**International Journal of**
**PHYSICS EDUCATION, FITNESS AND SPORTS**

IJPEFS
International Journal of
PHYSICAL EDUCATION, FITNESS AND SPORTS

# Internal load in elite young soccer players during a whole season according to playing positions

**Daniel Castillo [a, *] and Javier Raya-González [a,]**

[a] Faculty of Health Sciences, Universidad Isabel I, Fernán González, 76, 09003, Burgos, Spain.

*Corresponding Author: Ph: +0034 655567762; Email: danicasti_5@hotmail.com

**Abstract:** The aims of this study were 1) to compare the internal load, measured as session rating of perceived exertion (s-RPE), between training sessions and official matches among playing positions in young elite soccer players and 2) to analyze the s-RPE association between training and official match-play. Nineteen young elite soccer players who competed in the Spanish First Division Under-19 Championship participated in this study. Internal load was registered during 120 training sessions and during 30 official matches. Only the players who participated in all the weekly sessions and played at least 70 min were included in the further analysis. No significant differences ($P > 0.05$, ES = -0.57/0.62) among playing positions were found in the s-RPE registered by soccer players in training sessions, official matches nor in the total sessions. On the other side, higher s-RPE was observed during trainings in comparison to matches in each playing position ($P < 0.001$, ES = 5.51-30.77). However, no association was observed between training s-RPE and match s-RPE for the whole of the players ($P = 0.60$, r = 0.04), nor for each specific playing positions ($P = 0.29$-$0.89$, r = -0.11/0.16). These findings could be useful for coaches in order to plan the distribution of the weekly training load. Nonetheless, it is also suggested that internal load monitoring cannot be confidently used, in isolation, as a tool to detect differences in the match-play demands, attending to playing positions, in young soccer players. Thus, the use of both internal (i.e., s-RPE) and external (i.e., global positioning system measures) load is suggested to manage the training and match load and to prescribe the training sessions appropriately.

*Key Words:* Football, Match Intensity, Quantification, Playing Time.

**Daniel Castillo** is a professor in Physical Activity and Sports Sciences Department in International University Isabel I. Master in Physical Activity and Sports Sciences Research, Master in Teaching Training for Secondary Education and Master in High Performance in Team Sports. Current major research directions include: monitoring training and match loads in team sports, soccer small-sided games- and match- related fatigue, physical fitness performance of professional soccer players, physical and physiological performances in soccer referees and cerebral palsy soccer players. Dr. Daniel Castillo has published around 30 scientific studies indexed in Journal Citation Reports (JCR) and is reviewer of several Sports Sciences Journals. On the other side, Dr. Castillo have worked as a Soccer Coach in U-19 team of elite Spanish soccer Club (Deportivo Alavés).

**Javier Raya-González** is Ph.D in Sport Sciences and currently is working as a Professor in the faculty of Health Sciences, University Isabel I of Burgos, Spain. He is part of the Sport Performance Lab and his main field of research is the strength training applied to team-sports players to optimizing the performance and to prevent sport injuries. Also, he is investigating the control and quantification of training and match load in team sports, as well as the influence of different supplements on sports performance.

# 1. Introduction

Perceived exertion (PE) is a valid, reliable [1-2] and very useful tool in soccer, mainly due to its low cost, its easy to use and its high-speed data processing [3]. The use of PE as indicator of internal load has been extended to training sessions [4-5] and official match-play [6-7]. The aforementioned studies have shown that the session rating of perceived exertion (s-RPE) in a training week (i.e., microcycle) is between 1200 to 2000 AU and around 550 AU during official matches. In this sense, to know the training and match load in soccer seems to be relevant in order to optimize the player's performance [8] and to reduce the injury risk [9].

The knowledge of the training and match load can help to coach staff to plan the training strategies. In this line, it would be interesting to address the physical and physiological demands associated to each playing position. It has been observed that soccer demands vary for each playing position [10-12], but no investigations have analyzed the differences among playing positions attending to the s-RPE. In this sense, knowing whether the match s-RPE is different for each playing position could help to the coach staff to plan recovery strategies according to the specific internal load demands for each playing position.

