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# Female soccer referees selected for the FIFA Women's World Cup 2007: survey of injuries and musculoskeletal problems

M Bizzini,<sup>1,2,3</sup> A Junge,<sup>1,2</sup> R Bahr,<sup>3</sup> J Dvorak<sup>1,2,4</sup>

<sup>1</sup> FIFA Medical Assessment and Research Centre (F-MARC), Zurich, Switzerland; <sup>2</sup> Schulthess Clinic, Zurich, Switzerland; <sup>3</sup> Oslo Sports Trauma Research Centre (OSTRC), Department of Sports Medicine, Norwegian School of Sport Sciences, Oslo, Norway; <sup>4</sup> Fédération Internationale de Football Association (FIFA), Zurich, Switzerland

Correspondence to:  
Dr M Bizzini, Schulthess Clinic,  
Lenggghalde 2, 8008 Zurich,  
Switzerland; [mario.bizzini@kws.ch](mailto:mario.bizzini@kws.ch)

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## ABSTRACT

**Background:** Few studies have examined the physiology, training and more recently injury profile of the soccer referee, and these have involved almost exclusively male referees.

**Purpose:** To analyse the frequency and characteristics of injuries and musculoskeletal problems in female referees selected for the FIFA Women's World Cup 2007.

**Study design:** Retrospective and prospective descriptive epidemiological study.

**Methods:** During the preparation camps a few months before the FIFA Women's World Cup 2007, all 81 preselected female referees completed a questionnaire on injuries and musculoskeletal problems. During the final 32 matches of the tournament in China, all injuries, musculoskeletal problems and related treatment of the 36 officiating referees were documented.

**Results:** Almost 50% of the referees reported having incurred at least one injury during their career that had led to time loss from the game. In the previous 12 months, 13 (16%) referees reported having sustained an injury and 64 (79%) reported musculoskeletal problems related to refereeing. During the World Cup and 14 (39%) referees incurred an injury and 17 (33%) were treated for musculoskeletal problems. The commonest location of injuries and problems were hamstrings, quadriceps, calf and ankle. The prospectively collected data found an incidence of 34.7 match injuries per 1000 match hours (95% CI 4.2 to 65.1).

**Conclusion:** Top-level female referees are exposed to an even greater risk of injury and/or musculoskeletal problems related to officiating than are male referees. Considering the growth of women's soccer, injury prevention programmes should be specifically developed for female referees.

Women's soccer has grown considerably in recent years. The official FIFA Big Count 2006 survey found that 26 million of the 265 million players actively involved in soccer, worldwide, were women and girls.<sup>1</sup> From 2000 to 2006 the number of registered female soccer players in FIFA's (then) 207 member associations (countries) increased by >50% to 4.1 million, whereas the number of registered men players increased by 21% to 34.2 million.

In accordance with the Laws of the Game, official soccer matches are officiated by a match referee and two assistant referees. In 2006, there were 840 000 referees and assistant referees registered at the national level worldwide, of whom approximately 10% (85 000) were woman.<sup>1</sup> Compared with the FIFA Big Count 2000, this

represented an increase of almost 50% in the number of female referees compared with just 11% for male referees. The 81 female referees preselected for the FIFA Women's World Cup 2007 represented 0.95% of the total number of registered female referees worldwide, whereas the respective percentage of the 123 male referees preselected for the 2006 FIFA World Cup was 0.16%.

In recent years, the physiological aspects of soccer refereeing have been described in detail for the men's game.<sup>2,3</sup> Research has shown that, during a match, international male referees cover an average distance of between 9 and 13 km, with a low percentage of high-intensity activities but a high number of activity changes and a great deal of decision-making. Published studies on women's soccer are rare,<sup>4</sup> and there are no peer-reviewed articles dealing with any aspects of performance in female referees. A study by Krstrup *et al*<sup>5</sup> found that the female player covered on average about 10 km during a soccer match, whereas male players averaged between 10 km and 14 km. The distance covered at high-intensity running (>15 km/h) by female players is lower than that of male players (1.3 km versus 1.9–2.4 km, respectively). Nevertheless, the exercise intensity as measured using the heart rate is similar between men and women. As the physical match activity of the referee is partly related to that of the players,<sup>6</sup> one may speculate that the match demands for female referees are similar to those for male referees in terms of internal load (exercise intensity) but lower for external load.

