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Noncontact Injuries, Rates, Mechanism and Occurrence in Field Hockey in Scotland

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ABSTRACT

gcjb fmaicw fmaicw * l glrcpkgrrclr* glt gtc nmpr a ppgc glhspw pg i , fgjc amlr ar glhspgc f tc ccl pcnmprcb* lmlamlr arglhspgc glfmaicwf tcpcacgtcbjgrrjc rrclrgmlglrfc agclrgdgajgrcp rspc*rfcpcdmpc*rfg rsbwugjjdmas mlrfcdpcosclaw* kcaf lg k*af p arcpg rga *rgkgle* lbl rspcmdlmlamlr arglhspgc glrfg nmpr,

***Methods:** retrospective onlineinjury questionnaire as completed by oc ey players n , male , female of all positions, various levels, and a es to capture noncontact injuries in hoc ey he questionnaire as available via the SurveyMon ey platform bet een November and March*

***Results:** verall noncontact injury rates ere per playin hours CI , / playin hours for females CI and CI, for males Injuries to the nees, hamstrinas,d an les are the most commonly reported injuries durin sidesteppin , landin , and sudden acceleration, causin minimaldorht injuries here ere no statistical differences p in level, a e, position, or ender Injuries occurred more frequently not statistically different in trainin than in competition, and competition, more injuries ere sustained in the quarter of the ame here ere more injuries durin the first half of the season than in the second half*

***Conclusion:** No statistically si nificant differences ere observed in injury rates in hoc ey bet een enders, positions, a es, and levels oc ey players sustained injuries o the nee, hamstrin , and an le durin sidesteppin , landin , and acceleratin causin minimal or sli ht injuries muscle/li amendlama e and bruisin in trainin and the rd quarter most frequently Noncontact injury rates in hoc ey are similar to other team sports*

ey ords: Field hockey, Injury, Non-contact, Scotland, Players

INTRODUCTION

Field hockey is a popular sport governed by the Federation Internationale de Hockey (FIH) worldwide and is now played in over 132 countries. The rules of Hockey continue to change (e.g. self-pass rule) altering the tactical strategies and physical demands to make the game quicker and may change the injury profile.

The injury profile of hockey players has previously reported lower limb injuries to account for over half the total (51%), with ligament sprains being the most frequently occurring (39.7%) followed by contusions (17.1%) and fractures (16.4%). Also, Goalkeepers seem to have the highest injury risk followed by those that play multiple positions such as midfi lders; while forward and defenders have similar injury rates.

Injury surveillance in the National Collegiate Athletic Association (NCAA) shows injury rates in women's hockey to be 7.9 and 3.7/1000 athlete-exposures (A-E's) in games and training respectively. Ankle ligament sprains were reported as 0.46 and knee ligament injuries as 0.07/1000A-Es. Injury rates in elite female hockey were reported as 70/1000 game or training exposures with a greater number of injuries in the second half of a game or training; non-contact injuries were most frequently occurring while defenders were at greatest risk than other positions. In male Hockey, forwards were injured most frequently caused to quicker movements and increased player contact. The trend was for a decreased injury rate as the level increased with 31% of district players reporting an injury compared to 23% of national players [1-3].

In elite competition injuries shows injury rates of 0.85/game or 39/1000 player matches; 47% were to the lower extremity with contusions occurring the most frequently while there was no difference in injury rates between the fi st and second halves. Most of the injuries (45%) were 'mild' or 'minimal' with a time-loss injury rate of 16/1000 player matches with male injury rates reported as 5 times higher than females and males sustaining more injuries to the head/neck and the lower extremity. Conversely, during elite competition in 2013, injury rates were 0.7/match for males and 1.2/match for females (or 20.8/1000 in males and 29.1 mean/1000 match hours for females). More injuries occurred in the circle of the scoring zone (about 50% of all for both genders) with more injuries to the head and face in females. In addition, more injuries occurred later in the game; 14% and 15% in the fi st quarter and 30% and 31% in the last quarter for females and males respectively, Furthermore, reported hockey players sustained 66 injuries, 37.8% of which required 1 day of absence in elite hockey during a tournament (matches and training) with similar rates of injury in both genders.

