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Research article

The Use of Generic and Individual Speed Thresholds for Assessing the Competitive Demands of Field Hockey

David Casamichana [1]✉, Esther Morencos [2], Blanca Romero-Moraleda [3,4] and Tim J. Gabbett [5,6]
[1] Faculty of Education and Food. Universidad Europea del Atlántico. Santander, Spain; [2] Exercise and Sport Sciences, Education and Humanities Faculty, Francisco de Vitoria University, UFV, Pozuelo de Alarcón, Madrid; [3] Education and Healthy Faculty, Camilo José Cela University, Madrid, Spain. [4] Laboratory of Exercise Physiology Research Group, School of Physical Activity and Sport Sciences-INEF, Universidad Politécnica de Madrid, Madrid, Spain; [5] Gabbett Performance Solutions, Brisbane, Australia; [6] University of Southern Queensland, Institute for Resilient Regions, Ipswich, Australia

Abstract
The current study compared the running demands of professional field hockey players using individualized speed zones and generic default settings of the GPS manufacturer. In addition, the differences in slow, moderate and fast players were studied. Sixteen male players from the same club participated in the study (age: 25.5 ± 2.9 years; body mass: 74.6 ± 5.5 kg; stature 1.77 ± 0.05 m). The peak speed of each participant was established at the end of the data collection period by analyzing all training and playing data throughout the season. Using players peak speed achieved for each participant during the season, individualized speed zones were retrospectively applied to all match-play data. Peak speed was used to categorize players into three groups, slow (5 players: 29.2-30.2 km·h^{-1}), moderate (6 players: 30.7-31.5 km·h^{-1}) and fast (5 players: 32.2-33.7 km·h^{-1}). Significant differences were observed between generic and individual thresholds for the distance covered in moderate, high, and very high-speed running in all positions ($p = 0.01$). Our findings show that the distances covered at high-speeds in midfielders and forwards were overestimated, while the very high-speed running and sprinting in backs were underestimated. Generic speed thresholds should be used if comparisons between positions is of importance. However, based on the different capacities of field hockey players, individual speed thresholds may be more suitable when addressing the relative stress on individual athletes.

Key words: global positioning system; planning; training; time motion; team sport.

Introduction

Monitoring and managing athlete workloads has received considerable attention in recent years. The demands of competition represent an important reference point when establishing training loads (Owen et al., 2017; Stevens et al., 2017), since we can express the load imposed in the training based on the proportion of the match´s demand. In addition, the weekly workload is strongly influenced by the activity of players during competition, with match-play demands typically the highest load performed during the week (White and MacFarlane, 2015).

Time motion studies in field hockey competition have shown that there are significant differences in the distance covered at high-speed running (HSR) and sprint running (SR) between positions, with forwards (FW) spending a greater percentage of time at HSR and SR (Jennings et al., 2012; Lythe and Kilding, 2011). Jennings et al. (2012) found that FW covered 10.1±7.4% more distance in HSR than midfielders (MD) (FW: 1896.6±368 m; MD: 1778.6±387 m) and 26.6±8.2% more than backs (BS). MD players perform more HSR than fullbacks and halfbacks, and also more SR than fullbacks as a percentage of total playing time (Jennings et al., 2012). These findings are in agreement with the only other research presenting data from the highest national level (Australia), where MD players were observed to cover more HSR than BS (Jennings et al., 2012). Spencer et al. (2004) documented the nature of motion analysis in field hockey and reported that high-intensity running accounted for 5.6% of the total match time, and this was composed of 4.1% striding and 1.5% SR. The results obtained were lower than other studies reported due to variation in the classification of motion activities (Lythe and Kilding, 2011; Spencer et al., 2004).