Only two studies have investigated injuries and musculoskeletal problems in elite referees.<sup>7,8</sup> In a retrospective study of 71 Swiss elite male referees,<sup>8</sup> 27% of the referees reported a time-loss injury (3.45 per 1000 match hours; 95% CI 1.2 to 5.7) and almost 90% reported musculoskeletal problems caused by refereeing during the preceding 12 months. The second study included the world's best 123 referees selected for the 2006 FIFA World Cup in Germany.<sup>7</sup> The retrospective data found a lower incidence of match injuries in the previous year (0.7 per 1000 match hours; 95% CI 0.1 to 1.3) and a lower prevalence of musculoskeletal problems (59%). The prospective study during the tournament found an incidence of 20.8 injuries per 1000 match hours (95% CI 4.17 to 37.4) and 35% of the referees were treated due to musculoskeletal problems. The locations of injuries and musculoskeletal problems were similar in both studies: hamstring, calf, ankle, lower back, and knee. Comparable information on injuries and

musculoskeletal problems of female referees has only been reported for five female referees officiating in the two top divisions of the Swiss Football League.<sup>8</sup>

The aim of this study was to investigate the injuries and musculoskeletal problems of female referees and assistant referees selected for the FIFA Women's World Cup 2007 in China and to compare the results with those previously reported for male referees officiating at the 2006 FIFA World Cup.

## METHODS

All subjects gave their written informed consent to participate and the study was approved by the University of Zürich ethics committee. The study included a retrospective survey of injuries and musculoskeletal problems in all female match referees (MRs) and assistant referees (ARs) preselected for the FIFA Women's World Cup 2007 and a prospective assessment of injury in all female referees officiating the final 32 matches of the tournament.

The selection of the study population, the study design and the data collection methods were identical to those used in a previous study<sup>[7]</sup> of male MRs and ARs preselected for the FIFA 2006 World Cup, to enable comparison of male and female referees of a similar skill level under comparable circumstances.

### Population

All 81 female referees (30 MRs and 51 ARs) from 33 National Associations worldwide, preselected for officiating during the FIFA Women's World Cup 2007 in China by the FIFA Refereeing Department, were included in the retrospective survey. Of the initial group, 42 (14 MRs, 27 ARs) were ultimately selected for the FIFA Women's World Cup 2007. Six referees (1 MR, 5 ARs) were sent home after failing the physical tests 1 week before the start of the tournament. The remaining 36 referees (13 MRs, 23 ARs) officiating at the final 32 matches of the FIFA Women's World Cup 2007 were included in the prospective part of the study.

### Retrospective study

The retrospective part of the study was carried out during the three preparation camps in January (Canary Islands, Spain), March (Algarve, Portugal) and May (Zürich, Switzerland) organised for female MRs and ARs by the FIFA Refereeing Department.

On the first day of the two camps in January and March, the 81 preselected referees were asked to complete a questionnaire on injuries and musculoskeletal problems. During the last camp in May, a physiotherapist conducted brief personal interviews with each of the 51 final preselected referees to confirm and complete the questionnaire data. Although the referees were explicitly informed that the data would be treated in complete confidence and only used for scientific purposes, it was considered possible that some referees might have thought their answers would influence their chances of selection and hence played down or did not declare their injuries and problems.

All definitions used, methods applied and variables assessed were in accordance with the recent consensus statement on injury definition and data collection procedures in studies of soccer injuries,<sup>9</sup> and have been described in detail by Bizzini *et al*<sup>7,8</sup> The five-page questionnaire covered the referee's characteristics of the referee (such as sociodemographics, refereeing qualifications and experience), injuries and musculoskeletal

problems caused by training or refereeing (related to the last match, the previous 12 months and the entire career), other medical problems, and time spent in training and in matches. The questionnaire was available in English, Spanish, German and French, the four official FIFA languages, as fluency in at least one of these languages is a prerequisite for selection as a FIFA referee.

### Prospective assessment

Two weeks before the tournament (August 27), the 42 selected referees and about 30 staff members were reunited at the referees' headquarters in Shanghai, China. A medical team (including one medical doctor, one physiotherapist and four massage therapists), two fitness trainers and one sports psychologist took care of the referees until the end of the tournament. A "typical" day for the referee comprised 1.5–2 hours of training on the pitch in the morning, then 1 hour of individual training (optional) and 1 hour of theory in the afternoon, followed by regeneration/treatment sessions (individual schedules). The referees trained "normally" while they were in the headquarters, but reduced their training programme a day or two before leaving to officiate matches. During the FIFA Women's World Cup 2007 (10–30 September 2007) the MRs and ARs (with the fourth official) travelled by air or rail to their appointed matches at the different venues in China. The physical condition of the MRs and ARs officiating at a match was checked by the medical team upon their return to the headquarters in Shanghai.