Given that the position-specific data is important to establish weekly training strategies that optimally prepare players for positional demands likely encountered during matches, the daily challenge for coach staff is to replicate the competitive demands during the training sessions [12]. This is because the game logic makes players have a different role depending on their playing position [13]. In order to know the differences in training and match load, attending to the specific playing positions, some authors have classified the players in defenders, midfielders and attackers [14]. However, other authors such as [10] have specified in greater depth the specific positions, differentiating between central defenders, fullbacks, central midfielders, wide midfielders and attackers. Specially, this last classification allows to know the specific positional demands during official matches, and consequently to prescribe training tasks with greater specificity and according to the specific competitive internal load.

So far, no study has been specifically designed to analyse the internal load during a whole season differentiating among playing positions and comparing the s-RPE in training and official matches. Therefore, the aims of this study were 1) to compare the internal load, measured as s-RPE, in training sessions and official matches among playing positions in young elite soccer players and 2) to analyze the s-RPE association between training and official match-play.

# 2. Methods

## 2.1 Participants

Nineteen young professional soccer players (age: $18.0 \pm 0.6$ years, height: $177 \pm 5$ cm, body mass: $70.1 \pm 6.8$ kg and body mass index: $22.3 \pm 1.5$ kg m$^{-2}$) who belonged to the same team of the Spanish La Liga Club Academy participated in this study. Participants trained four times a week and were involved in an official match at weekends in the Spanish First Division Under-19 Championship. The inclusion criterion was to take part at least 70 min in any match across the season. Players were classified by playing positions: central defenders (n = 4), fullbacks (n = 4), central midfielders (n = 3), wide midfielders (n = 5) and attackers (n = 3) [10]. Goalkeepers were not included in the study. All the participants were informed of the objectives of the research, participated voluntarily and had the possibility to withdraw at any time from the investigation without any penalty. All the participants, or their parents or legal guardians, signed their written informed consent. The study was conducted according to the Declaration of Helsinki and it met the ethical standards for sport and exercise science research [15].

## 2.2 Experimental Design

This investigation analysed the differences and the association between the training and match internal load, and paying attention to playing positions over a 30-week in-season period in a professional young soccer team. The s-RPE during

120 training sessions and 30 official matches were selected. The day after the official match was excluded from the analysis due to the different training regimes of the players who were starters (recovery) and non-starters (compensatory training). Only those players who played at least 70 min during the match and were available to complete the whole sessions of the week were selected for further analyses. Training sessions were carried out on the same playing surface (artificial grass) and half of the matches were played at home and the other half away.

## 2.3 Procedures

### 2.3.1 Session Rating of Perceived exertion (sRPE)

In order to quantify the soccer trainings' and matches' RPE, the 10-point scale proposed by [16] was administered at the end of each session/match. Players answered the question: how hard was the training/match? 10 min after every session [17]. Players were allowed to mark a plus sign (interpreted as 0.5 point) alongside the integer value and were not aware of their teammates RPE scores [18]. The same person was responsible for asking the question to the players (i.e. physical trainer). In addition, to calculate the session RPE (s-RPE), each score was multiplied by the training/match duration (min) as per [16]. Players became fully accustomed to the RPE procedures during preseason trainings and friendly matches (six weeks).

## 2.4 Statistical Analysis

Standard statistical methods were used for the calculation of the means and standard deviations (SD). All the variables were normally distributed according to the Shapiro-Wilk test, so we used a parametric analysis. One-way analysis of variance (ANOVA) with the Bonferroni post hoc test was used to compare the s-RPE among playing positions. Dependent paired t-tests were used to determine whether any significant differences existed between the s-RPE declared by players during training sessions and official matches in each playing position. Practical differences were calculated using Cohen's *d*

effect size (ES, large: > 0.8; moderate: between 0.8 and 0.5; small: between 0.5 and 0.2; trivial < 0.2) [19]. In addition, Pearson's product moment correlation coefficients (corresponding to 90% confidence intervals) were calculated to determine whether there was a relationship between the training s-RPE and match s-RPE. The following scale of values was used to interpret the magnitude of the correlation coefficients: <0.1, trivial; = 0.1– 0.3, small; <0.3– 0.5, moderate; <0.5– 0.7, large; <0.7– 0.9, very large; and <0.9– 1.0, almost perfect [20]. The data analysis was carried out using the Statistical Package for Social Sciences (SPSS 25.0, SPSS™ Inc, Chicago, IL, USA). Statistical significance was set at $p < 0.05$.

