

# The physical demands of elite English rugby union

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## Abstract

The aim of this study was to assess the physical demands of elite English rugby union match-play. Player movements were captured by five distributed video cameras and then reconstructed on a two-dimensional plane representing the pitch. Movements based on speeds were categorized as standing, walking, jogging, and medium-intensity running (low-intensity activity), and high-intensity running, sprinting, and static exertion (scrummaging, rucking, mauling, and tackling) (high intensity activity). Position groups were defined as forwards (tight and loose) and backs (inside and outside). Backs travelled more total distance than forwards (6127 m, s=724 vs. 5581 m, s=692;  $P<0.05$ ) and greater distances in walking (2351 m, s=287 vs. 1928 m, s=2342;  $P<0.001$ ) and high-intensity running (448 m, s=149 vs. 298 m, s=107;  $P<0.05$ ). Forwards performed more high-intensity activity than backs (9:09 min:s, s=1:39 vs. 3:04 min:s, s=1:01;  $P<0.001$ ), which was attributable to more time spent in static exertion (7:56 min:s, s=1:56 vs. 1:18 min:s, s=0:30;  $P<0.001$ ), although backs spent more time in high-intensity running (0:52 min:s, s=0:19 vs. 1:19 min:s, s=0:26;  $P=0.004$ ). Players travelled a greater distance in the first 10 min compared with 50–60 and 70–80 min, but there was no difference in the amount of high-intensity activity performed during consecutive 10-min periods during match-play. These results show the differing physical demands between forwards and backs with no evident deterioration in high-intensity activity performed during match-play.

【諸言】ラグビーにおいて、コンタクトを含む様々なプレイがあるため運動特性を明らかにする事は難しい

【目的】Time Motion Analysis(TMA)を用いて、イングランドプレミアシップの運動特性を明らかにする事

→データはパフォーマンス向上やラグビーユニオンに特化した研究に活かすため

2つの目的はHigh Intensity Work(Fatigue)の特性について明らかにする事

【方法】被験者はイングランドプレミアシップに所属するプロ選手。詳細は下記の通り

Tight FW(PR&LO) : 8名、Loose FW(HO&FL) : 6名、

Inside BK(SO&CTB) : 7名、Outside BK(WTB&FB) : 8名

(SHはサンプル数に限りがあり、動きが特殊なため除外)

対象試合 : 2002-2004年の2シーズンにかけて11月と2月に行われた5試合(試合結果は3勝5敗)、

天気はすべて晴れもしくは曇り

測定方法 : 5台のカメラで撮影(Sony DCR-TRV900E)

→カメラはFigure1の位置に固定

→試合前に1mの高さのポール用いてキャリブレーションを行い

実際の距離とカメラ上の距離を同期化

データ分析 : Speed Zone設定

Standing : 0-0.5m/sec、Walk : 0.5-1.7m/sec、Jog : 1.7-3.6m/sec、Medium-Intensity Running : 3.6-5.0m/sec、High-Intensity Running : 5.0-6.7m/sec、Max Speed Running : 6.7m/sec<

Static Exertion (静的な高強度なプレイ) とは : スクラム、ラック、モール、ラインアウト、タックルを分類

→手動で計算処理、他のプレイは自動で追尾しランニング距離、スピード、時間を算出

High-Intensity Activity=High-Intensity Running+ Max Speed Running+ Static Exertionとして分析&検討

統計分析 : 分散分析 (ANOVA) を実施

Post Hocテストとして、Tukey TestとChi-Square Test(χ<sup>2</sup>乗テスト)を実施

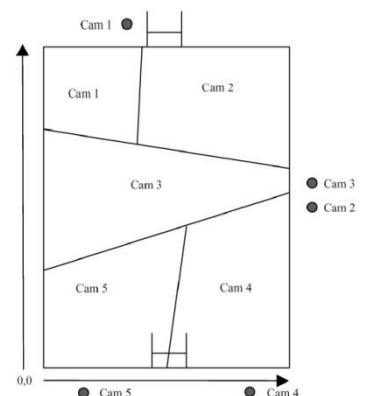


Figure 1. Camera locations around playing area perimeter.

【結果および考察】表1：走行距離

Table I. Total distance (m) travelled in each activity category (mean ± s).