Data on injuries and musculoskeletal problems were collected prospectively by one physiotherapist (MB) from the medical team. Confirmation of medical diagnoses was made by a physician at the referees' headquarters in Shanghai. Every acute injury incurred during a match or training was recorded according to the consensus injury definition.<sup>9</sup> All musculoskeletal problems that affected the performance of the referees were similarly recorded. The type and number of treatments (physiotherapy, massage, electrotherapy, taping, other) and training modifications (reduced training, such as on an exercise bike or in the pool) were recorded on a daily basis.

### Calculation of exposure time

For the retrospective study, exposure time was calculated based on the information provided in the questionnaire. Match exposure in the previous 12 months was calculated as the sum of matches officiated by all referees in the previous year multiplied by 1.5 hours (the minimum duration of a match). Match exposure over the career was given by: the number of referees × the average years in refereeing × the average number of games officiated per year × 1.5 hours.<sup>8</sup> Exposure in training was calculated for the season and pre-season separately. For the prospective survey, match exposure (in hours) was calculated by multiplying the number of games (32) by the number of referees (3) by the standard number of hours per game (1.5).

### Statistical analysis

The statistical analyses were carried out using SPSS V.11. Descriptive data are reported as the mean (SD) and/or range, unless otherwise stated. Group differences between MRs and ARs were analysed by  $\chi^2$  (categorical data) or unpaired t tests (continuous variables). For incidence rates, 95% confidence intervals were calculated according to the formula  $95\% \text{ CI} = \text{incidence} \pm 1.96 \times (\text{incidence}/\text{square root} [\text{number of incidents}])$ . Significance was set at  $p < 0.05$ .

## RESULTS

## Population characteristics

The study comprised 81 referees preselected for the FIFA Women's World Cup 2007 (mean age 35 (SD 4.4) years, range 26 to 44 years; height 1.66 (0.06) m, range 1.52–1.76 m; weight 59 (SD 6) kg, range 42 to 72 kg; and body mass index 21.4 (1.8) kg/m<sup>2</sup>, range 17.7 to 25.3 kg/m). They had received their first official licence for refereeing on average 12 years (range 4–25 years) before the study and had officiated for 9 years (range 2–23 years) in their top national leagues. They had held a FIFA licence for an average of 6 years (range 1–12 years), during which time they had also been officiating at international matches. Per year, the referees officiated on average at 32.8 (SD 20.2) national and 7.0 (4.4) international matches. In the 12 months before the World Cup, they had officiated on average at 29.9 (21.7) national matches and 8.3 (4.8) international matches. The referees officiated on average 2.8 (1.2) matches/week and trained 7.5 (3.1) hours/week before the season and 6.0 (2.9) hours/week during the season. Almost two-thirds of the referees (64.2%) reported that they had received advice about their training from qualified personnel and 69.1% declared that they did not practice any other sporting activities apart from refereeing and training for refereeing. No significant differences between MRs and ARs were seen for any of these variables.

## Retrospectively reported injuries

In total, 57 injuries (in matches and training over the career) were reported retrospectively by 15 MRs (50% of the MRs) and 24 ARs (47.1% of the ARs). One AR reported four injuries, 2 MRs reported three injuries, 11 (8 ARs, 3 MRs) reported two injuries and 25 (15 ARs, 10 MRs) referees reported one injury. All reported injuries had resulted in at least 2 weeks of absence from sport. Most injuries had resulted in an absence 2–4 weeks (42; 73.7%) or 5–8 weeks (11; 19.3%), although four injuries (0.1%) had resulted in an absence of 12 weeks or more.

A similar number of injuries had occurred during matches (27; 47.4%) and training (30; 52.6%). In both MRs and ARs, the most prevalent diagnoses were (in decreasing order) hamstring strains, calf strains, ankle sprains and quadriceps strains; adductor strains were reported only by AR (table 1).

Four (13.3%) MRs and eight (15.7%) ARs reported having had an injury in the previous year (one AR had two injuries) and one AR during the last game.