# 3. Results
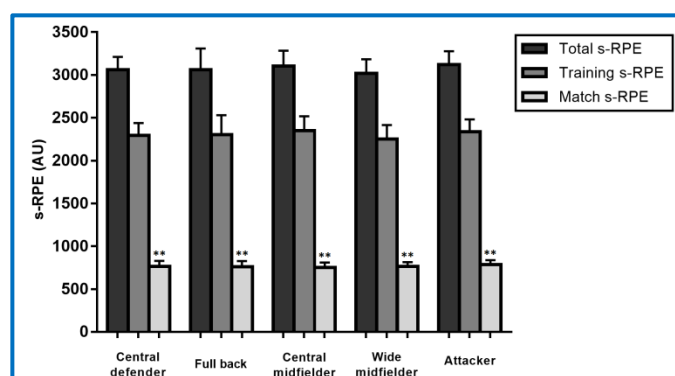


**Figure 1**. Internal load differences among playing positions.

** Significant differences ($P < 0.01$) between training and match s-RPE.

Figure 1 shows the internal load measured by s-RPE during training sessions and official matches. No significant differences ($P > 0.05$, ES = -0.57/0.62) among playing positions were found in the s-RPE registered by soccer players in training sessions, official matches nor in the total sessions (trainings and matches) along the week. On the other side, higher s-RPE was observed during trainings in comparison to matches in each playing position ($P < 0.01$, ES = 5.51-30.77).

Figure 2 shows that non-significant relationships ($P > 0.05$) were obtained between training s-RPE and match s-RPE for the whole of the players ($P = 0.60$, r = 0.04, Figure 2A), nor for specific playing positions ($P = 0.29$-0.89, r = -0.11/0.16,

Figure 2A to 2F).
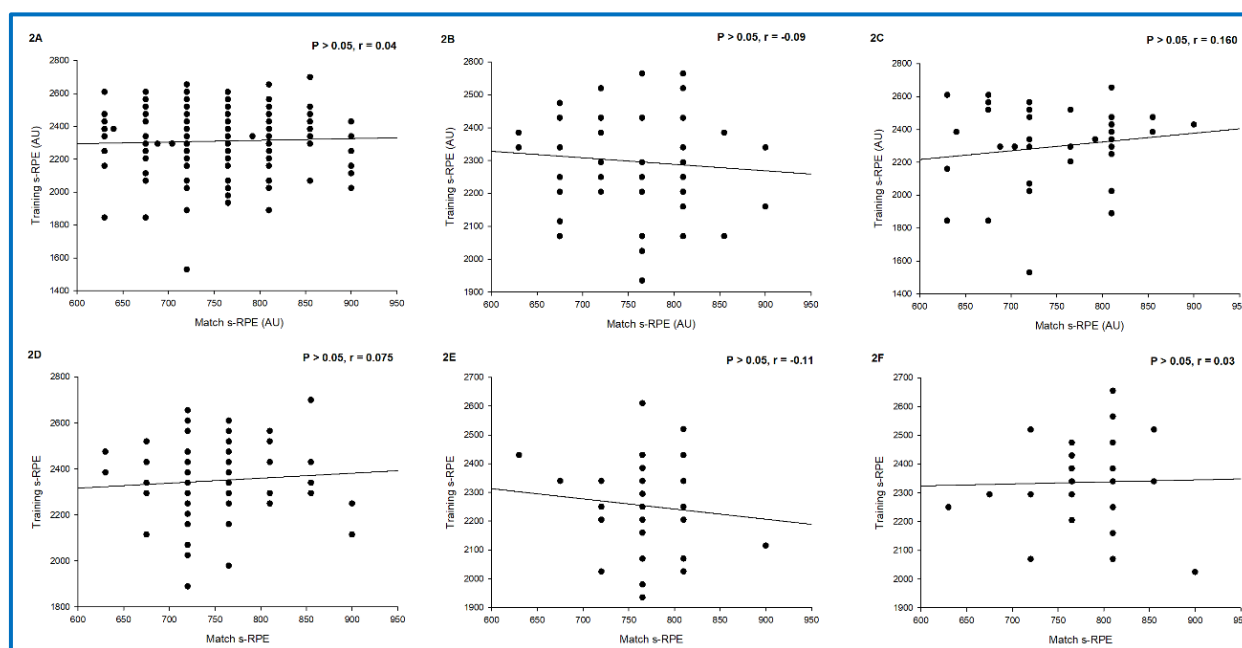


**Figure 2**. Relationships between training s-RPE and match s-RPE for all the players (2A), central defender (2B), full back (2C), central midfielder (2D), wide midfielder (2E) and attacker (2F).

