Physical demands of refereeing rugby sevens matches at different competitive levels

ABSTRACT

The aim of this study was to compare the physical demands of officiating across different competitive levels in rugby sevens. An observational design was used involving twenty-seven referees (26 males, 1 female, age: 27 ± 6 years, body mass (mean ± SD): 78.5 ± 9.3 kg, height: 179 ± 5 cm). GPS data was collected across a total of 114 matches during five separate rugby sevens tournaments played in England - between May and July 2018 - categorized into four competitive levels: (1) international, (2) professional, (3) semi-professional, and (4) amateur. Compared with referees officiating at the international, professional, and semi-professional levels, referees officiating at the amateur level covered less total ($p < 0.001$) and relative distance ($p < 0.001$). Additionally, these referees covered more distance walking and jogging ($p < 0.001$). Amateur referees also completed fewer sprints ($p = 0.006$), and repeated high-intensity efforts per game ($p < 0.001$), and spent longer between repeated high-intensity efforts ($p = 0.015$). Finally, for the amateur referees, the duration of the longest repeated high-intensity bout (i.e., worst case scenario) was lower ($p < 0.001$), with less distance covered ($p < 0.001$), and fewer high-intensity accelerations ($p < 0.001$). Refereeing rugby sevens is therefore more physically demanding at higher competitive levels, particularly in terms of high-intensity efforts. The results provide vital information for practitioners involved in the physical preparation of rugby sevens referees.

KEY WORDS: *Rugby 7s, referees, GPS, running demands, worst case scenario*

INTRODUCTION

Rugby sevens is an intermittent contact sport played across different ages and competitive levels (e.g., youth to adult, amateur to international) (11, 20). Although it is played under the same laws and on the same size field as 15-a-side rugby union, rugby sevens teams comprise fewer players, and matches are 14 minutes in duration (i.e. two halves of 7 minutes) (20). At all levels of rugby sevens, multiple daily performances and consecutive days of competition present a physical and psychological challenge, whereby players and referees must manage physical readiness and psychological arousal throughout the day, ensuring they peak in time for matches (9). Rugby sevens matches are under the control of a referee and two touch judges or assistant referees (23). Two in-goal judges also officiate in elite level matches but are usually only incorporated in the knockout stages of lower competitive levels. The referee is the sole judge of fact and is required to apply the Laws of the Game in every match (22). The ability of the rugby sevens referee to meet the physical demands imposed during match play is likely to be crucial for optimal positioning and thus decision-making (21).

Studies have described the match demands of refereeing 15-a-side rugby union (4, 5, 14, 15 26) and league (7, 12, 17), but only a few have examined the physical demands of refereeing rugby sevens matches (16, 23, 24). In sum, these studies have shown that officiating rugby sevens is characterized by higher running and physiological demands per minute (23). Also, these studies have shown that the running demands of refereeing rugby sevens is typically higher than the demands encountered when refereeing other rugby codes, and the demands are comparable to those experienced by rugby sevens players (23). However, a limitation of this research is that the referees were only evaluated at one competitive level, and thus no comparison was made between different competitive levels. To the authors' knowledge, there is only one study that has compared the movement demands of rugby referees across different levels (13). This study, found that less experienced referees spent more time in jogging and sprinting activities when compared to more experienced referees (13). However, this study was conducted during 15-a-side matches and compared the referees according to their level of experience at the same tournament, and thus no comparisons were made across tournaments of different competitive levels. This is an important limitation as such comparisons would provide vital information

that can be used by practitioners to optimize the training and preparation of referees for rugby sevens tournaments, and ensure this training is suitable for the competitive level they will officiate.

Thus, this study investigated the physical demands of officiating at different competitive levels in rugby sevens (i.e., amateur to international). Additionally, our study aimed to determine the specific physical demands of the most intense period of the match that the referee could be involved in (i.e., "worst case scenario") (18). Given that international rugby players have been shown to perform a greater quantity of very high speed running than provincial rugby players (21), it was hypothesised that officiating lower level matches (i.e., amateur) would be characterized by more low and moderate-intensity activities, while refereeing higher level matches (i.e., semi-professional, professional and international) would be characterized by more time spent in high-intensity activities.

