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The Positional Match Running Performance of Elite Gaelic Football

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ABSTRACT

There is currently limited information available on match running performance in Gaelic football. The objective of the current study was to report on the match running profile of elite male Gaelic football and assess positional running performance. In this observational study 50 elite male Gaelic football players wore 4-Hz GPS units (VXsports, New Zealand) across 30 competitive games with a total of 212 full game data sets collected. Activity was classed according to total distance, high speed distance (≥17 $km.h^{-1}$), sprint distance (≥22 $km.h^{-1}$), mean velocity ($km.h^{-1}$), peak velocity ($km.h^{-1}$) and number of accelerations. The average match distance was 8160 ± 1482 m, reflective of a relative distance of 116 ± 21 $m.min^{-1}$, with 1731 ± 659 m covered at high speed which is reflective of a relative high speed distance of 25 ± 9 $m.min^{-1}$. The observed sprint distance was 445 ± 169 m distributed across 44 sprint actions. The peak velocity was 30.3 ± 1.8 $km.h^{-1}$ with a mean velocity of 6.5 ± 1.2 $km.h^{-1}$. Players completed 184 ± 40 accelerations which represent 2.6 ± 0.5 $a.min^{-1}$. There were significant differences between positional groups for both total running distance, high speed running distance and sprint distance, with midfielders covering more total and high speed running distance, compared to other positions ($p<0.001$). There was a reduction in high speed and sprint distance between the first and second half ($p<0.001$). Reductions in running performance were position dependant with the middle three positions experiencing the highest decrement in performance. The current study is the first to communicate a detailed description of match running performance during competitive elite Gaelic football match play.

Key Words: GPS; Match analysis; Team sport; Intermittent exercise

INTRODUCTION

The sport of Gaelic football is indigenous to Ireland and is branched within the Gaelic Athletic Association (GAA). The sport is played with an amateur ethos super imposed on a professional work ethic [9]. Gaelic football is a team based invasion field game that entails a wide range of offensive and defensive skills to be executed at high speed as play shifts rapidly [38, 39]. The competitive elite Gaelic football season takes place over an eight month period. The two main competitions are the national league which takes place between February and April and the All-Ireland championship which takes place from May to September. The All-Ireland competition attracts mass national interest with over 80,000 spectators present at the all Ireland final [39]. Previously, Keane et al [28] estimated from video based time motion analysis that elite-level players cover 8594 m during competitive play. The estimated distances compare well to recent global positioning systems (GPS) technology analysis [14] that reported players cover 8815 m with a range of 6183-11104 m. Limitations with regard to subjective classification of speed bands and the inter observer definitions for movement classification must be considered before comparison of video analysis studies with GPS studies are made [27, 40]. Consequently, the nature of video based motion analysis limts its practical effectiveness in the construction of training drills which replicate the running performance profile of match-play.

Without many sport-specific published studies as reference, Gaelic football coaching staff preparing and prescribing training loads will rely on personal experience or anecdotal observations [38]. Therefore, inference as to the running performance of players has been appraised from other field sports due to apparent similarities in locomotion characteristics [8,

[24]. Recent technological innovations have made GPS athlete-tracking a convenient and popular method to quantify movement patterns and physical demands in sport [2, 3, 4, 5, 6, 8, 14, 15, 16]. GPS technology has been used to quantify the running demands of sports such as rugby league [5, 6, 7, 20, 29], rugby union [42], Rugby 7's [40] and Australian football [2, 15, 16, 31]. Johnston et al. [27] reported that GPS seems to be a practically superior athlete-monitoring system in comparison with other methods (e.g., time-motion analysis, hand notation techniques, video-based systems). The technology provides quantitative information on the position, displacement, velocity, and acceleration of field sport athletes, some of which would not be previously obtained from video time motion analysis alone [18].

Gaelic football, like other field sports such as Australian football [15, 16], rugby league [5, 6, 7, 20, 29] and soccer [10, 17] has a degree of positional differentiation regarding running performance profiles. Keane et al. [28] previouly reported that the midfield positions covered the greatest distances during match play. Collins, Solan and Doran [14] observed similar positional differences for high speed distance (≥17 km.h^{-1}) with midfielders covering a greater distance of match play high-intensity in contrast against other positional lines. However, caution must be taken when examining the activity profiles of these studies as positions were only demarcated across three specific positional lines (defender, midfielder, forward). With respect to positional running performance analysis, it is important for strength and conditioning coaches to understand all the positional roles within Gaelic football. The training situation needs to be constructed to consider the current tactical roles of each position during match play. Specifically the evolution of the half-backs and half-forwards as "link" players between the attack and defence needs to be considered. There is consequently a need to analyse the running performance of the five positional roles (full-back, half-back, midfield, half-forward, full-forward) within Gaelic football match play.

