RESUMEN

El objetivo de este estudio fue comparar la respuesta física de un árbitro de campo (AC) y de un mediocentro (MC) durante las dos partes de un partido de fútbol. Participaron un AC y un MC de la categoría División de Honor Juvenil. Durante la disputa del encuentro se registró la distancia total recorrida (DT), las distancias recorridas a más de 14 km·h \(^{-1}\) (D>14), a más de 21 km·h \(^{-1}\) (D>21) y a más de 24 km·h \(^{-1}\) (D>24), la velocidad media (\(V_{\text{med}}\)), el número de desaceleraciones (Nº dec.) y aceleraciones (Nº acce.) y player load (PL). El MC recorrió una mayor DT y registró un mayor Nº acce. y PL que el AC en cada una de las partes. En cambio, el AC recorrió una mayor distancia a velocidades de alta intensidad. Estos resultados ponen de manifiesto que el árbitro y el jugador tienen una respuesta distinta durante el partido.

PALABRAS CLAVE: carga externa, colegiado, jugador, competición.

ABSTRACT

This paper aims to compare the physical response of a soccer referee (SR) and a midfielder (MF) during both halves of a soccer match. One SR and one MF of the Spanish Under-18 Division participated in this study. During the match were registered the total distances covered (TD), the distance covered over 14 km·h \(^{-1}\) (D>14), over 21 km·h \(^{-1}\) (D>21) and over 24 km·h \(^{-1}\) (D>24), the average velocity (\(V_{\text{ave}}\)), the number of decelerations (Nº dec.) and accelerations (Nº acce.) and player load (PL). The MF covered a higher TD and registered a higher Nº acce. and PL than the SR en each half. Whereas, the SR covered higher distance at high-intensity velocity. These results suggest that the soccer referee and the player register a different physical response during the match.

KEYWORDS: external load, match official, player, competition.
1. INTRODUCTION

Refereeing might be influenced, among other factors, by the competitive levels of referees\(^1\), experience\(^2,3\), hydration\(^4\), as well as the players’ level\(^5,6\). Soccer players and referees cover 10-12 km during games, being the distance covered by referees\(^7\) is even higher. However, despite the fact that the distance covered by referees and players is usually similar, soccer players cover a higher distance at sprint velocity (>25.2 km·h\(^-1\))\(^5\). Since some studies determine that the activity of referees is directly related with the distance covered by the soccer players at high level categories\(^5,7\), it would be interesting to compare the physical response of referees and players in lower competitive levels.

Despite soccer is an activity different from refereeing, researchers agree that an optimal physical condition in referees as well as in soccer players, is a determining factor for the performance during a soccer match\(^8,9\).

Previous research studies have witnessed a decrease of the physical performance\(^10,11\), as well as of the neuromuscular capacity\(^12,13\) at the end of the games both in referees and players, influencing the decision-making of referees. Studies have also shown that refereeing is a physically demanding activity, as the energy expenditure during match-play is considerable\(^10,11\), and the metabolic demand of refereeing is higher than in soccer players\(^10\).

Previous research studies have also indicated that refereeing is a physically demanding activity, with high energy expenditure during match-play\(^10,11\), and the metabolic demand of refereeing is higher than in soccer players\(^10\). These findings highlight the importance of physical fitness and physiological characteristics in referees, as well as the need for specific training programs to improve their performance during soccer matches.

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and in soccer players. Therefore, the aim of our study was to compare the physical responses (external load) of a soccer referee and a midfielder.

2. METHOD

Participants
This study included the participation of a soccer referee (SR, 31 years, 78.8 kg, 1.83 m, 23.5 kg·m⁻²) and a player (MF, 17 years, 69.9 kg, 1.78 m, 22.0 kg·m⁻²) of the Spanish Under-18 Division, playing in the midfield position during the 17th roundmatchweek of the 2015-2016 season, in a match between two teams classified among the top five of the category.

The two participants trained an average of four sessions a week and had a match every weekend. They were informed on the procedures, methodology, benefits and possible risks of the study and gave their consent. The study followed the standards of the Helsinki Declaration (2013) and it was approved by the Human Research Ethics Committee (CEISH in Spanish) of the Basque Country University (UPV/EHU).

Procedure
During a match of the top Junior Spanish soccer League category, were registered different parameters of the external load both of the MF and the SR in each half. Before the game and due to the different roles acquired during the match, the MF and the SR had a 20-25 minute warm up period.

*External load.* Both the SR and the MF were equipped with a special vest with a GPS device that operated at a frequency of 10 Hz ((MinimaxX 4.0, Catapult Innovations®, Melbourne, Australia).

With the GPS device was registered the total distance covered (TD), the distances covered over km·h⁻¹ (14 D>14), over 21 km·h⁻¹ (D>21) and over 24 km·h⁻¹ (D>24), average velocity (\(V_{\text{aver}}\)), the number of decelerations between -1 y -3 m·s⁻² (\(N^0\) dec.),

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the number of accelerations between 1 and 3 m·s⁻² (Nº acce.) and the player load (PL)¹⁴ during the first and the second half.

**Statistical analysis**

The results are presented in absolute values. The change percentage (Δ) between the results of the first and second half and between the results of the SR and the MF of the external load parameters, were calculated through the formula Δ (%) = [(result 2 – result 1) / result 1] x 100. To obtain the results of each external load variables, was used the Catapult Sprint software.

3. **RESULTS**

Table 1 shows a generalized decrease during the second part of the magnitude of the parameters that characterize the external load. Likewise, there was a decrease in the physical responses of the MF in most of the variables analyzed, except for the D>14 and the Nº dec., which were higher in the second half.

**Table 1.** Descriptive results of the physical responses registered by the soccer referee (SR) and by the midfielder (MF) in the first and second half of the match.