The use of generic, arbitrarily defined speed thresholds (km·h^{-1}) is a common practice in time-motion studies in team sports (Cummins et al., 2013). However, inconsistency in these thresholds, particularly in hockey (Gabbett, 2010; Jennings et al., 2012; Macutkiewicz and Sunderland, 2011; Sunderland and Edwards, 2017), makes it difficult to compare different research studies even within a single sport (Cummins et al., 2013; Sweeting et al., 2017). Dwyer et al. reported a method to standardize protocols for time motion analysis recommending sport-specific velocity ranges (Dwyer and Gabbett, 2012). More recently, Sweetings et al. (2017) reviewed generic speed thresholds within team sport and the results of their study suggested that they do not account for differences between individual players. For example, results may be influenced by the peak speed of each player. Thus, in players with higher peak speed, the speed thresholds used to categorize an action as HSR or SR, represent a lower percentage of that player's maximum, thereby having greater ability to reach those thresholds.

In other team sports the use of individual rather than generic speed thresholds increases the activity at HSR of slower players while reducing the activity of the faster players (Buchheit et al., 2013; Gabbett, 2015; Murray et al., 2017). In adolescent soccer players, younger players recorded more repeated sprint sequences when using individual speed thresholds (> 61 % of individual peak running velocity) compared with the older players, whereas when

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employing generic speed thresholds (> 19 km·h^{-1}), older players performed more repeated sprint sequences than younger players (Buchheit et al., 2010). Furthermore, the use of individual speed thresholds reduces individual and position variability during competitive matches in soccer with the result that these measures are more stable indicators of high-speed activity than generic arbitrarily defined thresholds (Carling et al., 2016). Finally, it has recently been postulated that achieving a higher percentage of individual speed (95% *vs.* 85%) during the training week has a protective effect, decreasing the probability of injury (Malone et al., 2017). In addition, there is a U-shaped relationship between the number of weekly exposures to individual maximum speed and the likelihood of injury (Malone et al., 2017), which justifies the use of these individual speed thresholds.

Therefore, the aim of the current research was to compare the running demands of professional field hockey players using generic and individualized speed thresholds. Furthermore, we aimed to determine if differences were more pronounced in slow, moderate or fast players while also examining whether these speed thresholds were position specific.

Methods

Subjects

Sixteen male field hockey players from the same club participated in the study (age: 25.5 ± 2.9 years; body mass: 74.6 ± 5.5 kg; stature 1.77 ± 0.05 m). Players were categorized based on three positional lines of play, six backs (BS), five midfielders (MD) and five forwards (FW). All players where classified as slower (29.2-30.2 km·h^{-1}), moderate (30.7-31.5 km·h^{-1}) or faster (32.2-33.7 km·h^{-1}) based on peak speed for each player. The slower group consisted of 3 BS, 1 MD and 1 FW, the moderate group comprised 3 BS, 2 MD and 1 FW, and the faster group contained 2 MD and 3 FW (Table 1). The participants played in the Spanish Hockey League Premier Division and had a hockey playing experience in these league of 6.5 ± 1.8 years. The players trained, on average, 4 times per week and played one official match every weekend. These data arose from the daily player monitoring in which player activities were routinely measured over the course of the season. The study conformed to the recommendations of the Declaration of Helsinki and players gave their informed written consent for participation in the research study.

Procedures

Activity profiles were recorded in 16 outfield players competing for a single club in the Spanish Hockey League Premier Division in the 2014–2015 and 2015–2016 seasons. As determined by the league fixtures, matches were separated by a minimum of 6 days and there was a 2-month break over the Christmas period during both seasons. Ten players were present during both seasons. A total of 17 matches were analyzed, with a mean of 9.1 ± 4.4 matches per player. All matches were 60 minute in duration (4 x 15 minute quarters). All competitive matches took place between 12.00 and 15.00 hours and were played on a water-based turf in moderate temperatures (~21ºC) and humility (~60%).

