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Musculoskeletal pain in lacrosse officials impacts function on the field

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ABSTRACT

This study determined the prevalence of joint pain among lacrosse officials and described the impact of pain thereof on current officiating duties on the field. Members of the US Lacrosse Officials Development Programme were provided with an electronic survey (a 15.7% response rate resulted in N = 1,441 of completed surveys). Pain sites and severity, previous injuries and current impact of musculoskeletal pain on officiating duties were captured. Pain was present in 18.1–40.1% of respondents at the foot, shoulder, back and knee. A total of 437 officials reported diagnoses of osteoarthritis ([OA]; knee 48.7%, hip 10.5%, spine 10.1%, shoulder 8.0%) and 247 reported OA in more than one joint ($p < .05$). Officials with OA or previous lacrosse-related injuries reported frequent difficulty with running the entire field distance ($p < 0.0001$), starting and stopping on the field ($p < 0.0001$), keeping pace ($p < 0.0001$), focusing on multiple actions of players at once ($p < 0.0001$), and enjoyment (all $p < 0.0001$). Musculoskeletal pain is a common, unrecognized issue in this population that interferes with sport officiating functions. Additional study is needed to objectively determine the impact of OA pain and musculoskeletal injuries on measurable performance outcomes on the field and subjective measures of focus, attention and enjoyment.

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KEYWORDS

Lacrosse; injury; pain; knee; hip

Introduction

Lacrosse officials are responsible for enforcing rules of the game but are also unrecognized athletes who function as the “third team” on the field (US Lacrosse, 2019b). During typical regulation games, officials traverse a 60–120 yard field while cutting, pivoting and manoeuvring among players for durations ranging 32 to 48 min or more. The time to complete games can range from 45 min to 2 h, all of which requires focused attention on simultaneous details from offence and defence. Some referee at intensive weekend tournaments while others engage in single games in competitive leagues or school districts. In single or multi-day tournaments, officials may be responsible for monitoring several games in 1 day. Some participate during specific seasons, whereas others participate year-round. Officials are

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expected to keep pace with the game activities and perform their duties as best as possible to promote fair and safe play.

Research efforts have focused on establishing musculoskeletal injury patterns in lacrosse players using injury surveillance and biomechanical approaches (Barber Foss et al., 2018; Caswell et al., 2017; Hinton et al., 2005; Kerr, Caswell et al., 2016; Kerr, Lincoln et al., 2017, 2018; Kerr, Quigley et al., 2017; Lincoln et al., 2007; Tadlock et al., 2018). From these data and others, some injury prevention programmes by US Lacrosse (2019a) and pre-rehabilitation exercise programmes for players across the age spectrum are emerging (Vincent & Vincent, 2018, 2019). Lacrosse officials have not been the focus of research efforts despite their critical role on the field for player safety, however. Officials may be former lacrosse players, former athletes, parents or other interested individuals. Across all levels of competition, maintaining optimal performance of officials on the field is important for player safety. Similar to the players, some have a history of injury or history of musculoskeletal pain in different bodily areas or joints. Depending on the age or previous sport experience of the individual, degenerative joint pain and osteoarthritis (OA) may be present. Pain-related impairments can potentially interfere with key officiating functions and enjoyment. Officials must be able to repeatedly run the entire field distance, focus on multiple actions of players at once, keep pace with the location of action during play, and maintain ability to start and stop quickly based on location of action on the field. Retention of officials over the long term is critical for continued growth of the game and expansion of the available pool of experienced officials. Musculoskeletal pain has the potential to diminish the enjoyment of officiating and deter continued involvement. A first step towards developing injury prevention programmes and health promotion for lacrosse officials is an understanding of the scope and effect of musculoskeletal pain in this population.

Most of what is known about musculoskeletal injuries and pain in sports officials who cover similar field distance is from football (Bizzini et al., 2011; Gabrilo et al., 2013; Kordi et al., 2013). Acute seasonal injuries occur in 46–56% of football referees, with most injuries occurring in the abdominal region and the lower limbs (Gabrilo et al., 2013; Kordi et al., 2013). Among a cohort of Swiss football referees, 25.8% reported experiencing at least one musculoskeletal complaint and 22.5% reported an injury from officiating (Bizzini et al., 2011). Injuries ranged from chronic overuse (tendinitis, bursitis) to acute (sprain, dislocation, fracture, muscle strain, concussion) (Gabrilo et al., 2013). Evidence is accumulating to show that former or retired players from football, American football or rugby who experienced injuries or played the sport commonly develop early-onset debilitating OA (Gian et al., 2017; Golightly et al., 2009; Gouttebauge et al., 2018; Hind et al., n.d.; Lynall et al., 2017). The prevalence of injuries OA among various subgroups of sport officials, including lacrosse, is largely unknown despite similar cumulative stresses and injury risks of performing on the field.

