INCIDENCE OF INJURIES AND ASSOCIATED FACTORS AT THE SENIOR INTER PROVINCIAL FIELD HOCKEY TOURNAMENT

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PRRNIC008

A dissertation in partial fulfilment of the requirements for the degree of

MASTER OF SCIENCE IN EXERCISE AND SPORTS PHYSIOTHERAPY

in the Department of Health and Rehabilitation Sciences

Faculty of Health Sciences

UNIVERSITY OF CAPE TOWN

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FEBRUARY 2020

DECLARATION

I, Nicholas Samora Pereira PRRNIC008, hereby declare that the work on which this dissertation is based is my original work (except where acknowledgments indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

Signed:

Signed by candidate

Date:

09 February 2020

ACKNOWLEDGMENTS

"If I have seen further than others, it is by standing on the shoulders of giants" – Isaac Newton.

There have been an immeasurable number of individuals who have helped me get to this point. For every kind word, assisting gesture and the role you've played in my life – I am eternally grateful.

I would like to thank my parents, for emphasizing the importance of education as a way of achieving a better life for myself and my siblings. For the sacrifices they made so that we may have educational opportunities – I could never repay you for your love, selflessness and support.

To my fiancé, Roslyn – thank you for supporting me through this journey. For the sacrifices you've made for me to pursue this qualification, for the life events we put on hold due to this commitment – I am eternally grateful for your love and support and this achievement would not be possible without you by my side. You are my greatest supporter, my trusted advisor and best friend.

To my initial supervisor and current co-supervisor, Dr Lieselotte Corten. Seeing you achieve your PhD during my first year of this qualification was an inspiration. The empathy and compassion you've shown me throughout this process shows your inspiring commitment to education and passion for your students. Your expertise and firm but fair commentary have been an asset to my learning through this process and I'm incredibly grateful to have had your guidance throughout this journey.

To my current supervisor and coursework chairperson, Dr Theresa Burgess – you have been a mentor to me throughout my three years at the University of Cape Town. Thank you for the opportunity to continue my education through this University and its Master of Science in exercise and sports physiotherapy program. It has been a beautiful and eye-opening learning experience and has been everything I could hope for and more. I hope to live up to the high standards of the graduates who have gone before me and be an example for graduates who will follow.

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LIST OF ABBREVIATIONS

Abbreviation	Definition
ACL	Anterior Cruciate Ligament
DEF	Defender
FIFA	Fédération Internationale de Football Association
FWD	Forward
GK	Goalkeeper
FIH	Federation of International (field) Hockey
HREC	Human Research Ethics Committee
ICC	International Cricket Council
IPT	Inter Provincial Tournament
KNHB	De Koninklijke Nederlandse Hockey Bond
MID	Midfielder
PHL	Premier Hockey League
RTP	Return to Play
SAHA	The South African (field) Hockey Association
STROBE	Strengthening Reporting Observational Studies in Epidemiology
TIP	The Team-sport Injury Prevention Cycle
TRIPP	The Translating Research into Injury Prevention Practice
UCT	University of Cape Town

GLOSSARY OF RESEARCH TERMS

All Injury: This definition includes any and all physical complaints reported by participants in the study. The definition was adapted from a football consensus to fit the purposes of field hockey. It is defined as: *"any physical discomfort resulting from football (hockey) related activity, regardless of severity or need for medical attention"* (Bahr, 2009a; Clarsen & Bahr, 2014).

Medical Attention: These are injuries requiring evaluation or treatment from health professionals. These are used when measuring the utilization of services and allocating professionals to teams or events. It captures less injuries than "all injury," but more than time loss injuries (Clarsen & Bahr, 2014).

Time Loss: This is a narrow definition of injury in which a player is unable to participate in matches or training due to injury or illness. This is classified in the literature as a time loss injury (Clarsen & Bahr, 2014).

Lower Extremity: This anatomical is typically comprised of the following regions: hip, groin, upper leg, knee, lower leg, ankle, and foot (Wong & Hong, 2005).

Inter Provincial Tournament: This is usually an annual tournament where provinces within a country participate against one another in a sporting code. In this study it refers to two tournaments in 2018 where males and females representing their provinces, played against one another over seven days at one venue.

"A" – Section: The inter provincial tournament observed in this study comprised of three divisions, "A," "B," and "C". Only the "A" section of both tournaments was studied as this is the top tier of provincial field hockey in South Africa.