Individual player activity was identified and player outfield positions categorized into BS, MD and FW (Jennings et al., 2012). Match analysis was based on data from a global positioning system (GPS, GPSports Ltd.). For each player, on-field activities were recorded using a single GPS unit, operating at 10 Hz (dimensions, 48 × 20 × 87 mm) (SPI Elite, GPSports, Fyshwick, Australia) for the duration of the game. The GPS units were positioned between the scapular planes at T2–T6 of the spinal column and secured in place with a harness. Data from each GPS unit were downloaded to a laptop computer and analyzed using commercially available software (Team AMS, v.R1.215.3) and docking station running v2.03B firmware. The validity and reliability of the GPS system have been previously reported (MacLeod et al., 2009; Scott et al., 2016). The mean satellite availability was 10.6 ±1.2 during data collection.

External load variables

The total distance (m) and total distance relative to playing time (m·min^{-1}) was calculated for each data file. All variables were studied as generic values (m) and also normalized (m·min^{-1}) to account for differences in total playing time due to substitutions and match stoppages. Activity profiles were first quantified based on distance covered in generic speed zones. The velocity (speed) zones were established based on previous studies (White and MacFarlane, 2015). These zones included moderate speed running (MSR; 15.1-18.9 km·h^{-1}; RMSR: relative moderate speed running), high-speed running (HSR; >19 km·h^{-1}; RHSR: relative high-speed running), very high-speed running (VHSR; >24 km·h^{-1}; RVHSR: relative very high-speed running) and sprint running (SR; >30 km·h^{-1}; RSR: relative sprint running).

The peak speed of each participant was established at the end of the data collection period by analyzing all training and playing data throughout the season, which included maximal sprint sessions (with and without stick). The overall period included dedicated speed training sessions. The individualized speed zones were retrospectively applied to all game data with knowledge of peak speed achieved for each participant during the season. The peak speed reached by the players was on average 31.3 ± 1.38 km·h^{-1}. The cut-off points of the generic speed zones used when setting speed thresholds were 9.0, 15.0, 19.0, 24.0 and 30 km·h^{-1}, which represents ~30%, 50%, 60%, 75% and 95% of the average peak speed of the players. These percentages were then applied to each player to provide the distance covered in each category according to the player's individual peak speed.

Statistical analysis

Data are presented as mean ± SD. Three- way analysis of variance (ANOVA) was used to compare player positions (BS, MD, FW) and players grouped as slower, moderate and faster between generic and individual thresholds. Bonferroni's test was used post-hoc to identify specific differences. Cohen's d were computed and effect sizes were categorized as small (0.10), medium (0.50), or large (0.80) (Cohen, 1988). The Statistical Package for the Social Sciences (SPSS, Version 20.0 for Windows; SPSS Inc, Chicago, IL) was used to conduct the analysis with significance being set at $p \leq 0.05$.

Results

The peak speed of FW was significantly higher ($p < 0.05$) than BS (32.5 ± 1.8 km·h^{-1} and 30.3 ± 0.6 km·h-1, d = 1.83). The peak speed of MD was 31.7 ± 0.9 km·h^{-1} (Table 1).

The distance covered (m) and normalized demands (m·min^{-1}) in generic and individual thresholds across positional groups (BS, MD, FW) are outlined in Table 2 and Table 3. Generic thresholds showed greater differences across positions than individual thresholds ($p < 0.05$, d range GEN: 0.74-1.84; $p < 0.05$, d range IND: 0.43-1.46).

There were significant differences between generic and individual speed thresholds for more intense demands in BS and all variables in MD and FW. The results reflect generic thresholds to have an overestimation for VHSR and SR in BS ($p < 0.05$, d range = 0.18-0.3, mean percentage difference: 29.44% and 77.04 %, respectively) and MSR, HSR, VHSR and SR for MD and FW ($p < 0.05$, d range for MD in MSR, HSR, VHSR and SR = 0.25-0.46, mean percentage difference: 13.43%, 15.45%, 21.17% and 40.27%, respectively; $p < 0.01$, d range for FW in in MSR, HSR, VHSR and SR = 0.51-0.84, mean percentage difference: 10.53%, 19.01%, 22.12% and 64.53%, respectively) (Table 2 and 3).

