NORWEGIAN SCHOOL OF SPORT SCIENCES

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Prevalence and burden of health problems in Norwegian top-level referees

A one-season prospective cohort study

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Abstract

Background: Football referees make decisions during straining physical activity and under great pressure. Despite their central role in the game, little is known about referee health, particularly among female referees. Few long-term prospective studies have been reported, and most studies has solely focused on injuries.

Aim: To investigate the prevalence and burden of health problems in female and male top-level referees.

Study Design: Prospective cohort study.

Method: Fifty-five male and female Norwegian top-level referees reported health problems (injuries and illnesses) in preseason and during the 2020 competitive season, using the Oslo Sports Trauma Research Center Questionnaire on Health Problems. When a new health problem which caused absence from training or match was reported, a sports physiotherapist contacted the participant for more details about the health problem.

Results: We recorded data for 49 weeks and had a compliance of 98.1%. On average 34% (95% Confidence Interval 31% to 36%) reported a health problem every week during the season; of these 20% (CI 19% to 22%) were substantial health problems. Female referees report more health problems compared to male referees and on-field referees report more health problems compared to assistant referees. Gradual onset injuries were most prevalent and caused most absence from training and matches, whereas illnesses were a small contributor to the overall burden. Injury incidence was 3 injuries (CI 2.5 to 3.5) per athlete year, 12 injuries (CI 7 to 19) per 1000 match hours and 7 injuries (CI 6 to 9) per 1000 training hours. Illness incidence was 1.4 (CI 1.1 to 1.8) per athlete year. Injuries to the legs and feet represented the highest burden of health problems.

Conclusion: Top- level referees report a substantial prevalence of health problems in a full season. Overuse/repetitive gradual onset injuries in the lower extremity represent the highest injury burden and specially in female referees.

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1. Theory

1.1 Introduction

This master thesis is about a unique population: football referees. Arguably referees are neglected in sport science, but still essential actors in football. Modern referees should be regarded as sports performers, who invest much time and effort in their own careers (Samuel, Galily, & Tenenbaum, 2017). At the elite level referees are under pressure from players, coaches, fans and media. Modern football is not only about what happens on the pitch; television rights, immense spending on player transactions and large-scale stadiums increases the public interest on a global scale (Goldblatt, 2019). Making crucial match decisions which have consequences not only on the game result, but also with large financial and personal consequences for clubs and players, underline the mental toughness required in top-level refereeing. Countries like England, Spain, Italy and France have professional, full-time, referees. In Norway, none of the top-level referees are full time professionals, all having part- or fulltime work or studies along with refereeing. This adds to the total load, which includes physical training, match preparation and travel, as well as the physical and mental match load. Football is a high intensity sport, with increasing high-intensity running demands (Bush, Barnes, Archer, Hogg, & Bradley, 2015). Match officials have to understand and read the game of football well to ensure optimal positioning for precise decision-making. Furthermore, intensities during match play are interrelated between players and referees; therefor, top-level referees require substantial aerobic and anaerobic capacity (Weston, Drust, & Gregson, 2011).

Injuries in football referees have potential consequences for national and international football associations in administering matches, but also personal consequence for the referee, with potential loss of income and professional status (e.g., relegation or losing possibility of a higher ranking). Few prospective studies have investigated injuries in top-level referees (table 2); no studies have been conducted on injuries in Norwegian top-level referees. Prospective studies using validated reporting methods, applying broad definitions of health problems, is vital to thoroughly describe injuries and illness in the athlete population (Bahr et al., 2020). We applied the Oslo Sport Trauma Research Center Questionnaire on Health Problems (Clarsen et al., 2015), registering injuries and illness over 46 consecutive weeks in the 2020 season describing prevalence and burden of health problems among Norwegian top-level referees.

1.2 The referee

1.2.1 Characteristics

Experience is fundamental in refereeing, consequently, top-level football referees are normally older compared to players (Weston et al., 2012). The mean age of referees participating in a study on match activity in the two top leagues in Norway was 31 ± 6 years. Their mean weight and height were 79 ± 7 kg and 183 ± 5 cm, respectively (Riiser et al., 2017). It requires even more time to become an international referee, thus the age of referees officiating tournaments like UEFA Champions League and Europa-league, UEFA Euros and FIFA World Cup are higher than at the national level. Referees selected for the 2006 FIFA World Cup preparation camps (44 on-field referees and 79 assistant referees) had a mean age of 41 years; mean height of 178 cm; mean weight of 76 kg, and mean BMI of 23.8 (Bizzini, Junge, Bahr, Helsen, & Dvorak, 2009). In a recent study by McCarrick, Neave, and Wolfson (2019) they compared personality characteristics of three different levels of referees: professional, intermediate and amateur level. Outcome measures were mental toughness, locus of control, assertiveness and social comparison and found that professional referees display higher measures of mental toughness and assertiveness compared to intermediate and amateur referees. They also have a more internal locus of control and perceive themselves to be superior to their colleagues.

1.2.2 The role of the referee

The referee has several roles in a game: to keep track of time, record the match score and enforce the Laws of the game. However, the referee's role in the game exceeds being a timekeeper and whistle-blower. At the elite level referees perform in a team, where the on-field referee is the "team leader", cooperating with two assistant referees and a fourth official. The match officials have two main goals: to protect the players and the integrity of the game (UEFA, 2019). Recently, video assistant referee (VAR) has been permitted in specific competitions and leagues, expanding the referee team and including technology to assist decision-making (The International Football Association Board, 2020).

1.2.3 Physical fitness

FIFA referees who were pre-selected for the FIFA World Cup 2014 displayed mean aerobic capacity of 51.9 ± 4.2 (ml/kg/min) for on-field referees and 50.3 ± 6.2 (ml/kg/min) for assistant referees (Castagna et al., 2017). Lower aerobic capacity has also been reported: ten top level Danish referees presented mean VO2max of 46.3 ml//kg/min (range 40.9 - 55.7

ml//kg/min), in a study on the effect of intermittent exercise training (Krustrup & Bangsbo, 2001). Casajus and Castagna (2007) examined if age affected physical capacity by dividing 45 Spanish elite referees into three age-categories: young = 27-32 years, average = 33-38 years and old 39-45 years. The mean VO2max for all participants was 54.9 ± 3.9 (ml/kg/min), with no difference between age groups ($P > 0.05$); although, there was a significant difference between young and old referees in 50m sprint time (young = 6.62 ± 0.18, old = 6.90 ± 0.31; $P < 0.001$), which might indicate an age-related decline in capacity for neuromuscular power. A study on elite Norwegian football players reports higher mean VO2max (63.7 ml//kg/min) compared to referees (Wisløff, Helgerud, & Hoff, 1998).

Sprint times from physical testing of Norwegian top-level referees indicate a high-level sprinting ability. The fastest 40 m sprint time was 5.62 s (mean 5.70 s; SD 0.08); fastest 30 m sprint time was 4.17 s (mean 4.22 s; SD 0.13); and mean 9.34 s (SD 0.25) for the Change of direction ability (CODA) test, which measures assistant referees ability to change direction (Riiser et al., 2018). In comparison, Ingebrigtsen et al. (2014) reported a mean 35-meter sprint time of 4.94 s (range 4.47–5.35 s) by Norwegian top-level players.

1.2.4 Testing

The Norwegian referees' complete physical tests bi-annually in pre-season and mid-season. Specific test demands are presented in table 1. To be eligible for matches they must pass both the physical and a theoretical test. Physical testing consists of a repeated sprint test and a high intensity interval run test. Top-level assistant referees also perform the CODA test (Norges Fotballforbund, 2019). Additionally, it is mandatory for FIFA referees to conduct a Yo-Yo-intermittent recovery test, which is used to measure their ability to perform repeated bouts of intense runs (Bangsbo, Iaia, & Krustrup, 2008). A relationship has been demonstrated between physical match performance and performance on the Yo-Yo intermittent recovery test (Krustrup & Bangsbo, 2001).

Table 1: Official test demands for Norwegian referees in the 2020 season.

	On-field referees (male)	**On-field referees (female)**	**Assistant referees (male)**	**Assistant referees (female)**
Sprint test (40m)	6.0 s	6.4 s	–	–
Interval test (75m/25m)	15 s/18 s	17 s/20 s	15 s/20 s	17 s/22 s
CODA	–	–	10.0 s	11.0 s
Sprint test (30m)	–	–	4.7 s	5.1 s

1.2.5 Physical training

Referees are not organised in teams and hence are more comparable to individual athletes than team sports athletes. They normally train 3-6 times each week. Fitness training reflect match demands, focusing on high-speed running and repeated sprinting (Castagna et al., 2017). The literature on training preparations for referees is limited and mostly focuses on adaptation of physical traits, leaving aside development of technical, tactical and decision-making skills (Cipriano et al., 2019). As physical load is most relevant for this thesis, I will present some of the few available studies on physical training in top-level referees.

After 12 weeks of intermittent interval training Danish top-class referees improved on both the Yo-Yo intermittent recovery test and time to exhaustion during an incremental treadmill test. Although participants improved on the Yo-Yo intermittent recovery test, there was no improvement in maximal oxygen uptake (Krustrup & Bangsbo, 2001). Weston, Helsen, Macmahon, and Kirkendall (2004) also used performance on the Yo-Yo intermititent recovery test to examine the long term effect of specific high-intensity training sessions on referee fitness levels. In this study, two types of high intensity running sessions were compared: football-field based training and running-track based training. Results showed no significant difference for mean percentage HRmax between field-based training and track-based training (86.4 ± 2.9 versus 88.2 ± 2.4 % HRmax, $P > 0.05$). For training to be as match-spesific as possible, the football field training sessions are preferable because they include movements in different directions and has the same type of turf as in matches (Weston et al., 2004).

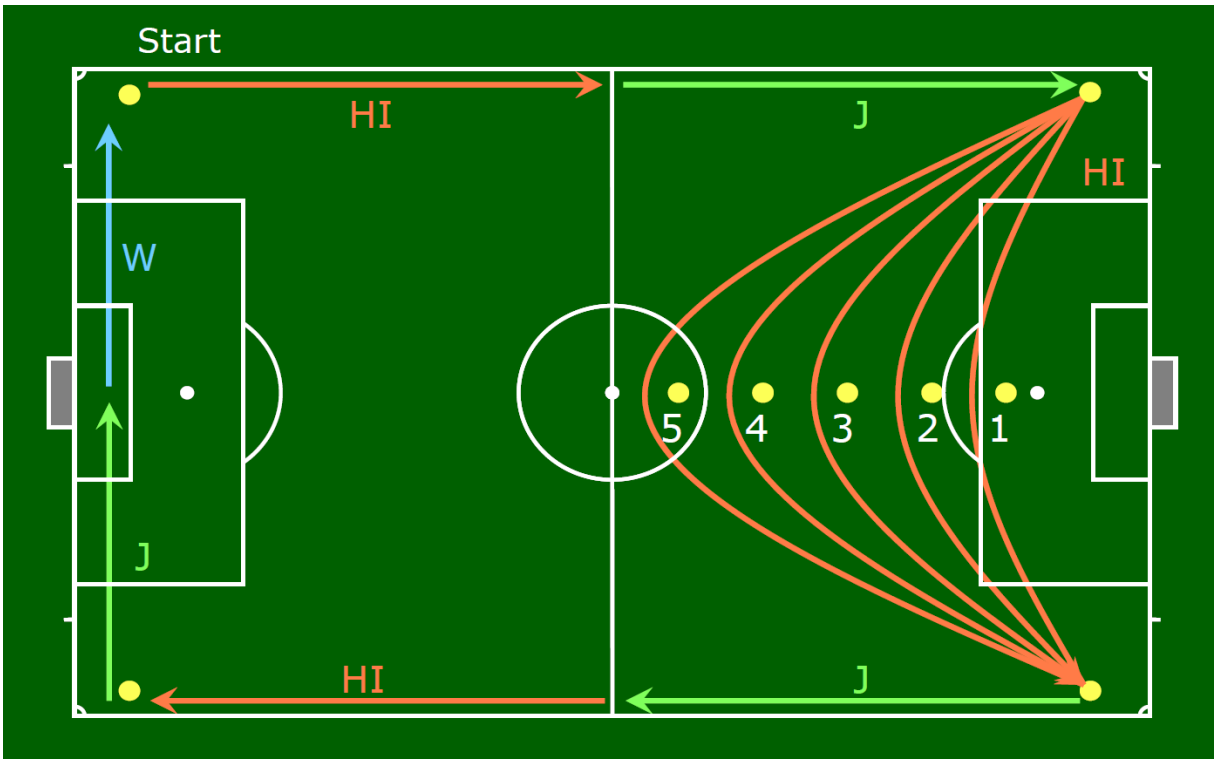

Figure 1: Example of football-field based training. Green lines represent jogging, blue lines walking and orange lines high intensity running. Adapted from the macrocycli 2020-21 by Helsen (2021).