Therefore, this study aimed to address these significant evidence gaps by (1) Determining the prevalence and patterns of musculoskeletal pain among lacrosse officials, and (2) quantifying the impact of pain on officiating roles. We first hypothesized that the knee, ankle and low back would be the most common pain sites for both men and women. Second, we hypothesized that pain would interfere with several officiating duties including focus on multiple players, covering field distance and keeping pace with the action on the field.

Methods

Study design

This cross-sectional study and all its procedures were reviewed and approved by the University of Florida Institutional Review Board (study number #201801464). Due to the anonymous nature of data collection, a waiver of documentation of consent was obtained.

Participants and procedure

Individuals who were ≥ 18 years old and currently active in the US Lacrosse Officials Development Programme were provided with an anonymous online survey (potential catchment $N = 9,178$). The survey was distributed to the nine U.S. regional managers of the Programme for posting on the appropriate electronic sites (June–July 2018). Electronic responses were collected and stored using the Research Electronic Data Capture REDCap (Harris et al., 2009) system at the University of Florida.

Survey instrument

At present, there are neither injury surveillance mechanisms nor specific survey instruments available to query lacrosse officials regarding musculoskeletal health and perceived impact of pain on officiating duties and enjoyment of the game. We designed a 29-item survey to determine: (a) previous lacrosse injury, (b) current sites of musculoskeletal pain, (c) impact of pain on main officiating duties, and (d) enjoyment in the role of officiating. All eligible officials in all nine U.S. regions were provided with a survey link to complete the study. Respondents indicated the competition levels in which they officiated (youth, high school, collegiate or professional) and during what seasons they officiated (spring, fall, summer or all year-round). Respondents also reported whether they officiated games for boys/men, girls/women, or both.

Previous lacrosse injuries

Participants were asked to recall whether or not they sustained any lacrosse-related injuries to the major joints, limbs and head (concussions) for which they received medical care. Injury type was categorized into fracture, sprain/strain or other based on description of injuries (such as dislocations, contusions). Body sites were categorized into shoulder, elbow-arm, hand-wrist, lumbar spine, hip, leg, knee, ankle, foot, neck and head. Answers were recorded as binary (yes/no).

Current sites of musculoskeletal pain

Respondents were asked about musculoskeletal pain based on previous participation as a lacrosse player or not. If applicable, former players first reported whether or not they had incurred an injury that required medical attention from a physician while playing lacrosse, and then, if persistent pain still currently exists at the same site. For the remaining respondents who were not former lacrosse players, the survey asked whether or not they regularly experience

musculoskeletal pain in the key areas: shoulder, elbow-arm, hand-wrist-fingers, elbow, back, knee, ankle-foot-toes and neck. Dropdown lists were provided for each question. For all respondents, current average weekly pain severity at rest and during exercise was captured using an 11-point numerical pain rating scale (NRS_{pain}), where 0 = no pain, and 10 = worst imaginable pain. NRS_{pain} is responsive, valid and reliable among persons with chronic joint pain (Alghadir et al., 2018; Ferreira-Valente et al., 2011). Participants were asked whether they had an official physician diagnosis of OA in any joint. A dropdown list was provided for respondents to select the joint(s) for which OA was diagnosed (knee, hip, ankle, shoulder, spine, hand).

Impact of pain on officiating duties

Presently, there are no available questionnaires from which to assess the impact of musculoskeletal pain among individuals who referee sports. As such, five Likert-style questions were developed by some members of the study team based on observations of referee actions on the field and from on-field interviews with referees themselves. Participants answered the following: *Do you feel that your bodily pain prevents you from performing at your best officiating on the field: (a) Running the entire field distance, (b) Focusing on multiple actions of players at once during game time? (c) Being able to keep pace during the entire game? (d) Are you concerned that you have to slow down or stop moving on the field because of the pain? and, (e) Does musculoskeletal pain interfere with the enjoyment of officiating?* For each of the five items, respondents could select a choice of “never”, “occasionally”, “sometimes”, “often” and “always”.