Table 4 displays distances (m) covered and relative distance (m·min^{-1}) for generic and individual thresholds according to peak speed in fast (n = 45 files), moderate (n = 64 files) and slow players (n = 34 files). Significant differences were found between generic and individual thresholds in all variables in fast players (MSR: $p < 0.01$, d = 1.06, mean percentage difference: 19.3%; HSR: $p < 0.01$, d = 1.43, mean percentage difference: 29.96%; VHSR: $p < 0.01$, d = 1.03 mean percentage difference: 41.27%; SR p = 0.03, d = 0.57; mean percentage difference: 62.28%). Moderate speed players showed significant differences between generic and individual thresholds for VHSR ($p < 0.01$, d = 0.09, mean percentage difference: 5.91%). Only generic thresholds showed differences between fast players with slow and moderate players showing differences for MSR ($p < 0.01$, d = 1.05 d = 1.13, mean percentage difference: 26.23% and 25.78%, respectively), HSR ($p < 0.01$, d = 1.5 d = 1.4, mean percentage difference: 35.12% and 38.40%, respectively), VHSR ($p < 0.01$, d = 1.78 d = 1.06, mean percentage difference: 44.87% and 65.43% respectively), and SR ($p < 0.05$, d =0.81 d = 0.51, mean percentage difference: 64.49% and 98.51%, respectively). VHSR in moderate speed players showed significant differences with slower players (p = 0.02, d = 0.65, mean percentage difference: 37.29%; Table 4).

Table 1. Physical characteristics of field hockey players. Data are presented as mean ± standard deviation.

Position	n	Age (yr)	Height (m)	Mass (kg)	Peak speed (km·h^{-1})	Time on pitch (mins per match)
Backs	6	26.4 ± 2.8	1.76 ± 0.06	74.4 ± 4.6	30.3 ± 0.7	66.3 ± 13.2
Midfielders	5	24.2 ± 3.1	1.78 ± 0.07	74.2 ± 7.3	31.7 ± 1.5	65.9 ± 7.4
Forwards	5	26.2 ± 2.8	1.77 ± 0.04	75.4 ± 4.8	32.0 ± 1.4	60.8 ± 13.3
Total	16	25.5 ± 2.9	1.77 ± 0.06	74.6 ± 5.5	31.3 ± 1.4	64.6 ± 11.6
Speed Group						
Slower	5	26.4 ± 3.3	1.75 ± 0.06	74.7 ± 4.8	29.9 ± 0.4	63.0 ± 12.9
Moderate	6	26.2 ± 2.3	1.78 ± 0.07	74.3 ± 5.7	31.1 ± 0.4*	69.2 ± 10.4
Faster	5	23.8 ± 2.9	1.77 ± 0.04	74.9 ± 6.9	33.1 ± 0.7*#	58.9 ± 10.9
Total	16	25.5 ± 2.9	1.77 ± 0.06	74.6 ± 5.5	31.3 ± 1.4	64.8 ± 12.0

*indicates significant difference from Slower players, # indicates significant differences from Moderate players

Table 2. Generic vs individual demands of forwards, midfielders and backs for distance covered (m). Data are presented as mean ± standard deviation (SD)

