Activity profile of field hockey players: comparison with soccer players

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I/ Introduction

Fields hockey is a team sport played by men and women with three (stickers, midfield and defender) (Jennings et al., 2012) or four (Fullback, Half-back, Inside Forward and Striker) (Lythe and Kilding, 2011) principal positional group. Description of the specific physical requirements of positional groups within male international-level or national-level field hockey is crucial for coach and specifically for fitness coach. Indeed, identifying physical demands of field hockey player will allow fitness coach to plan sport-specific training protocols needed during in-season physical training sessions. The enhancement of the needed physical demand of hockey player is crucial in competition moment. The development of motion analysis software and global positioning systems (GPS) could be a decisive tools to identify the physical demands of hockey field players (Lythe and Kilding, 2011;White and MacFarlane, 2013;Vescovi and Frayne, 2015).

II/ Identification of physical demands of field hockey player

GPS data

GPS recording devices (SPI Elite, GPS ports Systems Ltd, Australia) could be used to record the position coordinates of players at a frequency of 1 Hz and speed and distance information derived from the changes in position coordinates. The validity and reliability of GPS use in hockey (MacLeod et al., 2009) has been previously reported. Individual units were

worn by each outfield player during all matches. Data could be downloaded using the manufacturer- supplied software (GPS ports Team AMS v1.2.1.0) and exported to Microsoft Excel for formal analysis. GPS data could be edited to only include time spent on the field of play and then separated into five speed zones in accordance with criteria used previously [0–11 km/h (standing, walking, jogging); 11.1–14 km/h (low speed running); 14.1–19 km/h (moderate-speed running); 19.1–23 km/h (high-speed running); > 23 km/h (sprinting)] (Di Salvo et al., 2007). The maximum straight-line running speed could be determined one week prior to the first match during a 0 – 40 m sprint test, from a stationary start, using two-timing gates (Microgate Srl; Race time 2. Light Radio, Bolzano, Italy). The maximum speed could be defined as the players running speed between the 30 m and 40 m splits.

Heart rate

Each player wore a HR monitor chest strap (Team Polar, Polar Electro Oy, Kempele, Finland), which recorded HR every 5 s, during all matches (five matches in the current example) (Lythe and Kilding, 2011). Data was downloaded and processed using manufacturer- supplied software (Polar Precision Performance v4.03.043). Using substitution timings, HR data was edited so that analysis did not include half-time data, injury breaks, or time spent off the field of play. By referencing to HRmax, which was obtained from the Multi Stage Fitness Test conducted one week prior to the first match, the match HR data was divided into 4 zones (Johnston et al., 2004): Low-Moderate Intensity < 75 % ; High Intensity = 75 – 84 % ; Very High Intensity = 85 – 95 % ; Maximal Intensity > 95 %.

Video footage

All matches could be filmed using 2 high-speed cameras. Exact timings, including the start and end of each half, timing and details of substitutions, position changes of players and stoppages, could be reviewed post-match and used to edit the GPS and HR data. In accordance with Spencer et al. (Spencer et al., 2005), the resulting data could be presented by

position on the field (goalkeeper excluded) rather than for each individual player. Frequency of movement changes could be determined using GPS data and verified using video footage. A movement change was counted if a player moved from one speed zone i. e. from standing still to walking, or from jogging to sprinting, according to the predefined speed zone classifications (Di Salvo et al., 2007).

III/ Activity profile of hockey field player

Physical outputs (Lythe and Kilding, 2011)

The mean match time for each individual player was 51.9 ± 17.8 min (74 % of total match duration). Fullbacks averaged the highest match playing time (64.8 ± 16.0 min) while halves, inside forwards and strikers averaged 54.8 ± 22.4, 49.0 ± 14.4 and 50.4 ± 15.4 min, respectively. Mean total distance covered per position was 8 160 ± 428 m (Table 1). The mean total distance covered by each individual player was 6 798 ± 2009 m, of which the major proportion was covered at low and moderate intensities. Speeds faster than 19 and 23 km/h accounted for 4.5 % and 1.6 % of total distance covered, respectively.