Statistics

Statistical analyses were conducted using IBM SPSS (Armonk, NY; version 25.0). Descriptive statistics were calculated for demographics and all study variables (presence of musculoskeletal pain, pain from prior lacrosse injury or from diagnosis of OA). Odds ratios (OR) were calculated to determine difference in current pain between sexes. Chi-square tests (χ^2) were used to determine whether differences existed between men and women with respect to pain prevalence or pain location. Mann–Whitney *U* was used to test whether proportions of responses on the difficulty levels with officiating duties were different when officials were grouped by pain mechanisms (prior lacrosse injury, OA), OA joint location (knee, hip, shoulder, ankle, spine) or sex (men, women). An α level of 0.05 was considered significant.

Results

Characteristics

Of the 9,178 eligible respondents, a total of 1,615 individuals initiated the survey and 174 did not get beyond completing the demographics and were not included in the final sample (Table 1). All geographic regions defined by US Lacrosse were represented and consisted of both sexes with varying levels of lacrosse experience. All nine geographic regions defined by US Lacrosse were represented and consisted of men and women with varying levels of lacrosse playing experience (“never played” to “professional”). Among

Table 1. Characteristics of the US Lacrosse Official survey respondents. Values are means \pm SD (minimum and maximum) or per cent of the group.

N = 1,441	
Age (yr)	52.0 \pm 12.9 (18.0–84.0)
Height (m)	1.73 \pm 0.94 (127.5–197.5)
Weight (kg)	87.2 \pm 17.1 (47.3–150.0)
Body mass index (kg/m ²)	28.7 \pm 4.6 (18.4–54.3)
Men/Women (#, %)	1145 (79.5)/295 (20.5)
Geographic region represented (%)	
Northeast (n = 425)	29.5
Southwest (n = 73)	5.1
Pacific Northwest (n = 66)	4.6
Mid-Atlantic (n = 275)	19.1
Great Plains (n = 38)	2.6
Southeast (n = 209)	14.5
Mountain (n = 63)	4.4
Great Lakes (n = 212)	14.7
Pacific Southwest (n = 79)	5.5
Missing (n = 1)	0.1
Highest level lacrosse played	
Never played (n = 736)	51.1
High school (n = 151)	10.5
Collegiate (NCAA, club; n = 330)	22.9
Post-collegiate league (n = 214)	14.9
Professional (n = 10)	0.7
Position previously played *	
Faceoff (n = 98)	13.9
Attack (n = 220)	31.2
Midfield (n = 356)	50.4
Long stick midfield (n = 79)	11.2
Defence (n = 289)	40.9
Goalie (n = 112)	15.8
Levels of Officiating **	
Youth U7-U11 (n = 910)	63.1
Youth U11-U13 (n = 1096)	76.0
Youth U13-U15 (n = 1174)	81.4
High School U15-U18 (n = 1227)	85.1
Collegiate (n = 512)	35.5
Other leagues (n = 226)	15.6

*Participants may have reported more than one position; ** participants may have reported officiating at more than one level; other leagues = box lacrosse, professionals, world festivals, post-graduate leagues.

those who previously played the sport (n = 750), the different field positions were all represented. A total of 88.6% of respondents played other sports in high school or college (1011 men and 265 women). Nearly half of the sample (48.2%) had officiated for more than 10 years. The per cent of respondents who officiated for 1–2 years to 9–10 years increased by age bracket from 12% to 51.8%.

Officiating duties

Overall, 60.4% reported officiating during the spring, 26.2% in the fall and 27.6% in the summer and a total of 40.9% participate all year-round. The majority of respondents refereed boys' and men's leagues compared to girls' and women's (56.4% versus 39.2%). Fifty-nine individuals reported officiating for both sexes.

Previous lacrosse injuries

Former lacrosse players reported their sport-specific injuries (Table S1, top). A total of 73.7% of respondents who were former players reported a musculoskeletal injury. The three most common sites for prior injury included the ankle (86.5%), hand/wrist (79.8%) and knee (61.9%). Women were more likely to report ankle injuries (46.4% in women versus 41.3% in men; OR 1.23 [95%CI 0.952–1.593]; $p = 0.010$) and hip injuries (6.7% versus 3.9%; OR = 1.77 [95% CI 1.03–3.06] $p = 0.037$) compared to men. The prevalence of arm/elbow injuries was higher in men than in women (9.3% versus 4.1%; OR = 2.43 [1.319–4.478] $p = 0.030$).