Noncontact injuries accounted for 36.8% of practice and 17.7% of competition injuries in the NCAA over 15 sports including hockey whereas non-contact injuries in Hockey were 62% and 20.53%. Rishraj et al. reported noncontact injury rates of 41.5/1000 athlete-exposures. However, details on these injuries are limited.

More recently, In a systematic review (with 22 studies and no selection bias), reported that noncontact injuries accounted for 12%–64% of all injuries and mainly to the lower body (up to 77%). Similarly, in a systematic review of youth hockey injuries (26 studies included via PRISMA), found injuries were up 11.32 per 1000 athlete-exposures with adult hockey up to 15.2 per 1000 athlete-exposures, however, there is limited information on time-loss injuries and the mechanism of injury.

In outdoor and indoor hockey, sampled both genders and levels (including youth divisions) indicated that the injury rate was 3.7 per 1000 playing hours with a greater in matches than training at 2.7 vs 9.7 per 1000 hours which is much lower than practice and match injury rates reported by in men's hockey, (4.2 vs 41.2 per 1000 hours in training and matches respectively). Rees also reported noncontact injuries accounted for 66.9% of all injuries and 42.5% of all injuries occurred to the hamstring, knee, and hip/groin[4-10]. Furthermore, this led to an injury burden of 61.4/1000 hours days lost to injury with muscle strains (mostly hamstring) causing the most significant time loss (35 and 22.6/000 hrs respectively).

In a follow-up prospective study in Dutch elite hockey players (n=80), Barbosa et al. found similar patterns to their earlier study with noncontact injuries also being most prevalent and mainly to the lower extremities. Furthermore, noncontact injuries occurred at 2.88 (95%CI 1.81, 3.96) per 1000 player-hours in the control group of mixed-gender youth hockey players.

Overall, more research is required due to the lack of detailed investigations into noncontact injuries and due to the lack of evidence specifically into the frequency, mechanism, characteristics, timings, and nature of injuries in Hockey. Therefore, the purpose of the study was to:

- Assess the frequency of injury.
- Establish any gender, age, level, or positional differences.
- Timings of injury.
- Assess the nature and time-loss of noncontact injuries sustained in Hockey [11].

MATERIALS AND METHODS

Study design

Th s is a retrospective cross-sectional study that used a questionnaire-based data collection procedure to recall injuries in terms of the anatomical site injured, the mechanism, severity, timing, and when in the season it occurred. The questionnaire was open to all hockey players, ages, and levels in Scotland who were actively playing during the 2013–14 season. The questionnaire was administered either electronically (via Survey Monkey®, n=336) or a paper version (n=4) with informed consent gained before completion. Ethical approval was granted from the Edinburgh Napier University ethics committee for this study and the participants provided written informed consent.

The questionnaire included sections on player profiles, noncontact injuries, current training practices, and validation. The 31-point questionnaire (achieved a mean validation result of content validity index (I-CVI) of 96.0% between the reviewers and 96.8% across the questionnaire, mean Scale Content Validity (S-CVI) of 97.6% across reviewers and 98.4% across the questionnaire) and a reliability score (Pearson product correlation) of 0.965[12].

Inclusion/exclusion criteria

Data were excluded if the information on hours or weeks played was unanswered, if the number of hours per week exceeded 25, or if it was not possible to calculate the value. Any written answers were converted into numbers with 1 game=1.5 hours played.

Injury, injury rate, and severity definition

The defin tion of noncontact used in this study was reported: "A traumatic event without contact with another athlete or object" (p=415). The severity of defin tion used was set out (0-1 day timeloss, slight; 2 days-3 days, minimal; 4 days-7 days, mild; 8 days-28 days; moderate, 28+ day, severe). Lastly, the injury rate calculation was recommended which was injuries per 1000 playing hours [13,14].

Data analysis

Data were presented descriptively as percentages along with 95% Confide ce Intervals (CI). Injury rates were presented as the

number of injuries per 1000 playing hours. Statistical analysis used the Mann-Whitney U test (gender differences, age, and severity) and the Krushal-Wallis test for the anatomical site and timing of the injury. An α level <0.05 was used to accept statistically signifi ant differences. IBM SPSS (version 23) (New York, USA) was used for all analyses.