METHODS

Experimental Approach

An observational design was used and referees wore an augmented concurrent multi-GNSS receiver (GNSS) Unit (Apex, 10 Hz, STATSports, Belfast, UK), between their shoulder blades using an elasticated vest, worn beneath their normal kit. The validity and reliability of this unit has been reported previously (3). The GNSS unit was switched on 5 minutes before, and immediately turned off at the end of each match. Data from all referees who completed the entire first and second halves were included in the final analysis. Data was excluded for one referee in the amateur level who sustained an injury and was replaced at half time. In two matches during the knock-out stage at the professional tournament, extra time was played. However, data from this extra time was not included in the final analysis, and only data from the two "standard" halves were used.

Subjects and Experimental Procedures

This study received institutional ethical approval and informed consent was obtained from each referee. In total, data was obtained from 27 referees (26 male, 1 female), with at least two years refereeing experience (6 ± 3 years), and 24 were amateur and three were professional. Three referees provided data for two different competitive levels. Data was recorded for between one and six matches for each referee, culminating in a total of 114 matches across five rugby sevens tournaments between

May and July 2018. These tournaments were categorised into four competitive levels: (1) International (34 matches, 6 referees, age: 27 ± 3 years, body mass: 74.8 ± 4.7 kg, height: 177 ± 5 cm, refereeing experience: 8 ± 3 years), (2) professional (22 matches, 6 referees, age: 28 ± 5 years, body mass: 83.8 ± 9.2 kg, height: 181 ± 2 cm, refereeing experience: 5 ± 2 years), (3) semi-professional (26 matches, 8 referees, age: 27 ± 4 years, body mass: 79.3 ± 11.5kg, height: 179 ± 8 cm, refereeing experience: 4 ± 1 years) , and (4) amateur (32 matches, 10 referees, age: 27 ± 8 years, body mass: 79.4 ± 10.3 kg, height: 180 ± 6 cm, refereeing experience: 6 ± 2 years). The total match time analysed was made up by the periods of match play activities as well as stoppages in play (excluding the half-time interval), which led to total match time exceeding 14 minutes (15 min 57 sec ± 1 min 08 sec).

Physical Demands Analysis

Data collected included: total distance (m), relative distance ($m.min^{-1}$), percentage of time spent walking (<5.40 $km.h^{-1}$), jogging (5.41 – 10.80 $km.h^{-1}$), and in low intensity (10.81 – 14.40 $km.h^{-1}$), medium intensity (14.41 – 18.40 $km.h^{-1}$), high intensity (18.41 – 25.20 $km.h^{-1}$), and maximal speed (> 25.20 $km.h^{-1}$) running, average number of sprints (n), average maximal speed of a sprint ($km.h^{-1}$), average maximal distance of a sprint (m), average sprint distance (m), and average duration of a sprint (s). The speed zones have been used previously to analyse the physical demands of rugby players and referees (19, 23). A sprint was defined as when the referee reached 20 $km.h^{-1}$ and sustained this speed for at least 1 second. This was classified based on previous research with rugby sevens referees (23, 24).

To further investigate high intensity activities, the frequency (n), duration (s), time between repeated high-intensity efforts (RHIE) (s), distance (m) and maximal speed ($km.h^{-1}$) of RHIE bouts was analysed. A bout was defined as a minimum of three sprints and/or high acceleration efforts (>2.79 $m.s^{-2}$) with less than 21 seconds of recovery between efforts (2, 11). The single longest period of a RHIE bout from each match was identified and analysed as the "Worst Case Scenario" (WCS) (18). The definition of a bout duration was from the time the referee first performed a high-intensity activity (i.e., sprint or high-intensity acceleration) and repeated a minimum of two other efforts with less than 21 seconds between those activities. For each WCS, the total duration (s), total distance (m), maximal

speed ($km.h^{-1}$), total distance relative to the bout duration ($m.min^{-1}$), number of sprints (n), and number of accelerations (n) was analysed.

Statistical Analysis

After collection, data from each GNSS unit was downloaded to analysis software (i.e., STATSports Apex software, v. 3.0.04101). Data was then exported to Microsoft Excel and statistical analysis software (IBM Corp., Armonk, NY, USA; IBM SPSS v. 22.0). Data distributions were tested using Kolmogorov-Smirnov tests. Next, means, standard deviations, and confidence intervals of the mean (95%) were calculated. To examine any differences between the competitive levels a series of one-way analysis of variances (ANOVAs) were used, with homogeneity of variances tested using the Levene's test and post-hoc analyses conducted using Tukey HSD when homogeneous and T2 Tamhane when non homogeneous. Effect sizes were calculated as partial eta squared (η_p^2), but are only presented for significant differences. Partial eta squared values of ≥ 0.01, ≥ 0.06, and ≥ 0.14 were interpreted as small, medium, and large effect sizes, respectively (5), and α was set at 0.05.