## 4. Discussion

The aims of this study were 1) to compare the internal load, measured as s-RPE, in training sessions and official matches among playing positions in young elite soccer players and 2) to analyze the s-RPE association between training and official match-play. A novel aspect of this investigation was the analysis of internal load demands (s-RPE) for each specific playing position during a full competitive season (i.e. 30 weeks). The main results of the study showed no differences in the internal load among playing positions, neither in training nor in official match-play. In addition, all playing positions presented higher s-RPE values in training than in official matches, but no association was observed between training s-RPE and match s-RPE.

In recent years, several studies have shown that the competition demands oscillate significantly according to the different playing positions [10-12]. However, all these previous studies have studied the competitive demands in terms of the external load (e.g., total distance or high intensity actions) while none of them has done it taking into consideration

the internal load (i.e., s-RPE). In the current investigation, no significant differences (P < 0.05) were found among playing positions, neither in training (P = 0.10-1.00, ES = -0.57/0.51) nor in competition (P = 0.21-1.00, ES = -0.39/0.37). These results suggest that there is no relationship between the external load and the s-RPE, mainly because the players are adapted to the external demands of their playing positional role [21]. Therefore, a player with high external demands (e.g., distance covered at high intensity) could present an internal load (measured as s-RPE) similar to other player with lower external demands, but, both players would address the physical demands that the style of game would require [13]. Thus, it is necessary to quantify both the internal and external load in order to have an accurate knowledge of the players´ real demands during training sessions and official matches.

In previous studies it has been observed that internal load (measured as s-RPE) is higher during training sessions (≈ 1200 UA) than in official matches (≈ 550 UA) [17-18]. Evidently, given that the number of the training sessions per week is higher, the sum of

weekly s-RPE is greater than in the official match-play. These differences between training and competition are in accordance with the results obtained in our study (2308 and 765 AU, respectively). However, in our investigation were reported higher values of s-RPE than those obtained in previous studies, because the efforts are worse assimilated in young (U-19) than in senior soccer players [22]. On the other side, our results showed that those players with higher weekly s-RPE did not obtain higher s-RPE values during official matches. This could be because the training sessions are not adapted to the physical profile that the style of game requires for each individual player or playing position.

## 5. Conclusions

The findings of this study demonstrated that the internal load, measured as s-RPE, is similar in each soccer-specific playing position, both for training sessions and official match-play. In addition, the training s-RPE was higher than match s-RPE in all playing positions, although no association was observed between training s-RPE and match s-RPE. This information could be useful for coaches in order to plan the distribution of the weekly training load. Nonetheless, it is also suggested that internal load monitoring cannot be confidently used, in isolation, as a tool to detect differences in the competition demands, according playing positions, in young soccer players. Thus, the use of both internal (i.e., s-RPE) and external (i.e., global positioning system measures) load is suggested to manage the training and match load and to prescribe the training sessions appropriately.

## References

[1] H. Alexiou, A.J. Coutts, A comparison of methods used for quantifying internal training load in women soccer players, *International Journal of Sports Physiology and Performance*, 3 (2008) 320–330.

[2] B.R. Scott, R.G. Lockie, T.J. Knight, A.C. Clark, X.A.K. Janse de Jonge, A comparison of methods to quantify the in-season training load of professional soccer players, *International Journal of Sports Physiology and Performance*, 8 (2013) 195–202.

[3] G.A. Borg, Perceived exertion: a note on "history" and methods, *Medicine and Science in Sports and Exercise*, 5 (1973) 90–93.

[4] A. Los Arcos, R. Martínez-Santos, J. Yanci, J. Mendiguchia, A. Méndez-Villanueva, Negative associations between perceived training load, volume and changes in physical fitness in professional soccer players, *Journal of Sports Science and Medicine*, 14 (2015) 394–401.