Position	Variable	Generic	Individual	Mean difference	95% CI of Mean Difference	P value	Effect size
Total n=155	Distance at moderate speed running	1371.9±432.0	1249.0±494.7	122.9±385.7	61.7-184.1	<.001	.25
	Distance at high-speed running	543.6±215.5	476.5±207.9	67.1±173.8	39.5-94.6	<.001	.32
	Distance at very high-speed running	108.7±78.1	94.3±61.9	14.4±49.7	6.5-22.3	<.001	.23
	Distance at sprint running	2.21±6.01	1.30±4.54	0.91±5.12	0.09-1.72	.03	.56
Backs n=55	Distance at moderate speed running	1039.5±309.2	1020.4±440.4	19.1±465.7	-106.8-145.0	.76	.04
	Distance at high-speed running	363.9±135.7	373.1±170.9	-9.3±174.6	-56.5-37.9	.69	.05
	Distance at very high-speed running	50.3±39.6	65.1±48.9	-14.8±29.1	-22.7--6.9	<.001	.3
	Distance at sprint running	0.09±0.67	0.41±1.71	-0.32±1.15	-0.63--0.01	.04	.18
Midfielders n=57	Distance at moderate speed running	1581.2±306.7*$^{(1.76)}$	1386.1±564.6*$^{(0.76)}$	195.0±384.2	93.1-297.0	<.001	.34
	Distance at high-speed running	645.3±167.1*$^{(1.84)}$	545.6±241.6*$^{(0.82)}$	99.7±167.0	55.4-144.0	<.001	.41
	Distance at very high-speed running	144.0±82.2*$^{(1.41)}$	113.4±65.8*$^{(0.9)}$	30.6±53.2	16.5-44.8	<.001	.46
	Distance at sprint running	4.37±7.91*$^{(0.75)}$	2.61±6.93*$^{(0.43)}$	1.75±6.63	-0.01-3.51	.05	.25
Forwards n=43	Distance at moderate speed running	1519.5±458.0*$^{(1.26)}$	1359.4±341.1*$^{(1.46)}$	160.1±217.3	93.3-227.0	<.001	.46
	Distance at high-speed running	638.7±209.1*$^{(1.6)}$	517.2±144.8*$^{(0.9)}$	121.5±149.1	75.6-167.4	<.001	.84
	Distance at very high-speed running	136.7±66.1*$^{(1.63)}$	106.4±58.9*$^{(0.77)}$	30.2±49.6	15.0-45.5	<.001	.51
	Distance at sprint running	2.06±6.04	0.71±2.05	1.35±5.72	-0.41-3.11	.13	.65

Effecet size: effect size between Generic and Individual. *indicates significant difference from backs position group. Cohen´s d indicated in brackets between positions for generic and individual data.

Table 3. Generic vs individual demands of forwards, midfielders and backs for distance covered per min of play (m·min^{-1}). Date are presented as mean ± standard deviation (SD).

Position	Variable	Generic	Individual	Mean difference	95% CI of Mean Difference	P value	Effect size
Total n=155	Distance at moderate speed running	21.70±7.20	19.86±8.00	1.84±5.79	0.92-2.76	<.001	.23
	Distance at high-speed running	8.60±3.54	7.57±3.28	1.03±2.69	0.60-1.45	<.001	.31
	Distance at very high-speed running	1.74±1.33	1.49±0.99	0.24±0.81	0.12-0.37	<.001	.25
	Distance at sprint running	0.03±0.09	0.02±0.07	0.01±0.08	0.00-0.03	.02	.14
Backs n=55	Distance at moderate speed running	16.18±5.73	16.29±8.43	-0.11±6.91	-1.98-1.76	.91	.01
	Distance at high-speed running	5.58±2.01	5.92±3.01	-0.34±2.63	-1.05-0.37	.34	.11
	Distance at very high-speed running	0.75±0.55	1.00±0.73	-0.25±0.46	-0.38--0.13	<.001	.34
	Distance at sprint running	0.00±0.01	0.01±0.02	0.00±0.01	-0.01-0.00	.03	.23
Midfielders n=57	Distance at moderate speed running	24.15±4.57*(1.55)	21.19±8.24*(0.6)	2.96±5.54	1.49-4.43	<.001	.36
	Distance at high-speed running	9.90±2.75*(0.50)	8.36±3.59*(0.72)	1.54±2.45	0.90-2.19	<.001	.42
	Distance at very high-speed running	2.24±1.40*(1.38)	1.75±1.06*(0.83)	0.49±0.82	0.28-0.71	<.001	.46
	Distance at sprint running	0.07±0.13*(0.74)	0.04±0.10*(0.47)	0.03±0.11	0.00-0.06	.04	.30
Forwards n=43	Distance at moderate speed running	25.51±7.57*(1.43)	22.65±5.09*(0.9)	2.86±3.58	1.76-3.96	<.001	.56
	Distance at high-speed running	10.74±3.43*(0.55)	8.65±2.24*(0.98)	2.09±2.38	1.36-2.83	<.001	.93
	Distance at very high-speed running	2.33±1.22*(1.73)	1.78±0.96*(0.94)	0.55±0.87	0.28-0.82	<.001	.57
	Distance at sprint running	0.03±0.09	0.01±0.03	0.02±0.09	-0.01-0.05	.13	.66

