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CHAPTER 4

INJURIES IN DUTCH ELITE FIELD HOCKEY PLAYERS: A PROSPECTIVE STUDY

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ABSTRACT

This study describes the prevalence, incidence density, severity, and nature of injuries in elite field hockey players over the Dutch 2015–2016 season. Eighty players answered a baseline questionnaire and were subsequently followed-up every two weeks to report the hours spent on training/competition and experienced injuries, which were registered using the Oslo Sports Trauma Research Centre Questionnaire on Health Problems. Of the 74 players included in the analysis, 52 (70%) reported 112 injuries. Eighty-seven injuries (78%) received medical attention, and 56 (50%) led to training/competition time-loss. Thirty-four injuries (30%) hampered players' availability for training/competing. Most of the injuries (74%) were not caused by any contact. The mean prevalence of injury was 29% (95% confidence interval [CI] 3–55) for all, 9% (95% CI 0–20) for acute, and 14% (95% CI 0–36) for overuse injuries. Players sustained 3.5 (95% CI 2.5–4.5) new acute injuries per 1,000 hours of training and 12.3 (95% CI 7.6–17.0) per 1,000 hours of competition. The median of the severity score was 28 from 100 (25%–75% interquartile range [IQR] 16–42) for all, 35 (IQR 23–53) for acute, and 21 (IQR 16–31) for overuse injuries. On average, one in four elite field hockey players experiences an injury within a two-week period during the season. Although acute injuries are common, overuse injuries pose a comparable problem in elite field hockey. Since injuries are a burden on players' health and may hamper performance and availability for training/competing, prevention is of great importance.

INTRODUCTION

Field hockey is an Olympic sport played by men and women worldwide from recreational to elite level. Five Continental and 129 National Federations are members of the International Hockey Federation.¹ The Royal Dutch Hockey Association (KNHB) reported an increase of 37% in field hockey participation between 2005 and 2015 in the Netherlands.² Although playing field hockey may contribute to players' health through the well-known benefits of exercise,³ it also entails a risk of unfavourable consequences; i.e. injuries.⁴

Especially at the elite level the injury rate appears to be high. During major international hockey tournaments in 2013, an average of 29.1 injuries per 1,000 match-hours and 48.3 injuries per 1,000 match-hours were registered in women and men, respectively.⁵ During the London Summer Olympic Games 2012, 17% of all field hockey players sustained an injury.⁶ While injury data from tournaments may provide valuable information on injuries in elite field hockey, the brief follow-up period in such tournaments may result in a skewed estimation of the injury problem. Retrospective data have shown that 74% of players have sustained at least one acute injury during their career.⁷ However, to get a better scope of the full injury problem in elite field hockey, prospective full season data is required. Yet, to our knowledge, there are no such registrations in elite field hockey.

Previous studies have described injuries in collegiate women field hockey players registered in the National Collegiate Athletic Association Injury Surveillance System (NCAA ISS) and reported 7.9 injuries per 1,000 player-matches, and 3.7 injuries per 1,000 player-practices.^{8,9} However, the definition of injury used by the NCAA ISS may not have been sensitive enough to capture overuse injuries⁸ – those injuries with no sudden and clearly identifiable onset. Overuse injuries can be as frequent as acute injuries in sport.¹⁰⁻¹² Nevertheless, previous research on the epidemiology of injuries in field hockey have employed methods that were able to capture mainly acute events – not overuse injuries.⁴

As methods for recording both acute and overuse injuries have been established and successfully employed to monitor injuries in different sports,^{11,13,14} the aim of this study was to describe the prevalence, incidence density, severity, and nature of injuries experienced by Dutch elite field hockey players over a season. Prospectively monitoring athletes over the season is fundamental to understand the full injury problem in field hockey and facilitate the development of evidence-based preventive measures.^{15,16}

METHODS

Study design and participants

This prospective cohort study was conducted between September 2015 and July 2016 and was composed of a dynamic sample of adult Dutch elite field hockey players. Players were invited to participate in the study by convenience. A professional field hockey player approached athletes playing in the elite league of the Royal Dutch Hockey Association (KNHB), which comprised of 24 teams (12 men and 12 women). Those who manifested interest in participating in the study received a digital information letter about the study purpose and procedures, and their enrolment was allowed over the course of the first three months of the field hockey season. Electronic informed consent was obtained from all participants. The study protocol was approved by the ethics committee of the VU University Medical Center, Amsterdam, the Netherlands.