RESULTS

In total, 456 athletes answered the questionnaire. Of those, 317 (166 male and 151 female) were included (Table 1). All participants were volunteers who were active hockey players.

Table 1. A breakdown of the respondents included in the study by gender, position level, age and experience

Variable	Category	Category	Category	Category	Category	Category	Category
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Gender	Males	Females					
	166 (52.4)	151 (47.6)					
Age (yrs)	18 – 25	26 – 40	40+	No response 1 (0.3)			
	177 (55.8)	87 (27.4)	52 (16.4)				
Position	Goalkeeper	Defender	Midfielde	Attacker	No Response		
	23 (7.3)	132 (41.6)	101 (31.8)	58 (18.3)	3 (1)		
Experience (yrs)	≤ 1 year	2 – 5	6 – 10	11 – 15	16 – 20	21+	
	0	43 (13.5)	95 (30)	73 (23)	33 (10.4)	73 (23)	
Level	Summer	District	Regional	National	Internationala	Master	No Response
	16 (5)	105 (32.5)	70(21.7)	93 (28.8)	25(7.7)	2 (0.6)	6 (1.9)

Injury rate

There were 243 noncontact injuries reported (59.7% to females, and 43.2% to males). There were more injuries to the lower body (80.6%) than the upper body (15.6%). Injuries to the knee, hamstring, groin, and lower back were 0.88 (95% CI=0.62–1.06), 0.86 (95%CI: 0.65 – 1.07), 0.32 (95% CI: 0.19 – 0.46) and 0.28 (95% CI: 0.17 – 0.42) respectively (Figure 1).

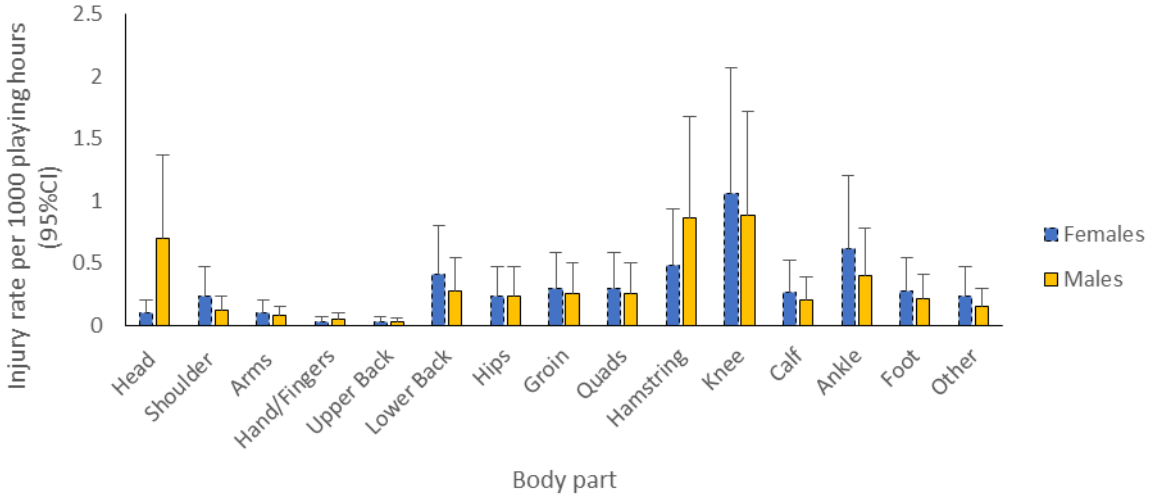

Figure 1. The injury rate of males and females by body part per 1000 playing hours (with 95% CI)

The frequency of injury for all hockey players and all hours was 4.09/1000 hours 95% CI: 3.59–4.54), females sustaining injuries at a rate of 4.73/1000 hours (95%CI: 3.98–5.4) and males sustaining injuries at a rate of 3.47/1000 hours (95%CI, 2.83 – 4.06). When 'no time off' is removed the injury rate is 3.63/ 1000 hours for all players (3.98 females, 3.24 males). If no time loss injuries are removed the injury rate for females is 3.98, males 3.24/1000 hours (3.63/1000 hours combined). There were no significant gender differences when no time loss was removed (p=0.233 and p=0.287 respectively). Injuries occurred most frequently to knees, hamstrings, and ankles for males and females (no significant gender differences, p=0.233 and p=0.287 respectively) (Figure 2).