Effect size: effect size between Generic and Individual. *indicates significant difference from backs position group. Cohen´s *d* indicated in brackets between positions for generic and individual data.

Table 4. Generic vs individual demands of slow, moderate and fast players for distance covered (m). Data are presented as mean ± standard deviation (SD).

Speed Group	Variable	Generic	Individual	Mean difference	95% CI of Mean Difference	P value	Effect size
Slower n=45	Distance at moderate speed running	1258.4±440.1	1119.6±756.4	138.8±651.6	-56.97-334.6	.16	.18
	Distance at high-speed running	452.7±186.6	424.6±296.9	28.1±256.4	-48.90-105.2	.47	.09
	Distance at very high-speed running	59.4±35.8	71.5±58.1	-12.2±55.3	-28.69-4.53	.15	.2
	Distance at sprint running	0.07±0.34	0.83±3.19	-0.76±2.98	-1.65-0.14	.10	.23
Moderate n=64	Distance at moderate speed running	1250.8±397.0	1266.2±354.9	-15.4±105.5	-41.72-11.00	.25	.04
	Distance at high-speed running	476.8±183.6	477.2±160.9	-0.4±52.9	-13.58-12.77	.95	.02
	Distance at very high-speed running	94.7±63.4*(0.65)	100.3±59.0*(0.50)	-5.58±16.76	-9.77--1.39	.01	.09
	Distance at sprint running	1.44±4.78	1.55±5.37	-0.11±2.06	-0.63-0.40	.67	.02
Faster n=34	Distance at moderate speed running	1695.6±377.1*(1.13)#(1.05)	1368.3±306.5	327.3±147.6	275.8-378.8	<.001	1.06
	Distance at high-speed running	734.9±187.5*(1.5)#(1.4)	514.7±153.9	220.2±102.4	184.5-255.9	<.001	1.43
	Distance at very high-speed running	171.8±86.9*(1.78)#(1.06)	100.9±68.5	70.9±31.3	60.0-81.8	<.001	1.03
	Distance at sprint running	4.7±8.7*(0.81)#(0.51)	1.78±5.13	2.94±7.55	0.31-5.58	.03	.57

Effect size: effect size between Generic and Individual. *indicates significant difference from Slower players, # indicates significant differences from Moderate players. Cohen´s *d* indicated in brackets between positions for generic and individual data.

Table 5. Generic vs Individual demands of slow, moderate and fast players for distance covered per min of play (m·min^{-1}). Data are presented as mean ± standard deviation (SD).

