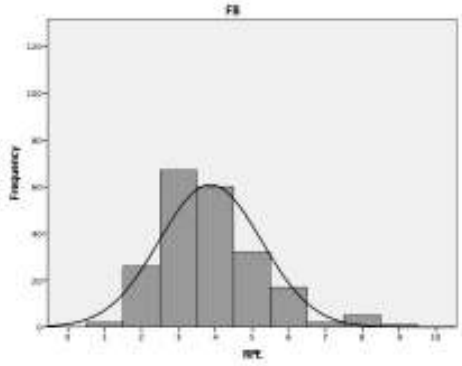



**Fig. 4 – RPE histogram (CMF)**

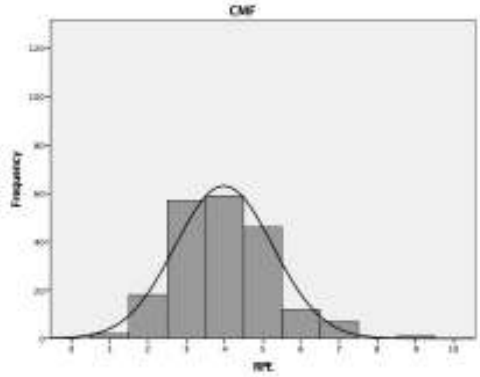



**Fig. 5 – RPE histogram (AMF)**

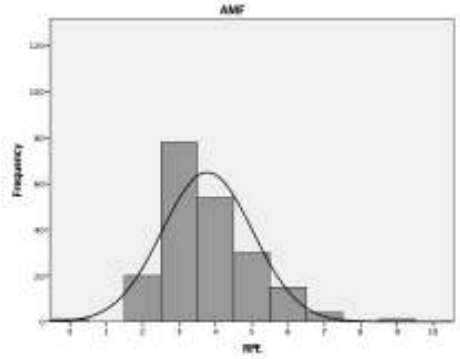



**Fig. 6 – RPE histogram (WMF)**

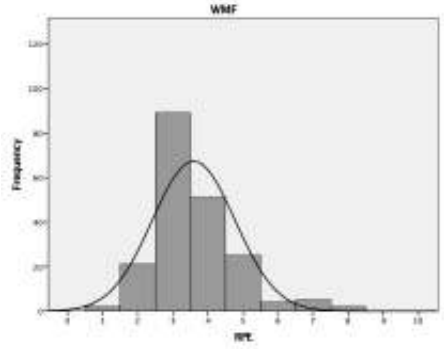
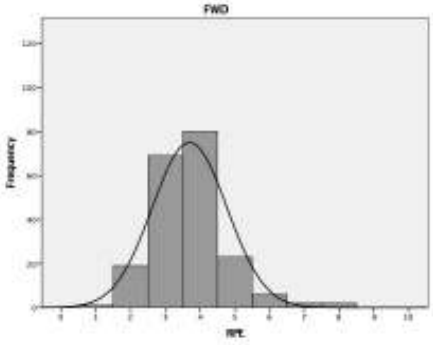



**Fig. 7 – Histogram of RPE (FWD)**




The RPE's analysis of variance performed by means of the Welch's F-Test with Games-Howell post-hoc presented a significant difference between playing positions ($F_{GOL,\ FWD}$ = 18,61; p<0,0001), as presented in Table 3 and Fig. 8. The GK reported significant lowerRPEvalues than any other playing position (CB=-0,66; FB = -0,68; CMF = -0,79; AMF =s -0,59; WMF = -0,40; FWD = 0,51; p<001), while CMFreportedhigher RPEvalues than all open-field positions, although the difference is only significant with respect to WMF (CMF-WMF = 0,39; p<0,05).