Given the increasing focus on game and position specific conditioning for players, it is imperative that competition demands are analyzed to better understand both the game and position-specific demands in Gaelic football [11]. Consequently, the aims of this study were two fold; (1) to examine the match-play running performance of elite Gaelic football players using portable GPS technology and (2) to report the positional differences in running performance across the halves of competitive match play.

METHODS

Experimental Approach to the Problem

The current observational study was designed to examine match-play running performance of elite Gaelic football players using portable GPS technology to examine positional differences in match-play demands. Fifty inter-county elite Gaelic football players (n=50) were analysed across two full competition seasons (February – September 2013/2014, February – September 2014/2015) resulting in two hundred and twelve (n = 215) individual samples being collected. All players analysed were competing at national league level (NFL) and All-Ireland championship level. Data was only included if a full match (70 minutes) was completed. Data were classified according to position of play during each individual match (i.e, full-back, half-back, midfield, half-forward and full-forward). All competitive matches took place between 14.00 and 20.00 hours. Temperatures during match-play ranged from 10 to 22°C. The GPS was used to determine specific running performance variables during elite Gaelic football match play. Players were requested to abstain from strenuous physical activity in the 24-48 hours before competitive play. All players were advised to maintain their normal diet, with special emphasis being placed on the intake of fluids and carbohydrates.

Subjects

Fifty elite male Gaelic footballers with a mean (±*SD*) age (24 ± 6 years), height (180 ± 7 cm), weight (81 ± 7 kg) and years on squad (5 ± 3 years) respectively, volunteered to participate in the study. Players were selected as they were members of the county's squad that season, and therefore were deemed the best players in the county at the time of data collection. After ethical approval, participants attended an information evening where they were briefed about the purpose, benefits, and procedures of the study. Written informed consent and medical declaration were obtained from participants in line with the procedures set by the local institutions research ethics committee.

Experimental Procedures

The participants wore an individual GPS unit (VXsport, New Zealand, Issue: 330a, Firmware: 3.26.7.0) sampling at 4-Hz and containing a triaxial acceloremter and magnetometer in a total of 30 games. The GPS unit (mass: 76 g; 48mm x 20mm x 87mm) was encased within a protective harness between the player's shoulder blades in the upper thoracic-spine region this ensured that players' range of movement in the upper limbs and torso was not restricted. The device was activated and satellite lock established for a minimum of 15 minutes before the commencement of each match [34]. The GPS technology has been shown to be a valid and reliable way of measuring distance and movement speeds in a range of high speed, intermittent, contact, and noncontact sports [8, 12, 26, 27, 35]. Specifically, the VX Sport GPS unit has more recently been examined by Malone et al. [35] for accuracy and reliability during intermittent activity. Test-retest (7 days apart) reliability for total distance covered, maximum speed, and average speed was quantified. Systematic differences were examined using a paired t-test on the test-retest data and revealed no significant differences for the total distance covered (300.5 ± 3.3; 303.6 ± 5.6 m), maximum speed (23.9 ± 1.9; 24.1 ± 1.3 km.h^{-1}), and average speed (10.2 ± 1.0; 10.2 ± 0.9 km.h^{-1}). The typical error (TE ± 95% confidence interval [CI]) was 0.84 ± 0.3 for total distance covered, 0.75 ± 0.26 for maximum speed, and 0.55 ± 0.19 for average speed, respectively. The coefficient of variation (CV% ± 95% CI) was 1.0 ± 0.4 for the total distance covered, 4.2 ± 1.5 for maximum speed, and 4.4 ± 1.5 for average speed, respectively.