Weston, Gregson, et al. (2011) collected data on training and match activity of one male English top-level referee, during seven consecutive seasons between the 2002/2003 and 2009/10 English soccer seasons. Before and after the study period the referee underwent physiological tests consisting of skin fold measures and an incremental treadmill test (VO2max and blood lactate testing). Training load was registered using session Rate of Perceived Exertion (sRPE) whilst training sessions were categorized by type of training, e.g., gym-based strength or high-intensity aerobic training. Match load was measured using video analysis of 15 ± 6 matches per season. During the study, high-intensity aerobic and speed endurance training sessions decreased, whereas gym-based strength training and on-field speed development increased. Consistent with the study by Krustrup and Bangsbo (2001), the referee did not substantially change VO2max, increasing only by 1,5 ml/kg/min. He did, however, improve running economy, measured by an increase in running speed at lactate threshold. The authors highlights the change from aerobic training to an extended focus on strength and power over the course of the follow up period; higher top speed sprints in the final season, probably as a consequence of changes in training content. They found no evidence of age-related reduction in physical fitness, even though the study period lasted 8 years (Weston et al., 2011).

1.2.6 Match activity

In contrast to subjects related to referee health there is extensive literature on match demands on top-level referees.

Riiser et al. (2017) measured match activity of 16 on-field referees and 33 assistant referees, during two seasons, from the two top divisions in Norway. Assistant referees had 86% more accelerations than on-field referees during matches ($P < 0.001$, $d = 1.9$). Mean total distance covered by on-field referees was 11,218 m (range 10,989–11,447 m), compared to 7483 m (range 7365–7601 m) for assistant referees. Meters covered as high intensity running (HIR = >19.8 km) were 171% more for on-field referees (mean = 619 m vs 228 m). No difference in number of accelerations and acceleration distance was found between halves (Riiser et al., 2017). These results are in alignment with referee match activity in international matches, where on-field referees also cover more ground than assistant referees (mean 10.27 km + 0.90 vs. 6.76 + 0.83 km) (Krustrup et al., 2009). Differences between on-field referees and assistant referees is a natural consequence of different tasks during matches. There are no substantial differences between female and male referees (Mallo, Veiga, López de Subijana, & Navarro, 2008). A correlation between age and reduced physical match performance has been demonstrated, especially indicating a decrease in power (sprinting and high intensity running). However, there was no impact on ability to keep up with play, measured as average distance from fouls, implying little consequence for decision making (Weston, Castagna, Impellizzeri, Rampinini, & Breivik, 2008). There is an association between match intensity, team level and physical performance in referees. Mean heart rate and high-speed running during match is correlated to players, with increasing demands in matches between teams with higher ranking (Castillo, Castagna, Cámara, Iturricastillo, & Yanci, 2018; Weston, Bird, Helsen, Nevill, & Castagna, 2006; Weston, Drust, et al., 2011).

1.2.7 Physical fitness in relation to decision-making

There are two important aspects of physical fitness in relation to decision-making. The ability to keep up with play to create optimal distance and angle to evaluate situations. Also, if a referee becomes physically exhausted, mental fatigue might influence the ability to assess situations (Mallo, Frutos, Juárez, & Navarro, 2012). Interestingly, when 15 matches from the Norwegian top league was analysed, Norwegian top-level referee made the correct decision in 98 % of the assessed foul situations taking place.

No association was found between running performance and positioning in relation to accurate decision making, and according to the authors: "…Norwegian top referees possess the necessary fitness to avoid fatigue that would influence decision making accuracy, and maintain adequate positional ability throughout the matches." (Riiser, Andersen, Sæterbakken, Ylvisåker, & Moe, 2019, p. 5).

1.2.8 Psychological and cognitive demands

A referee's performance is first and foremost determined by accurate decision-making. It is estimated that referees make 200-250 foul vs no-foul decisions during a game (Plessner, Schweizer, Brand, & O'Hare, 2009). Decisions are made during high physical loading and with pressure from players, coaches, spectators and media. Making decisions as a referee in football is complex and taken under great time pressure. When deciding to interfere with the play or not, referees have to combine complex visual information and relate the information to knowledge of the Laws of the Game, in addition to other factors like match control (Plessner et al., 2009). Several aspects which influence decisions were identified in a qualitative study by Lane, Nevill, Ahmad, and Balmer (2006), who interviewed five experienced referees. Some of the key themes influencing decisions during matches was experience, the interplay between strictly following the Laws of the game and using common sense when managing the match, player reactions and crowd noise.

Effect of environmental pressure has been studied by measuring effect of crowd size and the home advantage on decision-making: Nevill, Balmer, and Williams (2002) used video analysis to study the effect of crowd noise on decision making by randomly allocating referees into two groups considering situations from an English Premier League match. One group watched video with sound, the other with the sound muted. Results showed a bias toward fewer fouls against the home team in the group studying video with sound, whilst referees watching video with sound were more uncertain making their decision. Downward and Jones (2007) collected data on number of first yellow cards awarded in the Football Association (FA) Cup, during six seasons (1996 – 2002). The referees awarded more yellow cards against the away team, and there was a relationship between crowd size and bias in favour of the home team. However, the bias was attenuated in games with the largest crowds, which the authors explain by more balanced crowds and/or higher standard referees officiating these fixtures. Nevertheless, replication of results varies, thus, the topic of referee bias towards crowd size and home advantage is controversial (Johnston, 2008).

1.3 Injuries in referees

Compared to studies on injuries in football players, the knowledge of injuries in match officials is scarce (Ekstrand, Hägglund, & Waldén, 2011; Weston et al., 2012).

More than 40% of male referees selected for the 2006 World Cup declared having acquired an injury during their career. Female referees selected for the 2007 World Cup reported higher incidence and prevalence of injuries, compared to male referees who officiated the 2006 World Cup. Injuries and musculoskeletal problems were most prevalent in the lower extremities: hamstring, knee, calf and ankle. Most injuries happened during training (Bizzini, Junge, Bahr, & Dvorak, 2009a; Bizzini et al., 2009).

Gabrilo, Ostojic, Idrizovic, Novosel, and Sekulic (2013) collected injury data from Croatian referees, officiating at different levels. Almost 30% of participants reported injuries during the last year. UEFA referees were less injured compared to lower-level referees, which might indicate a higher fitness level. The highest prevalence of injuries was reported by 1st division referees, lowest prevalence was reported amongst 3rd division referees. These differences might be explained by greater match and training load for higher level referees.

Several studies have investigated injuries among Brazilian referees. Vieira et al. (2019) distributed monthly web-surveys, for three consecutive seasons (2011-2014). Referees reported mean incidence of 3.7 per 1000 match hours and 3.5 per 1000 training hours, which is considerably lower than results from the 2006 and 2007 World Cups (Bizzini, Junge, et al., 2009a; Bizzini et al., 2009). The authors attribute the discrepancy in incidence to methodological differences, e.g., presence of medical staff, study duration and differences in population characteristics. Also, results have to be interpreted with caution as low compliance and challenges with the precision of self-reported data may have led to bias. Oliveira, Reis, and Silva (2016) performed a retrospective study, comparing three situations where referees get injured: testing, training and match. Injuries during physical training was most prevalent, constituting 59% of injures, followed by physical tests (23%) and match (18%) injuries.

Elite Irish referees reported an incidence of 8 injuries per 1000 hours of training and 16.4 injuries per 1000 hours for match officiating. The match and training exposure data were self-reported. In total results showed that, 72% were gradual onset injuries and 28% were acute injuries. Thigh, lower leg and ankle were the most common injury locations. The referees reported injury data weekly for 12-months using a web-based survey, which make this study comparable to our study (Wilson, Byrne, & Gissane, 2012).

Research on referee health solely focus on injuries. With the exception of one study on mental health in football referees by V. Gouttebarge, Johnson, Rochcongar, Rosier, and Kerkhoffs (2017), no other studies have reported illnesses or other health problems.

1.3.1 Mental health and injuries

As described in this paper, referees endure social and mental pressure in relation to their performance as referees (Wolfson & Neave, 2007). This is hypothesised to affect mental health. Symptoms of common mental disorders (CMD); distress, anxiety/depression, sleep disturbance, eating disorders, adverse alcohol use is common among European professional football referees, and are similar to results from studies on elite athletes. Symptoms of CMD could have a negative influence on performance, which further is relevant in relation to how injuries could affect mental health in athletes (V. Gouttebarge et al., 2017). Professional football players are two to nearly four times more likely to report symptoms of CMD if they report one or more severe musculoskeletal injuries during their career, compared to players who did not report an injury during their career (Vincent Gouttebarge, Aoki, Ekstrand, Verhagen, & Kerkhoffs, 2016). Referees obtaining an injury have expressed this as an event which might impact their career (Samuel et al., 2017).

Author (year)	Method	Participants (n)	Referee level	Incidence	Prevalence
Bizzini et al. (2009a)	Retrospective questionnaire and prospective recording during World Cup	Female referees selected for the FIFA Women's World Cup 2007 (81 retrospectively 36 prospectively)	Professional	34.7 injuries per 1000 match hours (95% CI 4.2 to 65.1).	During career: Almost 50% reported injuries (time-loss) Previous 12 months: 16% reported having sustained an injury During the World Cup: 39% of referees incurred an injury
Bizzini et al. (2009)	Retrospective questionnaire and prospective recording during World Cup	Male referees and assistant referees selected for the 2006 FIFA World Cup (123 retrospectively 63 prospectively)	Professional	20.8 injuries per 1000 match hours (95% CI: 4.17 to 37.4)	During career: More than 40% reported having incurred an injury Previous 12 months: 4.5% of on-field referees and 5.1% of assistant referees had incurred one injury During the World Cup: 22% incurred an injury
Bizzini et al. (2009b)	Retrospective cohort study	Top Divisions of the Swiss Football League (66 male and 5 female)	Professional	On-field: 6.8 match injuries per 1000 match hours (95% CI 1.4 to 12.3). Assistant referees: 1.7 per 1000 match hours (95% CI 0.2 to 3.7)	During the career: On-field = 52% Assistant referees: 39% Previous 12 months: On-field: 36%, Assistant referees: 20%
Bizzini et al. (2011)	Retrospective cohort study	Swiss referees (489)	All levels of play	2.06 injuries per 1000 match hours (95% CI 1.36 to 2.76) 0.09 injuries per 1000 training hours (95% CI 0.04 to 0.23)	During career: 22.5%
Gabrilo et al. (2013)	Retrospective cohort	Croatian on-field referees (157) and assistant referees (185)	Various competitive levels	4.92 injuries per 1000 match hours (95% CI 3.17 to 6.69)	Previous 12 months: 29%

Wilson et al. (2012)	Prospective cohort	Male and female Irish referees (27 males and 4 females)	Elite level, semi-professional	16.4 injuries per 1000 match hours (95% CI 10.9 to 23.8) 8.8 injuries per 1000 training hours (95% CI 1.8 to 7.0)	
Paes et al. (2011)	Retrospective survey	Male Brazilian referees (200)	First and second divisions	2.28 per 1000 match hours (95% CI 1.0 to 3.5) 2.16 injuries per 1000 training hours (95% CI 1.2 to 3.0) 94.53 injuries per 1000 testing hours (95% CI 62.1 to 126.9)	Physical training: 60% Physical tests: 27% Match: 13%
Kordi et al. (2013)	Prospective cohort study	Iranian referees (74)	Professional	19.6 injuries per 1000 match hours 4.6 injuries per 1000 training hours	
Oliveira et al. (2016)	Retrospective study	Male Brazilian referees (36)	The A series of the Brazilian championship	FGF: 1.41 per 1000 match hours Testing: 166.7 injuries per 1000 testing hours FPF: 0.47 per 1000 match hours 88.3 injuries per 1000 testing hours	
Vieira et al. (2019)	Prospective design	Male Brazilian referees (257)	Professional	37.8 injuries per 1000 match hours 39.9 injuries per 1000 training hours	

FGF = Federação Gaúcha de Futebol, football Association of Rio Grande do Sul state, FPF = Federação Paulista de Futebol, Football Association of São Paulo state

1.4 Injury definitions, risk factors and prevention

1.5 Injury definitions

In football context, the Fédération Internationale de Football Association Medical Assessment and Research Centre (F-MARC) hosted a meeting in 2005, to establishing a consensus statement on injury definitions and methodologic issues, for studying football injuries. The statement separates injuries into three categories:

1. Any physical complaint, irrespective of need for medical attention;
2. Medical complaints: e.g., a player receiving medical attention in conjunction with an injury.
3. Time-loss: "… an injury that results in a player being unable to take a full part in future football training or match play…". (Fuller et al., 2006).