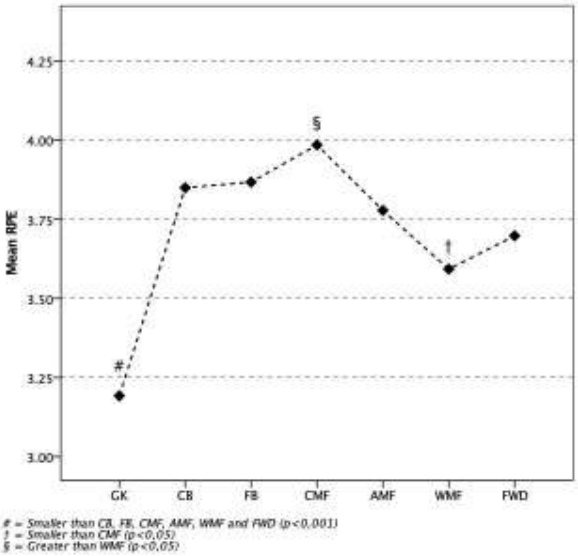
**Table3 – Results of Welch's F-Test followed by Games-Howell's posthoc**

| Position | | Meandifference (*A* – *B*) | Std. Error | p-value | ConfidenceInterval (95%) | |
|---|---|---|---|---|---|---|
| ***A*** | ***B*** | | | | **Lower bound** | **Upper bound** |
| *GK* | *CB* | **-0,658**** | **0,103** | **0,000** | **-0,96** | **-0,35** |
| | *FB* | **-0,676**** | **0,107** | **0,000** | **-0,99** | **-0,36** |
| | *CMF* | **-0,793**** | **0,102** | **0,000** | **-1,09** | **-0,49** |
| | *AMF* | **-0,586**** | **0,100** | **0,000** | **-0,88** | **-0,29** |
| | *WMF* | **-0,401**** | **0,096** | **0,000** | **-0,69** | **-0,12** |
| | *FWD* | **-0,506**** | **0,089** | **0,000** | **-0,77** | **-0,24** |
| *CB* | *GK* | **0,658**** | **0,103** | **0,000** | **0,35** | **0,96** |
| | *FB* | -0,018 | 0,132 | 1,000 | -0,41 | 0,37 |
| | *CMF* | -0,135 | 0,128 | 0,941 | -0,52 | 0,24 |
| | *AMF* | 0,072 | 0,127 | 0,998 | -0,30 | 0,45 |
| | *WMF* | 0,257 | 0,124 | 0,369 | -0,11 | 0,62 |
| | *FWD* | 0,152 | 0,119 | 0,860 | -0,20 | 0,50 |
| *FB* | *GK* | **0,676**** | **0,107** | **0,000** | **0,36** | **0,99** |
| | *CB* | 0,018 | 0,132 | 1,000 | -0,37 | 0,41 |
| | *CMF* | -0,117 | 0,131 | 0,974 | -0,51 | 0,27 |
| | *AMF* | 0,090 | 0,130 | 0,993 | -0,29 | 0,47 |
| | *WMF* | 0,275 | 0,127 | 0,317 | -0,10 | 0,65 |
| | *FWD* | 0,170 | 0,122 | 0,805 | -0,19 | 0,53 |
| *CMF* | *GK* | **0,793**** | **0,102** | **0,000** | **0,49** | **1,09** |
| | *CB* | 0,135 | 0,128 | 0,941 | -0,24 | 0,52 |
| | *FB* | 0,117 | 0,131 | 0,974 | -0,27 | 0,51 |
| | *AMF* | 0,207 | 0,126 | 0,652 | -0,17 | 0,58 |
| | *WMF* | **0,392*** | **0,123** | **0,026** | **0,03** | **0,76** |
| | *FWD* | 0,287 | 0,118 | 0,184 | -0,06 | 0,64 |
| *AMF* | *GK* | 0,586** | 0,100 | 0,000 | 0,29 | 0,88 |
| | *CB* | -0,072 | 0,127 | 0,998 | -0,45 | 0,30 |
| | *FB* | -0,090 | 0,130 | 0,993 | -0,47 | 0,29 |
| | *CMF* | -0,207 | 0,126 | 0,652 | -0,58 | 0,17 |
| | *WMF* | 0,185 | 0,121 | 0,727 | -0,17 | 0,54 |
| | *FWD* | 0,080 | 0,116 | 0,993 | -0,26 | 0,42 |
| *WMF* | *GK* | **0,401**** | **0,096** | **0,000** | **0,12** | **0,69** |
| | *CB* | -0,257 | 0,124 | 0,369 | 0-,62 | 0,11 |
| | *FB* | -0,275 | 0,127 | 0,317 | -0,65 | 0,10 |
| | *CMF* | **-0,392*** | **0,123** | **0,026** | **-0,76** | **-0,03** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | *AMF* | -0,185 | 0,121 | 0,727 | -0,54 | 0,17 |
| | *FWD* | -0,105 | 0,113 | 0,967 | -0,44 | 0,23 |
| *FWD* | *GK* | **0,506**** | **0,089** | **0,000** | **0,24** | **0,77** |
| | *FB* | -0,152 | 0,119 | 0,860 | -0,50 | 0,20 |
| | *CB* | -0,170 | 0,122 | 0,805 | -0,53 | 0,19 |
| | *CMF* | -0,287 | 0,118 | 0,184 | -0,64 | 0,06 |
| | *AMF* | -0,080 | 0,116 | 0,993 | -0,42 | 0,26 |
| | *WMF* | 0,105 | 0,113 | 0,967 | -0,23 | 0,44 |

