Incidence of Injury and Pain in Referees in German National Handball Leagues: A Cross-sectional Study

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Research article

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Abstract

Background: Handball referees play an important role during a handball match. Surprisingly, not much is known about their sports-related injuries and resulting pain, therefore the purpose of our study was to focus on injuries and sports-related pain in referees in German handball leagues.

Methods: During the 2018/19 national German handball season, referees of the German Federation of Handball were contacted and asked to complete an injury and pain questionnaire on the penultimate matchday of the first and the second round of the season.

Results: 70 referees participated in the study. One in three referees reported an injury during the last year and perceived some form of pain. Of those suffering from pain, 16.7% referees reported chronic pain disorders. During the season, 31.4% of referees incurred an injury and the majority of the 70 referees officiated despite pain (n=43). Prospective data suggested an incidence of 11.6 (95% CI: 10.3 to 13.0) injuries per 1000 match hours, and 19.0 (95% CI: 16.8 to 21.3) sports-related pain events per 1000 match hours. The most common injuries were foot and knee injuries and a substantial number of the referees (n= 25) reported taking analgesics for the pain.

Conclusion: German handball referees are at risk of sports-related injuries with subsequent pain. Considering the injury profile, the incidence of sports-related pain events, and the high physiological and psychological demands of refereeing, it appears that prevention programs should be developed and integrated into the routine of the referee.

Background

Handball is one of the most popular sports in Europe besides football, volleyball, and basketball [1]. Since handball is a sport with high physical intensity and frequent body contact, it is not surprising that the incidence of injury is comparatively high in players [1]. Most of these injuries affect the head/neck, upper extremities including the shoulder and knee and ankle [1, 2].

Referees play an important part in handball matches. They have to be very close to the current state of play in order to get the best perspective [3]. This may result in body contact with players and in physical fatigue and consequently in an increased risk for injuries and false decision making in some cases [3]. The fact that referees are often older than players may exacerbate these risks and consequently, referees in modern handball should be trained adequately [3, 4].

Although referees are at risk of injuries during handball matches, research dealing with this issue and possible consequential damages and symptoms is scarce. Especially, localization of the injury, restrictions due to the injury, and pain levels have not been well analyzed. Therefore, the aim of our study was to (i) analyze the incidence of injuries in handball referees, (ii) to examine localization of the injury and its underlying mechanism, (iii) to explore the consequent restrictions, and finally (iv) to evaluate referees' pain levels.

Methods

Study design

We conducted an exploratory cross-sectional paper-based survey to assess pain and injury among referees in the German handball leagues during the season 2018/19. Questioning was conducted during the penultimate matchday of the first round of the season. For prospective data, referees were encouraged to participate in the survey again on the penultimate matchday of the second round of the season.

Participants

Potential participants were all referees registered with the German Federation of Handball (DHB) at the time of the survey. The questionnaires were distributed by the Referee Chairman of the DHB, and anonymized completed questionnaires were sent to us by those referees who gave written informed consent.

Outcome measures

The questionnaire comprised of the following questions (see Table 1):

Table 1
Composition of the questionnaire

Demographics	**Age, sex, height, weight**	
	Experience being a referee	
	Training loads	Endurance, strength, circuit
	Occupation	
	Number of actions	Per week, last 4 weeks
	International participations	
Injury	1-year Incidence of sports-related injury	Match, training
	Incidence of injury during season	
	Type of injury	
	Mechanism of injury	
	Degree of disability	
	Therapy	
Pain	Sports-related pain	Occurrence, location, intensity
	Use of analgesics	Type, frequency

Statistical analysis

Statistical data processing was performed using SPSS (Version 24; IBM Deutschland GmbH, Ehningen). Since all data had a normal distribution (Kolmogoroff-Smirnoff-Lilliefors test), data are expressed as means and standard deviations (95% CI). For statistical analysis between different subgroups, the T-test for independent samples and the Chi^2 test for categorized data were applied. The level of statistical significance was set at $p < 0.05$. Correlations were calculated applying Pearson's coefficient, and are indicated as Pearson's r.