ABSTRACT

Background

Field Hockey is an Olympic sport that is played widely across the world at various levels. In South Africa, it is a growing sport with increasing participation for both males and females. It is a high-speed team sport, consisting of short bursts of sprinting with technical coordination of a stick and ball, as well as the tactical execution of a coach's game plan. Participation in sports, including field hockey, comes with an accepted risk of injury; however, within the team setting it can have several implications for the individual: their health, physical performance, and psychological state, both immediately and in the long term. Despite injury incidence in other team sports being well-documented, there is limited research in field hockey generally, and injury incidence and associated risk factors in South African field hockey specifically.

Aim

The aim of the present study was to determine the incidence of injury and associated factors amongst players participating in the 2018 South African men's and women's inter provincial field hockey tournament.

Objectives

The specific objectives of the study were to determine (at the 2018 men's and women's senior field hockey seven-day inter provincial tournament in South Africa):

- the incidence of injury amongst players;
- the burden of acquired sport injuries defined by time loss and medical attention;
- the associative factors related to injury (i.e. coaching qualifications, presence of medical staff, and other non-modifiable risk factors); and
- the injury incidence, injury burden and distribution of anatomical injuries between males and females.

Methods

The study had a descriptive, longitudinal design. All players and coaches attending the 2018 South African Hockey Association men's and women's IPT were invited to enrol in the study and were recruited prior to the start of the respective tournament periods. All the attending players participate in senior field hockey, either for club or university teams in their province. Each provincial hockey union selects their best available team of players to represent them at the inter provincial tournament which comprises of three sections. Only the teams participating in the "A" sections were eligible for recruitment into the study. The female tournament was hosted in Durban during May of 2018 and the male tournament was hosted in Pietermaritzburg in August of 2018. Participants were excluded if they were under 18 years of age or did not provide informed consent. Enrolled coaches and players were asked to complete a self-reported questionnaire. Players information was used to gather the provincial team, playing position and previous injury history. Coaching information was used to gather the educational level, years of experience and the resources available to coaches. Players were additionally asked to independently complete daily injury report forms on all seven tournament match days. This was used to collect information on injury incidence and nature, medical attention required, and time loss during the tournament week.

Results

Two hundred and seventy-two players (133 females; 139 males) and 22 coaches took part in this study. All injury incidence was found to be 99.5 (95% CI: 71.9 – 127.1) injuries per 1000 player match hours for males and 77.9 (95% CI: 47.1 - 108.1) injuries per 1000 player match hours for females. The incidence of medical attention injuries was 70.3 (95% CI: 46.1 – 94.4) injuries per 1000 player match hours for males, and 51.9 (95% CI: 32.3 – 71.5) injuries per 1000 player match hours for females.

The incidence of time loss was 7.5 (95% CI: -0.7 – 15.75) injuries per 1000 player match hours for males, and 4.3 (95% CI: 1.04 – 9.7) injuries per 1000 player match hours for females. A large portion of injuries affected the lower extremity, accounting for 69% of injuries in male players and 70% of injuries in female players.

There were no significant relationships between injury incidence and the availability of team medical support staff, coaches' education level, coaches South African Hockey Association (SAHA) level, or coaches' first aid qualifications respectively. However, players with coaches who had a Federation of International Hockey (FIH) qualification had lower injury incidence rates compared to players with coaches who did not hold this qualification ($p = 0.015$; Fisher exact), with a lower incidence of injury in players coached by a FIH qualified coach (logistic regression analysis $p = 0.054$).

Players who reported previous injuries within the last 12 months were 3.5 times more likely to sustain an injury during the tournament, compared to players with no previous injury history ($p < 0.0001$). Female players were 2.4 times more likely to seek medical attention compared to male players ($p = 0.046$). There was a statistically significant association between players reporting previous injury (within the past two years) and injury during the tournament ($p < 0.0001$), with players who had a previous injury being 5 times more likely of sustaining an injury during the tournament.

Conclusion

To our knowledge, this was the largest observational study conducted in South African field hockey that included both male and female players. High incidence rates of all injuries and medical attention injuries were identified, however, the incidence of time loss injuries was much lower in comparison to existing literature. It is possible that players continue to participate in matches despite injuries requiring medical attention, that medical support staff may not limit match participation for injured players adequately, or that players seek reassurance from medical support staff for minor injuries. The findings support the

existing literature reporting that the lower extremity experiences the largest amount of injuries reported by field hockey players. In the present study, the lower extremity was affected in 69% of all injuries reported in the male tournament, and in 70% of all injuries in the female tournament.