According to a recent consensus statement by the International Olympic Committee (IOC) the definition of an injury is: "tissue damage or other derangement of normal physical function due to participation in sports, resulting from rapid or repetitive transfer of kinetic energy." (Bahr et al., 2020, p. 3).

Different injury definitions give contrasting results, with less injuries reported when using narrow definitions (time-loss) and more injuries reported when using broad definitions (all complaints). Conflicting results by using different injury definitions was demonstrated with the development of the Oslo Sports Trauma Research Center Overuse Injury Questionnaire (OSTRC-O). Two methods for injury surveillance were compared: a standard method, using a time-loss definition, and the OSTRC-O, using an all-complaints definition. Results clearly exposed the inadequacy of former methods to record the burden of gradual onset injuries: the OSTRC-O identified ten times as many injuries compared to standard methods (Clarsen, Myklebust, & Bahr, 2013), which also have been confirmed by several other studies (Bahr, 2009; Brooks & Fuller, 2006).

Choice of injury definition has to be considered in relation to the purpose and setting of the study (Clarsen & Bahr, 2014). For example, a broad injury definition might be excessive if investigating ACL injuries in handball players, as this type of injury is clearly an acute injury

which initially will result in time lost from training and competition. Alternatively, if a study seeks to detect gradual onset injuries, using a time-loss definition would result in underestimation of the burden of gradual onset injuries (Bahr, 2009). There are several strengths and limitations to using different injury definition. Recording injury data with a time-loss definition may be valid because it reflects the most influential effect of injury: complete absence from training or competition. More narrow definitions have also been proposed, only taking match participation into account (Orchard & Hoskins, 2007). Time-loss injuries are often easy to identify, a trait which increases reliability of measurements, allowing for easier comparison of studies. As mentioned, the main limitation of the time-loss definition is the probability of masking gradual onset injuries, which affect performance, but do not necessarily cause total absence from participating in sports. This is especially relevant for individual sports where athletes are more flexible in adjusting training and may not need to withdraw from group training or competition. The medical attention definition has potential benefits over time-loss: medical staff are more likely to capture injuries where the athlete is still able to train or compete, albeit with limitations to performance. Using this definition in a study requires more resources and availability of medical staff may vary, especially between team sports and individual sports. Furthermore, interpretation issues of what constitutes an injury are probable; skill level and cultural differences may lead to discrepancies between different practitioners (e.g., doctors and physiotherapists). In contrast to the time-loss definition, both medical attention and the all-complaints definitions are less reliable because interpretation issues may lead to systematic bias in data collection (Bjorneboe, Florenes, Bahr, & Andersen, 2011; Clarsen & Bahr, 2014).

In our study we use self-reported data, which places responsibility of interpreting what constitutes a health problem on the referee (athlete), who probably lacks medical knowledge. Using a broad injury definition and self-reported data may reduce reliability of results (Clarsen & Bahr, 2014). Bizzini et al. (2009) collected injury data on referees during the 2006 World Cup, using medical staff. Acute injuries were recorded, as well as musculoskeletal problems which received medical attention. Comparing our study and the study by Bizzini et al. (2009) it is an example of how different settings, time span and access to medical staff affect how injuries are recorded. Nilstad, Bahr, and Andersen (2014) demonstrated the difference between results when injuries are reported by individual athletes or by medical staff. Elite female football players and medical staff concurrently recorded injuries during one competitive football season. Players used text message to report injuries and the team

physiotherapist reported injuries using the same form as individual registration. Results show 232 recorded time-loss injuries. Only 10% of these were registered by medical staff, 62% by individual registration and 28% through both methods.

1.6 Acute vs gradual onset injury

Injuries have commonly been divided into acute and overuse injuries. The IOC consensus statement criticizes this dichotomy for lacking nuance and recommend three categories: acute sudden onset, repetitive sudden onset and repetitive gradual onset. Describing how load is applied to tissue (acute vs. repetitive), as well as the presentation (sudden vs. gradual) is favourable and more accurate when describing mode of onset. In contrast to defining injuries as overuse, repetitive sudden onset captures how repetitive load could present suddenly (Bahr et al., 2020). One such example is bone stress fractures which could present suddenly, but the reason for the injury is lack of tolerance of cumulative load over time (Warden, Davis, & Fredericson, 2014).

Unmasking gradual onset injuries is a challenge in sports medicine epidemiology because of formerly described methodological issues and different injury definitions. Bahr (2009) uses data from beach volleyball to demonstrate this point. Injury registration using a time-loss definition was compared to a questionnaire focusing on gradual onset injuries in the lower back, dominant shoulder and knees. Inconsistent results were detected because of different methods: the time-loss definition indicated low injury risk, in contrast to the survey which showed a high prevalence of pain from gradual onset injuries. The author makes the following recommendations for future research: studies should be prospective with continuous or serial measures; injury reporting should be done by athletes, using modern technology (e.g., SMS); results should be reported as prevalence not incidence; severity of injuries should be based on function, not restricted to time-loss alone (Bahr, 2009).

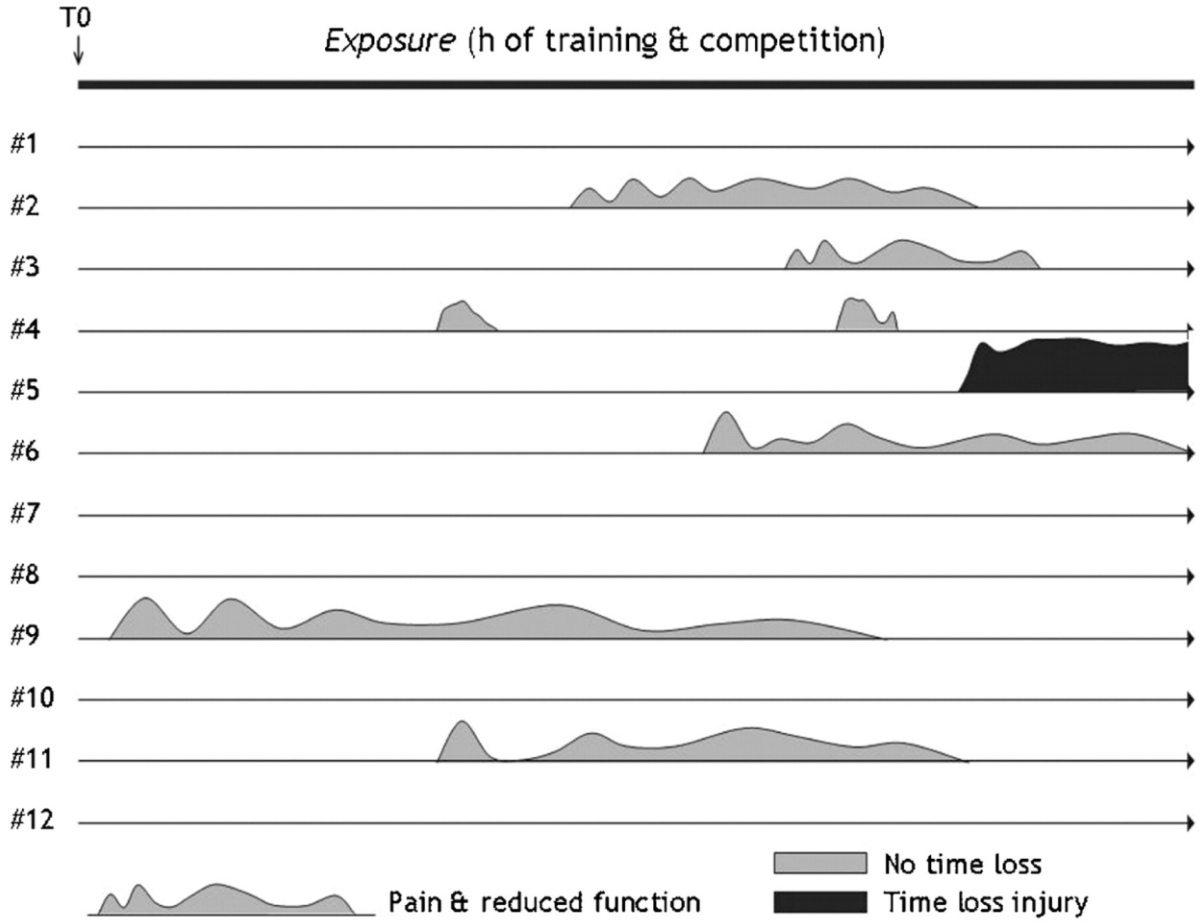

Figure 2: Hypothetical example of the inadequacy of the time-loss definition to expose gradual onset injuries. Using a prospective cohort of 12 athletes as an example, only one injury is recorded (#5). However, grey parts illustrate pain and reduced function which is not registered as injuries. From "No injuries, but plenty of pain? On the methodology for recording overuse symptoms in sports" by Bahr (2009, p. 1), Br J Sports Med 2009;43. Permission to reproduce obtained from the Copy Clearance Center

To address the problem of recording the burden of gradual onset injures, Clarsen et al. (2013) developed a questionnaire: the Oslo Sports Trauma Research Center Overuse Injury Questionnaire (OSTRC-O). The questionnaire relies on four basic questions where athletes report to which extent participation, training volume and performance is affected by a problem, defined as: pain, aching, stiffness, looseness or other complaints related to a specific body part. Degree of pain is also ranked from no pain to severe pain. Burden of gradual onset injuries is described by a severity score calculated from each answer. The new method was validated by using the OSTRC-O simultaneously with methods described in the consensus statement by Fuller et al. (2006). However, as Clarsen et al. (2013) discuss in their article, direct comparison of the two methods is problematic for several reasons: different injury

definitions (time-loss vs. all physical complaints); different ways of reporting rate of injury (prevalence vs. incidence); different measures of injury severity (time lost from full participation vs. severity score). Improvements have been made to the OSTRC-O; The Oslo Sports Trauma Research Center questionnaire on health problems (OSTRC-H), so that it now includes all types of health problems and is not restricted to specific anatomical areas. According to OSTRC-H, a health problem is: "… any condition that you consider to be a reduction in your normal state of full health, irrespective of its consequences on your sports participation or performance, or whether you have sought medical attention. This may include, but is not limited to, injury, illness, pain or mental health conditions." Clarsen et al. (2020, p. 3). The four basic questions from OSTRC-O were modified to include illness and other health problems. The OSTRC-H has been validated (Clarsen, Ronsen, Myklebust, Florenes, & Bahr, 2014), recently updated (Clarsen et al., 2020) and widely adopted in sports medicine epidemiology (Andersson, Bahr, Clarsen, & Myklebust, 2018; Dalen-Lorentsen et al., 2020; Joar Harøy et al., 2018; Hofstede et al., 2020; Leppänen et al., 2019; Moseid, 2020).

1.7 Prevalence vs. incidence

Two common outcome measures in epidemiology are prevalence and incidence. Prevalence is the proportion of athletes with an illness or injury in a population, at a given time. It can be made both as a point estimate, but also as serial measurements (period prevalence, e.g., weekly measurements during one season). Incidence is the number of new cases (injury or other health problem) during a defined period (Bahr et al., 2020). Bahr (2009) proposes prevalence to be favourable when describing the risk and magnitude of injuries, because of the fluctuating nature of gradual onset injuries.

1.8 Severity

Sports injuries are unequal, both in type and severity. Some injuries are rare, but severe (many days lost), while other injuries are common, but have faster recovery rates. Gradual onset injuries might not lead to absence from sports participation. Bahr, Clarsen, and Ekstrand (2018) stress the importance of reporting burden of injuries. Combining injury rate and consequence is one possible way of describing burden; using a risk matrix to express differences in injury burden is a visual and effective communication tool (figure 3).