Results

Characteristics of the referees

70 referees participated in the study – their characteristics are summarized in Table 2.

Table 2
Referees characteristics

		Referees (n = 70)
Demographics	Age [years]	31.8 ± 7.2
	Female gender [n]	7
	BMI [kg/m^2]	24.8 ± 2.1
Training habits	Duration per training unit [h]	1.2 ± 0.8
	Endurance training [%]	64.7 ± 24.4
	Strength training [%]	26.3 ± 21.6
	Circuit training [%]	5.9 ± 10.9
Referees' characteristics	Experience [years]	14.9 ± 6.4
	Commitment international [%]	12.9
	Commitment 1. league [%]	35.7
	Commitment 2. league [%]	62.9
	Commitment 3. league [%]	52.9
	Commitment in 1. league women [%]	51.4
	Match load [hours/week]	1.0 ± 0.4
	Training load [hours/week][1]	3.6 ± 2.5
[1]based on three days of training / week		

Retrospectively reported injuries

Twenty-two (31.4%) referees had suffered a sports-related injury within the last year. Most of the injuries occurred during training. In total, 28 injuries were reported, with foot (53.6%) and knee (32.1%) injuries being most common (Table 3). Injury mechanism included turns and changes of direction (29.7%), as well as sprints (21.6%) and physical contact with players or ball (21.6%). Physical overload was reported by none of the referees. Due to their injury, daily living activities were affected: refereeing (72.0%), walking (60.0%), stair climbing (44.0%), occupation (24.0%), car driving (20.0%), and sleeping (16.0%). Therapy included physiotherapy (64.0%), analgesics (44.0%), taping (40.0%), massage (24.0%), trans-dermal electro stimulation (12.0%), and surgery (12.0%).

Table 3
Injuries reported by referees during the last year

	Match	Training	Both	Total
Foot	1	12	2	15
Knee	1	6	2	9
Pelvis		1	1	2
Chest		1		1
Hand		1		1
Total	2	21	5	28

Retrospectively reported pain

Sports-related pain was reported by 24 (34.3%) referees during the last year; the pain occurred, immediately after the match in 37.5% of the (9/24 referees), on the day after the match (9/24; 37.5%), up to 4 days (3/24; 12.5%), up to one week (1/24; 3.1%), or continuously (3/24; 12.5%). The mean pain intensity perceived among referees was 3.0 ± 1.8 Numeric Rating Scale (NRS) with a maximum perceived pain of 5.3 ± 2.2 NRS and a minimum pain of 0.9 ± 1.1 NRS. The point-prevalence of pain intensity at the time of the survey was 1.6 ± 1.8 NRS. Fifteen (21.4%) referees reported using analgesics with different frequency.

Twenty-six (37.1%) referees reported that they officiated at matches despite suffering from pain, and 8 (11.4%) referees reporting doing so regularly.

Other retrospective information

To gain a better understanding of causes for injuries, we divided the referees into two groups. Group 1 included all referees who suffered an injury within the last year, the second group (group 2) of referees did not have an injury during the last year. We found an association with training load and injury during the last year (trainings load in group 1: 1.5 ± 0.9 h vs. trainings load in group 2: 1.1 ± 0.7 h; $p = 0.04$). Significant more referees who experienced an injury during the last year officiated a handball match despite of pain ($p < 0.02$).

Referees suffering from sports-related pain mediated an increased mean pain intensity (NRS: 3.4 ± 1.6 vs. 1.4 ± 1.3; $p < 0.02$). Furthermore, we found some moderate correlations: age ($r = 0.493$; $p < 0.02$) and experience ($r = 0.499$; $p < 0.02$) were associated with a higher intake of analgesics. A higher BMI moderately correlated with increased analgesic intake ($r = 0.441$; $p = 0.04$), and mean pain intensity ($r = 0.420$; $p < 0.04$).