The incidence of match injuries was 0.6 per 1000 match hours (95% CI 0 to 1.2) for the entire career, 2.8 per 1000 match hours (95% CI 1.3 to 4.3) over the previous 12 months, and 8.2 per 1000 match hours (95% CI 2.6 to 13.9) in relation to the last match.

## Retrospectively reported musculoskeletal problems

Almost 80% of the referees (22 MRs, 42 ARs;  $p > 0.05$ ) reported having had some sort of musculoskeletal problem related to officiating, during their entire career. The figures were similar for the previous 12 months. In total, 37 referees (45.7%; 14 MRs, 23 ARs;  $p > 0.05$ ) reported having had at least one problem during the last match that they officiated. In both MRs and ARs, the most prevalent locations of problems over the entire career were the hamstrings, calf, low back and knee (table 2). Problems with the Achilles tendon and ankle in MRs and problems with the adductors in ARs were also common. Headache, which strictly speaking should not be considered a musculoskeletal problem, also ranked highly, with a prevalence of 36.6% in MRs and 23.5% in ARs. Compared with MRs, ARs reported more problems in the adductors ( $p < 0.05$ ) and knee ( $p < 0.05$ ) in the previous 12 months, but not during their career (table 2).

## Other retrospective information

Two MRs and three ARs had undergone surgery; in one MR and two ARs this was on the ankle. Additionally, two MRs and six ARs reported having had other operations (three caesareans and one each of appendix removal, hernia, nose, muscle and foot operations). Five MRs and 10 ARs reported medical problems (mostly asthma and allergies). When asked whether they did anything to prevent injuries or musculoskeletal problems, 62 (76.5%) referees stated that they performed stretching exercises, 43 (53.1%) reported receiving massage and 33 (40.7%) indicated that they undertook other measures (eg, visiting a sauna or gym).

## Referees officiating during the FIFA Women's World Cup 2007

All 36 referees selected for officiating as MRs ( $n = 14$ ) or ARs ( $n = 22$ ) during the Women's World Cup were included in the

**Table 1** Injuries reported by FIFA female referees during their career

	Match referees (n = 30)		Assistant referees (n = 51)		Total
	Game	Training	Game	Training	
Hamstring strain	4	3		7	14
Calf strain	3	1	4	2	10
Ankle sprain	3	2	3	1	9
Quadriceps strain	–	2	2	2	6
Adductor strain	–	–	–	4	4
Knee sprain	–	–	–	2	2
Patellar tendon partial tear	–	–	2	–	2
Achilles tendon partial tear	1	–	1	–	2
Low back muscle strain	–	–	1	1	2
Toe fracture	–	1	1	–	2
Stress fracture metatarsal bone	–	1	–	–	1
Plantar fascia partial tear	1	–	–	–	1
Low back herniated disc	–	–	–	1	1
Meniscus lesion	–	–	1	–	1
Total	12	10	15	20	57

**Table 2** Number and percentage of referees reporting musculoskeletal problems

Location of problems	Match referees (n = 30)			Assistant referees (n = 51)		
	Last match, n (%)	Previous 12 months, n (%)	Entire career, n (%)	Last match, n (%)	Previous 12 months, n (%)	Entire career, n (%)
Head	3 (10.0)	10 (33.3)	11 (36.6)	4 (7.8)	12 (23.5)	12 (23.5)
Neck	–	2 (6.6)	3 (10.0)	3 (5.9)	8 (15.7)	9 (17.6)
Low back	2 (6.6)	3 (10.0)	7 (23.3)	3 (5.9)	14 (27.4)	14 (27.4)
Hip	3 (10.0)	4 (13.3)	4 (13.3)	3 (5.9)	3 (5.9)	5 (9.8)
Groin	–	–	4 (13.3)	–	3 (5.9)	6 (11.8)
Adductors	–	1 (3.3)	3 (10.0)	4 (7.8)	12 (23.5)	12 (23.5)
Quadriceps	2 (6.6)	3 (10.0)	5 (16.6)	2 (3.9)	10 (19.6)	10 (19.6)
Hamstring	3 (10.0)	8 (26.6)	9 (30.0)	7 (13.7)	19 (37.3)	19 (37.3)
Knee	1 (3.3)	1 (3.3)	7 (23.3)	3 (5.9)	12 (23.5)	12 (23.5)
Patellar tendon	2 (6.6)	2 (6.6)	5 (16.6)	2 (3.9)	5 (9.8)	5 (9.8)
Calf	4 (13.3)	9 (30.0)	10 (33.3)	4 (7.8)	14 (27.4)	14 (27.4)
Achilles tendon	2 (6.6)	4 (13.3)	7 (23.3)	2 (3.9)	7 (13.7)	7 (13.7)
Ankle	2 (6.6)	3 (10.0)	8 (26.6)	2 (3.9)	6 (11.8)	8 (15.7)
Others*	1 (3.3)	4 (13.3)	4 (13.3)	3 (5.9)	4 (7.8)	4 (7.8)