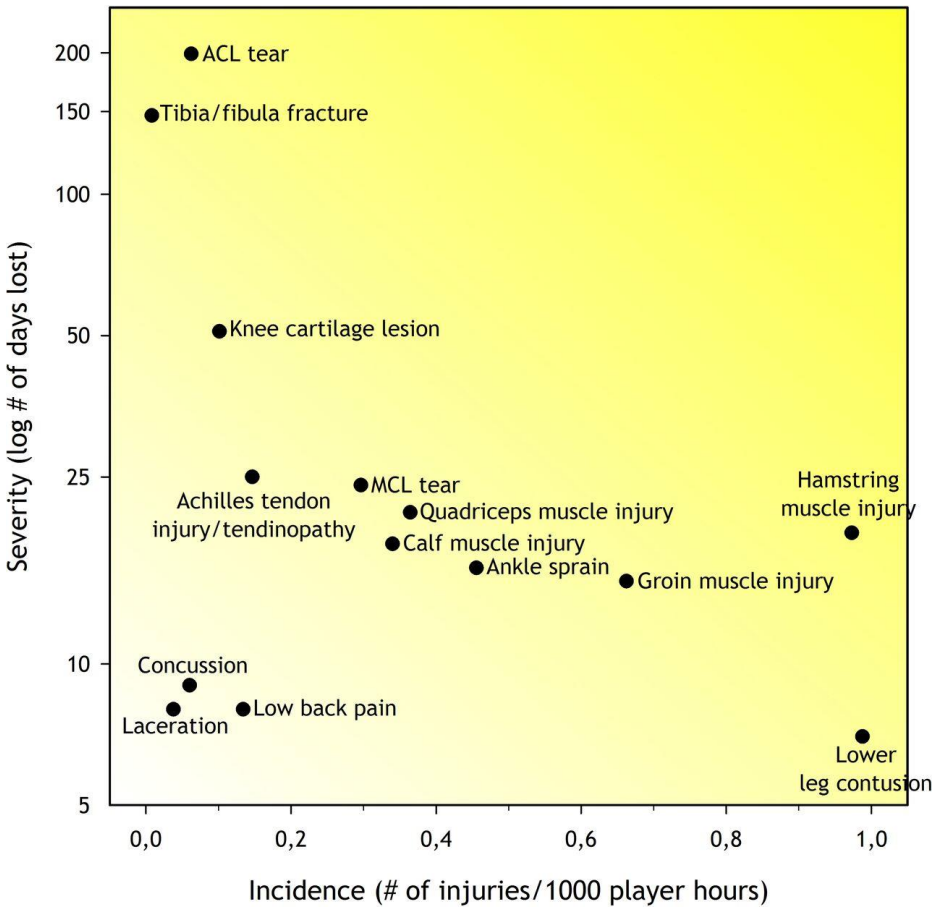

Figure 3: Quantitative risk matrix in UEFA Champions League football (based on data from the UEFA Elite Club Injury Study), illustrating the relationship between the severity (consequence) and incidence (likelihood) of the 14 most commonly reported injury types. For each injury type, severity is shown as the average number of days lost from training and competition (log scale), while incidence is shown as the number of injuries per 1000 hours of total exposure (match and training combined) for each injury type. Please note that the colour shading is conceptual; because of the log scale on severity axis, the shading does not match the relative importance of each of the injury types exactly. MCL, medial collateral ligament. From "Why we should focus on the burden of injuries and illnesses, not just their incidence" by Bahr et al. (2018, p. 1), BR J Sports Med August 2018 Vol 52 No 16. Permission to reproduce obtained from the Copy Clearance Centre

Exclusively using time-loss is a simpler description of burden, but as exemplified in this thesis, the time-loss definition is limited and fails to expose chronic health problems and gradual onset injuries. Time-loss can be combined with a measure of exposure to provide context, e.g., incidence per 1000 hours of match exposure (Fuller et al., 2006). Alternatively, a severity score can be described with results from OSTRC-H. The severity score is calculated from the responses from four questions and ranges from 0-100, with 0 representing full participation and 100 representing no participation at all. Severity scores can be useful to

monitor progress and burden of gradual onset injuries or other health problems (Clarsen et al., 2020; Clarsen et al., 2013), however, the severity score is not thoroughly validated and has to be interpreted in light of its limitations, e.g., being an arbitrary unit (Bahr et al., 2020)

1.9 Risk factors

Commonly, risk factors are divided into internal and external factors. Meeuwisse, Tyreman, Hagel, and Emery (2007) describes an athlete's intrinsic risk factors, like strength, flexibility, age or gender, which potentially predispose for injury. Intrinsic risk factors can be modifiable or non-modifiable, e.g., strength vs. age. The predisposed athlete is then exposed to extrinsic risk factors, like playing conditions, opponent behaviour or equipment (figure 4). Risk factors should not be regarded as stable, but dynamic and changing. Internal and external risk factors interact and affect each other, either causing adaptation or injury (Meeuwisse et al., 2007).

Training load and competitions are risk factors for injuries; however, high load need not cause injury if the athlete has adapted gradually, tolerating high chronic load. Rapid changes in intensity, frequency or duration in training or competition challenge healthy adaptation and increase risk of injury. Matches are often more intense than training, making congested match schedules a contributor to successive rapid changes in load (Soligard et al., 2016). In parts of the season, Norwegian FIFA referees officiate cup ties in European tournaments midweek and national series or cup matches during the weekend. International matches are often high-profile matches, with large consequence for teams and stakeholders. In addition to travel, these circumstances put more stress on referees. Even though travel and psychological stress are less established as risk factors for injuries, congested match schedule increases total load put on referees. Travel and limited days between matches might reduce the quality of recovery and time spent on injury prevention. Some studies show international travel as a risk factor for illnesses, however, the literature relating travel to illness is limited. The relationship between load and illness has been proposed to be a J-shaped curve, meaning high loads are associated with increased risk of illness (Schwellnus et al., 2016).

Previous injury is a risk factor for new injuries. A prospective cohort study on Swedish male football players revealed that previous hamstring or groin injuries, or knee joint trauma, increased the likelihood of an identical injury the following season (Hägglund, Waldén, & Ekstrand, 2006). Also, obtaining a lower limb muscular injury increases the risk of an injury

at a different location, which could be explained by changes in running biomechanics, compensatory movements or deconditioning following the index injury (Toohey, Drew, Cook, Finch, & Gaida, 2017). Whalan, Lovell, and Sampson (2020) collected injury data in semi-professional football players using the OSTRC-H. Players reporting a minor or moderate complaint (non-time loss), had three to seven times greater risk of a subsequent time-loss injury.

1.10 Why athletes get injured

Bahr and Krosshaug (2005) describes a comprehensive, multifactorial, model for understanding aetiology of sports injuries, with special emphasis on injury mechanism. This includes detailed descriptions of whole body and joint biomechanics, as well as playing situation, including player and opponent behaviour. The model is probably more applicable to players than referees, as the nature of officiating is non-contact and has no opponents. More relevant is the Dynamic Model of Etiology in Sport Injury (Meeuwisse et al., 2007), which emphasises the non-linear relationship between risk factors and injury, describing several *changing* circumstances which together constitute causes of injury. The Dynamic Model of Etiology in Sport Injury increases utility for understanding injuries in referees by including all types of injuries (Meeuwisse et al., 2007).

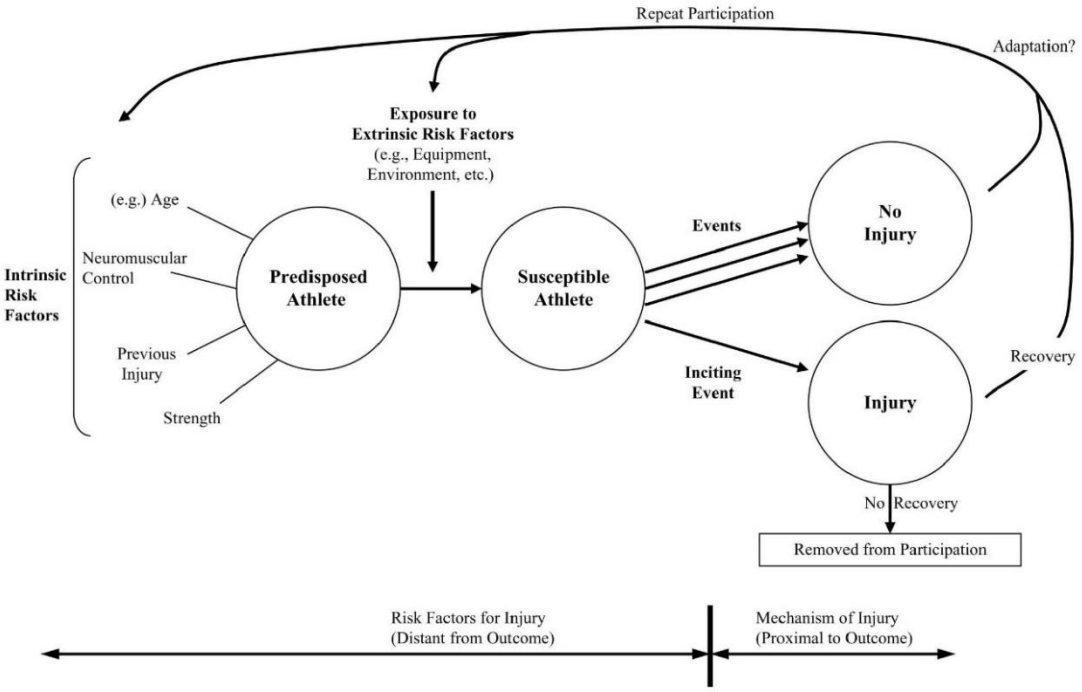

Figure 4: A dynamic, recursive model of etiology in sport injury. From "A Dynamic Model of Etiology in Sport Injury: The Recursive Nature of Risk and Causation" by Meeuwisse et al. (2007, p. 3), Clin J Sport Med Volume 17, Number 3, May 2007. Permission to reproduce obtained from the Copy Clearance Centre

1.11 Injury prevention

van Mechelen, Hlobil, and Kemper (1992) describes a four-step model of injury prevention, often referred to as the sequence of prevention model. The first step of the model emphasises the importance of knowing the extent of the problem. According to van Mechelen et al. (1992) this should be described as the incidence and severity of the problem. The second step deals with injury causes, describing the mechanisms of the injury and determining aetiology. In the third step, prevention strategies should be introduced. Preventive measures should build on the knowledge of aetiology gathered from the second step. Finally, effectiveness of the injury prevention strategy should be assessed (Figure 5).

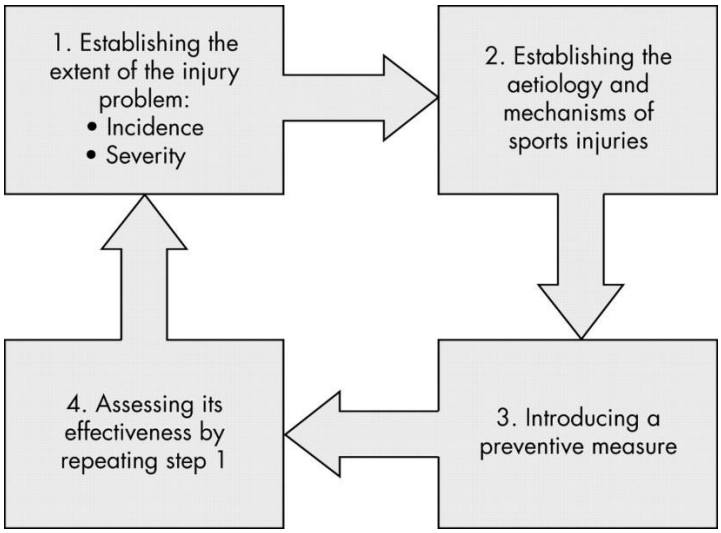

Figure 5: Four step sequence of injury prevention research. From "Understanding injury mechanisms: a key component of preventing injuries in sport", R Bahr, and T Krosshaug BJ J Sports Med 2005;39:324-329. Permission obtained from the Copt Clearance Centre

The model of prevention is used as a theoretical framework for many research programs (Clarsen, 2014; Joar Harøy, 2018; Moseid, 2020), though it is criticized for being inadequate. Finch (2006) finds fault with the sequence of prevention model for not considering implementation of research into practise. In her view, effective research alone, will not successfully reduce injuries. Consequently, Finch (2006) proposed The Translating Research into Injury Prevention Practice framework (TRIPP) which adds two stages to the four-step sequence of the van Mechelen prevention model. Stage five in the TRIPP model is described as: "the stage of developing and understanding the implementation context.". Stage six is described as: "determining how effective the scientifically proven interventions are when applied to the real-world context of player behaviours and sporting culture." (Finch, 2006). The RE-AIM framework is another tool to assess sports interventions in the context of which they are implemented. The intention with applying the RE-AIM framework is to improve study design and to evaluate sports safety initiatives (Finch & Donaldson, 2010). As an example: Andersson, Bahr, Olsen, and Myklebust (2019) questioned handball captains and coaches about their attitudes, beliefs and current behaviour towards injury risk and prevention of shoulder injuries. Length of injury prevention program and player motivation were highlighted as the main barriers; thus, addressing these barriers would be beneficial for successful implementation.