Table 1: Average distance covered per position 70 and percent of total distance covered in each speed zone (mean ± SD) (Lythe and Kilding, 2011).

	Speed range (km/h)	Total distance (m)	Percent of distance	Frequency	Duration (s)
Zone 1	0-6	2410 ± 95	29.6 ± 0.8	310.6 ± 54.1	7.4 ± 1.0
Zone 2	6.1-11	2585 ± 258	31.3 ± 0.9	445.0 ± 65.2	2.5 ± 0.7
Zone 3	11.1-14	1424 ± 124	17.6 ± 0.5	220 ± 33.1	1.9 ± 0.4
Zone 4	14.1-19	1232 ± 263	15.4 ± 0.7	126.9 ± 28.6	2.2 ± 0.6
Zone 5	19.1-23	355 ± 110	4.5 ± 0.3	36.3 ± 15.2	1.7 ± 0.4
Zone 6	>23	124 ± 69	1.6 ± 0.2	8.3 ± 5.4	2.0 ± 0.4
Total		8130 ± 360	100	1148 ± 129	

Using the position data, the majority of match time was spent in low (60.9 %) and moderate intensity (33 %) activities (Figure 1). The distances covered by each position progressively increased as the player moved up the field from defense to attack. Fullbacks covered significantly less total distance than all other positions.

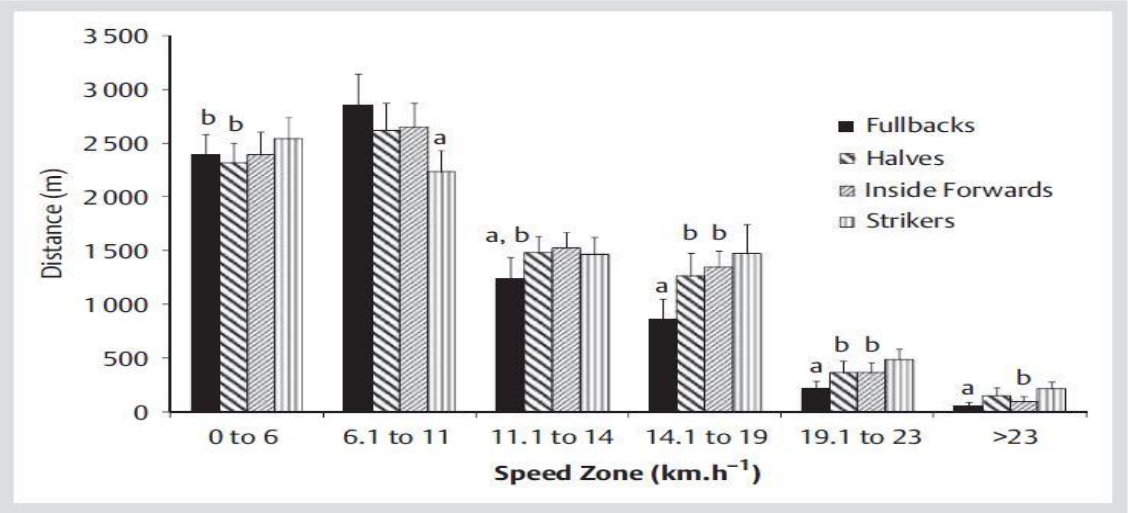

Figure 1: Distance covered during match-play for specific positional groups (where a denotes a significantly lower (P < 0.05) distance than all other position groups; and b denotes a significantly lower (P < 0.05) distance than strikers (Lythe and Kilding, 2011).