In addition, previous injury history was identified as a significant risk factor for injury, which is aligned with findings from injury monitoring studies of different team sports. The findings of this study highlight the need for consensus on injury definitions in field hockey. Further research is critical to determine injury prevention strategies for male and female field hockey players.

CHAPTER ONE: INTRODUCTION AND SCOPE OF THE DISSERTATION

1.1 Introduction

Field hockey is an Olympic discipline, played widely across the world at various levels (Mukherjee, 2012; Theilen, Mueller-Eising, Wefers Bettink, & Rolle, 2016). In South Africa, field hockey continues to grow as a sport, with increasing participation at youth level for both genders, from "mini hockey" to structured primary and high school participation. It is a high-speed team sport, consisting of short bursts of sprinting with technical coordination of a stick and ball, as well as tactical execution of a coach's game plan (Espí-López, López-Martínez, Inglés, Serra-Añó, & Aguilar-Rodríguez, 2018; Hammond, Lilley, Pope, & Ribbans, 2013; Hollander et al., 2018).

The South African Hockey Association (SAHA) has structured field hockey for senior participants (under 19 and above) in several tiers ranging from club and university levels to provincial and national levels (SAHA, 2013). Depending on the tier, the competition can range from season long leagues (e.g. Durban "Super League" and Cape Town "Grand Challenge"), to shorter knockout leagues (e.g. Varsity Cup) and Interprovincial Tournaments (IPT), which are condensed formats of Olympic field hockey and the Federation of International Hockey (FIH) World Cup.

Injuries during sport are an accepted risk of participation; however, within a team setting injuries can have several implications, both immediate and long term. For example, time loss from the sport can affect participation in the short term, and can result in a long-term economic burden of subsequent health costs due to injury (James C. Brown et al., 2015). The former can affect the performance of a team during matches, seasons, and tournaments and can create selection burdens for coaching staff (Hagglund et al., 2013).

During a tournament, a team may have a physiotherapist, physical trainer, or team doctor present. However, their presence will depend on the financial position of a team and their access to health professionals, which may vary from team to team. The literature has indicated that medical and sport science staff can influence the incidence of injuries in team sport (Ekstrand, Lundqvist, Davison, D'Hooghe, & Pensgaard, 2019). Furthermore, associations have been found between coaching education and player behaviour in team sports (Brown, Gardner-Lubbe, Lambert, van Mechelen, & Verhagen, 2018), and the use of validated injury prevention programs by coaches or auxiliary staff and injury incidence (O'Brien, Young, & Finch, 2017). Therefore, coaching and medical staff, and sporting bodies have a responsibility to both prevent and manage injuries, understanding that their decisions can ultimately affect their team's performance as well as the injury status of players.

Injury data collected from FIH tournaments report the incidence of injury between 0.7 per match (female) to 1.2 per match (male; Theilen et al., 2016). In South Africa, research into a provincial female hockey season reported injury incidence during 2004 to be 6.32 per 1000 hours played (Naicker, McLean, Esterhuizen, & Peters-Futre, 2007). The definitions used in these studies were vastly different, making comparison and generalisation regarding injury incidence inappropriate. There is currently no data available on injury incidence in South African male field hockey players and no incidence literature for field hockey has been published in South Africa since 2007, therefore research is required to observe the current injury burden in South Africa and its associated factors.

1.2 Aims and objectives

The aim of the study was to determine the incidence of injury and associated factors amongst players participating in the 2018 South African men's and women's field hockey inter provincial tournament. The specific objectives of the study were to determine (at the 2018 men's and women's senior field hockey seven-day IPT in South Africa):

- the incidence of injury amongst players;
- the burden of acquired sport injuries defined by time loss and medical attention;
- the associative factors related to injury (i.e. coaching qualifications, presence of medical staff, and other non-modifiable risk factors); and
- the injury incidence, injury burden and distribution of anatomical injuries between males and females.