In a football context, the story of the development and implementation of the injury prevention programme "FIFA 11+" shows the importance of exercise selection, but also attitudes and beliefs among players and coached towards injury prevention (Bizzini, Junge, & Dvorak, 2013). In 2005, an injury prevention programme, "the 11", was created to reduce common football injuries. The programme focused on core stability, balance, dynamic stabilization and eccentric hamstrings strength. However, when applied in an experimental study there was no statistically significant effect on reducing injury incidence in female youth football players. Low compliance in the intervention group was probably the reason for the lack of effect (Steffen, Myklebust, Olsen, Holme, & Bahr, 2008). Later, a revised version called "FIFA 11+" did reduce severe injuries, overuse injuries, and injuries overall, also in female youth football players (Soligard et al., 2008). Results from a meta-analysis show that FIFA 11+ potentially reduces football injuries by 39% (Thorborg et al., 2017).

Compliance with the "FIFA 11+" programme was 77% in the study by Soligard et al. (2008), compared to 52% in the initial study by Steffen et al. (2008). Differences in content between the two versions was more variation and progression, as well as running exercises in the FIFA 11+ programme (Soligard et al., 2008). Content of injury prevention programmes need to be sport specific and exercises relevant for players. Compliance clearly reduces if the coaches consider exercises not to be football-specific (Soligard et al., 2010). Coaches are key when implementing prevention programmes and delivering injury prevention exercises. Increasing knowledge and addressing attitudes toward injury prevention is essential for successful implementation. Also, national football associations should be involved in injury prevention strategies (Bizzini et al., 2013; Myklebust, Skjølberg, & Bahr, 2013)

Multicomponent injury prevention programmes are effective in reducing both acute and gradual onset injuries; however, results from studies are heterogeneous (Lauersen, Bertelsen, & Andersen, 2014). Also, many exercises in combination makes it is uncertain which type of exercise intervention is most effective. To answer this question, Brunner et al. (2019) performed an umbrella review, aiming to identify the most effective exercise combinations in prevention programmes targeted at the lower extremities. Strength and balance exercises were key components in effective injury prevention programmes and should be prioritized. A limitation of the umbrella review is the focus on acute injuries in the included studies, and results might not transfer directly to prevention of gradual onset injuries.

Ability to tolerate load is fundamental in prevention of gradual onset injuries, making training planning and monitoring fundamental. The International Olympic Committee consensus statement on load in sport and risk of injury highlights the problem of rapid changes in load, which is associated with injury. High load in itself is not necessarily a problem, if the athlete has adapted gradually (Soligard et al., 2016). For football referees it is especially important to be mindful of transitions between off and on-season, during training camps or in breaks during the season.

Assistant referees incur more groin injuries compared to on-field referees (Bizzini, Junge, et al., 2009b; Gabrilo et al., 2013), which could be explained by their sideways movement pattern during matches and testing. In a study by Bizzini, Junge, et al. (2009b) the most prevalent types of injuries were hamstring strain (26%) and calf sprain (26%). Effective injury prevention programmes targeting the groin and hamstring have been developed (Harøy et al., 2018; van Dyk, Behan, & Whiteley, 2019), and could be included in FIFA 11+ (Harøy et al., 2017).

1.11.1 Injury prevention in referees

To mitigate injuries and promote physical performance, UEFA's referee fitness expert Werner Helsen distributes exercise programs to international referees. The programs consist of running and sprinting exercises, strength training and multi-component injury prevention exercises (Helsen, 2014, 2015). Based on the injury profile of referees, modifications have been done to the original FIFA 11+, with the referee version (FIFA 11+ Referee) also consisting of a combination of running drills, strength, plyometric and balance exercises (Bizzini & Junge, 2011). The injury prevention program has widespread use among top-level referees, both in Norway and internationally (Bizzini & Dvorak, 2015).

Only one study to date has examined the effect of the FIFA 11+ Referee Program. In total, 269 male amateur football referees were randomized into an intervention group, who performed the FIFA 11+ Referee Program during one season, and a control group who used their usual warm-up routine. Injuries were reduced by 65% in the experimental group compared to referees in the control group (Al Attar et al., 2021). Several limitations of this study should be addressed: injuries were reported only if it caused absence from training and matches, which potentially underestimates the burden of injuries. (Bahr et al., 2018). Consequently, the preventive effect of FIFA 11+ Referee on gradual onset injuries remains

unclear. Results should be generalized with caution, as all participants were amateur referees and no female referees were included.

Reducing illnesses is also possible: Schwellnus et al. (2020) reduced illnesses and infectious diseases among rugby players by introducing simple preventive strategies, like regular hand washing, use of antiseptic gel, discouraging sharing of water bottles and utensils, among others. Efforts to reduce burden of illnesses among referees could be considered, especially when travelling, during training camps and ahead of important tournaments.

1.12 Summary

At the elite level football referees are under pressure from players, coaches, fans and media (Goldblatt, 2019). Referees make decisions during straining physical activity; on-field referees cover approximately 11km during matches, combining high intensity running, jogging and walking. Assistant referees cover approximately 7 km, however, they have more accelerations than on-field referees (Riiser et al., 2017). Compared to players, few studies have investigated injuries in top-level referees (Bizzini et al., 2009a; Bizzini et al., 2009; Ekstrand, Spreco, Bengtsson, & Bahr, 2021; López-Valenciano et al., 2020; Wilson et al., 2012), no studies have been conducted on injuries in Norwegian top-level referees. Studies on referee health focus exclusively on injuries, mostly include only male referees, or just a small number of female referees (Bizzini et al., 2009a; Junge et al., 2011; Kordi et al., 2013; Wilson et al., 2012).

Knowledge about the extent of the problem is a crucial first step towards further research and injury prevention measures (van Mechelen et al., 1992). Reliable and valid measurement tools and consistency in methods and definitions is essential in sport epidemiology (Bahr et al., 2020). The Oslo Sports Trauma Research Center Questionnaire on Health Problems (OSTRC-HP) is a validated research tool, which includes all types of health problems.

We conducted a prospective study to describe the prevalence and the burden of health problems in top-level referees applying state of the art surveillance methods.

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3. Article

Date

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Title

Keeping an eye on the ball: prevalence and burden of health problems in top level referees

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Keywords: Epidemiology; football referees; injuries; illnesses; health problems; the Oslo Sports Trauma Research Center Questionnaire on Health Problems (OSTRC-H)

Abstract

Background: Football referees make decisions during straining physical activity and under great pressure. Despite their central role in the game, little is known about referee health, particularly among female referees. Few long-term prospective studies have been reported, and most studies has solely focused on injuries.

Aim: To investigate the prevalence and burden of health problems in female and male top-level referees.

Study Design: Prospective cohort study.

Method: Fifty-five male and female Norwegian top-level referees reported health problems (injuries and illnesses) in preseason and during the 2020 competitive season, using the Oslo Sports Trauma Research Center Questionnaire on Health Problems. When a new health problem which caused absence from training or match was reported, a sports physiotherapist contacted the participant for more details about the health problem.

Results: We recorded data for 49 weeks and had a compliance of 98.1%. On average 34% (95% Confidence Interval 31% to 36%) reported a health problem every week during the season; of these 20% (CI 19% to 22%) were substantial health problems. Female referees report more health problems compared to male referees and on-field referees report more health problems compared to assistant referees. Gradual onset injuries were most prevalent and caused most absence from training and matches, whereas illnesses were a small contributor to the overall burden. Injury incidence was 3 injuries (CI 2.5 to 3.5) per athlete year, 12 injuries (CI 7 to 19) per 1000 match hours and 7 injuries (CI 6 to 9) per 1000 training hours. Illness incidence was 1.4 (CI 1.1 to 1.8) per athlete year. Injuries to the legs and feet represented the highest burden of health problems.

Conclusion: Top- level referees report a substantial prevalence of health problems in a full season. Overuse/repetitive gradual onset injuries in the lower extremity represent the highest injury burden and specially in female referees.

Introduction

Football referees have a central role in the game and their main objectives are to protect the players and the integrity of the game (The International Football Association Board, 2020; UEFA, 2019). To make correct decisions during matches referees pursuit proximity to infringements, making physical fitness key in referee performance (Riiser, Andersen, Sæterbakken, Ylvisåker, & Moe, 2019). On average referees run 10.36 km ± 1.11 during matches (Silva, Godoy, Neves, Vale, & Hall, 2019). On-field referees cover more distance than assistant referees, although assistants perform more accelerations compared to on-field referees (Krustrup et al., 2009; Riiser et al., 2017). Also, referees officiate with a high mean percentage of HRmax (85.64 % ± 1.94), which is probably explained by repeated bouts of high intensity running (Silva et al., 2019).

Compared to players, the literature on injuries in referees is scarce (Bizzini, Junge, Bahr, & Dvorak, 2009a; Bizzini, Junge, Bahr, Helsen, & Dvorak, 2009; Ekstrand, Spreco, Bengtsson, & Bahr, 2021; López-Valenciano et al., 2020; Wilson, Byrne, & Gissane, 2012). The majority of studies are retrospective, while prospective studies have various time spans and settings (e.g., series vs. tournament). There are large differences in the study design, some use self-reported data (Vieira et al., 2019; Wilson et al., 2012), others use medical staff to report injuries (Bizzini, Junge, Bahr, Helsen, et al., 2009; Kordi, Chitsaz, Rostami, Mostafavi, & Ghadimi, 2013). Several studies include different levels of officiating and few or none female referees are included. Also, there are differences in methodology and definitions of injury (Al Attar et al., 2021; Bizzini, Junge, Bahr, & Dvorak, 2009b; Oliveira, Reis, & Silva, 2016; Vieira et al., 2019; Wilson et al., 2012). None have included illnesses. Reported injury incidence ranges from 0.47 to 34.7 per 1000 match hours (Bizzini et al., 2009a; Oliveira et al., 2016). More than half of top-level referees report having suffered from an injury during their career (Bizzini et al., 2009a; Bizzini et al., 2009), and most injuries incur during physical training (Bizzini et al., 2009b; Bizzini et al., 2009; Oliveira et al., 2016; Vieira et al., 2019; Wilson et al., 2012)

Reliable and valid measurement tools, consistency in methods and definitions, and accurate reporting are essential in sports epidemiology (Bahr et al., 2020). A validated and widely adopted research tool for monitoring health problems in athletes is the Oslo Sports Trauma Research Center Questionnaire on Health Problems (OSTRC-HP) (Clarsen et al., 2020).

This study aims to describe the prevalence and the burden of health problems in top-level referees applying state-of-the-art surveillance methods.

Method

Study design

We conducted a prospective cohort study on health problems in Norwegian top-level football referees, inviting all referees from the female and male top divisions to participate. Referees recorded injuries or illnesses once a week for 49 weeks, in the preseason and during the 2020 competitive season. The study was approved by the Norwegian Data Protection Authority (806416) and reviewed by the ethics committee of the Norwegian School of Sport Sciences (2019/125-051219). Written informed consent was provided from all participants.

Injury and Illness data collection

To ensure key information was delivered to all and to optimize the best possible compliance the participants were presented to the study during a pre-season training camp, where the vast majority of the included referees were present. We introduced the questionnaire and explained the definitions of an injury and an illness, besides conducting test recordings to familiarise the participants with the principles and the content of the questionnaire. During the study period participants received a text message (Mondays 8 PM) containing a link to the questionnaire, distributed by a web-based application (Athlete monitoring, Fitstats Inc., New Brunswick, Canada). If a referee failed to complete the questionnaire, an automatic SMS reminder was sent after 24 hours. Besides, a member of the project group contacted non-responders if they had failed to answer the reminder. We encouraged participation and compliance through email correspondence and by attending referee meetings throughout the season.

Health problems were collected using the updated version of OSTRC-HP, which consists of four key questions about the athlete's participation in sports, training volume, performance, and symptoms of health problems during the past 7 days.