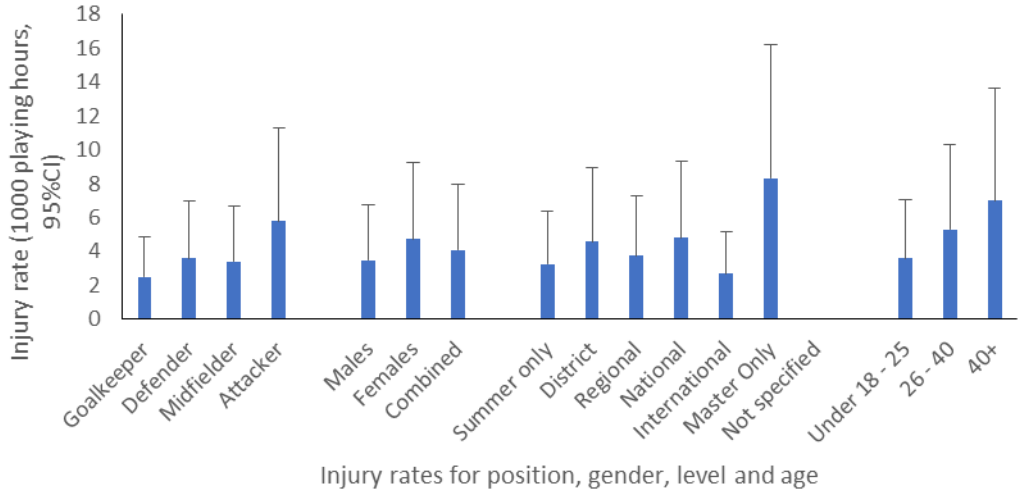

Figure 2. Injury rates per 1000 playing hours (for games and training) for each position, gender, level, and age (95% CI)

Mechanism of injury

The most frequent mechanism was 'cutting' (19.6%, 26% if 'Other and not specifi d are removed), sudden acceleration 13.8% (18.2%), Landing (12.9%, 17.1%) and 'Other' (28.5%). These injuries occurred on both sides of the body (left=40.3%, right=42%, both sides=16%). Hockey players sustained Index injuries (51.4%) and recurrent injuries (48.6%) (Figure 3).