\*Including shin splints and heel pain.

prospective study. No significant differences between this group and the remaining, non-selected 45 referees were seen in relation to their personal characteristics or the percentage that were previously injured or had a history of musculoskeletal problems, except that headache was reported less often by the referees who were selected.

During the World Cup, more than half of the referees (61.1%, 10 MRs and 12 ARs;  $p > 0.05$ ) received treatment. Treatment was given in connection with 14 injuries and 17 musculoskeletal problems. Four ARs (AR1, AR3, AR4, AR9) were treated for both injuries and musculoskeletal problems (in two cases, AR4 and AR9, the injury and problem were connected). In total, 146 physiotherapy sessions, 129 massage therapy sessions, 107 applications of electrotherapy and 20 tapings were carried out in treating the injuries and musculoskeletal problems (tables 3, 4).

### Injuries during the FIFA Women's World Cup 2007

During the FIFA Women's World Cup 2007 tournament, 14 referees (38.9%) incurred an injury during a match ( $n = 5$ ; 35.7%) or training ( $n = 9$ ; 64.3%). The five match injuries resulted in an incidence of 34.7 match injuries per 1000 match hours (95% CI 4.2 to 65.1), equivalent to approximately 1 injury in 20 matches.

Strain of the rectus femoris muscle was the most common injury ( $n = 5$ ; 35.7%), followed by hamstring strain, calf strain and ankle sprain (each twice). Four (80%) of the five match injuries were muscle strains; the latter also comprised 56% of all training injuries ( $p > 0.05$ ). None of these injuries resulted in absence from officiating. However, all 14 referees had to reduce or modify their training regimen for an average of 5.6 days (range 2–10). The treatment of these injuries required 80 physiotherapy sessions, 62 massage therapy sessions, 68 applications of electrotherapy and 20 tapings.

In 12 out of 14 cases, no relationship was found between the tournament injury and previous injuries reported in the questionnaire. Two referees who sustained a rectus femoris muscle strain during the tournament (one MR during a match and one AR during training) had a history of a quadriceps muscle lesion in the previous year (table 3).

### Musculoskeletal problems during the FIFA Women's World Cup 2007

During the Women's World Cup 2007, 12 referees (33.3%; 5 MRs, 7 ARs) were treated in connection with 14 problems. Two

referees (MR10, AR9) reported two different problems. The commonest locations of musculoskeletal problems were the lower back muscles, plantar fascia, hip joint (three cases each), psoas/adductor muscles and calf muscles (two cases each). Muscle tightness was identified as the cause of the problem in about half the cases. The treatment of these musculoskeletal problems required 60 physiotherapy sessions, 67 massage therapy sessions and 39 applications of electrotherapy.

In four cases (MR8, MR10, AR9, AR12), the referees sustained problems of a similar nature to those that had already been declared in the retrospective questionnaire (two concerning the hip joint and two concerning the calf muscles). However, >70% of all documented problems during the World Cup were not related to any previously reported injury or musculoskeletal problem (table 4).

### DISCUSSION

To our knowledge, this is the first published study describing the injuries and musculoskeletal problems of female soccer referees. Previously, the only data available on female referees were those reported as part of a retrospective survey of all referees officiating in the top two divisions of the Swiss Football League, which included five female referees.<sup>8</sup> The present study includes a retrospective survey of the world's 81 best female match referees and assistant referees preselected for the FIFA Women's World Cup 2007, and a prospective assessment of all 36 female referees involved in the final stage of the tournament.

The protocol adopted in the present study was the same as that previously described for studies on Swiss elite referees<sup>8</sup> and referees selected for the 2006 FIFA World Cup,<sup>7</sup> to enable comparison with these earlier studies. The five female referees officiating in the top two divisions of the Swiss Football League reported (retrospectively, over their career) two hamstring strain injuries in training and no match injuries, and headache was the most prevalent problem.<sup>8</sup> Despite the small number of subjects, this tends to concur with some of the findings of the present study.