Players were included in the study after completing an online questionnaire providing information on age, body height and weight, years of hockey experience, playing position, injuries experienced in the past 12 months, and any injury at baseline. During the course of the study, players received, every two weeks, an email with a secure link to a follow-up questionnaire. The follow-up questionnaire contained questions on the number of hours spent on field hockey specific training (i.e. on the pitch), strength and conditioning training (to improve field hockey performance), and competition in the past two weeks. Subsequent questions concerned any health complaints experienced

in the past two weeks, regardless of their nature or body system affected. A reminder email was sent after seven days in case of non-response. Regardless of responding to the reminder or not, these players received the regular questionnaire in the next follow-up.

Health complaints registration

Health complaints were registered using the Dutch version¹³ of the Oslo Sports Trauma Research Centre (OSTRC) questionnaire on health problems.¹¹ The OSTRC questionnaire contains four key questions that record to what extent a health complaint has affected (1) sport participation, (2) training volume, (3) sport performance, and (4) the extent of the individual experienced health symptoms (i.e. no symptom; mild; moderate; severe). The four key questions of the OSTRC questionnaire generate a severity score ranging from zero (i.e. no health complaint) to 100 (i.e. severe health complaint). Participants were instructed to report all health complaints, even if they had already registered the same complaint previously.

In case of no health complaint (i.e. severity score = zero), the questionnaire was finished. In case of health complaint (i.e. severity score > zero), players were asked to report their training and competition time-loss in days (defined as the number of days in which no full participation in training or matches was possible), whether the health complaint was being registered for the first time or not, and if it concerned an injury or illness. In case of injury, players were asked to describe the circumstances of the injury onset, the affected body location, the injury type (e.g. contusion, ligament sprain), the use of protective gear on the injured body location and received medical attention. In case of illness, players were asked to report the symptoms and received medical attention. In case of more than one health complaint, players were instructed to report the most severe complaint first. Further complaints could be registered separately using the same procedure.

Injury classification

All reported health complaints were reviewed by the primary researcher (SDB), who is also a physiotherapist, and classified as injuries if they were disorders of the musculoskeletal system or concussions.¹⁷ Non-field-hockey-related injuries (e.g. commuting bicycle accident) and illnesses were excluded from further analyses. Injuries were classified as acute if their onset could be linked to a specific identifiable event, or as overuse if the onset could not be linked to a clearly identifiable event.¹¹ A recurrent injury was defined as an injury at the same body location and type as a previous injury (i.e. index injury), regardless of being a re-injury (i.e. after full recovery) or exacerbation (i.e. no full recovery).¹⁸ Injuries leading to moderate/severe reductions in training volume, or moderate/severe reductions in field hockey performance, or inability to participate in regular training/competition were classified as substantial injuries.¹¹ Substantial injuries were identified by questions two and three of the OSTRC questionnaire.¹¹ Additionally, injuries were coded according to the Orchard Sports Injury Classification System version 10 (OSICS-10).¹⁹

Data analysis

Descriptive data analysis was conducted to present baseline and follow-up measures. Continuous data with Gaussian distribution are described as means and its 95% confidence intervals (95% CI); otherwise, the median and its 25%–75% interquartile range (IQR) are presented.²⁰ Categorical data are presented as percentages. Data analysis was performed in the R software environment for statistical computing version 3.3.2.²¹

The prevalence of injury was calculated for every two-week follow-up measure by dividing the number of respondents reporting injury by the total number of respondents for that specific follow-up;¹¹ i.e. the two-week point prevalence. The mean prevalence of injury over the entire follow-up was subsequently calculated by dividing the sum of the two-week point prevalence of all follow-up measures by the number of follow-ups.²⁰