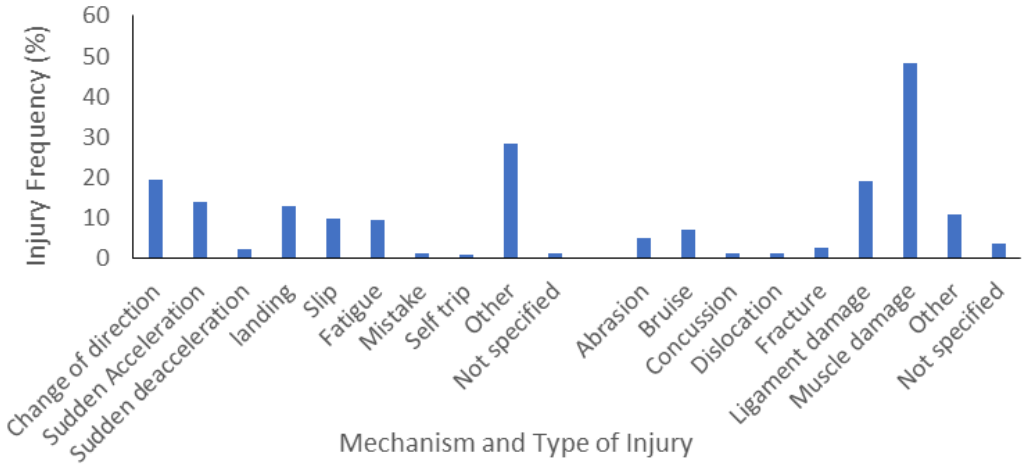

Figure 3. The breakdown of the mechanisms, type of injury for all hockey players

Characteristics of injured players

A positional comparison shows similar injury rates; Goalkeepers have the lowest injury rate (2.5/1000 hours, 95% CI:1.4–2.78) followed by midfi lders (3.57/1000hrs, 95% CI:2.6–4.2) then defenders (3.57/1000 hours, 95% CI: 2.8–4.24), attackers have the highest injury rate (5.8/1000 hours, 95% CI, 4.4–7.2) (p=0.139). A comparison of injury rates by level shows no signifi ant difference (p=0.936). The lowest injury rate (2.66/1000 hours, 95% CI, 1.7–3.6) was found in the higher level and the highest was Masters (8.33/1000 hours, 95% CI: 0.21–32.56). Injury rates by age show a slight increase (p = 0.368) for Under 18's – 25 years group (3.6/1000 hours, 95% CI, 3.03–4.11), 26 years–40 years group (5.3/1000 hours, 95% CI, 4.09–6.4) and 40+ groups (6.99/1000 hours, 95% CI, 4.75–9.3) (Figure 1).

Seasonal variability

Injuries occurred throughout the hockey season with more injuries (65%) in the fi st half (Pre-season–December) than the second half (35%) of the season (January-July). The months that had the most injuries were September - November (16%, 16.8%, and 14.4% respectively) (Figure 4). Hockey players sustained 31% of all injuries during training, 18.9% during the 3rd Quarter of a game (minute 35–42.5), 13.9% during the 2nd Quarter (minute 17.5–35), and 11.5% during the 1st quarter (0 minutes-17 minutes). There are no signifi ant differences in timing (p=0.433).

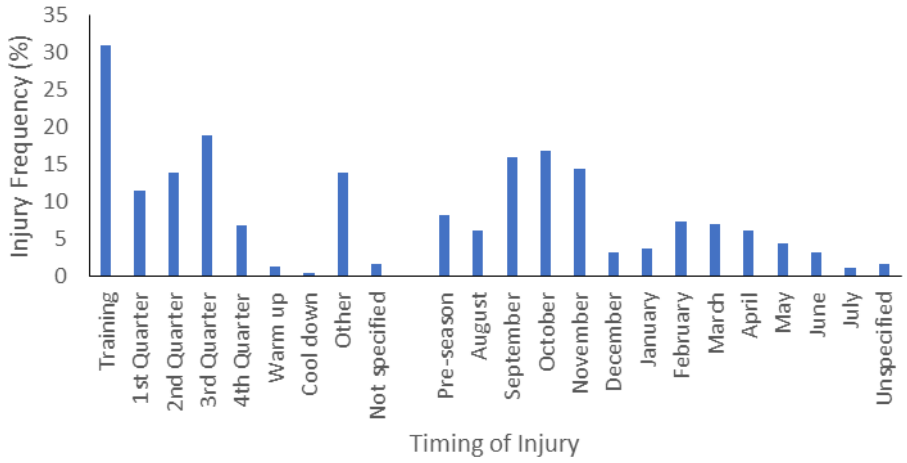

Figure 4. Injuries sustained in each month, training, and competition (%)

Nature of injuries

The most common type of injury was muscle damage (48.3%). Also frequently occurring (19.2%) are ligament injuries and abrasions (4.9%) (Figure 3). The time loss data shows 31.4% missed no hockey sessions, 19.8% missed 2 weeks-4 weeks, 17.4% missed the next session, followed by 10.5% missed 1 week–2 weeks and 1week–2 months (Figure 5).

Figure 5. Time loss from hockey for all hockey players

DISCUSSION

Th s was a cross-sectional study that aimed to explore solely on noncontact injuries in fi ld hockey in Scotland. Th s was a novel study as it is, to the author's knowledge, the fi st of its kind. Other studies have reported hockey injuries which may include some noncontact data without the analysis on noncontact injuries. In total, 317 valid questionnaires were included in the analysis to assess the frequency of occurrence, any gender, age or level differences, the timing of the injury, and the mechanism, nature, and severity of noncontact injuries. Of 243 non-contact injuries included in this study, the injury rate was 4.09/1000 playing hours (4.09 for females and 3.47 for males). Injuries to knees, hamstring, and ankle that occurred during sidestepping and sudden acceleration were most common and caused minimal or slight injuries. There were no statistical differences in gender, position, age, or level.