Prospectively reported injuries and pain

Fifty-two of the 70 referees (74.3%) responded in the prospective part of the survey. Seventeen (32.7%) referees suffered a sports-related injury during the observational period, with injuries occurring more often during training than during a match. In total, 27 injuries were reported, with foot (51.9%) and knee (25.9%) injuries being most common (Table 4). Injury mechanism included turns and changes of direction, as well as sprints (both 27.6%). Physical overload was reported by four of the referees. Due to their injury, daily living activities were affected: refereeing (82.4%), walking (82.4%), stair climbing (58.9%), car driving (35.3%), occupation (29.4%), and sleeping (11.8%). Therapy included physiotherapy (82.4%), analgesics (64.7%), taping (64.7%), and massage (35.3%). A physician attended 41.2% of the injured referees.

Table 4
Injuries reported by referees during the season

	Match	Training	Both	Total
Foot	5	8	1	14
Knee	3	1	3	7
Pelvis		1	1	2
Trunk		1		1
Arm		1		1
Shoulder		1		1
Head		1		1
Total	8	14	5	27

The cumulative training load of 205 hours per week, resulted in 2.6 injuries per 1000 training hours (95% CI: 2.09 to 3.31). Taken cumulatively, 56 officiated matches per week resulted in 11.6 injuries per 1000 match hours (95% CI: 10.3 to 13.0).

Most referees reported officiating despite having pain (n = 43). 18 referees reported sports-related pain during the season. Their mean pain intensity during the season was 2.3 ± 1.4 (maximum pain 4.8 ± 2.7; minimum pain 1.0 ± 1.4). The point-prevalence of pain intensity at the time of the survey was 1.5 ± 1.8, and pain intensity immediately after their last officiated match was reported to be 3.1 ± 2.2. 20 (46.5%) of these pain-affected referees reported the use of analgesics. Furthermore, 67.4% of these referees also agreed to the sentence that a referee need to be ready to tolerate pain due to sporting reasons. The accordance with this statement was significantly higher in referees suffering from pain than in those without pain ($p < 0.04$). The incidence of sports-related pain was 19.0 (95%-CI 16.8 to 21.3) per 1000 match hours.

Gender differences

Aside anthropometric data (height, weight, BMI), we could not detect gender differences.

Discussion

To our knowledge, this is the first specific report on pain being a severe symptom among referees in sports. Whereas previous surveys focus on injuries and functional complaints, this recent research emphasizes the need for remedies to prevent and relieve pain. Based on a sample of national handball referees our data suggest one out of three referees suffer from pain, one out of three officiate despite pain, and almost every tenth to do so regularly. The mean pain intensity in all referees was three, independently of the time of surveying. Given a mean pain intensity of three is alarming, as this pain level is classified as light to moderate and is assigned to Step 1 of the pain ladder according to the standard WHO Pain Management guidelines [5]. Consequently, considerable number of the referees surveyed would need pain therapy. Step 1 implies the need for at least non-opioid analgesics, in particular nonsteroidal anti-inflammatory drugs (NSAID), for pain therapy.

Our data reporting injuries and injury rates (1-year prevalence 36%; season prevalence 32.7%) are similar to injury rates for referees in other types of sports. In Iran's Football Premier League, 6-month injury incidence was reported to be 22.4%, 31 out of 59 (56%) referees reported a history of knee injury, and injured referees reported decreased activities in daily and recreational living [4]. In Gaelic football, the annual injury prevalence was 58%, with 14% injured at the time of the survey [6]. Almost every third injury led to time off from refereeing for a median duration of 3 weeks and this study reported that more injuries occurred during matches (60%) than during training. Data on Swiss Football League referees suggested that injuries were more frequent during training than during matches [7]. Our data suggests that injuries were more likely to occur following matches than training when taking into account the number of match / training hours. However, since the training load equals approximately 7-times the weekly match load, the probability of suffering injury in training also increases.

