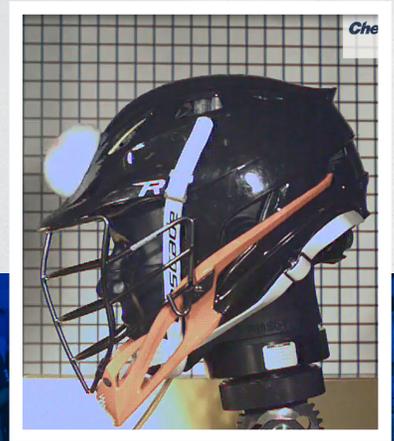
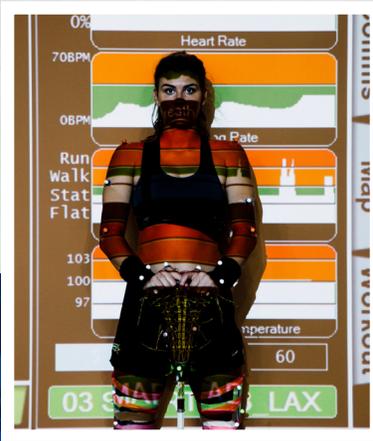




RESEARCH REPORT



2018

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The Center for Sport Science at US Lacrosse (the “Center”) serves as a national hub for the study of health, performance, and safety in lacrosse. Created in 2016, the Center is devoted to research, education, collaboration, policy development, and best practice guidelines that benefit the safety and wellness of lacrosse players and organizations.

The Center seeks to expand and elevate initiatives that US Lacrosse has been committed to since its creation in 1998. Combined, the Center and US Lacrosse have granted over \$1.5 million in health-related research funding since 1998 to improve the well being of lacrosse participants at all levels of play.

Dr. Bruce Griffin serves as the director of the Center, with members of US Lacrosse’s Sport Science and Safety Committee serving in an advisory role. The Center looks to continue its growth and success with the recent addition of a research coordinator and a SafeSport program manager.



The ability of the Center for Sport Science to fund new research and safety initiatives is driven by the generous support of our donors and members. Please consider making a tax-deductible gift to help us further elevate and improve game safety and to enrich lives through lacrosse.

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TITLE OF THE STUDY:

Continuation of the Lacrosse Study Tracking Injuries and Concussions in Kids (LAX-STICK)

RESEARCHERS:

Principal Investigators: Shane V. Caswell, PhD, ATC, George Mason University; Zachary Y. Kerr, PhD, MPH, The University of North Carolina at Chapel Hill

WHY WE DID THIS RESEARCH:

Lacrosse is one of the fastest growing team sports in the United States. Substantial research has focused on understanding the epidemiology of injury among athletes at the collegiate and high school competitive levels. However, data at the youth level is limited. This prospective observational study describes the epidemiology of sport-related injury experienced by male and female youth (8U-14U) lacrosse players.

Previously funded by NOCSAE, LAX-STICK has proven to be very successful and continues to provide much needed information regarding youth lacrosse injuries to US Lacrosse and the medical community. Data from this project has resulted in peer-reviewed publications, and was presented at the US Lacrosse Sport Medicine Symposium in January 2017. Continuing this research has allowed researchers to observe changes over time in injury patterns among youth lacrosse players and evaluate the effectiveness of new interventions designed to improve player safety.

WHAT IS KNOWN ABOUT THIS TOPIC:

Youth lacrosse players (male and female, 14U) total 447,213 athletes in the United States (“US Lacrosse Participation Survey”, 2017). There is limited data regarding the epidemiology of sport-related injuries experienced by boys and girls youth lacrosse players. Over the 2015 and 2016 seasons, 10 youth lacrosse leagues (among Indiana, Massachusetts, Michigan, South Carolina, and Virginia) were observed for data collection of sport-related injuries (Kerr et. al, 2018). Of 1090 boys’ lacrosse players (U9, U11, U13, and U15), 241 total injuries were observed, resulting in an overall injury rate of 12.7/1000 athlete exposures. If we consider time-loss (TL) injuries, the injury rate reduced to 2.2/1000 athlete exposures. With 408 girls’ lacrosse players participating in the study, 59 total injuries were observed, resulting in an overall injury rate of 8.7/1000 athlete exposures. Considering TL injuries only, the injury rate was 1.6/1000 athlete exposures. Additional research is needed to better understand the etiology and prevention of youth lacrosse-related injury. Given that participation in youth lacrosse is continually increasing, it is imperative to continue and increase data collection efforts to better ascertain injury incidence estimates.