RESULTS

Total Distance and relative distance

Compared with all other competitive levels, referees who officiated at the amateur level covered significantly less total, F (3, 110) = 13.68, $p < 0.001$, $\eta_p^2 = 0.27$, and relative, F (3, 110) = 17.56, $p < 0.001$, $\eta_p^2 = 0.32$, distance (Table 1). However, there were no significant differences between the other competitive levels ($p > 0.05$).

Speed zones

For referees who officiated at the amateur level, a greater percentage of the total distance was covered walking, F (3, 110) = 10.42, $p < 0.001$, $\eta_p^2 = 0.22$, and jogging, F (3, 110) = 24.72, $p < 0.001$, $\eta_p^2 = 0.40$, compared with the other competitive levels (Figure 1). In addition, the referees involved in the international and professional levels covered a significantly greater percentage of the total distance in the high-intensity, F (3, 110) = 47.92, $p < 0.001$, $\eta_p^2 = 0.56$, and maximal, F (3, 110) = 8.50, $p <$

0.001, $\eta_p^2 = 0.18$, speed zones. Furthermore, the referees who officiated at the semi-professional level covered a significantly greater percentage of the total distance in the medium-intensity speed zone, $F(3, 110) = 18.55$, $p < 0.001$, $\eta_p^2 = 0.33$. Finally, the referees who officiated at the semi-professional and amateur levels covered a significantly greater percentage of the total distance in the low-intensity speed zone, $F(3, 110) = 19.25$, $p < 0.001$, $\eta_p^2 = 0.34$.

**** Figure 1 near here ****

At the international competitive level, referees covered a significantly greater percentage of the total distance in the medium and high-intensity speed zones compared with all of the other zones, $F(2.1, 71.0) = 78.35$, $p < 0.001$, $\eta_p^2 = 0.70$ (Figure 2). At the professional level, the referees covered a significantly greater percentage of the total distance jogging, and in the medium and high-intensity speed zones, in comparison with walking, low-intensity, and maximal speed zones, $F(1.7, 37.6) = 29.72$, $p < 0.001$, $\eta_p^2 = 0.58$. There were no significant differences in the professional level between the distance covered jogging and in the medium ($p = 0.538$) and high-intensity ($p = 0.360$) speed zones. At the semi-professional level, referees covered a significantly greater percentage of the total distance in the medium-intensity speed zone in comparison to the other zones, $F(3.0, 77.1) = 178.20$, $p < 0.001$; $\eta_p^2 = 0.87$. Finally, at the amateur level, referees covered a significantly greater percentage of the total distance jogging in comparison to the other speed zones, $F(2.4, 76.1) = 112.79$, $p < 0.001$, $\eta_p^2 = 0.78$.

**** Figure 2 near here ****

Sprints

Overall, there were significant differences in the number of sprints performed by the referees, $F(3, 108) = 33.47$, $p < 0.001$, $\eta_p^2 = 0.48$ (Table 1). Notably, the referees who officiated at the professional level performed more sprints compared with the referees who officiated at the semi-professional level, ($p = 0.001$) and the referees who officiated at the amateur level performed less sprints compared with the referees who officiated at all the other levels (all $p < 0.001$). Moreover, for referees