Following each match GPS data were downloaded using the same proprietary software (VXSport View, New Zealand). Each file was trimmed so that only data recorded when the player was on the field was included for further analysis. The proprietary software provided instantaneous raw velocity data at 0.25 s intervals, which was then exported and placed into a customised Microsoft Excel spreadsheet (Microsoft, Redmond, USA). The spreadsheet allowed analysis of distance covered (m) in the following categories; total distance; high-speed distance (≥17 km.h^{-1}); sprint distance (≥22 km.h^{-1}). The peak and mean velocity (km.h^{-1}) were also recorded. An acceleration was classified once a participant changed speed by 2 km.h^{-1} within 1 second. The change was triggered over a minimum time of 2 s (to demarcate a lunge from a sprint). The acceleration stopped when the player decelerated to <75% of maximum speed reached in the preceding acceleration effort.

Statistical Analysis

Data are presented as mean ± SD with and 95% confidence intervals (95% CI). Descriptive analysis and assumptions of normality were verified prior to parametric statistical analysis. A multivariate analysis of variance (MANOVA) was used to compare differences in running performance variables between positional groups and playing half. The dependant variables across the range of analysis were, total distance (m), high speed distance (m; ≥17 $km.h^{-1}$), sprint distance (m; ≥22 $km.h^{-1}$), mean velocity ($km.h^{-1}$), peak velocity ($km.h^{-1}$) and number of accelerations (n) with playing position and match periods (e.g, first and second half) independent variables. When significant main effects were observed a Scheffe's post hoc test was applied. Standardised effect sizes (ES) were calculated with <0.2, 0.21- 0.6, 0.61-1.20, 1.21-2.00 and 2.01-4.0 representing trivial, small, moderate, large and very large differences, respectively [(15)]. All statistical analyses were performed using SPSS for Windows (Version 22, SPSS Inc. Chicago, IL, USA) with statistical significance set at an accepted level of $p<0.05$.

RESULTS

Selected running performance variables for each playing position are shown in Table 1. Independent of position the mean distance covered during match play was 8160 ± 1482 m which equates to a relative work rate of 116 ± 21 $m.min^{-1}$. The high speed distance of players was 1731 ± 659 m, which equates to a relative high speed running distance of 25 ± 9 $m.min^{-1}$. Players undertook 184 ± 40 accelerations, which equates to a relative acceleration number of 2.6 ± 0.5 $a.min^{-1}$. The sprint distance analysis indicates that players cover 445 ± 269 m across 40 sprints. The peak velocity of players was 30. 3 ± 1.8 $km.h^{-1}$ with a mean velocity of 6.5 ± 1.2 $km.h^{-1}$.

The analysis of variance revealed significant main effects for playing position (F=11.8, p<0.001). Post hoc analysis revealed that midfielders covered a greater total distance compared to all other positions (ES=0.72-1.39). Similarly, midfielders also had higher relative distances compared to all other positions (ES=0.71-2.14), while higher values were observed for half-forwards and half-backs when compared to full-forwards (ES=1.25) and full-backs (ES=1.06) only. Midfielders, half-backs and half-forwards also had greater high speed distance compared to all other positions (ES=0.80-2.37). Similar trends were observed for sprint distance (ES=0.65-3.46) with midfielders, half-forwards and half-backs covering higher distances compared to all other positions. Full-forwards had less accelerations when compared to all other positions (ES=1.34-2.37). Midfielders and half-backs had a higher number of accelerations compared to full-back, full-forward half-forward positions (ES=1.10-2.45). Further analysis revealed no significant main effects for playing position for peak and mean speeds.

Table 1 near here

A significant main effect for the half of play (F=7.26, p<0.001) was observed. Post hoc analyses revealed that the high speed distance in the second half (ES=0.28; 0.29) reduced compared to the opening half (p=0.023). Figure 1 shows the temporal changes in high speed distance with respect of position. A significant effect for position (F=6.11, p<0.001), revealed that midfielders had a greater high speed distance decrement when compared to all other positions (ES=0.82-2.39). Half-forwards experienced significantly (p=0.002) higher decrement in high speed distance when compared to full forwards (ES=1.35) and full backs (ES=1.16) only. Figure 2 shows the temporal changes in sprint distance with respect of position. Significant main effects for position were revealed (F=6.11, p<0.001), with half-backs and midfielders having higher sprint distance decrement when compared to other positions (ES=0.92-2.19). No significant main effects were observed for playing position for total distance between halves.