Speed Group	Variable	Generic	Individual	Mean difference	95% CI of Mean Difference	P value	Effect size
Slower n=45	Distance at moderate speed running	20.10±6.36	18.62±12.09	1.48±9.64	-1.41-4.38	.31	.12
	Distance at high-speed running	7.12±2.42	6.99±4.51	0.14±3.83	-1.01-1.29	.81	.02
	Distance at very high-speed running	0.93±0.52	1.15±0.87	-0.23±0.82	-0.48-0.02	.07	.25
	Distance at sprint running	0.00±0.00	0.01±0.05	-0.01±0.04	-0.03-0.00	.09	.18
Moderate n=64	Distance at moderate speed running	18.36±6.05	18.56±5.45	-0.20±1.44	-0.56-0.16	.27	.03
	Distance at high-speed running	7.00±2.70	6.99±2.35	0.01±0.74	-0.17-0.19	.91	.04
	Distance at very high-speed running	1.39±0.92	1.47±0.87	-0.08±0.25	-0.14--0.02	.01	.09
	Distance at sprint running	0.02±0.06	0.02±0.07	0.00±0.03	-0.01-0.01	.63	.01
Faster n=34	Distance at moderate speed running	29.11±5.57*(1,49)#(1.82)	23.55±5.02*(0.49)#(0.88)	5.56±2.20	4.79-6.32	0.001	1.1
	Distance at high-speed running	12.64±2.81*(1,49)#(1.82)	8.94±2.72*(0.5)#(0.78)	3.70±1.45	3.19-4.21	0.001	1.36
	Distance at very high-speed running	3.00±1.58*(1.87)#(1.35)	1.77±1.25*(0.28)	1.23±0.56	1.03-1.42	0.001	.98
	Distance at sprint running	0.08±0.14*(0.86)#(0.62)	0.03±0.09	0.05±0.12	0.01-0.09	.03	.55

Effect size: effect size between Generic and Individual. *indicates significant difference from Slower players, # indicates significant differences from Moderate players during the match covered per minutes of play (m·min-^{1}). Cohen´s *d* indicated in brackets between positions for generic and individual data.

For relative values, faster players in all variables and RVHSR for moderate players showed significant differences between generic and individual thresholds (RMSR: $p < 0.01$, $d = 1.1$, mean percentage difference: 19.09%; RHSR: $p < 0.01$, $d = 1.36$, mean percentage difference: 29.27%; RVHSR: $p < 0.01$, $d = 0.98$, mean percentage difference: 41%; SR: p<0.01, $d = 0.55$, mean percentage difference: 62.54%, respectively for faster; RVHSR for moderate: $p < 0.01$, $d = 0.90$; mean percentage difference: 5.44%) (Table 5).

Discussion

The current study identified differences between individual and generic speed thresholds in quantifying the activity profiles of elite field hockey players. In addition, we compared the differences in distance covered at individual and generic speed thresholds by player position (BS, MD and FW) and slower, moderate and faster speed players. The findings of the current study demonstrate that the distance covered at very high speed and sprinting of MD and FW, and of the fastest players is overestimated while the BS and slower players are underestimated when using generic with respect to individualized speed thresholds.

When all players were considered independent of speed and playing position, the use of generic criteria to establish speed thresholds resulted in greater distances being observed. With respect to the use of individual thresholds (% of individual peak speed), BS have a significantly lower peak speed than the FW, so the use of individual thresholds could reduce the underestimation of distances covered at HSR and SR.

It should be noted that when the generic sprint limit is set too high (30 km·h^{-1}), some players may not be able to reach those speeds and their activity at HSR or SR will be underestimated (Jastrzębski and Radzimiński, 2015; Vescovi and Frayne, 2015). For example, one of the studied players (back) had a peak velocity (29.2 km·h^{-1}) below the threshold used to categorize an action as a sprint, while for the backs group, the generic threshold used to categorize actions as SR represented 99.1% of the groups peak speed.

When groups were classified based on the peak speed of each player, faster players reduced the activity performed in MSR, HSR, VHSR and SR when data were expressed according to the player's individual speed thresholds compared to when generic thresholds were used. However, the distance covered by faster players were higher than moderate and slow speed players at all speed thresholds when individual thresholds were used.