Category	Forwards			Backs		
	Tight forwards	Loose forwards	All forwards	Inside backs	Outside backs	All backs
Standing	355 ± 52	352 ± 53	354 ± 50	317 ± 22	272 ± 82 <sup>b</sup>	293 ± 63 <sup>a</sup>
Walking	1840 ± 224	2045 ± 208	1928 ± 234	2161 ± 155 <sup>b</sup>	2517 ± 277 <sup>b,c,d</sup>	2351 ± 287 <sup>a</sup>
Jogging	1985 ± 466	2075 ± 326	2024 ± 400	2094 ± 224	1936 ± 418	2010 ± 340
Medium-intensity running	807 ± 225	819 ± 218	812 ± 214	917 ± 164	725 ± 223 <sup>d</sup>	815 ± 215
High-intensity running	275 ± 114	327 ± 98	298 ± 107	439 ± 107	456 ± 185	448 ± 149 <sup>a</sup>
Sprinting	144 ± 189	192 ± 203	164 ± 189	124 ± 78	280 ± 185	207 ± 185
Total	5408 ± 702	5812 ± 666	5581 ± 692	6055 ± 455	6190 ± 929	6127 ± 724 <sup>a</sup>

<sup>a</sup>Significantly different to forwards,  $P < 0.05$ . <sup>b</sup>Significantly different to tight forwards,  $P < 0.05$ . <sup>c</sup>Significantly different to loose forwards,  $P < 0.05$ . <sup>d</sup>Significantly different to inside backs,  $P < 0.05$ .

HI Run

T-FW : 419m、L-FW : 519m、FW : 462m

I-BK : 563m、O-BK : 736m : BK : 655m

HI Run Rate(%)

T-FW : 7.7%、L-FW : 8.9%、FW : 8.3%

I-BK : 9.3%、O-BK : 11.9%、BK : 10.7%

O-BKは他のポジションに比べて優位にWalkの距離が多い

(傾向としてBKはWalkの距離とHIとSprintの距離がFWより多い

→加速と減速を繰り返す→生理学的要求が多く高い身体能力が必要→結果としてダメージが大きい)

表2：各運動強度の時間

Table II. Total time (min:s) spent in each movement speed range (mean ± s).

	Forwards			Backs		
	Tight Forwards	Loose Forwards	Forwards Mean	Inside Backs	Outside Backs	Backs Mean
Stand	27:42 ± 6:10	23:34 ± 4:34	25:55 ± 5:45	25:14 ± 3:27	21:37 ± 6:34	23:18 ± 5:30
Walk	26:37 ± 3:10	29:58 ± 3:06	28:03 ± 3:29	34:01 ± 2:01 <sup>b</sup>	39:11 ± 3:05 <sup>b,c,d</sup>	36:47 ± 3:41 <sup>a</sup>
Jog	13:19 ± 2:52	14:01 ± 2:03	13:37 ± 2:29	13:57 ± 1:30	13:17 ± 3:07	13:36 ± 2:27
Med run	3:14 ± 0:56	3:17 ± 0:52	3:15 ± 0:52	3:39 ± 0:39	2:53 ± 0:54	3:15 ± 0:52
LIA	70:52 ± 1:55	70:50 ± 1:25	70:51 ± 1:39	76:52 ± 0:36 <sup>b,c</sup>	76:58 ± 1:20 <sup>b,c</sup>	76:56 ± 1:01 <sup>a</sup>
High run	0:49 ± 0:20	0:58 ± 0:17	0:52 ± 0:19	1:18 ± 0:19	1:21 ± 0:33	1:19 ± 0:26 <sup>a</sup>
Sprint	0:17 ± 0:21	0:26 ± 0:17	0:20 ± 0:23	0:17 ± 0:10	0:36 ± 0:28	0:27 ± 0:23
SE	8:03 ± 1:22	7:47 ± 1:39	7:56 ± 1:56	1:33 ± 0:22 <sup>b,c</sup>	1:05 ± 0:30 <sup>b,c</sup>	1:18 ± 0:30 <sup>a</sup>
HIA	9:08 ± 1:55	9:10 ± 1:25	9:09 ± 1:39	3:08 ± 0:36 <sup>b,c</sup>	3:02 ± 1:20 <sup>b,c</sup>	3:04 ± 1:01 <sup>a</sup>

<sup>a</sup>Significantly different to forwards,  $P < 0.05$ ; <sup>b</sup>significantly different to tight forwards,  $P < 0.05$ ; <sup>c</sup>significantly different to loose forwards,  $P < 0.05$ ; <sup>d</sup>significantly different to inside backs,  $P < 0.05$ . LIA (Low Intensity Activity); HIA (High Intensity Activity).

