

Table 1: Overview of previous research into association football referees' locomotion and heart rates

YEAR OF STUDY	1992/3 - 1993/4			1991/1992		1997/1998	1992-1996	Euro 2000			2003	2004/2005
<b>Authors/ Publ. Year</b>	Castagna & D'Ottavio (2001)[29]	Harley <i>et al.</i> (1999)[30]	Asami <i>et al.</i> (1988)[31]	Catterall <i>et al.</i> (1993)[24]	Johnston & McNaughton (1994)[32]	Krustrup & Bangsbo (2001)[26]	D'Ottavio & Castagna (2001)[33]	Helsen & Bultynck (2004)[19]	Weston & Brewer (2002)[28]	Weston <i>et al.</i> (2006)[27]	Mallo <i>et al.</i> (2007)[27]	Button & Peterson (2005)[34]
<b>Subjects/ Matches</b>	8 Italian referees, 3 international 16 Serie A & B games	14 English County level referees County league matches	10 Japanese referees	14 class 1 English referees <i>n</i> =4 premier, <i>n</i> =2 1 <sup>st</sup> div, <i>n</i> =4 2 <sup>nd</sup> div, <i>n</i> =4 non-league	Australian referees	27 Danish referees, <i>n</i> =7 FIFA, <i>n</i> =5 other top division, <i>n</i> =15 2 <sup>nd</sup> div	33 Italian referees <i>n</i> =96 games Serie A, Serie B	17 UEFA referees Euro 2000 games	8 English referees Premier, Nationwide League, FA Cup League Cup <i>n</i> =60	19 English referees Premier League <i>n</i> =254	11 international referees  12 U-17 World Cup games	5 NZFC referees 6 NZFC Games
<b>Distance Covered</b>	11,584m ± 1,017 1 <sup>st</sup> H: 5977m ± 468 2 <sup>nd</sup> H: 5606m ± 584 * sig less than 1 <sup>st</sup> H	7,496m ± 1,122	10,168 ± 756	9438m ± 707m range: 7,977-10,187 1 <sup>st</sup> H: 4876 ± 45 2 <sup>nd</sup> H: 4561 ± 366 * sig less than 1 <sup>st</sup> H		10,070m ± 707m (9,200-11,490)	11,469 ± 983m			11,617 ± 617m	11,059 ± 935m 1 <sup>st</sup> H: 5699m ± 489 2 <sup>nd</sup> H: 5360m ± 496 * sig less than 1 <sup>st</sup> H	10,4290m ± 507m Range: 9,200-11,490 1 <sup>st</sup> Half: 5213 2 <sup>nd</sup> Half: 5147

<b>Ave HR (bpm)</b>				165 ±8 1 <sup>st</sup> Half: 165 ±8) 2 <sup>nd</sup> Half: 165 ±9)		162 ±2 (taken at 5s intervals)		155 ± 16	153 ± 6.7 1 <sup>st</sup> Half: 154 ± 7 2 <sup>nd</sup> Half: 152 ± 6	83 ± 3% max HR,		162 ±2
<b>Sprint %</b>	13% (1436m)	3%		12% (1109m)	6%	1%	5%				13%	2%
<b>Run %</b>	25% (2744m)	47%	18%	47% (4444m)	12%	6%	37%				24%	11%
<b>Jog %</b>	44% (4840m)		48%			47%	24%	37%				34%
<b>Walk %</b>	9%	42%	34%	23% (2163m)	19%	40%	8%				22%	69%
<b>Stand %</b>	(975m)					23%			8%			
<b>Backwards %</b>	9% (966m)	8%		18% (1722m)	16%	6%	13%					
<b>Other info</b>						11m from decisions in middle of field  15m from decisions in attacking third	Sprints lasted no more than 2-4 seconds		Estimated energy expended  1 <sup>st</sup> Half: 846 ± 107 kcal  2 <sup>nd</sup> Half 855 ± 119 kcal		Differences in the mean distance from infringe- ments in left attacking zone between first half and second half	Tempo changes 1,087 ±141 ie every 5-6 secs (1 <sup>st</sup> : 528, 2 <sup>nd</sup> : 561)