Site of injury

The location of the injuries reported by participants in this study was largely to the lower body (80.6% versus 11.5% to the upper body) which is slightly higher than other studies (i.e. 51%) and between 43%–7% in males Also, this is higher than Basketball and Handball which reported lower body injuries between 57% and 61.5% of all injuries sustained. However, these results are similar to Football in which 87% were to the lower extremity as both sports have similar movement patterns, size of playing area and tatics. More specifically, in the current study, knee injuries and hamstring injuries where most common (19.3% and 18.9% respectively), while in other hockey studies into female hockey injuries report injuries to the lower back and ankle/foot were more common (14% each) whereas in male hockey, ankle (13.5%) knee (10%) and lower leg (8%) injuries were the most common [15-18].

Frequency of injuries

The noncontact injury rates in this study occurred at 4.09/1000 hours overall. These results are less frequent than in elite women's hockey (41.5/1000AE's)which is accounted for the offensive nature of their play and includes contact injuries. In the NCAA, training injury rates reported as of 3.7/1000A-Es and 7.9/1000A-Es in competition. At the Olympics, the rate was even higher at 21 for men and 4/1000 hours for women with noncontact injury accounting for 38% of all injuries for men and 14% for women. The discrepancy in results maybe due to the intense nature of elite sport, the inclusion of contact and noncontact injuries and the unit and methods of measurements used (athlete-exposures vs /1000 hours of play).

The knee injury rates in this study are higher than other studies however, most studies only report knee ligament injuries. If only knee ligament injuries are considered, injury rates in this study are 0.135/1000hrs (95%CI 0.06 – 0.23) with knee ligament injuries in females of 0.27 (95% CI 0.12–0.47). Other studies in hockey report Anterior Cruciate Ligament (ACL) injury rates of 0.07/1000A-Es and epidemiological studies in handball report higher knee ligament injury rates (0.31/1000 hours; male knee ligament injury rate=0.06 and match knee injury rate of 0.97/1000 hours, The hamstring injury rate (0.48 and 0.86/1000 playing hours for females and males respectively) is lower than in other team sports, with the rate of injury for hamstrings in Rugby (all types) reported as 0.27 in training and 5.6/1000 hours in matches. Hamstring injuries in hockey appear to be less frequent than Australian Rules Football (4/1000 hours). However, the rate between Hockey and Football is similar with hamstring injuries in football occurring at 0.4 in training and 4.1/1000 hours in matches. Most hamstring injuries (between 60%– 80%) occurred during running/sprinting and kicking. However, injury rates in this study may be under reported as other studies have medical professionals recording injuries, particularly in prospective studies. Also, sports such as rugby and soccer involve kicking which has been known to increase the risk of hamstring injuries.

Ankle injuries in this study are reported less frequently (0.62 and 0.4/1000 playing hours for females and males respectively) than in other Hockey studies (0.9/1000 days) However, differences in unit of measurement used, sample group, playing surface, and level of competition may account for this difference. Ankle injury rates are also lower than Australian Rules Football (2.7/1000 hours) Football (0.4 for training and 1.6/1000 hours during matches) men's Basketball ankle injuries (1.06 and 2.33/1000 A-E's) for training and games respectively) However, these studies include all injuries not just noncontact, and/or have greater occurrences of cutting and landing [19-25].

Mechanism of injury

The majority of injuries in this study showed they were sustained during changing direction (or 'cut'), landing and accelerating (Figure 3). During a hockey match play, the main mechanism of injury is contact with the ball (52% for women and 37% for men). Handball shows a similar pattern of injuries during plant and cut, landing and turning with half of these injuries during a noncontact context. In basketball, the mechanism of injury came from general play (36.02%), landing (20.34%) and warming up (14.83). Th s data differs from those in Indian male hockey as injuries occurred during tackling (44%), other (33%) and dribbling (20%) [25].