196 at the amateur level, a lower maximal sprint speed was recorded compared with referees at the
197 professional competitive level, F (3, 108) = 4.43, p = 0.006, η_p^2= 0.11. Finally, there were no significant
198 differences between the levels for maximal distance, average distance, or average duration of sprints
199 (all p > 0.05).
200
201 **Repeated high-intensity efforts**
202 There were significant differences in the frequency of RHIE per game, F (3, 100) = 25.96, p <
203 0.001, η_p^2 = 0.43. Specifically, there were fewer RHIEs at the amateur level compared with all other
204 competitive levels (all p < 0.005,), and fewer at the semi-professional level compared with the
205 international (p < .001) and professional (p = 0.002) levels. In addition, at the amateur level, there was
206 a longer time between RHIEs, F (3, 657) = 3.95, p = 0.008, η_p^2 = 0.01, in comparison with all other
207 levels (all p < 0.05). Moreover, at the amateur level, RHIEs had a lower duration, F (3, 847) = 4.40, p
208 = 0.004, η_p^2 = 0.01, compared with the professional (p = 0.005) and semi-professional (p = 0.034) levels.
209 Furthermore, referees at the amateur level covered less distance, F (3, 847) = 5.74, p = 0.001, η_p^2 = 0.02,
210 compared with the professional (p =0.003) and semi-professional (p = 0.002) levels. Finally, referees
211 at the amateur level achieved a lower maximal speed in RHIEs, F (3, 847) =4.76, p = 0.003; η_p^2 = 0.01,
212 compared with the professional (p = 0.003) and semi-professional (p = 0.018) levels.
213
214 **Worst case scenario**
215 There were significant differences in the duration of the longest period of high-intensity
216 activities (i.e., WCS), F (3, 98) = 11.44, p < 0.001, η_p^2 = 0.25, with the amateur level being shorter than
217 all of the other competitive levels, and the semi-professional level being shorter than the professional
218 level (Table 1). Also, within the WCS, the referees officiating at the amateur level covered significantly
219 less distance than the referees who officiated at the other levels, F (3, 99) = 19.33, p < 0.001, η_p^2 = 0.36,
220 and reached lower maximal speeds in comparison with the referees at the semi-professional and
221 professional levels, F (3, 102) = 4.53, p = 0.005, η_p^2 = 0.11. Moreover, within the WCS, the referees
222 who officiated at the amateur and semi-professional levels, performed fewer sprints than the referees
223 who officiated at the professional level, F (3, 87) = 4.32; p = 0.007, η_p^2 = 0.13. In addition, the referees

who officiated at the amateur level performed fewer high-intensity accelerations than the referees who officiated at the other levels, $F (3, 96) = 11.83$, $p < 0.001$, $\eta_p^2 = 0.27$. Finally, within the WCS, there were no significant differences in the relative distance, and no significant differences between the international and professional levels for any variable ($p > 0.05$).

**** Table 1 near here ****

DISCUSSION

This study compared the physical demands of refereeing at different competitive levels in rugby sevens, from amateur to international. In summary, the results revealed that relative to the other competitive levels, referees who officiated at the amateur level ran less distance, covered a higher percentage of total distance walking and jogging, completed fewer sprints, and repeated high-intensity efforts, and spent more time between RHIE. Finally, compared with the other competitive levels, the WCS for the referees involved at the amateur level consisted of a shorter duration, less distance, and fewer accelerations.

The referees involved in the amateur competitive level covered a similar total distance to the distance reported in Suarez-Arrones et al. (2013) (i.e,. 1653 ± 165 m and 1665 ± 203 m, respectively) (23). The results from this previous study by Suarez-Arrones et al. (2013) showed that the relative distance covered by rugby sevens referees was 110 $m.min^{-1}$. This result was greater than the relative distance found in the present study at the amateur level, which might be due to different total match durations (including stoppages in play) in each study. However this finding from both studies was lower than the relative distance covered at the international, professional, and semi-professional levels (Table 1). Although comparisons with previous research should be made cautiously, one possible explanation for these differences is the higher level of rugby sevens played at the tournaments accessed in the present study (i.e., professional and international). For instance, professional players likely possess greater tactical awareness, and limit handling errors, which would reduce match stoppages (21). Consequently, the ball in play time is often higher at the professional level, requiring the referees to cover a greater distance per minute.

Overall, the results show that at higher competitive levels, the referees were required to cover greater distance at high-intensity running and maximal speed. The results previously reported by Suarez-Arrones et al. (2013) were similar to the findings for the semi-professional level in the present study, with the referees covering nearly 60% of total distance in low-intensity running, jogging, and walking, and approximately 15% in high-intensity running and at maximal speed. In the present study, there were differences between the lower (i.e., amateur) and higher (i.e., international and professional) levels. Specifically, in the latter, the referees covered approximately 50% of the total distance in speed zones below 14 $km.h^{-1}$, whereas in the former, the referees covered approximately 70% of the total distance within these zones. Moreover, differences were observed between these levels for high-intensity and maximal speed running. Indeed, the referees who officiated at the higher levels (i.e., international and professional) covered approximately 30% of the total distance within these speed zones, whereas referees at the lower level (i.e., amateur) covered only 11%. These results might be partly explained by the greater speed characteristics of the international and professional players, who cover larger distances at higher speeds than amateur players, and also because professional matches involve greater ball-in-play time (21). Thus, a referee officiating at a higher competitive level must have the capacity to cover more distance at higher-speed than referees officiating at lower competitive levels.