There is no consensus in the literature regarding the speed zones of the activities performed by the players at HSR and SR. Thus, Sunderland et al., (2017) used 20 km·h^{-1} as a cut-off point for categorizing sprint actions, while White and MacFarlane (2015) use 23 km·h^{-1}. High-speed actions have been established from 15 km·h^{-1} (Polglaze et al., 2018; Scott et al., 2018; Sunderland and Edwards, 2017). In this research study, percentages of the peak speed of each athlete have been used to establish the different speed thresholds, although other proposals have also been used in the literature. Ventilatory thresholds obtained from a percentage of final velocity in the 30-15 test (68 and 87% of VIFT) have been proposed in rugby players (Scott et al., 2017), also respiratory compensation threshold, or maximal aerobic speed has been used previously (Hunter et al., 2015).

It is worth noting that individual and generic speed thresholds may both be useful to practitioners. Individual speed thresholds provide information about the relative stress placed on players. Conversely, generic speed thresholds may provide important information on the ability of players to adequately perform the absolute demands of match-play, while the volume of work performed at individual thresholds may provide insight into the post-match intervention employed (e.g. extra recovery or extra conditioning).

Depending on playing position and peak velocity, the generic threshold could under- or overestimate the intensity of the effort during match-play. Achieving the maximal peak velocity during matches is determined by tactical and positional demands, as well as the match result (Buchheit et al., 2013). Results from other team sports have shown that faster players have 11.5% greater peak velocity during matches than slower players (Mendez-Villanueva et al., 2011). The differences between peak velocity classification groups in the current study was approximately 4.5 km·h^{-1} (13.4%). This result explains the significant differences between generic and individual thresholds, for moderate speed running in BS and high speed and very HSR in MD and FW.

Conclusion

In conclusion, generic and individual speed thresholds may be useful to practitioners. Generic speed thresholds are useful when determining the absolute stress imposed on players while individual speed thresholds based on peak velocity may be more suitable when addressing the relative stress on individual players. The current research shows that there are differences in peak speed capabilities of players, so the use of individual speed thresholds reduces the overestimation of distances covered at high speeds in MD and FW, and reduces the underestimation of high speed distance and sprinting in BS.

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✉ **David Casamichana Gómez**
Department of Health and Food, Faculty of Education and Sport. Universidad Europea del Atlántico, Spain

Key points

- Generic and individual speed thresholds may be useful to practitioners there are differences in peak speed capabilities of players.
- Generic speed thresholds are useful when determining the absolute stress imposed on players while individual speed thresholds based on peak velocity may be more suitable when addressing the relative stress on individual players.
- The use of individual speed thresholds reduces the overestimation of distances covered at high speeds in midfielders and forwards, and reduces the underestimation of high speed distance and sprinting in backs.

AUTHOR BIOGRAPHY

David Casamichana GÓMEZ
Employment
Faculty of Education and Food. Universidad Europea del Atlántico. Santander, Spain.
Degree
PhD
Research interest
Soccer; Team analysis; Training load; Physiological development
E-mail: david.casamichana@uneatlantico.es

Esther Morencos MARTÍNEZ
Employment
Exercise and Sport Sciences, Education and Humanities Faculty, Francisco de Vitoria University, UFV, Madrid, Spain
Degree
PhD
Research interest
Field hockey; Team analysis; Training load; strength and conditioning
E-mail: esther.morencos@ufv.es

Blanca ROMERO-MORALEDA
Employment
Faculty of Health, Madrid; Strength and conditioning coach Madrid Female Football Club
Degree
PhD
Research interest
Female football, Field hockey; Team analysis; Training load; strength and conditioning
E-mail: bromero@ucjc.edu

Tim J GABBETT
Employment
Gabbett Performance Solutions, Brisbane, Australia; University of Southern Queensland, Institute for Resilient Regions, Ipswich, Australia
Degree
PhD
Research interest
Applied sport science, training load
E-mail: tim@gabbettperformance.com.au