DISCUSSION

The aim of the current study was to analyse the running performance of elite Gaelic football using GPS technologies. Currently there is a dearth of up to date information related to the running performance of elite Gaelic football players, therefore cross comparison of the findings to previous literature is challenging. The current study examined running performance of elite Gaelic football players. The results show that there were positional differences in distances travelled across various speed zones. Additionally, reductions in both high speed and sprint distances were observed between halves of play. It is evident that Gaelic football running performance consists of interwoven generic movement with players completing low speed running interspersed with high speed running. The current study is the first to report a detailed description of match running performance across the five positional lines in elite Gaelic football.

Figure 1 near here

Independent of position the total distance covered during match play was 8160 ± 1482 m, this is marginally lower than previous studies [14] that reported total distances of 8815 ± 1287 m. Players covered 1731 ± 659 m at high speed, classed by an arbitrary figure ≥17 $km.h^{-1}$, the current data is marginally higher than previously observed in Gaelic football (1695 ± 503 m) [14]. Comparative analysis of relative outputs ($m.min^{-1}$) suggests that Gaelic football players compare well with their professional counterparts in other invasion based field sports. Gaelic football locomotion (116 $m.min^{-1}$) is similar to that reported for soccer match play (118 $m.min^{-1}$) [41], higher than that reported for rugby league back line players (89 $m.min^{-1}$) [6, 7, 20] and lower than that reported for Australian football players (127 $m.min^{-1}$) [15]. Careful consideration must be given here to difference in playing number, size of pitch and the rules of each specific game, all of which will influence findings in addition, to the variation in speed thresholds across studies for high speed distance [23, 25]. Sprint actions have been reported to have a positive effect on match outcomes within soccer [23, 25 41]. In the current study independent of position players on average sprinted 445 ± 169 m distributed over ~44 sprints. It is difficult to compare the figures definitively given that the demarcation of sprinting velocities varies across studies from 18-30 $km.hr^{-1}$ [23]. Peak velocity has been shown to be an important reproducible performance requirement for players within field sports [30]. No significant differences were noted across maximum velocity attributes of players suggesting a non positional specific threshold of velocity for elite match play.

Previous studies have attempted to analyse the positional profiles of Gaelic football players by three distinct positional roles (defender, midfielder and forward) [14, 28]. The evolution of tactical roles means there is a need to further differentiate positions into five distinctly separate positional roles. The current study is the first to differentiate players into the five positional roles. Similar to previous studies in soccer [10, 17, 21, 37], rugby league [5, 6, 20] and Australian football [2, 15, 16, 19] positional differences for running performance during elite Gaelic football were observed. Specifically, midfielders covered greater total distance compared to other playing positions, also high speed distances were greater for midfielders as well as half-forwards and half-backs in comparison to full-forwards and full-backs. The current results are comparable to those that have been reported previously during Australian football competition play [15, 16]. A temporal change with respect of high speed distance and sprint distance was observed. Results indicate that both high speed distance and sprint distance are reduced in the second half of match play. Trends similar to this are also evident in soccer [10, 33, 44] with a drop in sprinting, and high-intensity running reported in the period after half-time. A reduction in work-rate in the second half have been found during elite level

Australian football matches [15, 16] and attributed to a reduction in glycogen stores [45], this may suggest a need for nutritional re-supplementation strategies during the half-time period. A brief re-warm-up post half-time may also be necessary to attenuate the decrement in high speed and sprint distance covered. An active re-warm-up strategy during half-time has shown to be effective in improving performance in sports of similar nature [32, 33], and therefore should be considered in the case of Gaelic football.

The decrement in running performance observed in the current study was position specific with the middle three positional roles (half-back, midfield and half-forwards) exhibiting the highest decrement across running performance variables. Midfield players (11%) experienced the highest decrement in total running performance across halves of play followed by half-back (10.3%) and half-forward lines (8.2%). A non significant decrement was observed for both full back (0.2%) and full forward lines (2.5%). The current findings are similar to those observed in Australian football [10, 15, 16] and soccer [29]. The positional differences in running performance may be explained by the specific tactical roles of each playing position. Midfielders, half-backs and half-forwards are more nomadic than other positions due to their transitional role in both attack and defensive situations, which allows them greater freedom to complete higher distances and consequently accrue higher decrements in running performance. It is not possible to determine if the observed decrement can be linked to metabolic or central nervous system fatigue or even pacing strategies employed by players throughout match activities [2]. The findings from the current study show that positional roles play an important role in determining the amount of running involvement during match-play. The training of elite players needs to reflect these positional differences.