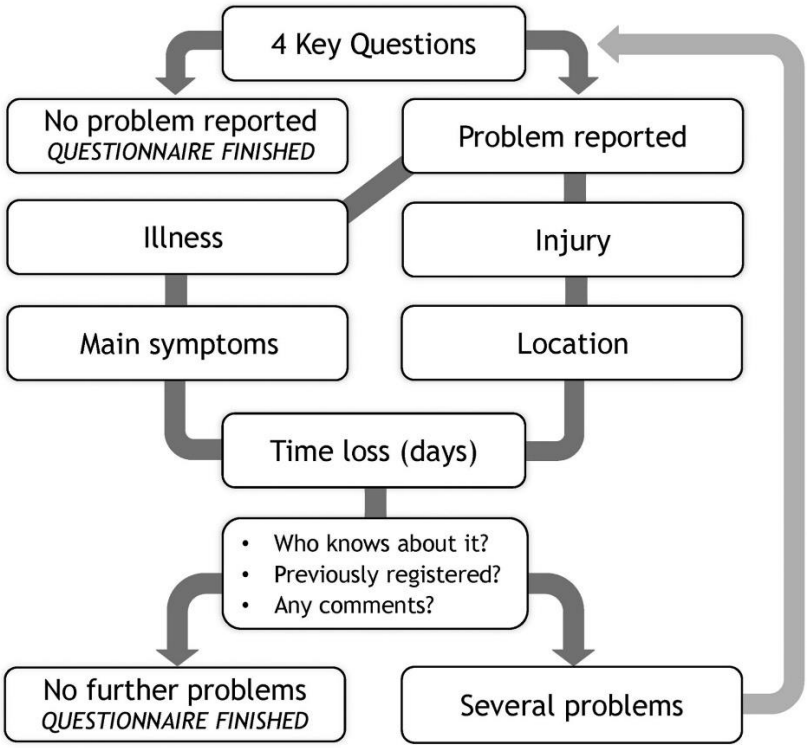

Figure 1 Diagram of questionnaire logic showing how the length of the questionnaire varied according to the number of health problems the athlete reported. From: "The Oslo Sports Trauma Research Center questionnaire on health problems: a new approach to prospective monitoring of illness and injury in elite athlete." by Benjamin Clarsen et al. Br J Sports Med 2014;48:754-760. Permission obtained from the Copt Clearance Centre

If the first question was answered with "full participation" or "could not participate", later questions were disregarded, as these questions become irrelevant (Figure 1) (Clarsen et al., 2020). Referees reporting a health problem provided additional information, e.g., mode of onset into acute injury, overuse injury or illness and registering injury location. Injury mechanism and type of activity were chosen from drop-down menus with descriptions of actions and activities, such as running or strength training, and match or training. Symptoms of illness were reported from a pre-defined list of symptoms. To measure injury and illness burden, participants registered time absent from training or competition. Besides, the participants could on request report additional information in a free text box. If two or more health problems occurred at the

same time, they were recorded separately by repeating parts of the questionnaire for additional health problems. If a recorded health problem resulted in an absence from training or officiating, the referee was contacted by a dedicated physiotherapist (GM) to ensure the most accurate diagnosis and all the details related to the health problem(s) being reported.

Definition and Classification of Health Problems

We used a broad definition of a health problem: a health problem is any condition that you consider to be a reduction in your normal state of full health, irrespective of its consequences on your sports participation or performance, or whether you have sought medical attention. This may include, but is not limited to, injury, illness, pain or mental health conditions (Clarsen et al., 2020). Definitions of an injury or illness used in this study are described by (Bahr et al., 2020). Health problems were defined as "substantial problems" if they caused a moderate or severe modification in training or competition, to a moderate or severe extent affected performance, or a complete inability to train or officiate (Clarsen et al., 2020).

Prevalence Calculations

The prevalence of health problems was calculated each week by dividing the number of athletes that reported any health problem by the number of questionnaire respondents (Clarsen, Ronsen, Myklebust, Florenes, & Bahr, 2014). We also calculated the weekly prevalence of the following sub-categories: substantial health problems, all injuries, substantial injuries, all illnesses, and substantial illnesses, as well as for subgroups: male, female, on-field and assistant referees. To identify trends during the study we created a timeline including all weekly prevalence measures. Mean prevalence for the entire season was calculated at the end of the study period.

Incidence and Burden of health problems

We expressed the incidence of each type of health problem as the number of cases per referee per season (49 weeks), and the number of cases per 1000 hours of officiating and training. The burden of injuries was described by categorizing the severity of each case based on time-loss as: slight (0 days), mild (1-7 days), moderate (8-28 days), or severe (>28 days). In addition, we created a risk matrix based on the severity (average

number of days lost) and the incidence of the most common injury locations. At the end of the study, incidence rates were calculated by different modes of onset, in accordance with the IOC consensus statement (Bahr et al., 2020).

Exposure

Training data was only reported by the referees at baseline, expressed as the median of total training hours during a normal week, with sub-categories for different types of training. Training exposure was estimated by multiplying training hours during a normal week with the number of participants, then by the number of weeks of the study period (49). Match exposure was calculated at the end of the study, using the number of matches multiplied by 90 minutes, thus excluding added time. We only used matches from the two top divisions for men and women, in addition to international matches for FIFA referees.

Results

Response rate to weekly questionnaires

We sent 2682 questionnaires and received 2632 responses during the 49-week study period. With one exception (technical problems with delivering the questionnaire in week 17) the response rate was 100%; the average was 98.1%.

Table 1 Baseline characteristics of the participants

	Total	Female	Male	On-field referee	Assistant referee
Number	55	17	38	22	33
Age	31 (20-53)	28 (20-35)	33 (24-53)	31 (24-53)	31 (20-44)
Years of officiating at the highest level	7	6	6	6	6
Training status					
Total training hours in a normal week	7 (4-15)	7 (4-12)	7 (4-15)	7 (4-12)	7 (4-15)
Endurance training	3 (1-10)	3 (2-6)	3 (1-10)	3 (1-6)	3 (1-10)
Strength training	2 (0-6)	2 (0-4)	2 (0-6)	2 (0-7)	2 (0-6)
Injury prevention	1 (0-5)	1 (0-2)	1 (0-5)	1 (0-3)	1 (0-5)
Practical referee training	1 (0-10)	1 (0-2)	1 (0-10)	2 (0-2)	1 (0-10)
Other	1 (0-1)	1 (0-3)	0 (0-3)	3 (0-3)	0 (0-1)

Presented as median (range).

Population characteristics

A total of 55 referees participated in the study. One participant withdrew in week 23, all reported data until withdrawal is included. Detailed characteristics of the participants are summarised in table 1. Based on the baseline questionnaire, 76% of the referees report having sustained one or more injuries during their career, 36% report having had one or more injuries in the last 12 months and 11% report having a chronic disease.

Match and training load

During the 2020 season 1004 matches were officiated by the referees: 218 by female referees, 786 by male referees, 367 by on-field referees and 637 by assistant referees. In total 1506 match hours were registered. In total, 18 865 training hours were estimated from baseline training data.

Prevalence of Health Problems

The average weekly prevalence of health problems was 34%, of which 20% were substantial health problems. Gradual onset injuries are most prevalent, followed by acute injuries and illnesses. Detailed prevalence of health problems is summarized in table 2.

Table 2 The average prevalence of health problems for all referees and sub-groups. Data are shown in mean (%) with 95% CIs.

	All (55)	Female (17)	Male (38)	On-field referees (22)	Assistant referees (33)
All Health problems	34 (32-36)	44 (41-46)	30 (27-34)	41 (38- 43)	30 (27-33)
Injuries	28 (27-30)	36 (34-38)	26 (23-30)	35 (33-37)	24 (22-26)
Acute injuries	7 (6-8)	11 (10-13	6 (2-10)	8 (7-10)	6 (5-6)
Gradual onset injuries	23 (22-24)	27 (24-30)	21 (19-23)	28 (25-30)	20 (18-22)
Illnesses	6 (5-8)	9 (7-11)	5 (3-6)	7 (5-9)	6 (4-8)
Substantial health problem	20 (19-22)	28 (26-30)	18 (14-22)	28 (26-31)	15 (13-17)
Injuries	16 (15-17)	21 (19-23)	15 (11-19)	24 (22-25)	11 (9-12)
Acute injuries	5 (4-6)	8 (7-9)	5 (1-9)	7 (5-8)	4 (3-4)
Gradual onset injuries	12 (11-13)	16 (13-18)	10 (9-11)	17 (15-19)	8 (7-9)
Illnesses	5 (3-6)	7 (5-9)	3 (2-5)	5 (4-7)	5 (3-6)

The weekly prevalence of health problems was higher at the beginning of the study period: The mean prevalence of all health problems in the first two months was 45%, in contrast to 28% in the last two months. Other clear trends between periods of the season were not observed. However, there are differences between sub-groups: female referees report more health problems than male referees; on-field referees report more health problems compared to assistant referees (table 2).

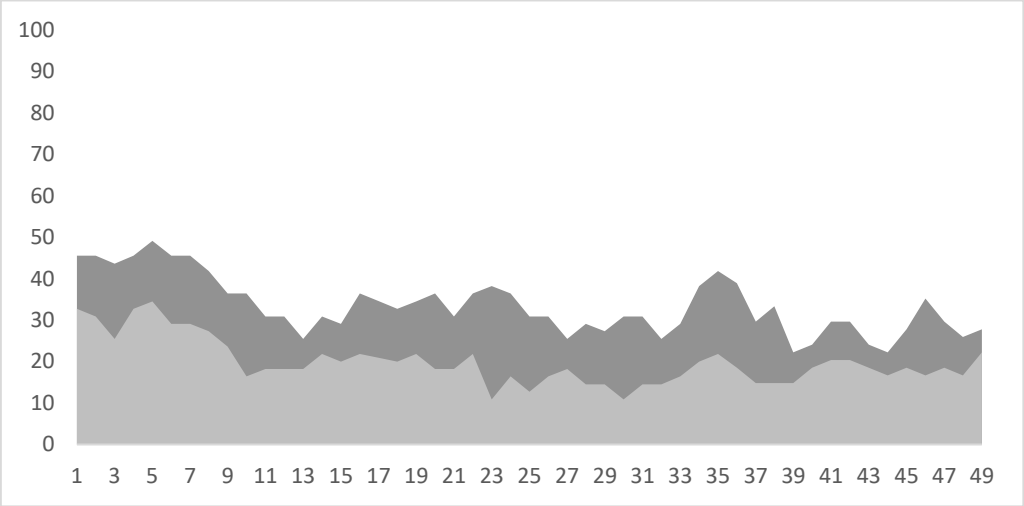

Figure 2A Weekly prevalence of all health problems (dark colour) and substantial health problems (light colour), during the 49-week study period for all referees. Due to the Covid-19 pandemic, the competitive seasons started in week 21 (male) and week 24 (female) of the study period.

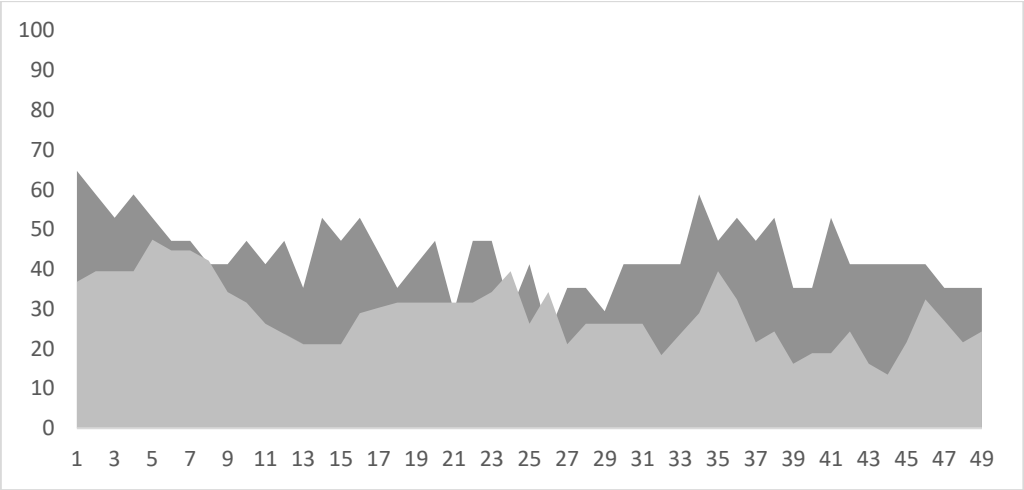

Figure 2B Weekly prevalence of all health problems during the 49-week study period, comparing male (light colour) and female (dark colour) referees. Due to the Covid-19 pandemic, the competitive seasons started in week 21 (male) and week 24 (female) of the study period.

Number, Incidence, and Severity of Health Problems

The referees reported 156 injuries, of which 62% were repetitive gradual onset injuries, 8% were repetitive sudden onset and 30% acute sudden onset injuries; 12% were match injuries and 88% injuries related to training. Rates of injuries were 3 (95% CI 2,5 to 3,5) injuries per athlete year, 12 (95% CI 7 to 19) injuries per 1000 match hours and 7 (95% CI 6 to 9) injuries per 1000 training hours.