The total number of injuries was calculated based on the unique injuries identified during the prospective follow-up period (i.e. September 2015 to July 2016). The injury incidence density (i.e. the number of new injuries per 1,000 player-hours of exposure) was calculated to summarise new acute injuries (i.e. recurrent injuries were counted the same as the index injury). This was done by dividing the number of newly sustained acute injuries over the course of the entire season by the total hours of training/competition (i.e. exposure) and multiplying the result by 1,000. Overuse injuries are reported as the mean of the prevalence repeatedly measured over the follow-up period.¹⁰

The cumulative severity and the average severity score were calculated for each injury to estimate its impact over the study period. The cumulative severity was calculated by summing the severity score of the OSTRC questionnaire measured every two weeks.¹¹ The average severity was calculated by dividing the cumulative severity by the duration of the injury (i.e. the number of follow-up measures in which the injury was reported). The same procedures were followed to calculate the cumulative days of time-loss and average days of time-loss for each injury.¹¹

RESULTS

Participants, response rate, and players' exposure

A total of 89 elite field hockey players expressed interest in participating in the present study. Eighty players (65% women and 35% men) from five teams agreed to participate. Players' characteristics at baseline are presented in Table 1. Six players (7%) did not answer any of the follow-up questionnaires. Four players (5%) withdrew their participation during the course of the study, but their data until the moment of drop out are included in the analysis. The median of the follow-up period per player was 38 weeks (IQR 36–40).

The median of the response rate measured every two weeks was 61% (IQR 51–77). In total, players spent 8,815 hours on specific training (median of 10 hours [IQR 5–14] per two weeks), 3,262 hours on strength and conditioning training (median of 3 hours

[IQR 1–5]), and 2,352 hours on competition (median of 2 hours [IQR 1–4]). This sums up to 14,429 hours of exposure (median of 16 hours [IQR 10–22] per two weeks).

Injury prevalence, incidence density, and nature

A total of 112 injuries were reported by 52 players (70%). Eight-seven injuries (78%) received medical attention, and 56 injuries (50%) led to training/competition time-loss. The mean prevalence of injury was 29% for all, 24% for medical attention, and 13% for time-loss injuries (Table 2). Twenty-three players (31%) reported one injury, 13 players (18%) reported two, and 16 players (22%) reported three or more injuries. Midfielders and forwarders reported most of the injuries (Figure 1A).

The mean prevalence of acute injuries over the season was 9% (Table 2). A total of 51 new acute injuries (45% of all injuries) were reported by 37 players (50%), resulting in an overall incidence density of 3.5 (95% CI 2.5–4.5) acute injuries per 1,000 player-hours of total exposure (including strength and conditioning training), and 4.6 (95% CI 3.3–5.9) acute injuries per 1,000 player-hours of field hockey exposure (excluding strength and conditioning training). Twenty-two (43%) acute injuries occurred during specific training (i.e. on the pitch), and 29 (57%) during competition, resulting in an incidence density of 2.5 (95% CI 1.4–3.6) acute injuries per 1,000 hours of specific training, and 12.3 (95% CI 7.6–17.0) per 1,000 hours of competition. Most of the acute injuries (43%) were not caused by any contact at all (Figure 1B). The most common diagnosis (i.e. OSICS-10 code) of acute injuries were hamstring strain and hip and groin muscle strain/tear (10% each), followed by ankle sprain, lumbar pain undiagnosed, and lower leg muscle haematoma (6% each). Acute injuries were common in the fingers, thigh and hip (Figure 1C).

A total of 61 overuse injuries (55% of all injuries) were reported by 36 players (49%). The mean prevalence of overuse injuries over the season was 14% (Table 2). Midfielders experienced most of the overuse injuries (Figure 1A). The most common diagnosis (i.e. OSICS-10 code) for overuse injuries were knee pain undiagnosed (13%), back referred hamstring tightness (11%), lumbar pain undiagnosed and other

stress/overuse injuries to thigh (8% each). Overuse injuries were common in the thigh, knee, lower leg, and lower back (Figure 1C).

Injury severity

The injury severity measures are presented in Table 2. The average and cumulative severity scores tended to be higher for injuries leading to training/competition time-loss. The average severity score was 28 (of 100) for all, 30 for injuries in need of medical attention, and 41 for time-loss injuries (Table 2). Correspondingly, the cumulative severity score was 37 for all, 44 for medical attention, and 68 for time-loss injuries. The average and cumulative severity scores were higher for acute (35 and 50, respectively) than for overuse injuries (21 and 28, respectively).