WHAT THIS STUDY DID:

This study employed a four-season observational cohort design. The protocol has been approved by the Western Institutional Review Board (Puyallup, WA).

On-site athletic trainers (ATs) reported injury data from games and practices into a single injury documentation application called the Injury Surveillance Tool (IST [Datalys Center, Indianapolis, IN]). All ATs received standardized training in the use of the IST. Injuries and exposures were reported for surveillance purposes. The ATs completed detailed event reports on each injury that they evaluated.

The statistical analysis was performed using SAS. Injury rate ratios were calculated with 95% confidence intervals. Injury rate ratios were used to compare injury rates by event type, sex, and division.

WHY THIS MATTERS FOR LACROSSE:

Lacrosse participation continues to rise nationwide (0.1% growth in 2017 according to the 2017 US Lacrosse Participation Survey). As lacrosse continues to grow in participation, a better understanding of injury epidemiology is needed. Understanding of injuries is necessary so that US Lacrosse, the national governing body of the sport, can continue to recommend rule changes to local lacrosse organizations to improve player safety, and in-turn increase player longevity.

TITLE OF THE STUDY:

Lacrosse Helmet Efficacy: A Rotational Impact Mitigation Study

RESEARCHERS:

Principal Investigator: Katherine M. Breedlove, PhD, ATC; University of Michigan
Consultant: Thomas G. Bowman, PhD, ATC; University of Lynchburg

WHY WE DID THIS RESEARCH:

The purpose of this research is to measure the rotational properties of various models of adult and youth lacrosse helmets in low and ambient temperatures. It has been noted that there is a strong relationship between rotational accelerations of the head and subsequent brain strain injury. Yet despite the known importance of rotational accelerations in concussion injury, only football helmets are required to be tested for rotational acceleration mitigation during certification, and it remains unknown how lacrosse helmets mitigate rotational accelerations. As such, this research addressed the following aims: (1) Utilized impact tests to evaluate the rotational impact attenuation ability of lacrosse helmets across various impact locations on adult and youth helmets; (2) Determined if the rotational impact attenuation ability of lacrosse helmets differ depending on testing environment temperatures (ambient and low temperature). The NOCSAE test does not currently require cold weather testing, however with the lacrosse season beginning in January or February, it is reasonable to expect lacrosse activity in cold weather conditions making this addition important and relevant.

WHAT IS KNOWN ABOUT THIS TOPIC:

Lacrosse helmet manufacturers are not required to test their helmets for the ability to attenuate against rotational forces. As such there is currently limited information about this subject. Our previous papers have evaluated linear accelerations in new and used lacrosse helmets prior to reconditioning. This previous work showed that differences between age of the helmet, location on the helmets, and between models were evident. As such it is important to evaluate if such differences exist for rotational accelerations.

WHAT THIS STUDY IS DOING:

This study tested two popular adult and two popular youth helmets for the ability to attenuate rotational forces by using a pendulum impactor, testing at two speeds (1.5 m/s and 3.0 m/s) which are similar to impacts found to be most common in lacrosse by previous studies. Helmets were then tested in six locations while at ambient (72 degrees F) and cold (20 degrees F) temperatures. Helmets were also tested with a tight (chinstrap and helmets were fully taut against headform) and loose (helmet was loosened to allow 1 - 2 inches of vertical movement on the headform) arrangement on the feedback that some players prefer to wear their helmets in this manner.

WHY THIS MATTERS FOR LACROSSE:

This study is important to US Lacrosse because this data provides clarity regarding the ability of current adult and youth lacrosse helmets to attenuate rotational impact forces by comprehensively examining athletic helmet performance, and the effect of variables such as fit on these results. Such information is critical to guide future helmet development efforts. These findings may also inform future US Lacrosse initiatives geared toward player safety as protective helmets are a key to preventing athletic injury during participation.

The most obvious immediate implementation of this research is the effect of fit on helmet attenuation ability with a "looser" helmet having a seeming positive effect on its ability to attenuate rotational forces. However the authors caution that at this time the results are very preliminary with further analysis needed and more research required (i.e. this headform did not have any hair or similar material which may effect these results) before any conclusions may be made. Additionally while the helmet may attenuate rotational forces with a looser fit, the effect of fit on linear forces is not known. Also rotation of the helmet exhibited in this study may cause other injury to the nose, mouth, teeth, and eyes which should also be taken into consideration.