LIAとHIAの時間の割合→スーパー12: FW:L86%、H14%、BK: L94%、H6% (Duthie et al 2005, Deutsch et al 2007)

→この研究ではFW:L88%、H12%、BK:L96%、H4%

表3：各HIAの回数と1回あたりの平均時間

Table III. Frequency and mean duration (seconds) of activity bouts in work categories (mean ± s).

	Forwards			Backs		
	Tight Forwards	Loose Forwards	All Forwards	Inside Backs	Outside Backs	All Backs
Hi-run						
No.	36 ± 16	48 ± 16	41 ± 16	58 ± 16	61 ± 37 <sup>b</sup>	59 ± 28 <sup>a</sup>
Av dur	1.4 ± 0.2	1.3 ± 0.3	1.3 ± 0.2	1.6 ± 0.3	1.5 ± 0.2	1.5 ± 0.2
Sprint						
No.	14 ± 14	19 ± 18	16 ± 15	15 ± 7	31 ± 21 <sup>b,c,d</sup>	23 ± 19 <sup>a</sup>
Av dur	1.2 ± 0.3	1.3 ± 0.3	1.2 ± 0.3	1.1 ± 0.2	1.3 ± 0.3	1.2 ± 0.3
Static Exer						
No.	91 ± 19	87 ± 25	89 ± 21	29 ± 7 <sup>b,c</sup>	18 ± 10 <sup>b,c</sup>	24 ± 10 <sup>a</sup>
Av dur	5.3 ± 0.9	5.0 ± 0.6	5.2 ± 0.8	3.2 ± 0.6 <sup>b,c</sup>	3.9 ± 0.9 <sup>b,c</sup>	3.6 ± 0.8 <sup>a</sup>

<sup>a</sup>Significantly different to forwards,  $P < 0.05$ ; <sup>b</sup>significantly different to tight forwards,  $P < 0.05$ ; <sup>c</sup>significantly different to loose forwards,  $P < 0.05$ ; <sup>d</sup>significantly different to inside backs,  $P < 0.05$ .

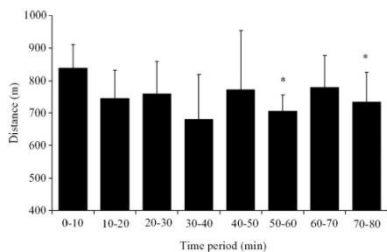


Figure 2. Total distance (m) travelled over each 10-min period during match-play (n=10). \*Significantly different to 0-10 min ( $P < 0.05$ ).

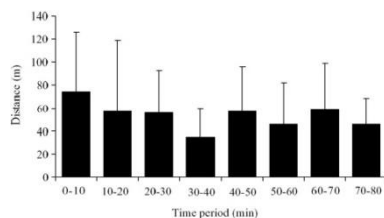


Figure 3. Distance travelled for 'running work' over each 10-min period of match-play (n=10).

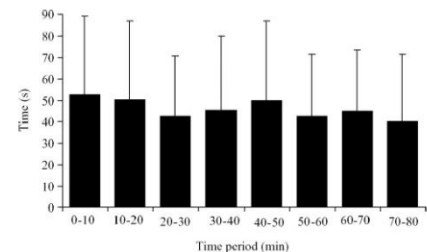


Figure 4. Time spent performing work activities during each 10-min period of match-play (n=10).

図2：10分ごとの走行距離→試合最初の10分と比べ、50-60分と70-80分で有意に短かった

図3：10分ごとのHi Intensity Run(HI Run+Sprint)の距離→各10分間で差はなし

(傾向としてラスト10分で少し落ちる)

図4：10分ごとのHIA(HI Run+Sprint+SE)の時間→各10分間で差はなし

• BKはSE(Static Exertion)の時間がFW

に比べ有意に短く、HIAの時間は短い

→スクラムやラインアウトの時間が長い

• BKはWalkの時間と距離が長い

LIAが有意に長い

• O-BKは他のポジションと比べ、高速のランニングパフォーマンス (Hi-Run

とSprint) の回数が有意に多い

• 対して、BKがSEの回数と1回当たりの参加時間は短い

→セットプレイがないため