Players reached, on average, 84.9 % of their maximum speed during matches, with strikers recording both the fastest speeds (mean 28.2 km/h ; maximum 31.5 km/h) and reaching the highest percentage of their maximum speed (89.2 %). The average sprint (> 23 km/h) duration was 3.3 ± 1.9 s and there was an average of 338 sprints performed per match. Strikers performed significantly more sprints (46.9; P < 0.05) than all other positions, and fullbacks performed significantly less sprints (19.8; P < 0.05) than all other positions.

Heart rate

Mean HR during match-play was 161 b/min, or in relative terms, 85.3±2.9 % HRmax (Table 2). Peak HR during the matches was 196 b/min, or 96.3 ± 2.7 % HRmax. Players spent 90% of the match above 75 %HR max, 60 % of the match above 85 % HRmax and 4 % of the match above 95% **HRmax**

Table 2: Mean heart rate (HR) responses during elite field hockey match-play according to player position (Lythe and Kilding, 2011).

	Team average	Fullback	Half	Inside	Striker
Overall mean HR (%HRmax)	85.3 ± 2.9	84.4 ± 2.5	84.8 ± 2.8	86.5 ± 2.6	85.6 ± 3.7

	Team average	Fullback	Half	Inside	Striker
Mean mean HR (%HRmax)	95.9 ± 2.8	95.1 ± 2.2	95.3 ± 2.5	96.7 ± 2.9	96.8 ± 2.6
% of match at <75% HRmax	9.9 ± 5.7	10.6 ± 3.6	8.1 ± 5.8	8.0 ± 3.3	11.8 ± 7.3
% of match at <75-84% HRmax	29.3 ± 12.2	30.0 ± 9.5	28.7 ± 12.5	29.8 ± 9.7	27.3 ± 14.6
% of match at <84-95% HRmax	56.4 ± 13.0	58.3 ± 11.0	61.1 ± 15.2	57.2 ± 9.8	53.1 ± 13.9
% of match at >95% HRmax	4.3 ± 6.6	1.0 ± 1.8	2.1 ± 3.7	5.1 ± 5.9	7.8 ± 9.0

IV/ Comparison between filed hockey and soccer players' physical profile

Distance covered and speed zone

The distance covered in different work intensities of male soccer players has been investigated (Di Salvo et al., 2007). Table 3 present the distance covered at different zones for different players' positions.

Table 3: Assessment of positional differences distance covered at different wok intensities (Di Salvo et al., 2007).

	Distance covered in different work intensities				
	0-11 km/h	**11.1-14 km/h**	**14.1-19 km/h**	**19.1-23 km/h**	**> 23 km/h**
Central defenders	7080 ± 420 m	1380 ± 232 m	1257 ± 244 m	397 ± 114 m	215 ± 100 m
External defenders	7012 ± 377 m	1590 ± 257 m	1730 ± 262 m	652 ± 179 m	402 ± 165 m
Midfield players	7061 ± 272 m	1965 ± 288 m	2116 ± 369 m	627 ± 184 m	248 ± 116 m
External Midfield players	6960 ± 601 m	1743 ± 309 m	1987 ± 412 m	738 ± 174 m	446 ± 161 m
Forwards	6958 ± 438 m	1562 ± 295 m	1683 ± 413 m	621 ± 161 m	404 ± 140 m

The comparison between the distance covered of field hockey and soccer players could be summarized in table 4.

Table 4: Comparison between the distance covered at different intensities of field hockey and soccer players.

	Speed range (km/h)				
	0-11	**11.1-14**	**14.1-19**	**19.1-23**	**> 23**
J. Lythe and Kilding (2011) (Field ice hockey)	2498 ± 124	1424 ± 124	1232 ± 263	355 ± 110	124 ± 69

Da silvo et al. (2007) (Soccer)	7014 ± 56	1648 ± 219	1451 ± 791	607 ± 126	343 ± 104

The distance covered at different intensities seemed to be higher in soccer players comparatively to field hockey. Indeed, soccer players covered 180%, 16%, 18%, 71% and 177% more distance than field hockey at speed range 0-11 km/h, 11.1-14 km/h, 14.1-19 km/h, 19.1-23 km/h and > 23 km/h respectively.