There will be passages of play in rugby sevens, where the transition of the ball from one side of the pitch to the other is quick, with less phases and stoppages (e.g., rucks, scrums) (27), and the referee is therefore required to cover greater distance in a shorter period of time. Thus, sprinting is a necessary demand for officiating rugby sevens matches. The findings of the present study show that referees involved at the professional level sprinted approximately 15 times per match, which was significantly higher than at the semi-professional and amateur levels (approximately 11 and 7 sprints per match, respectively), and similar to the number of sprints previously reported for rugby sevens players (25, 27). Moreover, the referees were required to sprint over an average distance of 25 meters and occasionally over 60 metres.

To our knowledge, this was the first study to analyse RHIE for rugby sevens referees. The findings show that the number of RHIE was highest at the professional and international competitive levels, which is unsurprising due to the greater percentage of total distance covered in high-intensity

speed zones. The mean duration of a RHIE was shorter and the time between RHIE was longer at the amateur level compared with the professional and semi-professional levels. These findings could be explained by the superior skill level of the international and professional players, resulting in fewer stoppages and more ball-in-play time (19). However, it should be noted that there were no significant differences between the amateur and international levels. This comparison was also similar for the results related to the distance covered during RHIE. These findings were surprising due to the fact that international matches encompass a greater frequency of long-duration activity cycles (21). Despite a direct comparison being difficult due to the different roles, the results show a similar number of RHIEs per match to those reported for rugby sevens players (25) and a similar average duration of RHIE to players (backs positional group) during rugby union matches (2). However, this comparison should be made cautiously, because players will also be involved in collisions, which are characterized as high-intensity efforts (2), and this does not typically apply to referees.

The analysis of the WCS, showed that the amateur competitive level had a lower duration, lower distance covered, and a lower number of accelerations performed by the referee during the most intense period of match, when compared with the other levels. Additionally, referees officiating at the amateur level also performed fewer sprints than those at the professional level. Interestingly, at the semi-professional level, the duration of the WCS, and the number of sprints performed within this period, was lower than at the professional level. Likewise, at the semi-professional level, the referees covered less distance than during the professional and international levels. These might be explained by the fact that at the professional level, the players are athletically superior to players at the lower levels (i.e., semi-professional and amateur), resulting in higher physical demands during the matches involving higher quality players (1, 8). These findings also suggest that at higher competitive levels, referees' ability to sustain high-intensity activity is more significant. Although the comparison between different studies should be made with caution, because of the different roles performed in a rugby match, within the WCS, the referees in this study covered a higher distance per minute, and performed more sprints, than previously reported for professionals rugby union players (18).

This study adds to the literature regarding the physical demands of refereeing rugby sevens. However, there are some limitations that should be noted. First, rugby sevens referees are often required

to officiate in more than one match per day and on consecutive days. Unfortunately, due to logistical challenges, this study did not investigate variation between matches (i.e., exercise-induced fatigue), and thus researchers should aim to examine such variation in the future. Second, the outcomes of this study are specific to referees within tournaments in the northern hemisphere, potentially limiting the generalisability of the findings. Future research is therefore encouraged to investigate the physical demands of officiating rugby sevens in other nations and at international tournaments involving both northern and southern hemisphere teams (e.g., World Sevens Series). Finally, the data for this study was collected during one season, and so, future research should aim to examine longitudinal data and investigate match-to-match and within season variations in physical demands.

In summary, this study examined the physical demands of refereeing rugby sevens matches at different competitive levels. The findings showed that rugby sevens refereeing is characterised by high intermittent running demands that are greater at higher levels of competition.