Characteristics of injured players

Th s data shows a gradual (not statistically signifi ant) increase in injury rate with age. The link between age and injury rate is equivocal with 306 elite male football players, showed a signifi ant increase with age for hamstring injuries however, and also with elite male football players, did not showed mixed evidence for an increased risk as age increases. Across sports generally, mean injury age was 21.7 years with the 15 year–19-year-olds sustained the most injuries Th s data shows a non-signifi ant positional difference with a trend towards defenders and midfi lders sustaining injuries at the same rate and attackers a slightly higher (Figure 2), whereas Rishi Raj showed backs (36%) were injured the most, then forwards (32%) followed by midfi lders (22%). However, Murtaugh (2001) reported that goalkeepers had the highest injury rate (maybe due to the increased contact with the ball and other players) followed by midfi lders with defenders and attackers having a similar rate to this study. Contact injuries may account for this result since those that played multiple positions had the highest injury rate of 0.51 injuries/athlete-year. In male hockey, injury frequency shows that forwards injury the most (37.7%) then defenders (30.5%) injured followed by midfi lders (24.2%).

Level of play and timings of injury

Th s data shows there was no signifi ant difference between level and injury rate. Sharma et al., showed that injury rates decrease with level; district players sustained 31%, state level sustained 25.2% and national sustained 23% of all injuries [26]. Th s discrepancy may be due to an increase in skill level which may reduce the number of contact injuries. Across several sports, there was mixed evidence to suggest there is a general trend therefore, further investigation is required.

Injuries in the present study were sustained more frequently during competition than in training (Figure 4). A similar trend was also found by Hootman et al. and Theilen et al. practice injury rates of 3.7/1000A-Es versus 7.9/1000A-Es in competition and in elite Hockey (66.6% in competition, 33.3% in training respectively). Th s trend was also found in American Football (Yard and Comstock, 2006) may be due to the increased intensity of competition compared to training,

There were more injuries in the 3rd quarter of a game (minute 35-42) followed by 2nd and 1st quarter (Figure 4) found in this study. Other hockey studies report slightly different figu es; 21% of injuries in the fi st half with 79% in the second half . Theilen et al reported more injuries after the fi st quarter than other periods. In Football, the data shows the number of injuries rise throughout each half . As these patterns are varied more investigation is required.

There were more injuries in the fi st half of the season in this study (Figure 4). Th s is during the Hockey season but is more than

the equivalent time in the second half although not signifi ant. Th s is a similar pattern in rugby. In Football and the NCAA, the injury rate appears to be more consistent throughout the year (2.0/1000hrs for overuse injuries, 6.0/1000 hours approx. for all injuries)

Nature of injuries

The most common type of injury in this study was muscle damage followed by other, ligament damage and bruise (Figure 1). Rishraj et al. report muscle strains (40%), tendonistis (24%) and contusions 17%) as the most frequent type of injury. Earlier research reported that ligament injuries accounted for 40% of all injuries with 17% are contusions and 16% as fractures, muscle strains below 9% and that males have a different injury profile. However, most Hockey studies include contact injuries and therefore this can affect the injury profile.

The severity of injuries in this study shows that nearly half of the players sustained a 'slight' or 'minimal' injury and nearly 20% sustain a moderate injury which is similar to women's elite Hockey in Canada in which most players returned to play before 7 days timeloss (Figure 5). In elite Hockey, women's injury resulted in 4 times the timeloss than the men's possibly due to the number of head and fewer lower extremity injuries [27-32]

Limitations and future directions

There are several limitations in this study that should be acknowledged. Th s study used a retrospective recall approach which can be prone to recall bias; exaggeration or minimising their playing time thus affects injury frequency, severity and timeloss reported. A prospective study may increase the accuracy of data. The defin tion of an "injury" used in this study may affect the results. In this study, no timeloss injuries were defi ed as no injury however, this may have caused under reporting of injuries in hockey. Players may report to training sessions, however, limited participation, not performing certain actions, reduced intensity or completion of an alternative session rather than timeloss. A sample of 317 participants represent approximately 5% of the hockey playing population in Scotland and therefore a greater sample size would increase the external validity of the study.

CONCLUSION

The noncontact hockey injury rate in Scotland is similar to other team intermittent sports with females sustaining injuries at a slightly higher rate than males. There were no statistical differences between playing positions, ages or levels. The most frequently reported mechanisms of injury were changing direction, landing, and accelerating to both sides of the body leading to muscular and ligament damage and bruising. The most common sites of injuries were to the knee, hamstring, and ankle. Injuries occurred mostly in training, 3rd quarter, and 2nd quarter of a game which led to no time off, 2 weeks-4 weeks and the next session.

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