1.3 Significance of the study

Injuries are an unavoidable aspect of sport, and a major role of modern sports medicine is to mitigate injuries, successfully reintegrate injured participants back onto the playing field, and make the sport safer for all ages and levels of participation (Emery & Pasanen, 2019). Frameworks for preventing injuries have been widely documented; most notably through the "van Mechelen" model, which outlines a method on reducing injuries by initially establishing the burden of injury through epidemiological studies. This model first quantifies the burden of injuries before initiating injury prevention strategies. Incidence is then re-calculated to assess the effectiveness of the intervention (van Mechelen, Hlobil, & Kemper, 1992). Various other models have since emerged. The Translating Research into Injury Prevention Practice (TRIPP) and the Team-sport Injury Prevention cycle (TIP) are examples of frameworks that have been established to continue the goal of reducing injury burden (Finch, 2006; O'Brien, Finch, Pruna, & McCall, 2019).

The foundation of these frameworks is that they all observe injury incidence. The initial quantification of injuries can therefore be considered the foundation of understanding injury prevention on a large scale (O'Brien et al., 2019; van Mechelen et al., 1992).

The significance of the present study was to determine the incidence of injuries at senior provincial field hockey tournaments for males and females. It also describes the type, burden, and location of injuries, explores relationships between coaching qualifications and injury incidence, and observes access to medical care. This study highlights the need for consensus on injury definitions in field hockey. Due to financial limitations found in South African field hockey, and evident lack of research, it is of the utmost importance to conduct this research in this setting to ensure player safety as medical resources and health professional care are often limited population.

1.4 Research setting

South Africa is a developing country with a history of international participation in team sports (Höglund & Sundberg, 2008). Field hockey is considered a developing sport within South Africa and is administered by the South African Hockey Association (SAHA) who are currently collaborating with the national Department of Sports and Recreation to professionalise the status of the sport. Participants of field hockey in South Africa range from primary school children to high school pupils, university, and club teams, as well as senior provincial and national teams (SAHA, 2016).

The coaches and players involved in the senior inter provincial tournament (IPT) are largely "self-funded" and take personal responsibility for funding their courses, tournaments, qualifications, and professional development. To date, very few coaches work in a permanent or full-time coaching setting (Sport24.co.za, 2018). With both players and coaches self-funding their tournaments, it is understandable that access to medical care is not possible for every team.

The female IPT took place in May 2018 in Durban, Kwa-Zulu Natal. The tournament was hosted by the Riverside Hockey Club at the Riverside sports complex in Durban North. The male IPT took place in August 2018 in Pietermaritzburg, Kwa-Zulu Natal. There were three divisions running concurrently during the tournaments; however, only the "A" divisions were observed during both tournaments as this is the top tier of field-hockey within South Africa.

1.5 Plan of development

The development of this study includes an overview of injuries and associated factors as well as critical review of the existing literature pertaining to field hockey and team sport injuries (Chapter Two). The literature review will provide context and rationale for the methodology used in this research to explore injuries in South African field hockey (Chapter Three). The results of this study will be presented in Chapter Four.

The results of this study will be discussed along with its implications for field hockey, opportunities for future research, and strengths and limitations (Chapter Five). The overall findings are summarised in Chapter Six and will conclude this dissertation.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction to field hockey

2.1.1 Background

Field hockey is a team sport played widely across the world, including during the summer Olympic games (Mukherjee, 2012). Five continental and 129 international federations belong to the FIH, who govern the sport of field hockey and arrange international elite and age group tournaments. The FIH also manage the technical rule and equipment changes which the sport has witnessed over the past several decades. From modest beginnings of grass-based fields with wooden sticks, the sport has evolved to make use of synthetic surfaces, carbon fibre sticks, and include rules that promote speed of play and spectator entertainment (Murtaugh, 2001).

Field hockey is a high paced team sport, consisting of repeated sprinting efforts combined with coordination of a stick and ball, as well as tactical execution of a game plan (Bussey, Kennedy, & Kennedy, 2016; Gouttebarge & Zuidema, 2018). With the evolution of this sport over time, which includes playing surface and equipment changes and related alterations to the technical skills and conditioning requirements to be competitive in the modern game, there have been subsequent changes to the nature of reported injuries (Hollander et al., 2018). The Netherlands was one of the pioneering countries for field hockey (Barboza, Nauta, van der Pols, van Mechelen, & Verhagen, 2018) and it is estimated that in the Netherlands alone there are over 250 000 participating hockey players of all ages (Theilen et al., 2016). To date, unfortunately, the participation in field hockey within South Africa is unknown.