PRACTICAL IMPLICATIONS

This study provides rugby sevens referees and practitioners with an understanding of the physical demands of officiating at different competitive levels. The findings can help practitioners optimise the training of rugby sevens referees to ensure that they have the capacity to perform the repeated high-intensity efforts needed on a match day. More specifically, the high intensity intermittent nature of officiating rugby sevens matches, requires the development of training programs that include high intensity efforts (i.e., > 18.1 $km.h^{-1}$) interspersed with short periods of recovery at low intensity running (i.e., 1 minute between 10.8 and 14.4 $km.h^{-1}$). Additionally the analysis of the WCS provides useful information for the prescription of training aimed at improving rugby referees' fitness to cope and overlap with the most demanding periods of the match. In particular, to induce overload in training for rugby sevens referees, practitioners may wish to design training programs which include sessions exceeding the WCS identified in the current study. For example, repeated high-intensity efforts (i.e., > 3 sprints) for a longer period (i.e., > 80 seconds) replicating the movement demands of the match, which should include change of directions exercises. Furthermore, sprint training should be designed for rugby sevens referees that reflects and replicates the physical demands encountered in this research. As rugby

sevens referees are subjected to a high physical demand during matches, they should follow structured weekly training plans that have an emphasis on intensive and intermittent exercise sessions.

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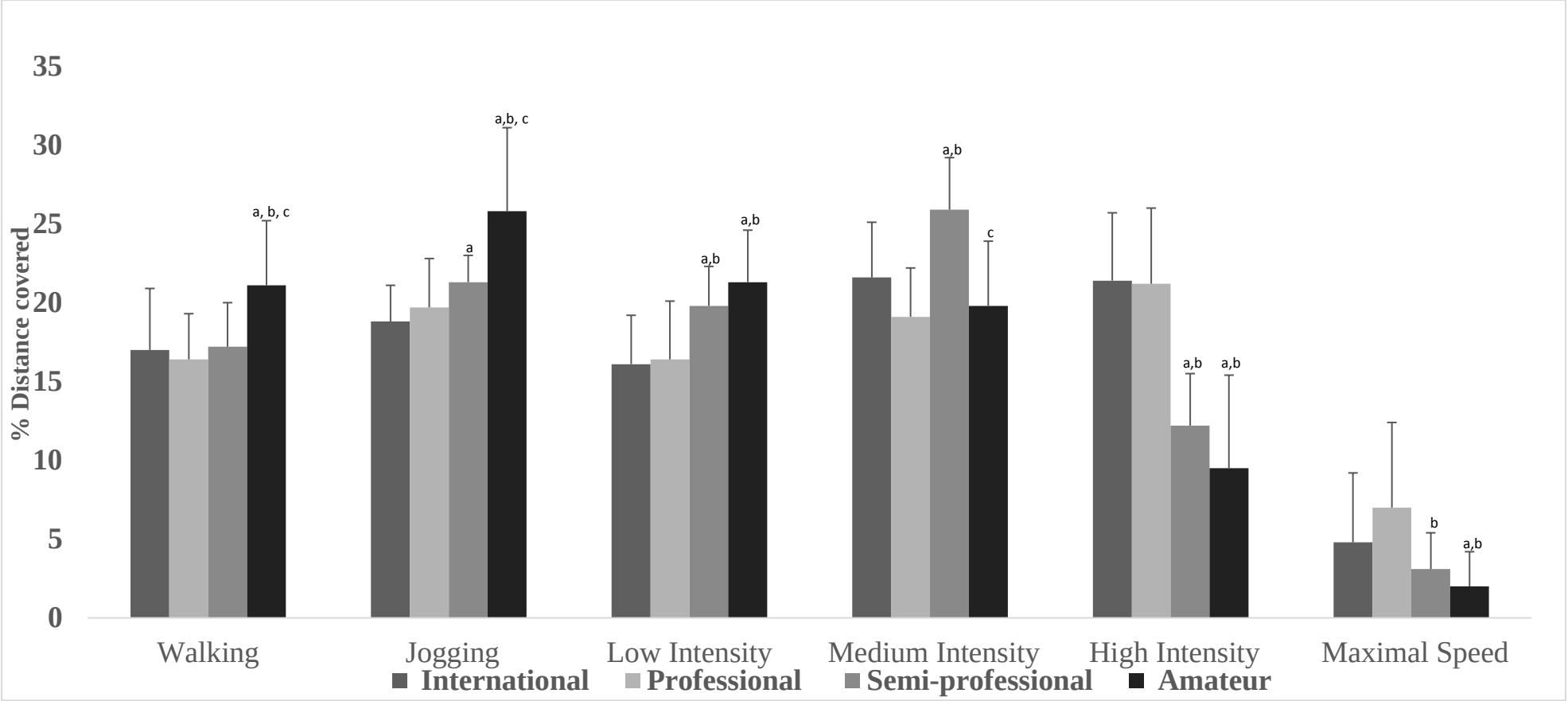

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418

419 **Figure 1** - Differences between the different competitive levels in terms of each speed zone showed in the percentage of distance covered. [a] = significantly different to
420 International tournament 1; [b] = significantly different to Professional tournament; [c] = significantly different to Semi-professional tournament.