TITLE OF THE STUDY:

Youth Lacrosse Player Experience Survey

RESEARCHERS:

Principal Investigator: Lisa Hepburn, PhD; MedStar Sports Medicine Research Center

Co-Investigators: Andrew E. Lincoln, ScD, MPH; Kezia Alexander, Reg Dunn; MedStar Sports Medicine Research Center

WHY WE DID THIS RESEARCH:

Our goal is to learn more about the youth lacrosse player experience, including how coaching, social impact, costs, and injuries influence both the player and their family's perspective on lacrosse.

WHAT IS KNOWN ABOUT THIS TOPIC:

Detailed information about the youth lacrosse experience has never been collected from a national sample. There are no published studies, to date, about this topic.

WHAT THIS STUDY DID:

Two online surveys were created using the Tonic for Health online survey platform. One survey was designed for parents of former youth lacrosse players and specifically asks questions about why their child stopped playing lacrosse. The second survey was designed for parents of current youth lacrosse players. The surveys ask questions related to the following concepts: time engagement, cost of team membership, training and travel, other sports played, injuries occurred while playing lacrosse, and coaching experience. Both surveys were sent via email to a large representative sample of US Lacrosse members in October 2018.

WHY THIS MATTERS FOR LACROSSE:

Understanding what affects the quality of the youth lacrosse experience for both the youth player and their family is important to US Lacrosse. Player experience is related to multiple factors including coaching, social impact, costs related to participation, injuries, and the required time commitment at various levels of play. By investigating the influence of these factors on the youth lacrosse experience, US Lacrosse will gain a greater understanding on how to keep players engaged, and continue to increase participation.



TITLE OF THE STUDY:

Effect of Treadmill-Based Resistance on Landing Alignment, Strength, and Ground Force Attenuation in Female Collegiate Lacrosse Players

RESEARCHERS:

Principal Investigators: David J. Stearne, PhD, ATC/L, CSCS; Joseph D. Sweeney; Kenneth P. Clark, PhD, CSCS, USAW; Human Performance Laboratory: West Chester University

WHAT IS KNOWN ABOUT THIS TOPIC:

Anterior cruciate ligament (ACL) injuries remain prevalent, especially in team sports involving frequent cutting, jumping, landing, and pivoting movements throughout game or practice. Sport comparison research has examined sex differences in ACL injury incidence, noting females to be at considerably higher risk in basketball and soccer, with lacrosse trailing right behind. A non-contact ACL injury typically occurs at foot strike when an athlete is decelerating, pivoting, landing, or responding to an unanticipated perturbation. Hip muscle activation can affect knee loading as upper body weight is transferred through the hip to the lower extremity. Femoral motion and position affect landing force attenuation and have been shown to be modifiable through strength training proximal to the knee. Targeting hip extensors acting eccentrically to attenuate ground force during landing can be logically linked to leg spring stiffness regulation and dynamic restraint along the kinetic chain. Accordingly, endurance of hip muscles may play a vital role in maintaining optimal alignment. Lower extremity muscle fatigue has been found to alter force production, proprioception, coordination, and landing kinematics, which might increase injury risk. Prior research indicates that, compared to males, females have statistically significant weaker hip extensors, but only marginally weaker knee extensors. An abrupt braking strategy during landing, associated with greater hip and knee extensions due to hip extensor weakness and inability to effectively regulate the load at ground contact, limits force attenuation capacity of the quadriceps and hamstrings that normally occurs with knee flexion and potentially subjects the joint to buckling.

WHY WE DID THIS RESEARCH:

Novel methods to strengthen hip extensors have been proposed, with closed kinetic chain resistance exercise widely considered most functional to promote adaptations relevant to knee stability and coordinated landing strategies. However, the use of treadmill-based resistance training for developing hip-specific strength in this context has not been investigated. Therefore, the purpose of this study was to examine the effect of six weeks of modified incline treadmill-based resistance training on functional landing strategies, vertical ground force attenuation and knee and trunk flexion angles in female collegiate lacrosse players.