Substantial injuries, defined as injuries hampering field hockey participation/performance, represented 30% of all injuries. Half (52%) of the injured players experienced substantial injuries. Thirty-two (94%) of the 34 substantial injuries received medical attention and 31 (91%) led to training/competition time-loss (Table 2).

DISCUSSION

Prevalence and nature of injury

This study presents the magnitude in which injuries impact health and hamper training/competition participation and performance in Dutch elite field hockey players. The results of this study show that, on average, one in four (29%) elite field hockey players reported to be injured within a two-week time period over the season. Of all injured players, 52% experienced substantial injuries and, therefore, reduced performance and/or availability for training/competition due to injury. The majority of injuries was not caused by any contact, and most of the injuries were overuse (i.e. with gradual and not clearly identifiable onset).

Table 1. Baseline data of elite field hockey players.

	All (n = 80)	Women (n = 52)	Men (n = 28)
Age, years	23.2 (15.4–31.0)	23.2 (15.3–31.1)	23.2 (15.5–30.9)
Height, cm	175.1 (158.7–191.4)	170.4 (160.0–180.8)	183.7 (172.6–194.8)
Weight, kg	68.1 (50.8–85.4)	63.3 (51.5–75.0)	77.0 (65.8–88.2)
Hockey experience, years	15.6 (6.6–24.7)	15.5 (6.3–24.6)	16.0 (7.0–24.9)
Playing position			
Goalkeeper	7 (8.8%)	5 (6.2%)	2 (2.5%)
Defender	23 (28.7%)	15 (18.8%)	8 (10.0%)
Midfielder	29 (36.2%)	20 (25.0%)	9 (11.2%)
Forward	21 (26.2%)	12 (15.0%)	9 (11.2%)
Injuries in previous 12 months	50 (62.5%)	30 (37.5%)	20 (25.0%)
Injuries at baseline	11 (13.8%)	6 (7.5%)	5 (6.2%)

Continuous data are presented as means and 95% confidence intervals. Categorical data are presented as the number of players and percentage of total players.

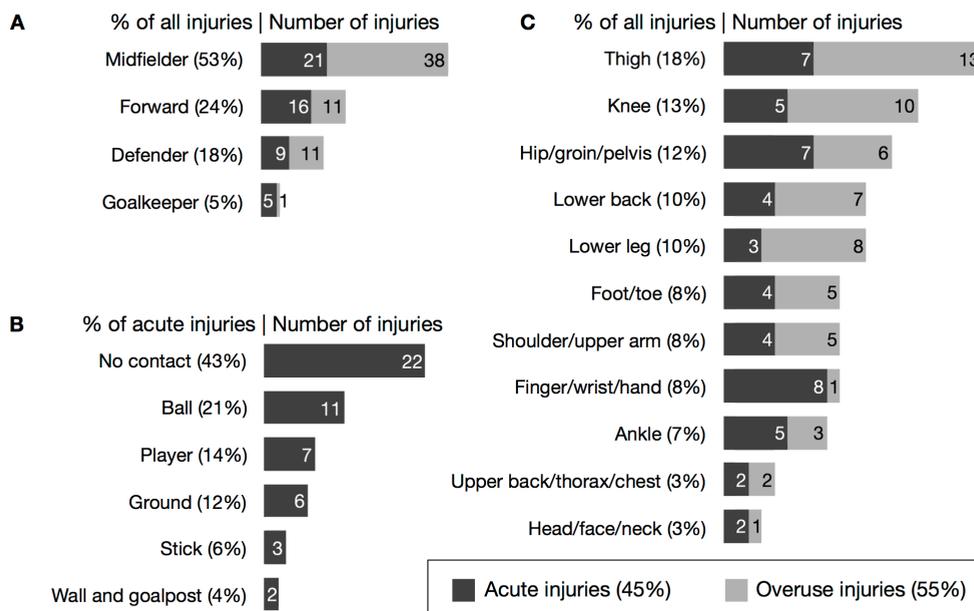


Figure 1. **A** Breakdown of injuries according to field hockey playing position and injury nature. **B** Breakdown of acute injuries according to cause (61 non-contact injuries were overuse injuries). **C** Breakdown of injuries according to body location and injury nature.