Current sites of musculoskeletal pain

Table S1 also provides the prevalence of former players who have current pain from the previous injury site (top of table). Overall, the three most common areas for persistent pain were the knee, low back and the shoulder (33.1%, 17.7% and 11.7%, respectively). Mean NRS_{pain} scores for these three sites at rest and during exercise ranged from 3.6 to 4.4 points out of 10 points.

Current musculoskeletal pain was also reported by respondents who were not former lacrosse players (bottom of Table S1). Overall, pain was most frequently reported by this subgroup in the knee (39.8%), foot (30.4%) and low back (17.3%). The average NRS_{pain} severity ranged from 3.5 to 4.6 points out of 10.

A total of 437 of respondents (33.5% of all officials [33.6% of non-lacrosse players and 33.4% of lacrosse players]) had received an OA diagnosis. One hundred and thirty-six individuals did not answer the question about an OA diagnosis. Figure 1(a,b) provides the sites of OA and the prevalence of single-joint, dual-joint and multi-joint OA. The knee was the most common site for OA (Figure 1(a)). Most respondents have single or dual-joint OA disease (84.3%), but 15.3% report having OA in multiple joints (Figure 1(b)). Men reported more a higher prevalence of pain in any joint and more than two joints with exercise participation. For pain at specific joints, men reported pain at the knee and hip more frequently than women ($p = 0.029$). Figure 2 shows these sex-differences in the proportions of officials reporting pain during exercise.

Sex, previous injury and OA pain on officiating functions

Respondents with pain from previous lacrosse injuries reported more frequent difficulties with the five game-related duties or enjoyment (Table 2). Moreover, individuals with OA in any joint indicated more frequent difficulties with the five game-related duties or enjoyment collected in this study (Table 3). Similarly, respondents with knee OA also had difficulty with all five duties. Those who reported hip OA had difficulty with three duties (*“running the entire field distance”, “concern with sudden starting and stopping on the field”* and *“enjoyment”*). No response distributions were statistically different for these duties for the other OA subtypes (shoulder, ankle, hand, spine). Men and women did not report differences in the responses to the level of difficulty in performing various officiating duties or enjoyment of the experience (p values ranged 0.247–0.918).

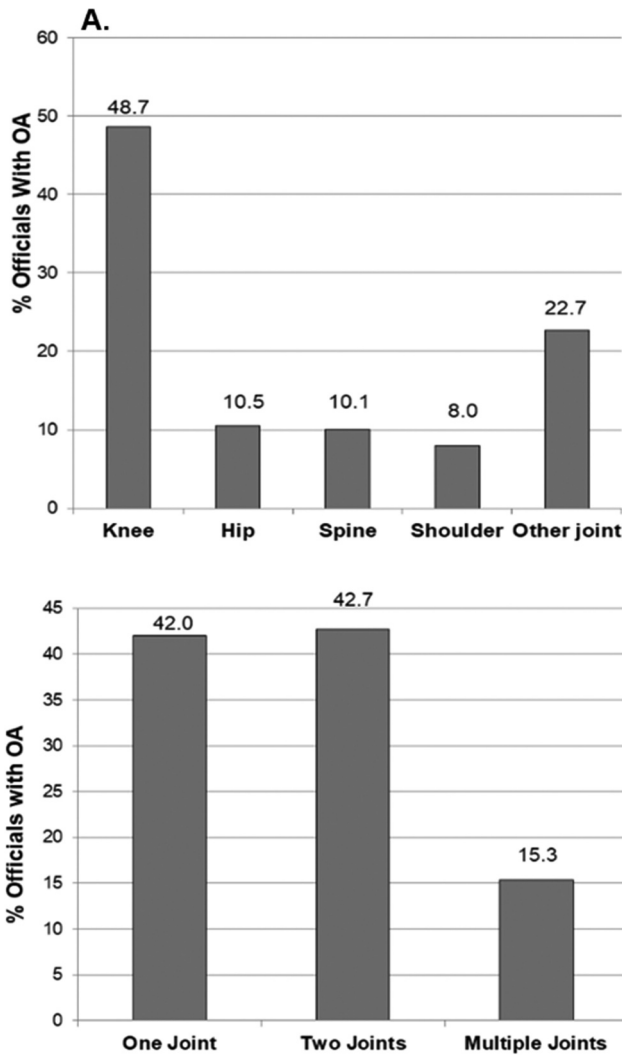


Figure 1. Prevalence of osteoarthritis (OA) according to (a). Joint involved ($n = 437$) and (b) number of joints involved. Data are indicated as a percentage (%), with specific values provided above. Note that no response for the presence of OA was given by 136 respondents.