Bizzini et al. confirmed their previous results [7] in a survey of the soccer referees at the 2006 FIFA world cup [8]. They demonstrated that 33.3% of the referees suffered from low back pain. However, reporting on pain focused on musculoskeletal disorders and did not specify the impact of pain on injury and daily living. Other studies dealing with pain or pain-like symptoms are sparse. In a study investigating the prevention on muscle soreness in soccer referees by means of absorbing heel inserts, it was hypothesized that 80% of referees suffered from muscle soreness [9]. One should be aware, that muscle soreness is a symptom complex including in particular pain, stiffness and weakness in the affected area others, and is more likely to be an acute and subacute disorder than an equivalent to chronic pain [10].

Besides injury and pain, it is the psychological demands on referees that could play an eminent contributing role [8]. We did not assess the occurrence of biopsychosocial factors within this survey. However, related data from studies on pain among sports students suggest the high relevance of social and psychological factors contributing to chronic pain and injury in sports [11]. There is one large study investigating the sources of stress among Greek handball referees [12], which ranked the following

stressor factors highest: "Making a wrong call", "Lack of cooperation with my partner", and "Refereeing an important game". Environmental discomfort has been proposed another important factor [13]. Referees in professional football, were surveyed for common mental disorders, and a one-season incidence of 10% for distress, 16% for anxiety/depression, 14% for sleep disturbance, 29% for eating disorders, and 8% for adverse alcohol use was reported [14]. Finally, self-efficacy has been proposed as being another important contributing factor to the occurrence of pain [11]. It has been shown that years of experience and physical/mental preparation are predictive of all factors of referee self-efficacy [13]. In our study, we could show that referees' experience predicted analgesic consumption. A link between analgesics and self-efficacy remains hypothetical, but seems likely. Altogether, evaluation of these co-factors may be helpful for further research and should be subject to further studies.

Limitations:

We are aware that our data is based on a voluntary survey, distributed among referees by with the help of the German Federation of Handball (DHB). The ratio of supposed non-responders is in line with similar research, but we cannot rule out that their non-response may have altered the results. The assessment of pain and injury is based on simple dichotomous or categorized questions, and linear data was acquired using numeric rating scales. This is the simplest way to get an overview about a topic that hitherto had been addressed only in parts. A more comprehensive assessment applying a battery of validated questionnaires, as recently promoted [11], would have revealed a more detailed description. We decided to use a very shortened and reduced survey, as we could not estimate whether referees were willing to respond or not. As handball referees present a small cohort, our primary aim was to obtain as many responders as possible. Reporting and interpretation of the results is based on the guidelines for cross-sectional studies of the STROBE initiative [15]. We assume our sample size to be adequately robust to represent the chosen cohort. Finally, the comparison of pain experienced by handball referees to referees in other disciplines is limited. Altogether, data reporting on referees is very limited and conclusions must be drawn carefully.

Conclusion

This survey shows that referees in German national handball leagues are at considerable risk for sport related injuries resulting in pain. In some cases, referees complained about signs of chronification, and there are hints that other biopsychosocial cofactors may play an important contributing role. In summary, we would like to amend the statement first published by Erickson and colleagues in 2012, that "umpires, referees, and sports officials should deserve the same attention by the sports medicine community as the athletes with whom they share the field", and that this attention should focus on preventive strategies not only to prevent injury but also the occurrence of pain disorders [16].

Abbreviations

CI: Confidence interval; NRS: numeric rating scale; BMI: body mass index; NSAID: nonsteroidal anti-inflammatory drugs; WHO: World Health Organization.

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee FB05 of the Goethe University of Frankfurt am Main and was in agreement with the Declaration of Helsinki (Version Fortaleza 2013).

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request (in compliance with data privacy).

Competing interests

JH is employee of Sandoz/Hexal since January 2020 which had no influence on conducting the study and interpreting the results. JF declares no conflict of interest.

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Authors' Contributions

JH and JF designed and conducted the study. Both authors collected, analysed and interpreted the data. JH and JF wrote the manuscript and approved the final version for publication.

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