** p < 0,05*
*** p <0,001*

**Fig. 8 – Analysis of variance of RPE across playing positions**




**Discussion**

This study investigated if professional football players' RPE reported after training sessions is influenced by their playing positions. The main findings are that all playing positions reported "moderate" both as a mean-RPE and mode-RPE during the in-season period analyzed, and open-field positions perceived effort in every intensity zone while the GK perceived their sessions within a narrower range of intensities. Additionally, the GK reported significant lower RPE values than any other playing position, while CMF reported higher RPE values than all open-field positions, although the difference is only significant with respect to WMF (CMF-WMF = 0,39; p<0,05).

The predominance of values within "moderate"intensity for all playing positions may be due to the in-season period where the training sessions analyzed took place. It is well stablished that a professional football team plays between 50 and 80 matches per season (Mohr, Krustrup, & Bangsbo, 2003), and that a congested match schedule can be prejudicial for players' adequate recovery (Carling, Le Gall, & Dupont, 2012; Dellal, Lago-Peñas, Rey, Chamari, & Orhant, 2015). In this sense, especially across in-season micro cycles, the effects of match-play on players' organism(Doeven, Brink, Kosse, & Lemmink, 2018) must be considered when prescribing suitable training loads to simultaneously induce adaptations(Gamble, 2006; Issurin, 2010)and enable recovery (Ispirlidis et al., 2008; Nédélec et al., 2013), thus shifting training purpose from the development of new physical abilities to the maintenance of those already developed during the pre-season (Reilly, 2007).Therefore, "moderate" intensity reporting predominance across all playing positions as identified by this study can besomehow explained by the results found by Malone *et al.*(2015) that analyzed training loads of a top level club in England and concluded that weekly volumes are significantly lower during mesocycles comprised in the second half of the season.

Another main finding of this study is that GK reported significant lower RPE values than any other playing position. The role goalkeepers perform in football is totally different than open-field players because has a particular physical demand characterized by explosive and short-duration actions such as accelerations, decelerations, jumps and dives(Ziv & Lidor, 2011). Although determinant for matches' final outcome, goalkeepers' physical abilities are less frequently recruited than open-field players'as previous studies demonstrated that goalkeepers cover less than half of their total distance, and less than a tenth of their sprinting distance(Bradley et al., 2009; Di Salvo, Benito, Calderón, Di Salvo, & Pigozzi, 2008). Thereby, goalkeepers' training is particular and usually divided between position-specific drills (performed in a small group under the goalkeeper coach's supervision), and participation in open-field activities with the rest of the players (e.g.

tactical training, set pieces, small-sided games). While position-specific training recruits goalkeepers' physical abilities successively, the participation in open-field activities reduce both the demand and its frequency(S. Malone et al., 2018) making goalkeepersspend a fair share of their training sessions being exposed to efforts that fall short of those they are used to perform. Therefore, goalkeepers' lower RPE values may be due tothe participation in less demanding physical activities with open-field players that distorts how they perceive their effort at the end of the whole training session. Moreover, it is possible that different results could be found if goalkeepers' RPE were collected right after position-specific training as well, which maybe would elucidate a more adequate way of using RPE in the context of goalkeepers' training load monitoring.