While participation in hockey ranges from junior and social exposure to elite competitions, all levels of participation are affected by injury (Barboza, Joseph, Nauta, Mechelen, & Verhagen, 2018). Injuries in field hockey have been documented since 1975 (Murtaugh, 2001), yet to date there has only been one published systematic review (Barboza, Joseph, et al., 2018).

The aim of the present review is to highlight the current literature pertaining to injuries seen in field hockey and observe some of the differences in definitions, outcome measures, and results across various formats and levels of the game in different age groups and gender categories. Of interest is existing research, or the lack thereof, within the South African field hockey context and the reasons for it. Due to the emergence of training loads and volume relating to injury and illness (Hulin, Gabbett, Caputi, Lawson, & Sampson, 2016), the present literature review also explores the influence of coaches in the incidence, as well as the prevention, of injury (McCall, Dupont, & Ekstrand, 2016). Finally, the review frames the present study within the global field hockey context and identifies opportunities for research questions - highlighting the need for continued research within South Africa.

Relevant literature for this review was identified through the databases of PubMed, Science Direct, Scopus, Google Scholar, and Medline through searching the following key words: “Field Hockey,” “Injury incidence,” “Injury Definition,” “Injury,” “Injury Prevention,” “Field Hockey Tournaments,” “Coaching and Injury,” “South African Field Hockey,” and “South African Hockey.”

2.2 Injury definitions and incidence of injuries in field hockey

Research pertaining to field hockey injuries has been present in the literature since 1975 (Barboza, Joseph, et al., 2018). However, as the game and its subsequent rules and surfaces have changed, so has the nature of injuries. It has been noted that across the current literature, a variety of definitions, methods, and classifications of burden for injury have been used - posing a challenge when quantifying the extent of injuries in field hockey (Clarsen & Bahr, 2014). This indicates the need for consensus in injury surveillance for field hockey research.

2.2.1 Injury definitions

The wide variation between study terminology, methods, and reporting in field hockey research does not allow for comparisons to be made. The nomenclature surrounding injury research in sports includes the definition of injury, burden of injury, time loss from training, and/or matches and mechanism of injury (contact or non-contact; Barboza, Joseph, et al., 2018). Unlike similar team sports such as cricket and football, there is no consensus statement on surveillance research in field hockey. In 2005, cricket published a consensus on definitions surrounding injury in research (Orchard et al., 2016). Other team sports such as football and rugby then followed to quantify and compare injury rates accurately (Fuller et al., 2006).

There is a growing need for field hockey to develop a similar consensus, particularly regarding the variation of injury incidence and prevalence found in the different formats of the game. To illustrate this variance, in the tournament format of field hockey, injury has been defined as "*a new musculoskeletal complaint resulting in time stoppage and the player being unable to continue to participate in the match*" (Theilen et al., 2016, p. 1). In another study examining tournament incidence at the summer Olympics, injury has been defined as "*any physical complaint resulting from match play that required medical attention from a physician, regardless of subsequent time lost*" (Barboza et al., 2018, page 3, table 1). The 2007 South African paper used the injury definition of: "*injury around a specified joint/body part which resulted in pain and an inability to play for at least five days or more*" (Naicker et al., 2007, page 2).

These examples illustrate the challenges when comparing studies with the heterogeneity of injury definitions used in existing literature. The only published systematic review to date concluded that due to the heterogeneity of the terminology, none of the included studies were comparable, making the generalisability of the research within field hockey difficult (Barboza, Joseph, et al., 2018).

With the challenges of reporting and capturing injuries in field hockey acknowledged, the incidence rates to be presented will be grouped according to playing format and participation level of the study participants.

2.2.2 Incidence of injuries

In a 2018 systematic review, incidence was extracted from multiple studies containing both tournament and seasonal injury data (Barboza, Joseph, et al., 2018). Incidence rates were only reported by 55% of the included studies in the review, and results were grouped according to two categories to allow for comparison: number of injuries per 1000 hours of field hockey exposure and number of injuries per 1000 hours of player sessions. The incidence rates in these categories still vary greatly. Injuries per 1000 hours of field hockey exposure range from 0.1 in a population of scholars (Murtaugh, 2001), to 90.9 at the African Continental Championship Tournament in an "elite population" (Theilen et al., 2016). Injuries per 1000 player sessions range between 1 in a female high school population (Murtaugh, 2001), to 70 in an under 21-year female age group (Dick et al., 2007; Lynall et al., 2018). This systematic review included all relevant literature on field hockey injuries; therefore, the wide incidence ranges may be an indication of how the format of the game, level of play, and age of the population can influence the incidence of injury (Rishiraj, Taunton, & Niven, 2009). Furthermore, this first and only systematic review in field hockey highlights the need for the standardisation of surveillance definitions.