Figure 2 near here

The results of this study need to be interpreted within the context of the study limitations. No measure of collision events, shouldering, tackling, breaking tackles, and blocking were included in this study. It is, however, clear that such collisions incur a large physiological demand [6, 7, 19, 20] and significantly increase match intensity. The impact of these elements was not quantified in the current study, and therefore future research related to these elements of match-play demand is warranted. Furthermore, in this study, match dynamics (winning and losing team) and styles of play were not analyzed. This could provide additional information into how match outcome and running performance interact. Additionally, the match to match variation in running performance must be considered, variance across activity profiles has been shown in soccer [22, 37]. Future studies in Gaelic football should aim to assess the match to match variability for running performance thresholds for Gaelic football. The temporal nature of running performance needs to be assessed across position with respect to quarters of play. Furthermore, each player is biologically different in both stature and physical capacity with this in mind the authors advocate the development of individualised player specific running thresholds as seen in soccer [1]. Finally future research should consider the current advancements in the understanding of team sport activity profiles and the known importance of accelerations and decelerations [36], as such the analysis of the metabolic power profile of Gaelic football should be undertaken to help our understanding of the energetic cost associated with competitive match play.

PRACTICAL APPLICATIONS

Training specificity is important for stimulating training adaptations to improve match performance. Understanding the running performance demands of a sport is therefore of paramount importance for strength and conditioning coaches. Despite this, few data are currently available on the match-play running demands of elite level Gaelic football. To provide relevant up to date data on match-play the current study examined the match running performance of elite Gaelic football players. The main findings were that positional differences exist in elite Gaelic football. Midfielders, half-forwards and half-backs had greater activity profiles compared to other position groups. Secondly, there was observed a distinct positional temporal decrement in high speed and sprint distance across halves of play. Analysis of the findings highlight the need for position-specific physical conditioning drills that replicate the running performances observed during the current study. The temporal decrement in high speed and sprint distance after half-time is also of practical significance to coaches, therefore a half-time active re-warm-up and between half nutritional supplementation may be required in elite Gaelic football to attenuate the decrement in running performance observed. Overall coaches should consider the positional running profile of players and the subsequent decrement in running performance to better optimize training outcomes for match day running performance.

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LEGEND OF FIGURES AND TABLE

Figure 1. Temporal changes in match play high speed distance (>17 km·h^{-1}) across halves of play.

Figure 2. Temporal changes in match play sprint distance (>22 km·h^{-1}) across halves of play.