Compared with their male counterparts involved in the 2006 FIFA World Cup,<sup>7</sup> the female referees involved in the FIFA Women's World Cup 2007 were younger (by a mean of 5 years) and had a shorter career refereeing both national matches (by 7 years) and international matches (by 2 years). However, the average number of matches per year was almost identical in

**Table 3** Characteristics and consequences of acute injuries during the FIFA Women's World Cup 2007 and previous injuries and problems reported retrospectively in the survey carried out earlier the same year

Referee	Type of injury during Women's World Cup	Match or training injury	Type and frequency of treatment	Days of reduced training	Previous injuries or problems reported retrospectively in January to May 2007	
					Injury	Problem
MR1	Rectus femoris muscle strain	Match	Physiotherapy (8); massage (6); electrotherapy (7)	10	Quadriceps strain (ca)	Quadriceps (ca)
MR2	Rectus femoris muscle strain	Match	Physiotherapy (5); massage (6); electrotherapy (4)	7	No	No
MR3	Knee ligament sprain (MCL)	Training	Physiotherapy (5) Taping (4) Electrotherapy (4)	4	Achilles partial tear (12) Plantar fascia partial tear (ca)	Hamstring (1m, 12, ca) Achilles (1m, 12, ca) Calf (12, ca) Low back (ca) Knee surgery (ca)
MR4	Heel contusion	Training	Electrotherapy (4); taping (3)	2	No	Knee surgery (ca)
MR5	Calf muscle strain	Training	Physiotherapy (4); massage (5); electrotherapy (4)	4	No	No
AR1	Ankle sprain	Match	Physiotherapy (9) Taping (8), electrotherapy (7)	5	Adductors (12)	Adductors (12, ca) Calf (12, ca)
AR2	Hamstring muscle strain	Match	Physiotherapy (6); massage (6); electrotherapy (5)	9	No	Knee (12, ca)
AR3	Rectus femoris muscle strain	Match	Physiotherapy (9) Massage (8) Electrotherapy (6)	7	Calf strain (1m) Achilles partial tear (ca)	Calf (1m, 12, ca) Hamstring (12, ca) Knee (12, ca) Achilles (ca)
AR4	Thoracic spine blockage	Training	Physiotherapy (3) Massage (3)	2	Hamstring strain (12) Calf strain (ca)	Hamstring (12, ca) Calf (ca)
AR5	Rectus femoris muscle strain	Training	Physiotherapy (7) Massage (5) Electrotherapy (7)	5	No	Quadriceps (12, ca) Hamstring (12, ca) Calf (12, ca) Ankle (12, ca) Knee (ca)
AR6	Ankle sprain	Training	Physiotherapy (5); taping (5); electrotherapy (4)	8	Hamstring (12)	Hamstring (12, ca)
AR7	Hamstring muscle strain	Training	Physiotherapy (9); massage (8); electrotherapy (5)	6	No	Adductors (1m, 12, ca)
AR8	Rectus femoris muscle strain	Training	Physiotherapy (5); massage (5); electrotherapy (4)	5	Quadriceps strain (12)	Quadriceps (12, ca)
AR9	Calf muscle strain	Training	Physiotherapy (11) Massage (10) Electrotherapy (7)	5	Calf (12)	Hamstring (12, ca) Calf (12, ca)

12, Previous 12 months; AR, assistant referee; ca, career; 1m, last match; MR, match referee.

male and female FIFA-referees. The female FIFA referees reported spending a similar number of hours to the male referees in training and preparing to officiate, but compared with their male counterparts, fewer female referees were instructed by a qualified person (64% women vs 84% men). A higher proportion of female referees (69%) than male (42%) referees reported practising other sports as part of their training or as a recreational activity.

The incidence of match injuries per 1000 match hours, reported retrospectively for the previous 12 months, was 0.69 (95% CI 0.09 to 1.29) for the 123 male referees selected to officiate at the 2006 FIFA World Cup<sup>7</sup> and 2.8 (95% CI 1.3 to 4.3) for the 81 female FIFA referees. No male referees but one female AR reported having incurred an injury during the last match of the tournament. A higher incidence of injury was seen not only in the retrospectively reported data, but also in the

prospective survey; during the World Cup tournaments, more female referees (38.9%) than male referees (22.2%) incurred an injury (relative risk 1.6; 95% CI 0.95 to 2.56).