<table>
<thead>
<tr>
<th></th>
<th>SR 1st Half</th>
<th>SR 2nd Half</th>
<th>Δ (%)</th>
<th>MF 1st Half</th>
<th>MF 2nd Half</th>
<th>Δ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TD (m)</td>
<td>4685</td>
<td>4508</td>
<td>-3,78</td>
<td>5480</td>
<td>5292</td>
<td>-3,43</td>
</tr>
<tr>
<td>D&gt;14 (m)</td>
<td>821</td>
<td>795</td>
<td>-3,17</td>
<td>753</td>
<td>759</td>
<td>0,80</td>
</tr>
<tr>
<td>D&gt;21 (m)</td>
<td>121</td>
<td>47</td>
<td>-61,16</td>
<td>47</td>
<td>21</td>
<td>-55,32</td>
</tr>
<tr>
<td>D&gt;24 (m)</td>
<td>35</td>
<td>0</td>
<td>-100,00</td>
<td>9</td>
<td>0</td>
<td>-100,00</td>
</tr>
<tr>
<td>Vel_aver (km·h⁻¹)</td>
<td>6,09</td>
<td>5,46</td>
<td>-10,34</td>
<td>6,85</td>
<td>6,24</td>
<td>-8,91</td>
</tr>
<tr>
<td>Nº dec.</td>
<td>49</td>
<td>40</td>
<td>-18,37</td>
<td>42</td>
<td>46</td>
<td>9,52</td>
</tr>
<tr>
<td>Nº acce.</td>
<td>66</td>
<td>60</td>
<td>-9,09</td>
<td>87</td>
<td>72</td>
<td>-17,24</td>
</tr>
<tr>
<td>PL (UA)</td>
<td>0,58</td>
<td>0,52</td>
<td>-10,34</td>
<td>0,82</td>
<td>0,74</td>
<td>-9,76</td>
</tr>
</tbody>
</table>

Δ% = change in the physical responses of the second half in relation to the first; TD= total distance covered; D>14= distance covered at over 14km·h⁻¹; D>21= distance covered at over 21km·h⁻¹; D>24 = distance covered at over 24km·h⁻¹; Vel_aver = average velocity; Nº dec = number of decelerations; Nº acce = number of accelerations; PL= player load.

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The MF covers a higher TD, registers a higher N° acce. (Figure 1) and shows a higher value of PL (Figure 2) than the SR in each half. However, the SR covers a higher distance at speeds over 14 km·h\(^{-1}\), 21 km·h\(^{-1}\) (Figure 3) and 24 km·h\(^{-1}\).

**Figure 1.** Number of accelerations (1-3 ms\(^{-2}\)) registered by the soccer referee (SR) and the midfielder (MF) in the first and second halves.

**Figure 2.** Player load (PL) registered by the soccer referee (SR) and the midfielder (MF) in the first and second halves.
4. DISCUSSION

Despite the fact that other studies have analyzed the differences in the physical responses during the first and second halves in referees and professional players\textsuperscript{5-7} this is the first research study that compares the external load of the two subjects in the most relevant junior base soccer category of Spain. The results of our study demonstrate that both the SR and the MF show a worsening of the physical response in the second half (Table 1). These results are in consonance with the ones obtained on the one hand by Mallo, Navarro, García-Aranda & Helsen\textsuperscript{10} that registered a reduction of 138 m in the TD covered in the second half in regard to the first in international SR, and on the other hand by Bradley, Sheldon, Wooster, Olsen, Boanas & Krustrup\textsuperscript{11} who also registered a reduction of 122 m in the second half in soccer players of England’s Premier League. These results stated that the fact of registering a worsening of the physical responses in the second half might have been due to muscle fatigue in the SR and the MF. Therefore, it is considered appropriate that the coaches and physical trainers of both referees and soccer players implement specific trainings in order to reduce the loss of the physical match performance.

On the other hand, some researchers have proved that the activity of the referee is influenced by the actions of the players. Therefore, one of the most important factors that affect the physical response of the referee is the rhythm of the match imposed by the players during the games. For that reason, it is interesting to analyze the physical responses (external load) of the referee together with the players’ one. In our study, the SR covers a distance higher than the MF at speeds over $14 \text{ km} \cdot \text{h}^{-1}$, $21 \text{ km} \cdot \text{h}^{-1}$ (Figure 3) and $24 \text{ km} \cdot \text{h}^{-1}$.

These results are in accordance with the study of Weston, Drust & Gregson in regard to the sprint velocity ($>24 \text{ km} \cdot \text{h}^{-1}$). However, these authors, unlike what we observed in our study, showed that the soccer players covered a higher distance at lower intensities ($>19$-$21 \text{ km} \cdot \text{h}^{-1}$). These differences might be due to the fact that Weston, Drust & Gregson compared the average physical responses of the players without considering the position of the player on the field and in the present paper was evaluated the response of the MF. In our case, the MF registered a higher Nº acc. and a higher value of PL than the referee in each half, for which it seems that the high intensity and short actions would be determining for their role as a player. Therefore, the position of a player would be a relevant factor to take into account by comparing the activity of the referee and of the player. Despite this is a case study and that the data recording included only one official match, more studies on the topic could help understanding the physical responses of the referee and the players of different positions in junior categories.

5. CONCLUSION

The results of this study show that in the second half of the match, both the referee and the player register lower values in the external load variables. The reason for the reduction of the physical responses showed might be due to accumulated muscle fatigue in both subjects. On the other hand, the referee and the player have a different response during the game; while the player covers a higher total distance and executes a higher number of accelerations, the referee covers a higher distance at speeds of $14$, $21$ y $24 \text{ km} \cdot \text{h}^{-1}$.

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REFERENCES


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