[5] M. Weston, Training load monitoring in elite English soccer: a comparison of practices and perceptions between coaches and practitioners, *Science and Medicine in Football*, 2 (2018) 216–224.

[6] A. Los Arcos, A. Mendez-Villanueva, R. Martínez-Santos, In-season training periodization of professional soccer players, *Biology of Sport*, 34 (2017) 149–155.

[7] J. Raya-González, F.Y. Nakamura, D. Castillo, J. Yanci, M. Fanchini, Determining the relationship between internal load markers and non-contact injuries in young elite soccer players, *International Journal of Sports Physiology and Performance*, 11 (2018) 1–19.

[8] Mujika, The alphabet of sport science research starts with Q, *International Journal of Sports Physiology and Performance*, 8 (2013) 465–466.

[9] T. J. Gabbett, The training-injury prevention paradox: should athletes be training smarter and harder?, *British Journal of Sports Medicine*, 12 (2016) 1–9.

[10] P.S. Bradley, M. Di Mascio, D. Peart, P. Olsen, B. Sheldon, High-intensity activity profiles of elite soccer players at different performance levels, *Journal of Strength and Conditioning Research*, 24(9) (2010) 2343–2351.

[11] M. Bush, C. Barnes, D.T. Archer, B. Hogg, P.S. Bradley, Evolution of match performance parameters for various playing positions in the English Premier League, *Human Movement Science*, 39 (2015) 1–11.

[12] L. Suarez-Arrones, N. Torreño, B. Requena, E. Sáez De Villarreal, D.Casamichana, J.C. Barbero-Alvarez, D. Munguía-Izquierdo, Match-play

activity profile in professional soccer players during official games and the relationship between external and internal load, *The Journal of Sports Medicine and Physical Fitness*, 55 (2015) 1417–1422.

[13] A. Mendez-Villanueva, M. Buchheit, Football-specific fitness testing: adding value or confirming the evidence?, *Journal of Sports Sciences*, 31 (2013) 1503–1508.

[14] C. Carling, F. Le Gall, R.M. Malina, Body size, skeletal maturity, and functional characteristics of elite academy soccer players on entry between 1992 and 2003, *Journal of Sports Sciences*, 30 (2012) 1683–1693.

[15] D. Harriss, G. Atkinson, Ethical standards in sport and exercise science research: 2016 Update, *International Journal of Sports Medicine*, 36 (2015) 1121–1124.

[16] C. Foster, J.A. Florhaug, J. Franklin, L. Gottschall, L.A. Hrovatin, S. Parker, C. Dodge, A new approach to monitoring exercise training, *Journal of Strength and Conditioning Research*, 15 (2001) 109–115.

[17] A. Los Arcos, J. Yanci, J. Mendiguchia, E.M. Gorostiaga, Rating of muscular and respiratory perceived exertion in professional soccer players, *Journal of Strength and Conditioning Research*, 28 (2014) 3280–3288.

[18] A. Los Arcos, A. Méndez-Villanueva, J. Yanci, R. Martínez-Santos, Respiratory and muscular perceived exertion during official games in professional soccer players, *International Journal of Sports Physiology and Performance*, 11 (2016) 301–304.

[19] J. Cohen, Statistical power analysis for the behavioral sciences (2nd ed.), Hillsdale N.J.: L. Erlbaum Associates, (1988).

[20] W.G. Hopkins, S.W. Marshall, A.M. Batterham, J. Hanin, Progressive statistics for studies in sports medicine and exercise science, *Medicine and Science in Sports and Exercise*, 41 (2009) 3–13.

[21] V. Gesbert, A. Durny, D. Hauw, How do soccer players adjust their activity in team coordination? an enactive phenomenological analysis, *Frontiers in Psychology*, 8 (2017) 854.

[22] H. Al Haddad, B. M. Simpson, M. Buchheit, V. Di Salvo, A. Mendez-Villanueva, Peak match speed and maximal sprinting speed in young soccer players: effect of age and playing position, *International Journal of Sports Physiology and Performance*, 10 (2015) 888–896.

### Acknowledgement

### Competing Interests

The authors declare that they have no competing interests

### About The License