One can only speculate as to the reasons for the higher incidence of injuries in female referees compared with male referees. It is possible that the difference is due to a lack of specific physical preparation (to match the physiological demands of international refereeing) of the female referees. From a historical perspective, the first FIFA Women's World Cup only took place in 1991 (China), whereas the "male" FIFA World Cup was first held in 1930 (Uruguay). Hence, international women's soccer generally has a shorter history and is still evolving in all aspects of the game including, presumably, refereeing. Although male FIFA referees have been systematically supported by expert fitness coaches since 2000, their female counterparts have only been enrolled in similar

**Table 4** Musculoskeletal problems during the FIFA Women's World Cup 2007 and reported retrospectively during the survey carried out earlier the same year

Referee	Reported problem during World Cup 2007	Days of reduced training	Type and frequency of treatments	Previous problems reported retrospectively in January May 2007
MR6	Plantar fascia tightness	1	Massage (6) Electrotherapy (6)	Hip (lm, 12, ca) Quadriceps (lm) Hamstring (12, ca)
MR7	Low back muscle tightness	0	Physiotherapy (7) Massage (9)	Hip (12) Hamstring (12) Calf (12)
MR8	Hip joint impingement (FAI), with low back muscle tightness	0	Physiotherapy(12) Massage (6)	Hip (lm,12,ca) Hamstring (lm,12,ca) Calf (lm,12,ca) Ankle (lm,12,ca)
MR9	Psoas and adductor muscle tightness	1	Physiotherapy (5) Massage (6) Electrotherapy (4)	Head (ca) Calf (12) Hamstring (ca)
MR10	Hip joint hypomobility, with psoas and low back muscle tightness Calf muscle tightness	3	Physiotherapy (7) Massage (5) Electrotherapy (7)	Head (12) Calf (lm, 12, ca) Ankle (ca) (Ankle surgery)
AR1*	Piriformis, gluteal and low back muscle tightness	1	Physiotherapy (5) Massage (3)	Head (lm) Adductors (12) Calf (12)
AR3*	Psoas and adductor muscle tightness	0	Physiotherapy (8) Massage (6) Electrotherapy (6)	Calf (lm, 12,ca) Hamstring (12,ca) Knee (12,ca) Achilles (ca)
AR4*	Upper thoracic spine hypomobility	0	Physiotherapy (3) Massage (2)	Hamstring (12,ca) Calf (ca)
AR9*	a) Low back and b) calf muscle tightness	0	Physiotherapy (5) Massage (4) Electrotherapy (4)	Hamstring (12, ca) Calf (12, ca)
AR10	Plantar fascia tightness	2	Massage (5) Electrotherapy (5)	Low back (12) Hamstring (ca)
AR11	Plantar fascia tightness	0	Massage (7) Electrotherapy (7)	Hip (lm, 12, ca) Hamstring (lm, 12, ca) Ankle (lm, 12) (Ankle surgery)
AR12	Hip joint impingement (FAI), with psoas and low back muscle tightness	0	Physiotherapy (8) Massage (8)	Head (lm) Hip (lm, 12, ca) Groin (ca) (Knee surgery)

12, Previous 12 months; AR, assistant referee; ca, career; FAI, femoro-acetabular impingement; lm, last match; MR, match referee.

programmes in recent years. The group selected for the FIFA Women's World Cup 2007 had only been participating in a structured training programme since 2005. This was also evidenced by the questionnaire data, which found that 83.7% of the male referees, but fewer than two-thirds (64.2%) of the female referees reported receiving advice about their training from qualified personnel. Other possible reasons for the higher incidence of injury in female referees include the gender difference in fitness level<sup>10</sup> and in neuromuscular characteristics.<sup>11</sup> Finally, another possible explanation could be the difference between men and women in pain perception and coping with pain.<sup>12</sup>

The injury locations reported most often in the retrospective survey (calf, hamstring and ankle) were similar in men and women. Muscle strains were the commonest type of injury in both groups, accounting for >50% of all injuries. In both men and women, adductor muscle strains were seen more often in ARs than MRs. This figure may be associated with the significant amount of sideways running of ARs during the

game. Concerning the circumstances of injury, in the retrospective questionnaire female referees reported having incurred more injuries during match-play than did male referees (47% versus 17% of all injuries, respectively), but during the World Cup tournaments, the incidences were similar for both (35.7% versus 42.9% of all injuries, respectively).