Table 2. Prevalence and severity of injuries experienced by elite field hockey players measured every two weeks over the Dutch season (September 2015 to July 2016).

	All injuries	Acute	Overuse	Medical attention	Time-loss ^a
Overall					
Number of injuries (number of players)	112 (52)	51 (37)	61 (36)	87 (46)	56 (41)
Prevalence, mean (95% CI)	28.8% (3.1–54.6)	8.8% (0.0–20.2) ^b	13.8% (0.0–35.9) ^b	24.0% (0.0–49.0) ^b	12.8% (0.0–26.8) ^b
Severity measures, median (IQR)					
Average severity	28.0 (16.0–42.4)	34.8 (23.4–53.0)	21.0 (16.0–31.0)	30.0 (18.0–46.0)	40.8 (31.0–57.3)
Cumulative severity	37.0 (22.0–73.5)	50.0 (28.0–83.0)	28.0 (16.0–60.0)	44.0 (24.0–81.0)	68.5 (37.0–100.0)
Average time-loss, days	0.5 (0.0–2.0)	1.0 (0.0–2.5)	0.0 (0.0–1.0)	0.8 (0.0–2.0)	2.0 (1.0–3.6)
Cumulative time-loss, days	1.0 (0.0–2.5)	1.0 (0.0–4.8)	0.0 (0.0–2.0)	1.0 (0.0–3.0)	2.0 (1.0–7.0)
Duration, ^d weeks	2 (2–4)	2 (2–4)	2 (2–4)	2 (2–4)	3 (2–4)
Substantial^c					
Number of injuries (number of players)	34 (27)	22 (12)	12 (9)	32 (27)	31 (26)
Prevalence, mean (95% CI)	6.4% (0.0–13.5) ^b	3.6% (0.0–8.9) ^b	1.3% (0.0–5.4) ^b	5.8% (0.0–11.9) ^b	5.9% (0.0–13.5) ^b
Severity measures, median (IQR)					
Average severity	53.0 (41.6–78.5)	55.0 (44.5–79.8)	45.2 (39.9–75.5)	53.0 (40.9–73.2)	57.0 (43.7–81.0)
Cumulative severity	82.5 (66.2–148.8)	84.5 (56.5–161.8)	81.5 (72.0–103.0)	81.5 (64.5–136.2)	86.0 (69.5–159.0)
Average time-loss, days	3.0 (1.8–5.2)	3.2 (1.2–5.2)	3.0 (2.0–5.5)	3.0 (1.5–5.1)	3.3 (2.0–5.9)
Cumulative time-loss, days	5.5 (2.0–10.0)	6.0 (2.0–14.0)	5.5 (3.5–7.0)	5.5 (2.0–10.0)	6.0 (2.5–12.0)
Duration, ^d weeks	3 (2–5)	2 (2–6)	4 (2–4)	3 (2–6)	4 (2–6)

95% CI: 95% confidence interval; IQR: 25–75% interquartile range.

^a Time-loss was defined as the number of days in which no full participation in training or matches was possible.

^b Due to variability in the prevalence of injury over the study, the lower bound of the 95% CI was negative. As prevalence values cannot be negative, the lower bound of the 95% CI was truncated to zero when this occurred.

^c Substantial injuries are those leading to moderate/severe reductions in training volume, or moderate/severe reductions in field hockey performance, or inability to participate in regular training/competition.

^d Injury duration represents the number of follow-up measures in which the injury was reported.