A study exploring the incidence of injuries in a Dutch field hockey season within an elite population clearly defined the population group, and used standardised outcome measures to report injury incidence (Barboza, Nauta, et al., 2018). Eighty participants (male and female) were observed over the course of a year. The Oslo Sports Trauma Questionnaire was administered, and injuries were coded using the Orchard Sports Injury Classification System.

There is support for both of these questionnaires and classification systems – the Orchard Sports Injury Classification System has been updated and evaluated from the end-users perspective and shown to have opportunities to improve its utilisation (Crossway, Games, Eberman, & Fleming, 2017); this is in contrast to the Oslo Sports Trauma Questionnaire which has been validated and translated into multiple languages and recommended for global use (Clarsen, Myklebust, & Bahr, 2013).

The results indicated that 70% of the study population reported injuries, with 50% of those injuries resulting in time loss from competition or training. Furthermore, 43% of injuries were from non-contact mechanisms and 55% were classified as "overuse injuries." The incidence rates observed in this study were 3.5 per 1000 player hours of exposure, including strength and conditioning, and 12.3 per 1000 player hours of competition. These results could be used as a reproducible standard for seasonal injury rates in other elite field hockey populations globally (Barboza, Nauta, et al., 2018).

In 2013, each of the major (under 21 and elite) international tournaments on the FIH calendar were observed for injury incidence (Theilen et al., 2016). Sixteen events were held during that year, with five female and 11 male tournaments accounting for 66 female and 188 male matches. Injury incidence was recorded at between 23.4 to 44.2 per 1000 player match hours for females, and between 20.8 to 90.9 for males. This incidence rate was higher than what was seen in the seasonal study for field hockey; the researcher postulated that this may be due to the definition of injury used by the authors. Their definition of injury recorded injuries that involved stoppage of play. These were documented by the match officials, which was collected and reviewed by the medical officer and tournament medical committee. The incidence rate reported with third party classifiers is higher than the self-reporting and outcome measure classification used in the Dutch seasonal study, possibly due to the definition of injury used.

Despite the international literature available, limited research on injuries in South African field hockey is available, with only one incidence study conducted to our knowledge (Naicker et al., 2007). The study assessed ankle dorsiflexion range and the incidence of ankle injuries during a club hockey season as a secondary objective. Other South African field hockey research not related to incidence includes an assessment of the five-meter shuttle test and its reliability and validity in measuring fitness in field hockey (Boddington, Lambert, & Waldeck, 2004), as well as a study exploring the incidence of musculoskeletal pain in the national woman's hockey team (Ellapen, Abrahams, Desai, Narsigan, & Van Heerden, 2011); thus, highlighting a need for more research to be conducted in South Africa.

2.3 Factors Affecting Injury

2.3.1 Associative risk factors

Field hockey involves a diverse number of movements including running, sprinting, ball hitting, and pushing, for which the nature of injuries can range from direct contact with stick/ball and the player (Mukherjee, 2012), as well as complications as a result of volume and intensity of running and sprinting (non-contact; Bussey et al., 2016). Although no causal relationship has been reported between associated risk factors and injury incidence (Pepe, Janes, Longton, Leisenring, & Newcomb, 2004), risk factors remain influential and present in the circumstances surrounding injury. Furthermore, they contain merits which cannot be refuted when retrospectively analysing injuries (Whittaker et al., 2017).

Risk factors can be categorised into modifiable and non-modifiable, as well as intrinsic and extrinsic, suggesting that it should accepted that in some cases, injury in sport is unavoidable (Whittaker et al., 2017). In the studies to be discussed in this section, it is noted that non-contact injury mechanisms and "overuse injuries" accounted for 43% and 55% of injuries respectively (Barboza et al., 2019). Injuries without direct injury mechanism and overuse injuries, fall into the modifiable risk factor category (Drew & Purdam, 2016).