In the retrospective questionnaire, musculoskeletal problems in the previous 12 months were reported by >80% of the female referees compared with 59% of the male referees. In contrast, during the two World Cup tournaments, almost the same proportion of female (33.3%) and male (34.9%) referees sustained musculoskeletal problems requiring medical attention.

The locations most often affected by musculoskeletal problems were the same for men and women: hamstring, calf, lower back and knee. There were also some trends showing that certain problems were more prevalent in MRs (Achilles tendon) and in ARs (adductor muscles), which may be related to the different physical demands of these refereeing roles.<sup>2,8</sup> The relatively high prevalence of headache in women referees

## Original article

## What is already known on the topic

- ▶ Women's football has grown considerably in recent years and several studies have analysed on injuries of female players.
- ▶ Despite the important role of the referee in football, no study has focused on injuries of female referees.

## What this study adds

- ▶ Almost 50% of the referees reported having incurred at least one time-loss injury during their career and 39% incurred an injury during the FIFA Women's World Cup 2007.
- ▶ The commonest diagnoses were hamstring strains, calf strains and ankle sprains.
- ▶ The incidence of injuries was higher in woman than male referees but the diagnosis were similar.

(around 30%) is difficult to explain. The causes for headache (not really a musculoskeletal problem, per se) are often multifactorial, but one could speculate that the psychological pressure of officiating at important matches may play a role in women's soccer.

In both male and female referees, the injuries and musculoskeletal problems sustained during the World Cup tournament caused no absence from officiating, but did result in a few days of reduced training. This minimal loss of time from the game is probably attributable to the team of experts (doctors, physiotherapists, massage therapists) responsible for the medical care of the referees.

The results of this study show that female referees – even more than male referees – are exposed to a certain risk of injury and/or development of musculoskeletal problems related to officiating. International referees are required to meet the demands of modern women's soccer, which is evolving rapidly in terms of intensity and speed. The role of the referee should not be considered to be any different from that of the players: they have to be specifically prepared to perform at high level

throughout the whole game. Injury prevention measures should therefore be integrated into their training programmes. We conclude that there is a need to develop specific injury prevention programmes for female match and assistant referees.

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## REFERENCES

1. The FIFA Big Count 2006: 230 million active in football: FIFA Communications Division, 2007: <http://www.fifa.com/search/index.htm?q=big+count>
2. **Castagna C**, Abt G, D'Ottavio S. Physiological aspects of soccer refereeing performance and training. *Sports Med* 2007;**37**:625–46.
3. **Stolen T**, Chamari K, Castagna C, *et al.* Physiology of soccer: an update. *Sports Med* 2005;**35**:501–36.
4. **Kirkendall DT**. Issues in training the female player. *Br J Sports Med* 2007;**41**(Suppl 1):i64–7.
5. **Krustrup P**, Mohr M, Ellingsgaard H, *et al.* Physical demands during an elite female soccer game: importance of training status. *Med Sci Sports Exerc* 2005;**37**:1242–8.
6. **Weston M**, Castagna C, Impellizzeri F, *et al.* Analysis of physical match performance in English Premier League soccer referees with particular reference to first half and player work rates. *J Sci Med Sport* 2008: in press.
7. **Bizzini M**, Junge A, Bahr R, *et al.* Injuries and musculoskeletal complaints in referees and assistant referees selected for the 2006 FIFA World Cup. Retrospective and prospective survey. *Br J Sports Med* 2009;**43**:490–7.
8. **Bizzini M**, Junge A, Bahr R, *et al.* Injuries and musculoskeletal complaints of referees — a complete survey in the top divisions of the Swiss Football League. *Clin J Sport Med* 2009;**19**:95–100.
9. **Fuller CW**, Ekstrand J, Junge A, *et al.* Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries. *Br J Sports Med* 2006;**40**:193–201.
10. **Lewis DA**, Kamon E, Hodgson JL. Physiological differences between genders. Implications for sports conditioning. *Sports Med* 1986;**3**:357–69.
11. **Rozzi SL**, Lephart SM, Gear WS, *et al.* Knee joint laxity and neuromuscular characteristics of male and female soccer and basketball players. *Am J Sports Med* 1999;**27**:312–19.
12. **Keogh E**, Herdenfeldt M. Gender, coping and the perception of pain. *Pain* 2002;**97**:195–201.