Table 3. Incidence of injuries categorized by mode of onset according to the IOC consensus statement (Bahr et al., 2020). Presented in relation to match and training exposure.

Mode of onset	Per 1000 match hours	Per 1000 training hours
Acute Sudden onset	31	2
Repetitive Sudden onset	8	1
Repetitive Gradual onset	64	5

In total 77 illnesses were reported, making rates of illnesses 1,4 (95% CI 1.1 to 1.8) per athlete year

Gradual onset injuries represented 60% of the burden (time loss) of health problems, illnesses and acute injuries represent 21% and 19% respectively. Average availability in training and matches was 94,3%.

Table 4 Number and severity of cases categorized based on time-loss as slight (0 days), mild (1-7 days), moderate (8-28 days), or severe (>28 days). Total time loss is based on days of absence from training and match.

	Cases	Slight	Mild	Moderate	Severe	Total time loss
Injury	156	40	79	26	11	1587
Acute	54	12	30	9	3	377
Knee	11	4	6	1	0	42
Ankle	3	1	1	1	0	20
Leg	6	0	3	2	1	68
Lower back	8	2	6	0	0	28
Chest/upper back	1	0	0	1	0	23
Foot	6	1	4	0	1	77
Thigh	6	1	2	3	0	63
Upper arm	1	0	1	0	0	1
Abdomen	1	0	1	0	0	2
Neck	2	1	1	0	0	1
Shoulder	1	0	1	0	0	7
Hip/groin	5	2	3	0	0	9
Pelvis/lower back	3	0	1	1	1	48
Overuse	102	28	49	17	8	1210
Thigh	6	4	1	0	1	146
Lower back	4	0	2	1	1	186
Shoulder	1	0	0	0	1	90
Knee	12	3	8	1	0	33
Foot	19	1	10	5	3	416
Leg	25	6	13	4	2	344
Hip/groin	11	3	7	1	0	31
Neck	1	0	0	1	0	9
Wrist	1	1	0	0	0	0
Pelvis/lower back	6	3	2	1	0	17
Ankle	13	5	5	2	1	147
Chest/upper back	2	1	0	1	0	11
No category selected	1	0	1	0	0	1
Abdomen	1	1	0	0	0	0
Illness	77	5	61	10	2	420
Infectious disease	15	0	8	6	1	159
Gastrointestinal	1	0	1	0	0	2
Respiratory	6	1	2	3	0	52
Psych.	1	0	0	0	1	52
No category selected	55	4	50	1	0	155

Discussion

This is the first study to prospectively monitor all health problems among female and male top-level referees using comprehensive injury surveillance reporting during one full season. Our main finding was a 34% mean weekly prevalence of all health problems, of which substantial health problems constituted 20%. We also discovered a higher prevalence of health problems in female referees compared to male referees, and in on-field compared to assistant referees. Gradual onset injuries were most prevalent and injuries to the foot and leg resulted in the highest injury burden.

Injuries

We report an incidence of 12 (95% CI 7 to 19) injuries per 1000 match hours and 7 (95% CI 6 to 9) injuries per 1000 training hours, which is lower than previous prospective studies on referees (Bizzini et al., 2009a; Bizzini et al., 2009; Vieira et al., 2019; Wilson et al., 2012). Wilson et al. (2012) reported 16.4 injuries per 1000 match hours and 8.8 injuries per 1000 training hours, using a broad injury definition and self-reported data collection during a whole season. During the 2006 and 2007 Worlds Cups injury rates were 20.8 and 34.7 injuries per 1000 match hours. In contrast to our study injury data was reported by medical staff and acute injuries were reported according to the consensus statement by Fuller et al. (2006). Only musculoskeletal complaints that received medical attention were recorded (Bizzini et al., 2009a; Bizzini et al., 2009). In male professional football players, the injury rate was 36 per 1000 match hours, which was almost ten times higher than rates of training injuries (López-Valenciano et al., 2020). Kordi et al. (2013) report incidence of 4.6 and 19.6 in training and matches in Iranian referees, however, data was recorded by direct contact with two physicians. We use a broad injury definition and our results comprise of injuries that did not lead to absence from training and matches or received medical attention. Also, differences in data collection methods, time frames and contexts of the studies challenge direct comparison (Bahr et al., 2020).

We found more injuries among female referees, which is consistent with previous findings (Bizzini et al., 2009a). Why the female referees had a higher prevalence is unclear, but factors as inequality of professional status, physical preparation, or match load can maybe explain some of the difference. Additionally, few female participants in

this cohort can influence the confidence of these results. Assistant referees reported fewer health problems than on-field referees, despite having more match exposure. Different physical match demands can probably explain parts of the discrepancy (Krustrup et al., 2009).

Gradual onset injuries are most common among referees (Bizzini et al., 2009b; Wilson et al., 2012). This may reflect the nature of physical performance for referees, being non-contact and running based (Weston et al., 2012). Gradual onset injuries do not necessarily result in time-loss and are often recurrent by nature, therefore, prevalence is recommended when expressing the burden of gradual onset injuries (Bahr, Clarsen, & Ekstrand, 2018). The average weekly prevalence of substantial gradual onset injuries was 12% (95% CI 11-13); injuries which to a moderate or severe extent led to modified training and affected performance.

Using time-loss as a measure of burden, legs and feet cause most days of absence from training and competition (table 4). Our findings support previous studies showing that top-level referees are prone to injuries to the lower extremity (Bizzini et al., 2009a, 2009b; Bizzini, Junge, Bahr, & Dvorak, 2011; Bizzini et al., 2009; Vieira et al., 2019; Wilson et al., 2012). In this study, diagnoses related to the lower extremities were plantar fasciitis, Achilles tendinopathy, fibular stress fracture, metatarsal stress fracture and gastrocnemius myotendinopathy.

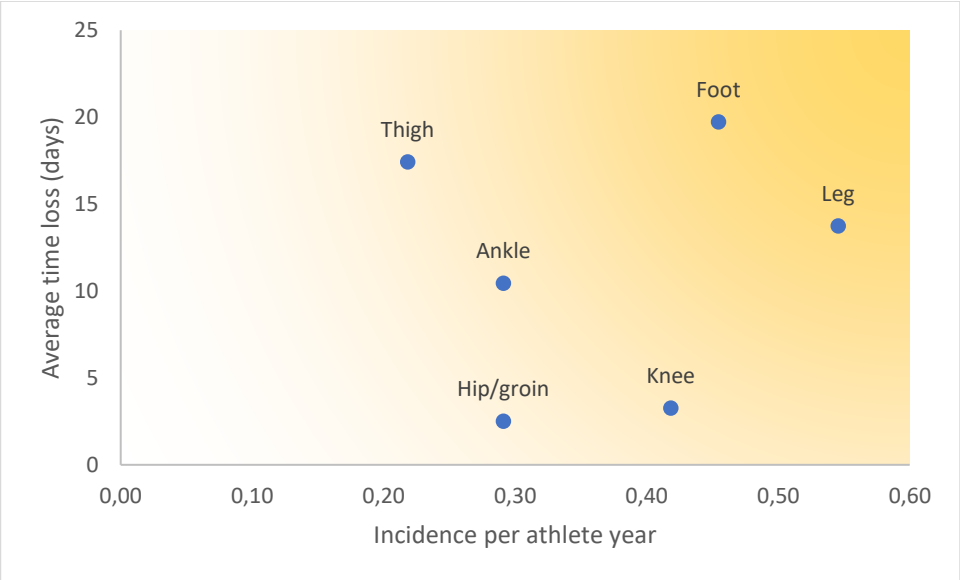

Figure 3 Risk matrix illustrating the relationship between severity (consequence) and incidence of the most reported localisation of injuries among Norwegian top-level referees. The incidence is shown as cases per athlete per year. Shading illustrates the relative importance of each of the injury types; the darker the colour, the greater the injury burden.

Illnesses

Illnesses were a minor contributor to the burden of health problems and constituted 21% of total time-loss. Most illnesses were reported as mild severity, which is equal to male professional football players (Bjørneboe et al., 2016). Infectious diseases, viral infections and yearly influenza were commonly reported in this study. Risk factors for acute illnesses are related to increases in training load, psychosocial stress, international travel and a congested sports calendar (Schwellnus et al., 2016), associated risk factors that most top-level referees are exposed to. Incidence rates from the UEFA Club Study were 1.5 per 1000 player-days; however, in contrast to this study, the definition of an illness was based on time-loss (Bjørneboe et al., 2016).

Methodological considerations

The main limitation of this study was the lack of prospective training data recorded regularly throughout the study period. Retrospective self-reported training data risks being biased and could be over or underestimated (Thomas, 2015). Furthermore, severe injuries were diagnosed by a sports physiotherapist limited to a telephone interview and none of the referees were examined in a personal consultation. Minor health problems were not followed up by the sports physiotherapist (GM), but most likely have been assessed by their preferred sports medicine clinician. Consequently, most of the reported injuries were self-reported and lack detailed clinical examination and hence diagnostic accuracy.

There are several possible data collection methods: self-report, coach or medical staff, web-based or text message etc. (Bahr et al., 2020). Because of the time span of our study, geographical distances between participants and scarce availability of medical staff to report health problems, our data collection method needed to be flexible. The OSTRC-H distributed by SMS was useful in this regard. Nevertheless, self-reported data relies on accurate reporting by the participants (Clarsen et al., 2020). Prospectively

referees categorized injuries into acute or overuse because these terms are familiar to the participants. Retrospectively, we categorized injuries according to the IOC consensus statement (Bahr et al., 2020). Some injuries had been reported as acute when the diagnosis exposed the injury as repetitive gradual or sudden onset. Of the 54 reported acute injuries, 47 were acute, three were repetitive gradual onset and four were repetitive sudden onset. In total, 102 injuries were reported as overuse by the referees, of which eight were retrospectively categorized as repetitive sudden onset (table 3).

Using a wide definition of health problems allowed minor and usually transient injuries and illnesses to be reported. Also, the referees could have different interpretations of what constitutes a health problem (Bahr et al., 2020). Weekly reporting for 49-weeks may exhaust some participants, potentially leading to underreporting of health problems in the later stages of the study. Different motivations to report data might explain why the prevalence of health problems is higher at the beginning of our study, compared to the end. Furthermore, at baseline, the majority of participants reported injuries during their career and approximately one-third reported an injury during the last 12 months; thus, some of our data is likely to be derived from former injuries.

The main strength of this study was the prospective design and applying the OSTRC-H, which has been validated and is recommended applied in sports injury and illness surveillance studies (Bahr et al., 2020). The comprehensive method with weekly reporting of health problems during one season (including off-season) favoured an accurate data collection. It has previously been shown that using text messages to record injuries is effective in injury registration, both being time-efficient and potentially provided a more complete picture of health problems compared to registration by medical staff only (Nilstad, Bahr, & Andersen, 2011). Compliance was excellent, 100% every week, except for technical issues in week 17. Thorough implementation of the study with support from stakeholders, thorough information, theoretical lectures and practical demonstrations most likely contributed to the high compliance.

The Covid-19 pandemic

In Norway, the 2020 national premier leagues were delayed due to the covid-19 pandemic. Consequently, large parts of our results are preseason data (21 and 23 weeks for men and women respectively) and hence, the competitive season was congested.

Other infectious diseases decreased during the Covid-19 pandemic, which could have affected the prevalence and burden of illnesses reported in this study (The Norwegian Institute of Public Health, 2021). At the end of the study, we asked the referees if the pandemic affected performance: 49% said the pandemic had negatively affected their performance in training and matches; 42% said they trained less in 2020 compared to 2019. During the study period, three referees tested positive for Covid-19, 65% were quarantined one or several times, spending a total of 710 days in quarantine. Still, it is unclear how and to which degree the pandemic has influenced the results of this study.

Perspectives

Throughout their career referees bear great individual responsibility for their own health: unlike players, they are not part of a team and have limited access to medical staff and exercise professionals. Our baseline training data indicate a wide range of time spent on injury prevention. If generalising our results, it is important to be attentive to specific population characteristics: Norwegian top-level referees are semi-professional and all participants have part- or full-time work besides officiating. Lack of professional status might influence recovery and reduce time spent on injury prevention as the total load related to refereeing includes developing physical fitness, match preparation, evaluation, travel, physical and mental match load.