Discussion

Musculoskeletal pain is a significant problem among officials which may extend to player safety. Over 70% of former players who officiate reported a prior lacrosse injury, some of whom still have residual pain today. The most common site for previous injury and OA is the knee, irrespective of sex. Nearly 33% of officials report having a diagnosis of OA. Chronic pain (especially knee pain) affects officiating functions on the field and enjoyment of the officiating role.

Musculoskeletal pain and OA have been characterized in other formerly athletic populations. Among retired soccer players (36 ± 6 years), knee OA is present in 44.3% and these

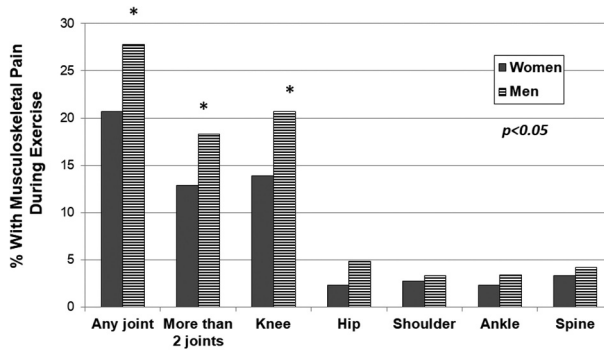


Figure 2. Prevalence of musculoskeletal pain with on-field officiating in men ($n = 1,145$) and women ($n = 295$). Values are percentages. *Denotes significant different between men and women at $p < .05$.

Table 2. Difficulty from any persistent pain from previous lacrosse injury on officiating duties and enjoyment. Data are expressed as per cent of the group with yes and no answers in individuals with and without pain.

Difficulty frequency	Never	Occasionally	Sometimes	Often	Always
1. Running the entire field distance*	37.1/56.3	34.0/28.0	19.6/11.8	5.8/2.6	3.4/1.3
2. Focusing on multiple actions of players at once during game*	78.4/82.6	14.4/12.5	5.8/3.5	2.6/0.8	0.0/0.7
3. Being able to keep pace during the entire game*	37.8/54.8	39.2/31.7	16.8/9.2	4.5/2.6	1.7/1.6
4. Do you feel you have to slow down or stop moving on the field because of the pain?*	43.4/61.0	42.4/32.2	12.8/5.4	1.0/1.0	1.5/0.3
5. Are you concerned with sudden starting or stopping on the field due to pain?*	67.2/86.2	0/0	21.4/8.7	6.6/3.8	4.8/1.3
6. Does pain interfere with enjoyment of officiating?*	39.7/59.9	32.1/28.6	17.6/8.1	7.9/2.8	2.8/0.7

*Denotes significant differences in proportions of yes responses to the question ($p < .0001$). Persistent pain from previous lacrosse injury (Yes/No) respondents with persistent pain: mean age = 51.4 ± 12.5 years, years officiating 4.5 ± 1.7 .

Table 3. Difficulty due to OA pain on officiating duties and enjoyment. Data are expressed as per cent of the group with yes and no answers in individuals with and without pain.

Difficulty frequency	Never	Occasionally	Sometimes	Often	Always
1. Running the entire field distance*	39.6/61.3	32.3/26.7	18.5/10.0	5.3/1.8	4.3/0.2
2. Focusing on multiple actions of players at once during game*	76.4/85.7	16.0/10.4	5.3/2.8	1.4/0.9	0.9/0.2
3. Being able to keep pace during the entire game*	38.2/58.5	39.2/29.8	15.1/8.9	4.1/2.0	3.4/0.8
4. Do you feel you have to slow down or stop moving on the field because of the pain?*	47.1/64.1	40.5/29.8	10.3/5.1	1.4/1.0	0.7/0.0
5. Are you concerned with sudden starting or stopping on the field due to pain?*	73.6/86.2	0/0	15.6/10.0	6.9/2.6	3.9/1.2
6. Does pain interfere with enjoyment of officiating?*	42.8/63.1	32.0/26.9	15.4/7.6	7.1/2.3	2.7/0.1