Heart rate

The average percentage maximal heart rate (%HRmax) for soccer players for different positions could be considered as high as it is always higher than 80%HRmax (Suarez-Arrones et al., 2015;Torreño et al., 2016) (Figure 2, Table 4).

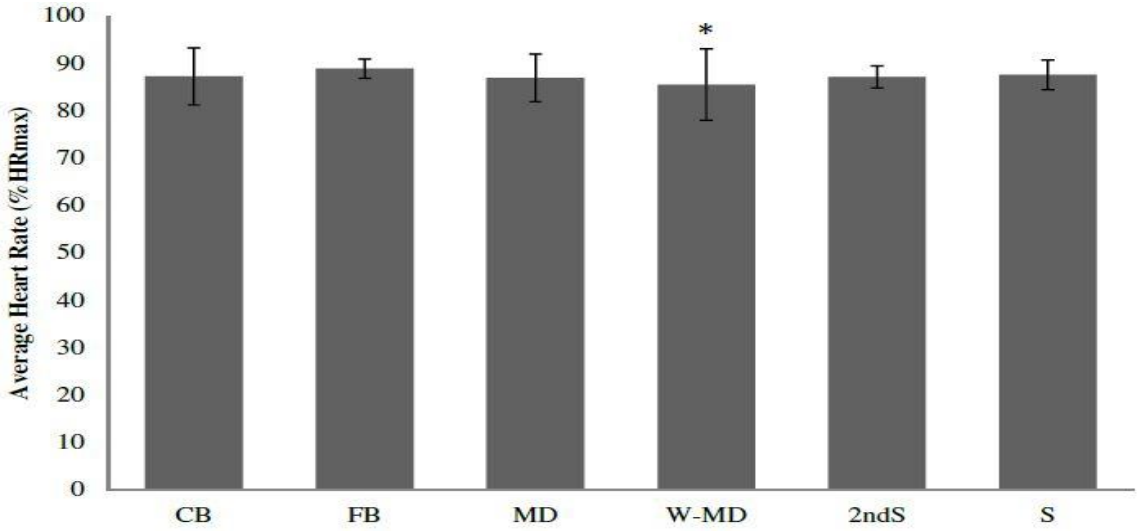

Figure 2: Average Heart Rate expressed in relation to the individual maximal HR (HRmax) during the half in professional soccer players (n = 348). Data are mean ± SD and presented by Suarez-Arrones L. et al. (2015) (Suarez-Arrones et al., 2015). CB: Centre Backs; FB: Full Backs; MD: Midfielders; W-MD: Wide Midfielders; 2nsS: Second Strikers; S: Strikers. *: Significantly smaller than any other group.

Table 4: Mean heart rate (%HRmax) in professional soccer players (n = 223) (Torreño et al., 2016).

	Heart Rate (% HRmax)	
	1st half	**2nd half**
Centre back (n = 45)	88 ± 6	86 ± 5
Full Back (n = 47)	89 ± 2[b]	87 ± 2
Midfielders (n = 54)	87 ± 6[+]	86 ± 3
Wide-Midfielders (n = 26)	83 ± 8	81 ± 6[+]

2nd Strikers (n = 20)	87 ± 2[b,d]	84 ± 2[a,b,c]
Strikers (n = 31)	88 ± 3	84 ± 6[b,c]

[a]: Substantial difference versus Centre back; [b]: Substantial difference versus Full Back; [C]: Substantial difference versus Midfielders; [d]: Substantial difference versus Strikers; [+]: Substantial difference than any other specific positions.

The average %HRmax of field hockey and soccer players are approximately similar. Indeed, the average %HRmax was 85.3 ± 2.9 and 86.8 ± 2.6 for field hockey (2) and soccer (10) players respectively.

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