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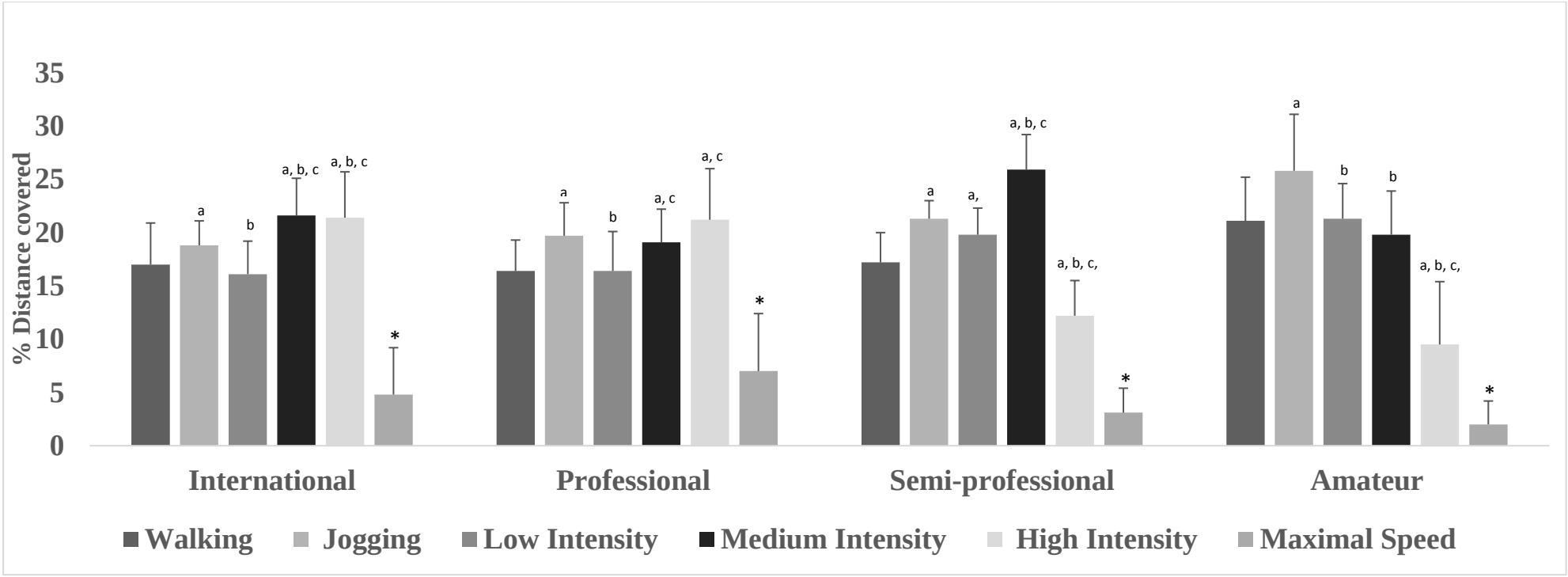

Figure 2 - Percentage of distance covered in each speed zone at each competition. [a] = significantly different to Zone 1; [b] = significantly different to Zone 2; [c] = significantly different to Zone 3; [d] = significantly different to Zone 4; * = significantly different to Zones 1, 2, 3, 4 and 5.

Table 1. Data related to the physical demands of officiating at different competitive levels, Mean ± SD, ($CI_{95\%}$).