WHAT THIS STUDY DID:

Hip-to-knee extensor strength ratios, peak vertical ground reaction force and rate of loading, and reactive strength index were measured with a Kistler force plate, and knee and trunk flexion angles were measured from motion capture on a drop jump from 30cm both pre and post training for 15 healthy female intercollegiate lacrosse players (age = 19.5 ± 1.7 years, height = $1.65 \pm .23$ m, weight = 59.33 ± 5.4 kg). Training occurred on two non-consecutive days per week, over six weeks with a treadmill set at 15 percent grade and progressive cable resistance load set initially at 40% of hip extensor strength average for a duration of 7 minutes per session. Participants used a waist harness attached to a cable machine for resistance during the treadmill walking. Compared to a shoulder attachment type, the waist harness has been found to more effectively concentrate work to the hip extensors, rather than knee extensors [7].

WHY THIS MATTERS FOR LACROSSE:

Calculated as vertical jump height divided by pre jump ground contact time, differences in reactive strength index reflect training adaptations to enhance fluid transition from eccentric loading to concentric propulsion pivotal to success in sports such as lacrosse, involving explosive cutting, jumping, landing and pivoting movements. Results of this study indicate that closed kinetic chain treadmill resistance training can enhance strength and positively influence plyometric type power-based performance during landing and countermovement activities.

Strengthening hip extensor muscles can affect knee stability and promote safer landing, take off, and cutting performance. Benefits of this study include enhancement of understanding of noncontact ACL injuries within the scientific and athletic communities from the standpoint of applying knowledge of underlying mechanisms to this injury to frame logical prevention programs. Exploring this novel approach to ACL injury prevention could benefit female athletes, in particular, by potentially reducing injury risk and promoting longevity in their sport. Examining hip-to-knee extensor strength ratios and training targeted at hip extensor-specific strength for its influence on landing biomechanics may play a role in noncontact ACL injury prevention. Moreover, improvement in reactive strength index demonstrates the capacity of treadmill-based resistance training to enhance landing coordination and explosiveness, contributing to more refined sport-specific movements during live play.



TITLE OF THE STUDY:

Youth Lacrosse Injury Surveillance

RESEARCHERS:

Principal Investigators: Lisa Hepburn, PhD; Andrew E. Lincoln, ScD, MPH, MedStar Sports Medicine Research Center

Co-Investigator: Reg Dunn, MedStar Sports Medicine Research Center

WHY WE DID THE RESEARCH:

(1) To collect and analyze youth lacrosse injury data and to describe the type and frequency of injuries that occur to youth lacrosse players. (2) To gain a better understanding of injury mechanisms in lacrosse game play. (3) To gain a better understanding of game play scenarios associated with injuries in youth lacrosse. (4) To describe trends over time in youth lacrosse injuries.

WHAT IS KNOWN ABOUT THIS TOPIC:

In a previous study of Boys' youth lacrosse tournament injuries, concussions were the most common injury (33%) followed by contusions (20%) and minor ligament injuries (12%). The highest number of injuries occurred to the head and neck, followed by the lower extremity. The most common mechanism of injury was body-to-body contact (collisions), followed by stick impacts. No data on Girls' youth lacrosse tournament injuries has been published.

WHAT THIS STUDY DID:

Fourteen youth lacrosse tournament providers (participants in the US Lacrosse sanctioned tournament program) were recruited to participate in the injury data collection efforts in the Summer and Fall of 2018. Together, they represent almost 100 youth lacrosse tournaments throughout the United States. Tournament providers received a mailing in June that included an introductory letter, data collection forms, tournament summary forms and instructions on how athletic trainers, staffing their events, should fill out the forms and return them to US Lacrosse. Tournaments were contacted in late August 2018 with a reminder to return data forms to US Lacrosse. Data from 18 tournaments were returned in the fall of 2018 and are presently being analyzed.

WHY THIS MATTERS FOR LACROSSE:

Collecting data at youth lacrosse tournaments provides injury data from one of several settings where a youth lacrosse player is at risk for injury. Certified athletic trainers are able to document injuries at these tournaments in a systematic way that provides quality information for researchers and decision makers at US Lacrosse to improve the safety of the sport.

Findings from this research will help provide data driven evidence on the most common types of injuries occurring at youth lacrosse tournaments. Tournament providers can use this data to be better prepared to treat injuries and to provide opportunities to reduce the occurrence of said injuries.