The injury profile of top-level referees is mainly gradual onset injuries; thus, the ability to tolerate load is essential to reduce injuries (Drew & Finch, 2016; Magnusson, Langberg, & Kjaer, 2010; Soligard et al., 2016; Warden, Davis, & Fredericson, 2014). Injuries to the lower extremities could be prevented with multicomponent injury prevention programmes (Brunner et al., 2019). The FIFA 11+ Referee programme includes strength, plyometrics, balance and running drills (Bizzini & Junge, 2011), and reduced injuries by 65% in amateur male soccer referees (Al Attar et al., 2021). Injuries were recorded using a time-loss definition, thus the effect on gradual onset injuries

remains unknown. Additionally, the effect might not transfer to top-level referees. More experimental studies on the effect of injury prevention measures in top-level referees are necessary, and gradual onset injuries should be included. Effective research on injury prevention alone does not reduce injuries (Finch, 2006). Implementation of prevention measures should address attitudes and current behaviour towards injury prevention among top-level referees and other stakeholders (Finch & Donaldson, 2010; McKay, Steffen, Romiti, Finch, & Emery, 2014). A key factor in the implementation process is including the football federations (Bizzini, Junge, & Dvorak, 2013). Severe injuries affect mental health in professional football players (Gouttebarge, Aoki, Ekstrand, Verhagen, & Kerkhoffs, 2016). Qualitative research addressing how injuries affect top-level referees could be valuable in gaining a broader understanding of referee health.

In this study, reports of health problems were usually followed by reports of reduced performance in training or match. Objective measures of effect on performance were not included and the association between health problems and referee performance remains unclear.

This study is one of few prospective long-term studies focusing on referee health, and it is the first to include illnesses and other health problems. More prospective studies are needed, especially in female referees. Up-to-date injury surveillance methods should be applied and health problems reported according to the IOC consensus statement (Bahr et al., 2020). The UEFA Elite Club Injury Study and the health monitoring programme for Norwegian Paralympic and Olympic candidates are inspirational in this regard (Clarsen et al., 2021; Ekstrand et al., 2021). Long-term health monitoring programmes of top-level referees in several leagues could be considered.

Conclusion

Top-level football referees experience a significant amount of health problems during a football season, leading to reduced participation and affecting self-reported performance. Female referees report more health problems than male referees during one season. Gradual onset injuries located to the lower extremities, especially legs and feet, are most burdensome. Results from this study should help guide future preventive measures.

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Appendix

3.1 Appendix A – Declaration of consent

Vil du delta i forskningsprosjektet

"Skaderegistrering toppdommere i Norge"?

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er å etablere kunnskap om skade- og sykdomsomfang og karakteristikk, ved bruk av data samlet fra fotballdommere i Toppserien og Eliteserien**.** I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål
Norske toppdommere er en sentral del av avvikling av serie- og cupspill i Norge, i tillegg dømmer utvalgte dommere (FIFA-dommere) kamper internasjonalt. Kampbelastningen på dommere er stor og kommer i tillegg til trening, forberedelser og evaluering av kamp. Fysiske testkrav for dommere har blitt strengere og kravene i kamp øker i takt med økt tempo i fotballen. I Norge er ingen dommere helprofesjonelle, men noen har profesjonaliseringsavtaler for å kunne satse å dømmingen. Dette gjør at treninger og kamper kommer i tillegg til annen jobb og bidrar i vesentlig grad til å øke totalbelastningen for dommerne. Det er gjort et fåtall studier på skader hos fotballdommere. Ingen studier er tidligere gjort med skaderegistrering av norske dommere. Dommerne investerer mye tid i dommergjerningen og det tar flere år å bli dommer på toppnivå. Tildeling av kamper og rangering av dommere baserer seg på prestasjoner, noe som fører til at fravær fra kamp vil kunne gjøre den skadede dommeren uaktuell for opprykk til nytt nivå, f.eks. fra Eliteseriedommer eller Toppseriedommer til FIFA-dommer. Skader vil også for den enkelte dommer kunne føre til økonomisk tap, siden deler av den totale inntekten er knyttet til regelmessig dømming i sesong. Denne studien ønsker å etablere kunnskap om skader og sykdom hos norske fotballdommere på elitenivå. Studien kan bidra til et bedre beslutningsgrunnlag for Norges Fotballforbund i oppfølging av toppdommerne og hvilke skadeforebyggende tiltak som bør gjennomføres. Prosjektet er en masteroppgave ved Norges Idrettshøgskole, seksjon for idrettsmedisinske fag.

Hvem er ansvarlig for forskningsprosjektet?
Norges Idrettshøgskole er ansvarlig for prosjektet.

Hvorfor får du spørsmål om å delta?
Alle hoveddommere og assistentdommere i Toppserien og Eliteserien får spørsmål om deltagelse.

Hva innebærer det for deg å delta?
Hvis du velger å delta i prosjektet, innebærer det at du fyller ut et spørreskjema, én gang i uken, før og under fotballsesongen 2020. Spørreskjemaet, som tar utgangspunkt i fire spørsmål, distribueres via SMS og tar kort tid å svare på. Du vil bli spurt om du har hatt skader eller sykdom i løpet av den foregående uken og i hvilken grad dette har påvirket trening eller kamp. Svarene blir registrert elektronisk. Ved studiens slutt vil dine svar gjennom sesongen bli gjennomgått sammen med deg, for å forsikre at resultatet er korrekt.

Det er frivillig å delta
Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykke tilbake

uten å oppgi noen grunn. Alle opplysninger om deg vil da bli anonymisert. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger

Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket.

- Bare Torstein Dalen-Lorentsen, stipendiat ved seksjon for idrettsmedisinske fag, Norges Idrettshøgskole, har tilgang til dataene som ennå ikke er uidentifisert.
- De identifiserbare dataene (navn osv.) blir byttet med en deltakerkode.
- Resultatene fra studien vil formidles på en måte hvor deltakerne ikke vil være gjenkjennelige.

NB: dommerseksjonen i NFF vil ikke ha tilgang til data i prosjektet og ingen innmelde helseplager via prosjektet får konsekvenser for kamper, turneringer eller treningsleir. De anonymiserte resultatene vil være tilgjengelig etter prosjektet er ferdig.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?
Prosjektet skal etter planen avsluttes 15.01.2025. Alle identifiserbare data blir slettet etter denne datoen. Uidentifiserbare data vil bli lagret på OSTRC-serveren. Bare prosjektleder Torstein Dalen-Lorentsen vil ha tilgang.

Dine rettigheter
Så lenge du kan identifiseres i datamaterialet, har du rett til:
- innsyn i hvilke personopplysninger som er registrert om deg,
- å få rettet personopplysninger om deg,
- få slettet personopplysninger om deg,
- få utlevert en kopi av dine personopplysninger (dataportabilitet), og
- å sende klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?
Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra Norges Idrettshøgskole har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?
Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:
- Norges Idrettshøgskole ved Christian Moen, Masterstudent, Seksjon for idrettsmedisinske fag, christim@nih.no, *+4795257255*. Eller Torstein Dalen-Lorentsen, Stipendiat, Seksjon for idrettsmedisinske fag, *torstein.dalen@nih.no, +4793841844.*
- Vår GDPR-ansvarlige, Karine Justad, Norges Idrettshøgskole, +4797536704, Karine.justad@nih.no
- NSD – Norsk senter for forskningsdata AS, på epost (personverntjenester@nsd.no) eller telefon: 55 58 21 17.

Med vennlig hilsen

Prosjektansvarlig	Masterstudent
Torstein Dalen-Lorentsen	Christian Moen

3.2 Appendix B – Approval from the Norwegian Centre for Research Data

NSD NORSK SENTER FOR FORSKNINGSDATA

NSD sin vurdering

Prosjekttittel

Skaderegistrering av norske toppdommere

Referansenummer

806416

Registrert

18.11.2019 av Christian Moen - christim@student.nih.no

Behandlingsansvarlig institusjon

Norges idrettshøgskole / Seksjon for idrettsmedisinske fag

Prosjektansvarlig (vitenskapelig ansatt/veileder eller stipendiat)

Torstein Dalen-Lorentsen, torstein.dalen@nih.no, tlf: 4793841844

Type prosjekt

Studentprosjekt, masterstudium

Kontaktinformasjon, student

Christian Moen, chr_moen@yahoo.no, tlf: 95257255

Prosjektperiode

15.01.2020 - 15.01.2025

Status

16.12.2019 - Vurdert

Vurdering (1)

16.12.2019 - Vurdert

Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet 16.12 2019 med vedlegg.

Behandlingen kan starte.

MELD VESENTLIGE ENDRINGER
Dersom det skjer vesentlige endringer i behandlingen av personopplysninger, kan det være nødvendig å melde dette til NSD ved å oppdatere meldeskjemaet. Før du melder inn en endring, oppfordrer vi deg til å lese om hvilke type endringer det er nødvendig å melde:

https://nsd.no/personvernombud/meld_prosjekt/meld_endringer.html
Du må vente på svar fra NSD før endringen gjennomføres.

TYPE OPPLYSNINGER OG VARIGHET
Prosjektet vil behandle særlige kategorier av personopplysninger om helse og alminnelige kategorier av personopplysninger frem til 15.01.2025

LOVLIG GRUNNLAG
Prosjektet vil innhente samtykke fra de registrerte til behandlingen av personopplysninger. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 nr. 11 og art. 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse, som kan dokumenteres, og som den registrerte kan trekke tilbake.

Lovlig grunnlag for behandlingen vil dermed være den registrertes uttrykkelige samtykke, jf. personvernforordningen art. 6 nr. 1 bokstav a, jf. art. 9 nr. 2 bokstav a, jf. personopplysningsloven § 10, jf. § 9 (2).

PERSONVERNPRINSIPPER
NSD vurderer at den planlagte behandlingen av personopplysninger vil følge prinsippene i personvernforordningen om:

- lovlighet, rettferdighet og åpenhet (art. 5.1 a), ved at de registrerte får tilfredsstillende informasjon om og samtykker til behandlingen
- formålsbegrensning (art. 5.1 b), ved at personopplysninger samles inn for spesifikke, uttrykkelig angitte og berettigede formål, og ikke viderebehandles til nye uforenlige formål
- dataminimering (art. 5.1 c), ved at det kun behandles opplysninger som er adekvate, relevante og nødvendige for formålet med prosjektet
- lagringsbegrensning (art. 5.1 e), ved at personopplysningene ikke lagres lengre enn nødvendig for å oppfylle formålet

DE REGISTRERTES RETTIGHETER
Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: åpenhet (art. 12), informasjon (art. 13), innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18), underretning (art. 19), dataportabilitet (art. 20).

NSD vurderer at informasjonen som de registrerte vil motta oppfyller lovens krav til form og innhold, jf. art. 12.1 og art. 13.

Vi minner om at hvis en registrert tar kontakt om sine rettigheter, har behandlingsansvarlig institusjon plikt til å svare innen en måned.

FØLG DIN INSTITUSJONS RETNINGSLINJER
NSD legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1 d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

Athlete Monitoring er databehandler i prosjektet. NSD legger til grunn at behandlingen oppfyller kravene til bruk av databehandler, jf. art 28 og 29.

For å forsikre dere om at kravene oppfylles, må dere følge interne retningslinjer og eventuelt rådføre dere med behandlingsansvarlig institusjon.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp underveis (hvert annet år) og ved planlagt avslutning for å avklare om behandlingen av personopplysningene pågår i tråd med den behandlingen som er dokumentert.

Lykke til med prosjektet!

Kontaktperson hos NSD: Gry Henriksen

3.3 Appendix C – Approval from the ethics committee, Norwegian School of Sport Sciences

Søknad 125-051219 – Skaderegistrering av toppdommere i Norge

Vi viser til søknad, prosjektbeskrivelse, informasjonsskriv og innsendt melding til NSD.

I henhold til retningslinjer for behandling av søknad til etisk komite for idrettsvitenskapelig forskning på mennesker, har leder av komiteen på fullmakt konkludert med følgende:

Vedtak

På bakgrunn av forelagte dokumentasjon finner komiteen at prosjektet er forsvarlig og at det kan gjennomføres innenfor rammene av anerkjente etiske forskningsetiske normer nedfelt i NIHs retningslinjer. Til vedtaket har komiteen lagt følgende forutsetning til grunn:

- *Vilkår fra NSD følges*

Komiteen gjør oppmerksom på at vedtaket er avgrenset i tråd med fremlagte dokumentasjon. Dersom det gjøres vesentlige endringer i prosjektet som kan ha betydning for deltakernes helse og sikkerhet, skal dette legges fram for komiteen før eventuelle endringer kan iverksettes.

Med vennlig hilsen
Professor Sigmund Loland
Leder, Etisk komite, Norges idrettshøgskole

NIH NORGES IDRETTSHØGSKOLE

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www.nih.no