	International	Professional	Semi-professional	Amateur
Distance				
Total distance (m)	1865 ± 187 (1800-1930)	1922 ± 182 (1842-2003)	1819 ± 129 (1768-1872)	1653 ± 165 (1594-1843) [a, b, c]
Relative distance ($m.min^{-1}$)	114.3 ± 10.1 (110.7-117.8)	118.4 ± 9.3 (114.2-122.4)	118.7 ± 8.8 (115.1-122.2)	103.5 ± 8.0 (100.6-106.4) [a, b, c]
Sprints				
Number per match (n)	13.7 ± 3.6 (12.4-14.9)	15.7 ± 3.3 (14.2-17.2)	11.9 ± 3.1 (10.7-13.2) [b]	7.1 ± 3.0 (6.0-8.3) [a, b, c]
Maximal speed ($km.h^{-1}$)	27.0 ± 1.6 (26.4-27.6)	28.1 ± 1.9 (27.3-29.0)	27.9 ± 1.7 (27.2-28.6)	26.2 ± 3.0 (25.1-27.3) [b]
Maximal distance (m)	58.5 ± 15.4 (53.1-63.9)	56.9 ± 11.7 (51.7-62.2)	57.1 ± 13.4 (51.7-62.5)	49.2 ± 16.8 (43.0-55.6)
Average distance (m)	25.6 ± 5.4 (23.7-27.5)	24.2 ± 4.3 (22.3-26.1)	26.3 ± 5.9 (24.0-28.7)	27.3 ± 8.3 (24.2-30.4)
Average duration (s)	4.4 ± 0.9 (4.1-4.7)	4.1 ± 0.6 (3.8-4.4)	4.4 ± 0.9 (4.1-4.8)	4.6 ± 1.2 (4.2-5.1)
RHIE				
Number per match (n)	9.6 ± 1.9 (8.9-10.2)	9.2 ± 1.4 (8.6-9.9)	7.4 ± 1.6 (6.7-8.1) [a, b]	5.3 ± 2.6 (4.3-6.4) [a, b, c]
Duration (s)	32.2 ± 18.9 (30.1-34.2)	36.5 ± 22.2 (33.4-39.7)	38.3 ± 40.6 (32.6-44.1)	29.4 ± 16.3 (26.6-32.2) [b, c]
Time between RHIE (s)	65.7 ± 38.5 (61.0-70.3)	62.9 ± 38.6 (56.7-69.1)	62.6 ± 39.3 (56.3-68.8)	79.9 ± 60.0 (67.6-92.3) [a, b, c]

Distance (m)	102.0 ± 57.6 (95.8-108.3)	114.4 ± 62.5 (105.6-123.3)	115.1 ± 87.9 (102.7-127.4)	89.0 ± 44.2 (81.5-96.7) [b, c]
Maximal speed ($km.h^{-1}$)	23.5 ± 3.2 (23.2-23.9)	24.1 ± 3.3 (23.6-24.5)	23.9 ± 3.5 (23.4-24.4)	22.7 ± 3.4 (22.2-23.3) [b, c]
WCS				
Duration (s)	67.9 ± 20.4 (60.8-75.0)	77.1 ± 22.3 (66.2-87.2)	61.0 ± 10.7(56.2-65.7) [b]	44.8 ± 22.3 (35.6-54.0) [a, b, c]
Distance (m)	205.3 ± 53.9 (186.5-224.1)	221.0 ± 61.9 (192.8-249.2)	170.7 ± 38.5 (154.5-187.0) [a, b]	122.1 ± 37.0 (106.5-137.7) [a, b, c]
Maximal speed ($km.h^{-1}$)	24.6 ± 2.5 (23.7-25.6)	24.9 ± 2.5 (23.7-26.0)	25.3 ± 2.4 (24.4-26.3)	22.9 ± 2.7 (21.7-24.0) [b, c]
Sprints (n)	2.1 ± 1.2 (1.7-2.6)	2.5 ± 1.0 (2.0-3.0)	1.7 ± 0.8 (1.4-2.0) [b]	1.5 ± 0.7 (1.2-1.8) [b]
Accelerations (n)	4.7 ± 1.4 (4.2-5.1)	3.8 ± 1.4 (3.1-4.4)	3.8 ± 1.2 (3.3-4.3)	2.5 ± 1.3 (2.0-3.1) [a, b, c]
Relative distance ($m.min^{-1}$)	184.3 ± 30.4 (173.7-194.9)	172.8 ± 16.0 (165.5-180.1)	172.1 ± 27.1 (161.2-183.1)	181.6 ± 40.2 (165.0-198.2)

[a] = significantly different to International tournament; [b] = significantly different to Professional tournament; [c] = significantly different to Semi-professional tournament.
RHIE: Repeated High-Intensity Efforts; WCS: Worst Case Scenario.