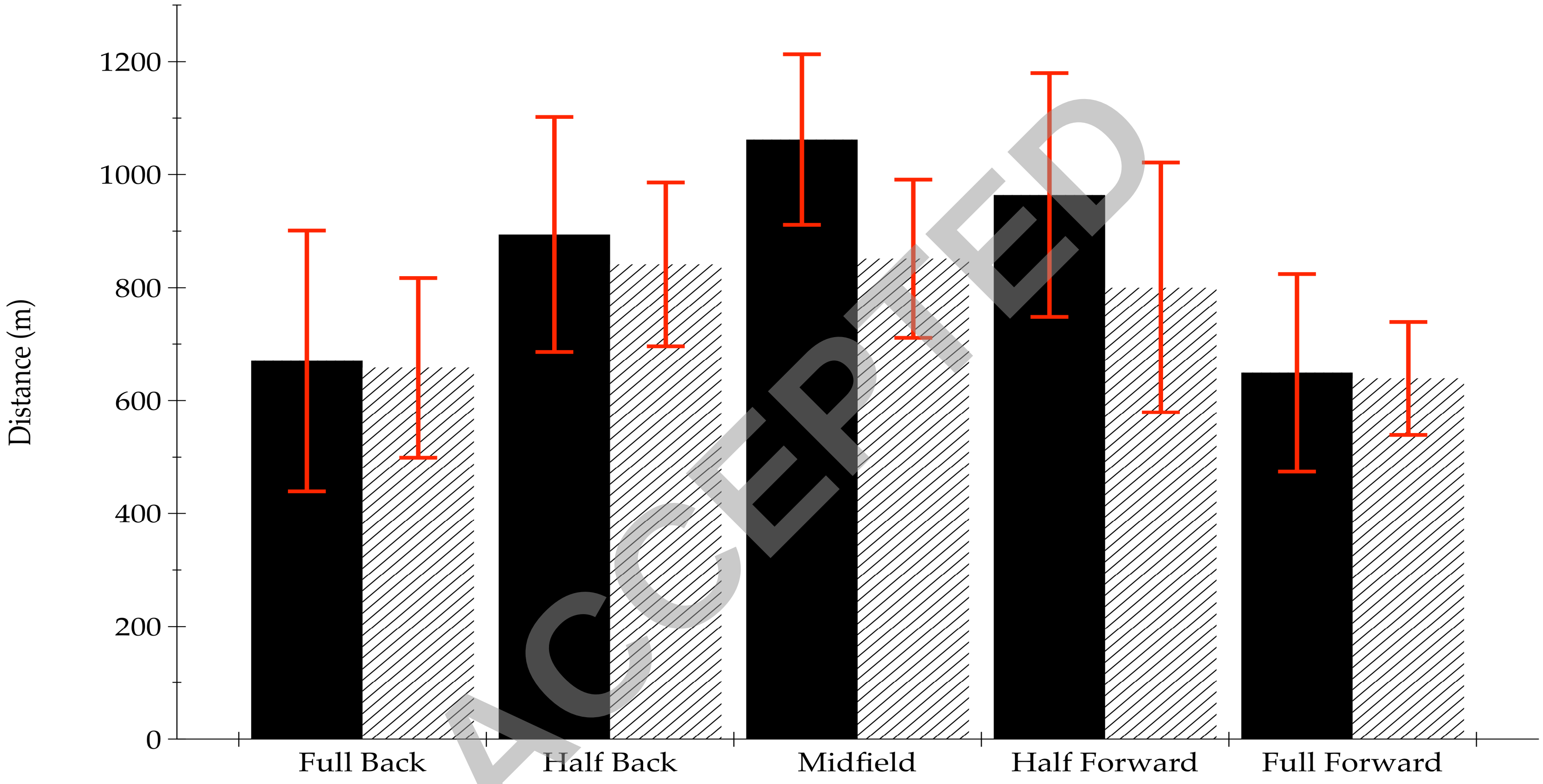
Table 1. The running performance metrics with respect of playing position (mean ± 95% CI). High speed distance ($\geq$17 km·h^{-1}); Sprint distance ($\geq$22 km·h^{-1}).

Table 1.

	Full-Back (n = 43)	Half-Back (n = 43)	Midfield (n = 43)	Half-Forward (n = 43)	Full-Forward (n = 43)
Running performance					
Total Distance (m)	6892 (6144 - 7344)	8700 (8200 - 9231)[ae]	9523 (9023 - 9744)[abde]	8952 (8552 – 9022)[ae]	7090 (6544-7290)[a]
High Speed Distance (m)	1369 (981 - 1569)	1784 (1584 - 1991)[ae]	2228 (1755 - 2422)[abde]	1884 (1544 - 2044)[ae]	1366 (1066-1666)
1st Half – High Speed Distance (m)	690 (645 - 721)	903 (882 - 1022)[ae]	1166 (981 - 1421)[abde]	964 (904 - 1022)[ae]	687 (667-708)
2nd Half – High Speed Distance (m)	679 (600 - 729)	881 (861 - 903)[ae]	1062 (931 - 1301)[abde]	920 (845 - 990)[ae]	679 (609-720)
Sprint Distance (m)	371 (351 - 391)[e]	494 (474 - 503)[aed]	488 (458 - 512)[ae]	512 (498 - 552)[abce]	357 (245 - 377)
Accelerations	152 (142 - 172)	204 (174 - 214)[ade]	219 (184 - 232)[abde]	195 (165-205)[ae]	152 (122 - 177)
Peak Velocity (km.hr^{-1})	30.2 (29.2 - 32.1)	31.2 (29.2 - 33.2)	32.1 (30.1 - 33.2)	29.8 (28.1-30.2)	29.2 (27.2 - 30.1)
Mean Velocity (Km.hr^{-1})	4.9 (4.1 - 4.8)	5.9 (5.2 - 6.1)	6.1 (5.8 - 6.8)	5.8 (5.2-6.1)	4.9 (4.1 - 5.5)

Significantly different from [a] full-backs, [b] half-backs [c] midfielders, [d] half-forwards, [e] full-forwards (all $p<0.001$).