*Denotes significant differences in proportions of yes responses to the question ($p < 0.05$). OA (Yes/No) respondents with OA: mean age = 57.9 ± 9.3 years, years officiating 4.8 ± 1.6 .

individuals have lost physical and mental aspects of quality of life (Gouttebargue et al., 2018). The prevalence range of OA among retired football players was 19.6% to 45.9% depending on previous injury history and concussions (Golightly et al., 2009; Lynall et al., 2017). Our study sample is different, however, as the officials ranged in age, former participation in lacrosse and other sports and body weight. The prevalence of OA was higher in our sample

compared to the U.S. adult population (33.5% versus 10.5% (Zhao et al., 2019), respectively) indicating that joint pain imposes a disproportionate burden for lacrosse officials.

Officials are expected to monitor a large area on the field during competition. Chronic pain can negatively affect physical performance, executive function and mental thought processes because it draws from cognitive resources (Crombez et al., 1998; Oosterman et al., 2012). Attentional processes are interrupted by pain; decision-making, task completion and executive function and attentional performance are significantly lower among people with chronic pain compared to those who are not (Eccleston & Crombez, 1999). Psychomotor slowing and reductions in sustained attention occur even among persons with low levels of musculoskeletal chronic pain, similar to pain levels we observed here (Oosterman et al., 2012). Anticipation or threat of pain itself (Crombez et al., 1998) from severe OA or multijoint OA during officiating duties may also heighten pain severity. Higher pain intensity levels are related to worse attention disruption and cognitive function (Vlaeyen et al., 2016). In the context of monitoring competition, pain interfere could disrupt several key cognitive functions. First, sustained focused attention to the complex action on the field can become difficult with pain. Second, pain can slow processing of visual information occurring on the field. Finally, persistent or severe pain may dampen alertness to multiple simultaneous player actions.

In this study, the effects of pain on difficulties with on-field functions were consistent, irrespective of sex and the source of pain (Tables 2 and 3). Pain did increase difficulty with running the entire length of the field, focusing on multiple actions of players and being able to keep pace with the action. Respondents indicated concern about discomfort during sudden stops and starts during officiating. Thus, chronic pain may increase the chances that safety issues such as illegal checking or contact could be missed. Pain also decreased the enjoyment of participating in lacrosse officiating.

Currently, US Lacrosse provides sample online exercise and physical preparation programmes relevant to refereeing (<https://www.uslacrosse.org/blog/up-your-game-preparing-for-your-season-physically>); greater awareness and use of these preparatory programmes by local leagues might help mitigate pain flares among individuals with chronic pain. Modification of existing core exercise programmes can improve joint motion and help protect lacrosse officials from joint injuries or pain (Vincent & Vincent, 2018). Pain relief may be gained by accessing on-field medical resources or modalities from athletic trainers, physicians or other healthcare professionals. In long tournaments or weekend events, officials should be encouraged to seek medical care between games to minimize discomfort. Officials with chronic pain may function more effectively and comfortably on smaller fields for younger age brackets compared to larger fields that require more running. Pain relief may translate to better engagement in officiating duties, improvement in player safety and enjoyment of lacrosse-officiating duties. A final potential consideration is for officials to undergo baseline fitness testing at each level of the sport to ensure that the individual can effectively and safely meet the demands of the role, a process which occurs in field hockey, basketball, football and rugby.

Limitations

Recall bias or accuracy of injury reporting may be potential limitations to this study. Injuries were self-reported, and information as to the mechanism and severity of

injury were not collected. Although we collected data from all nine regions of the country, the most heavily represented areas were along the east coast. We believe that our reporting bias is low as the respondents mirrored the areas of high and low presence of lacrosse programmes (greater in the east and south than Midwest and Pacific).

Conclusion

Musculoskeletal pain (chronic OA or post-injury), particularly at the knee, low back, shoulder and foot are common among lacrosse officials. Potential solutions include provision of educational resources for pain management, on-field use of medical resources and reallocation of affected officials to cover younger players with shorter games played on smaller fields. More officials per field would reduce movement and assigning fewer games at tournament events could reduce musculoskeletal pain impact.

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Disclosure statement

The authors have nothing to disclose.

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Data availability statements and deposition

The datasets generated and/or analyzed during the current study are not publicly available due to use of the third party for access to their membership but are available from the corresponding author on reasonable request.

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