This study also found that open-field players report statisticallyequivalent RPE except for CMF that reported significant higher values than WMF. This result is different than those found by Barrett et al.(2018)that identified full-backs as players with the highest RPE across all playing positions, goalkeepers excluded. In their study, general RPE was unfolded in muscular, respiratory and technical scales, and full-backs reported significant higher values in all of them, while midfielders reported significant higher values than forwards for muscular RPE.This last finding does not conflict with our results since in the study conducted by Barrett*et al*. all attacking players were categorized as forwards, and all midfield players were categorized as midfielders, irrespectively of their tactical role being performed through the center of the field or its flanks. Therefore, it is possible that players with tactical attributions to be performed through the flanks that our study categorized as WMF had been absorbed either by the forwards' or midfielders' group in the study of Barret et al., hence disabling comparisons with our results.

Di Salvo et al. (2007)analyzed the physical activity performed by players during official matches and found thatcenter midfielders and wide midfielderscover greater distances than any other playing positions. However, while center midfielders cover greater distances at 11,1-19km/h, wide midfielders cover greater distances above 19,1km/h of which the majority is in ball possession. In other study, Rampinini et al.(2007) undertook a different grouping criteria for playing positions and found that midfielders cover greater distances than forwards at 7,2-19,8km/h, and that midfielders spend less time standing still between one displacement and another than any other position. However, comparisons with our results are not possible since their study did not take tactical roles into account when grouping players according to playing position. Therefore, players we categorized as WMF could have been categorized in the study of Rampinini et al. either as midfielders or as forwards (if not both) thus making comparisons impossible.

Casamichana et al. (2013)investigated the relationship between several training indicators in professional football and found a very strong correlation between total distance covered and RPE ($r = 0,7$). In other study, Jaspers et al. (2018)applied machine learning techniques to assess the main external load indicators related to the RPE values reported by players after football training sessions and concluded that distances covered at 12-15km/h (0,487), and distances covered at 15-20km/h (0,507) have more influence than distances covered above 20km/h (0,428). Combining these results with those found by Di Salvo et al. (2007)andby Rampinini et al. (2007), it is possible that CMF reported significant higher RPE values than WMF in our study because they are more susceptible to perform displacements at moderate speed ranges that are the most influent in RPE values, whereas WMF are more susceptible to perform displacements at higher and less influent speed ranges due to their attacking and defending roles through the flanks of the field.

**Conclusions**

This study identified that RPE is influenced by playing position. The predominance of "moderate" intensity among players may be related to football training periodization that traditionally prescribes lower weekly volumes at the second half of the season, especially in a context of congested match schedule where recovery necessities between matches must be considered when planning training sessions.

Goalkeepers' lower RPE reinforces the influence of playing position on perceived exertion since these players endure a totally different physical activity profile when compared to open-field ones. On the other hand, goalkeepers' lower RPE may be result of a distortion on their perceived exertion caused by the participation in open-field activities with the whole group of players as these activities are known to be less demanding for goalkeepers than the position-specific training performed in small groups under their coach supervision.

In this regard, collecting goalkeepers' RPE alsobetween the position-specific training block and the moment they join the group in open-field activities can contribute to load monitoring as it can unfold both the perceived exertion in position-specific training, and the effect of less demanding activities on their total perceived exertion after the training session as a whole. Since the physical demands imposed on goalkeepers when they are enrolled in group activities is hard to manipulate (if possible), knowing goalkeepers' perceived exertion after position-specific training can help goalkeepers' coaches in their training session planningand load monitoring.

Finally, the difference between center midfielders' and wide midfielders' RPE may be related to the physical activity profile each of these positions endure during training and competition, thus reinforcing the influence that different kinds of actions have on perceived exertion, as it was concluded with respect to goalkeepers as well.

**Conflict of interest**

The authors report no conflict of interest.

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