Figure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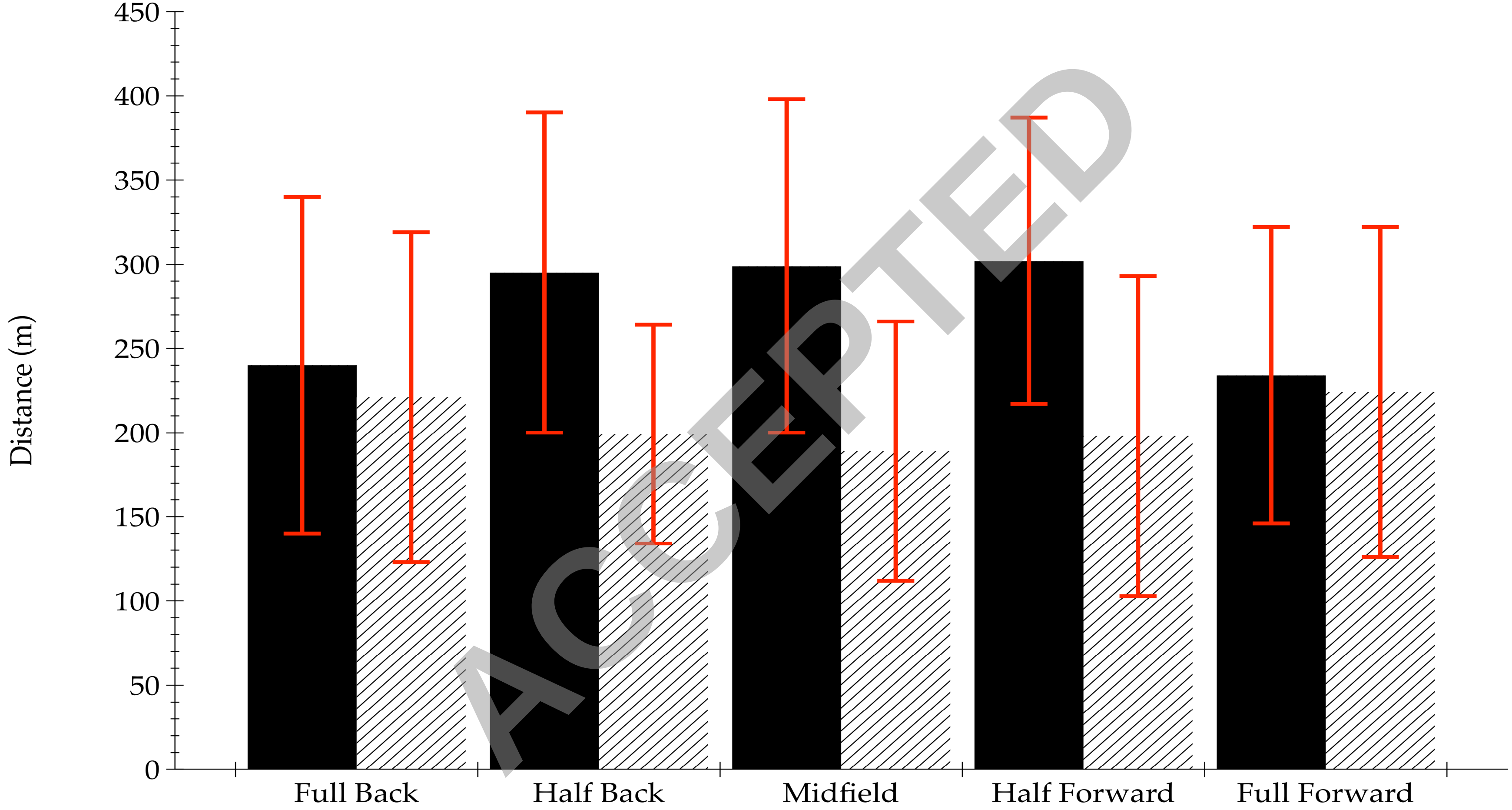
1000
800
600
400
200
0
Distance (m)
Full Back
Half Back
Midfield
Half Forward
Full Forward

1.

Figure 2.


450
400
350
300
250
200
150
100
50
0
Distance (m)
Full Back
Half Back
Midfield
Half Forward
Full Forward
ACCEPTED