2018 Lacrosse-Related Research from the US Lacrosse Sport Science & Safety Committee

Men's Lacrosse Injuries in International World Championship Play

AUTHORS:

Karen M. Sutton, MD, Sarah Cheney, Lisa Hepburn, PhD, Rueven Dressler, MD, Kenneth B. Tepper, MD, Andrew E. Lincoln, ScD

ABSTRACT:

Objectives: The sport of lacrosse is experiencing growth at the international level. During the summer of 2018, teams from 46 countries participated in the Federation of International Lacrosse Men's World Lacrosse Championship held over a two-week period in Israel. Currently, no data has been published about the types and frequency of injuries that occur at this level of play. This study utilized a standardized approach to collect injury data at all of the games to describe the frequency and mechanisms of the injuries that occurred.

Methods: Medical directors for each of the 46 teams were instructed to use a standardized lacrosse injury reporting form for each injury that occurred during game play. Injuries that happened during practice session were not recorded. The injury form was used to record demographic information about the athlete, the type of injury, and how the injury occurred. It also included information about whether a penalty was called at the time of injury and where on the field the injury occurred. Each team played between 6-8 games depending on their advancement in the tournament and could have a maximum of 23 players participating in each game. All of the injury forms were returned to the research team for data analysis. Injury rates were computed using 1 player-game as the exposure measure.

Results: There were 7417 athlete-exposures (AE) over 170 games. Medical staff reported a total of 145 injuries during the tournament for an injury rate of 1.95 per 100 AE. The most common injuries reported were contusions (n=41, 28%), sprains (n=27, 19%) and strained muscles (n=21, 14%). The most common mechanism of injury was body contact (n=46, 32%) followed by stick impact (n=33, 23%). A majority of injuries were contact related (n=94, 65%). Injuries rates among attack (n=42, 29%), midfield (n=44,

30%), and defense (n=46, 32%) were similar and all greater than that of goalies (n=7, 5%). Severe injuries included concussion (n=4), fracture (n=5), subluxation (n=2), and dislocation (n=3). The most common body parts injured were the head/neck (n=25, 17%), knee (n=22, 15%), and ankle (n=17, 12%). Most injuries occurred in the second (n=42, 29%) and fourth (n=48, 33%) quarters.

Conclusion: Similar to lacrosse competition in the United States, most of the injuries that occurred in men's international lacrosse were contact-related, either from stick or body-to-body contact. Continued enforcement of international lacrosse rules that forbid slashing and cross-checking may reduce the amount of stick to body injuries.

2018 Lacrosse-Related Research from the US Lacrosse Sport Science & Safety Committee

Epidemiology of Knee Internal Derangement Injuries in United States High School Girls' Lacrosse, 2008/09-2016/17 Academic Years

AUTHORS:

Bailey A. Tadlock, Lauren A. Pierpoint, Tracey Covassin, Shane V. Caswell, Andrew E. Lincoln & Zachary Y. Kerr

ABSTRACT:

Research on knee internal derangement (KID) injuries in high school girls' lacrosse is limited, yet needed to identify sport-specific risk factors. This study describes the epidemiology of KID injuries in United States high school girls' lacrosse during the 2008/09–2016/17 academic years. Athletic trainers (ATs) reported injury and athlete exposure (AE) data to the High School Reporting Information Online (RIO) surveillance system. KID injuries involved the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), medial collateral ligament (MCL), lateral collateral ligament (LCL), and menisci. Injury rates per 10,000AE and injury rate ratios (IRR) with 95% confidence intervals (CI) were reported. Linear regression assessed injury rate time trends. ATs reported 148 KID injuries (rate = 1.92/10,000AE). The injury rate was higher in competition than practice (IRR = 8.40; 95%CI: 5.66–12.49). ACLs comprised a large proportion of KID injuries (46.6%). The ACL injury rate increased over time ($P = 0.002$), highlighting the need to develop/refine lacrosse-specific KID injury prevention programs.



Find more research from the US Lacrosse Sport Science & Safety Committee and others on our web-based bibliography...

US LACROSSE RESEARCH BIBLIOGRAPHY

uslacrosse.org/sites/default/files/public/documents/safety/Bibliography-Sep2018.pdf



MISSION

As the sport's national governing body, US Lacrosse provides national leadership, structure and resources to fuel the sport's growth and enrich the experience of participants.

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