Our findings are consistent with previous studies using the same methods to register injuries in different sports. Clarsen et al.¹¹ reported a mean prevalence of injury of 25% (95% CI 24–27) in Olympic and Paralympic athletes from team, endurance, and tactical/technical sports followed-up in a weekly basis. The mean prevalence of overuse injuries was higher (20% [95% CI 18–21]) than acute injuries (4% [95% CI 3–5]). Comparable results were found in youth tennis players and adult runners.^{13,14,20} Comparing our results with other studies on field hockey is not possible since, to our knowledge, this is the first study reporting the prevalence of injury measured repeatedly over time in field hockey. The prevalence repeatedly measured over time is considered the preferred method to describe the overall risk of injuries in sports involving overuse injuries.¹⁰

Injury incidence density

Studies on field hockey have employed different populations, used different definitions of injury, and applied different methods for recording such injuries, which also makes comparisons difficult. In sports, continuous athlete monitoring (i.e. longitudinal data) is recommended to get the full spectrum of injuries in a determined setting.²² To the best of our knowledge, the study with the longest period of injury registration in field hockey (i.e. 15 seasons) reported that 3.7 injuries per 1,000 player-practices and 7.9 injuries per 1,000 player-matches were sustained by collegiate women field hockey players.⁸ These results seem to be consistent with the present study since the incidence density of acute injuries was lower in training than in competition. However, these findings are not directly comparable given that the definition of injury in the previous study⁸ was based on medical attention and at least one day of field hockey time-loss. In addition, in the present study, we have reported the number of acute injuries per 1,000 player-hours of training/competition (i.e. not per player-sessions) to take into account the players' 'time-at-risk' since this has been recommended to facilitate comparability between studies on sports injury.¹¹

Injury severity

Measuring the severity of sports injury is fundamental to understand the impact of injury on athletes' health.²³ Although the severity of sports injury has been commonly estimated according to days of sport time-loss, the results of the present study show that 50% of the injuries reported by field hockey players did not lead to playing time-loss. Although the definition of injury is context-specific,²⁴ this finding suggests that defining an injury as one that leads to playing time-loss only may underestimate the injury problem in field hockey. The same may apply to defining injuries based on received medical attention since 22% of the injuries described in the present study did not receive medical care.

The design of the present study with repeated measures over the season minimised the possibility of recall bias and enabled the assessment of the severity of injuries using different measures (i.e. severity score, duration, medical attention, play time-loss, and impact on hockey participation/performance) in order to describe the overall burden of injuries experienced by elite field hockey players. The substantial injuries described in the present study were more severe by definition since they are the ones hampering training/competition participation and/or performance. Substantial injuries represented 30% of all injuries and affected 52% of the injured players. This finding confirms the hypothesis that, by reducing performance, injuries may negatively affect team success over the field hockey season. Although such analysis goes beyond the aim of the present study, the negative impact of injuries on team's success has been described in other sports.²⁵

Limitations

There are also limitations to be considered when interpreting the findings of this study. First, our results come from a convenience and relatively small sample of elite field hockey players from five Dutch teams, which may not represent the whole elite field hockey population of the Netherlands. Future studies should ideally include larger and random samples of field hockey players in order to minimise selection bias. Second,

the hours of training/competition and injuries registered in this study were reported by players (i.e. self-report data) and were not diagnosed personally by a health professional. However, all injury cases were reviewed by a physiotherapist and coded according to the Orchard Sports Injury Classification System version 10 (OSICS-10),¹⁹ which has an overall high level of agreement between coders.²⁶ This does not rule out that having a health professional to evaluate the injured athlete 'on the field' may minimise report bias in future research.

Perspective

This study provides knowledge on the magnitude, severity, and nature of injuries experienced by elite field hockey players. While injuries may hamper players' performance and availability for training and competing, prevention is essential in field hockey, and the use of protective equipment has been encouraged in previous studies.^{4,27} The use of protective equipment is important for injury prevention. However, the present study shows that non-contact injuries, those that may not be preventable with protective gear, are also a burden on field hockey players' health. In sports, these injuries may be prevented with structured exercise,^{28,29} and load management.³⁰ Therefore, the investigation of such strategies is encouraged in elite field hockey.

In addition, the methods employed in the present study are relatively simple to be used in real-life settings to capture minor injuries, enabling health professionals to act earlier in order to prevent minor injuries from becoming severe and costly. Such methods have been used in previous research to register health problems in different sports,^{11,13,14,20} and enable recording health problems from athletes regardless of their consequences (i.e. required medical attention or sport time-loss) and nature (i.e. acute/overuse).

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