2.3.2 Modifiable risk factors

Modifiable risk factors can include training and match time exposure, the intensity of training, as well as the accumulation of these 'loads' over time (Bahr, 2009b; Gabbett, 2016). This is applicable not only to field hockey, but to all sport in general. Overuse injuries are often associated with pathologies such as tendinopathies, recurrent hamstring strains, non-specific lower back pain, and other non-traumatic orthopaedic conditions (Drew & Purdam, 2016). It is important to note that there are also modifiable risk factors, such as neuromuscular control and movement patterns, which are associated with increased risk of injury, often resulting in severe non-contact injuries, e.g. Anterior Cruciate Ligament (ACL) rupture (Hewett, 2017). Prevention programs into ACL ruptures have been extensively researched due to its increasing incidence in females and athletes under the age of 20 years. There is evidence to support neuromuscular control in this population as one of several reasons for their increased risk (Hewett, Ford, Xu, Khoury, & Myer, 2017).

There has been public debate between researchers regarding the interpretation of risk factors and their possible impact in preventing future injuries (Bahr, 2016a, 2016b; Hewett, 2016). This argument has centred around minimising the incidence of ACL injuries in female athletes. While there has been successful preventative programs (O'Brien et al., 2017), injury is the result of a complex interaction of multiple factors (Bittencourt et al., 2016). This should be acknowledged by researchers and should be implemented in sport in a way that is meaningful for coaches, athletes, and clinicians (O'Brien et al., 2019). Due to the need for good relationships and interactions between health professionals and coaches, this is often challenging; nevertheless, it should be explored for the benefit of player safety and team performance (Alentorn-Geli et al., 2014; Ekstrand, 2013; Gabbett & Whiteley, 2017).

A further observation regarding modifiable risk factors and injury is the link between crouching gait patterns seen in field hockey running, gluteus medius muscle activation, and concurrent lower back pain (Bussey et al., 2016). It has been reported that up to 50% of female hockey players suffer from lower back pain, with 12% of those cases resulting in time loss from matches or training (Bussey et al., 2016). It has further been reported that hockey players have higher rates of gluteus medius muscle activity compared to controls, even with prolonged standing which could potentially predispose the players to lower back injuries. This is due to the 'crouch-gait position' which is adopted during running and dribbling in field hockey, which does not allow for full extension of the hip (Bussey et al., 2016).

2.3.3 Non-modifiable risk factors

Non-modifiable risk factors for injuries cannot be controlled or changed to reduce the presence of injury. These can be classified as internal or external. Internal risk factors relate to intrinsic characteristics of the individual and include their age, gender, previous injury history, and experience in the sport (Bahr & Holme, 2003). In the earlier example, it was also reported that non-modifiable anatomical factors can influence injury risk, such as tibial slope in females in the ACL example (Hewett, 2017). External non-modifiable risk factors for injury include equipment and environmental factors relating to the sport.

In the case of field hockey, the surface type plays a significant role. Although most of the modern game is played on an artificial surface or "Astroturf," there are variations in the type of synthetics used, the density and maintenance of the surface, and the age of the field, which results in fluctuations in the playing surface conditions (Murtaugh, 2001). An intricate interaction with surface type is with the footwear of athletes – it is arguable that this is both modifiable and non-modifiable for various reasons, including the financial status of the athlete.

Regardless, the type of studs needed to grip on the synthetic surface and the fluctuation of stud length and surface type also contributes to a non-modifiable circumstance for many hockey players (Naicker et al., 2007). In South Africa, due to socio-economic status and access to well-maintained playing surfaces, there is unfortunately a lack of quality fields available for youth development. This creates challenges to the development of core skills for the game, which may influence injury but can also be linked with the large incidence seen in lower extremity and certain ankle injuries (Hollander et al., 2018).

A small population of elite South African hockey players were studied in 2004, and it was reported that 25% of all injuries sustained occurred at the ankle joint (Naicker et al., 2007). Athletes included in the study reported exposure to varying synthetic surfaces, as well as grass field training. There is no research available on the quality of playing fields in South Africa; however, anecdotally the researcher is aware of field hockey participants who are playing on poorly maintained fields. This is a cause for concern and calls for proactive measures to prevent lower extremity and ankle injuries and ensure safety for all South African field hockey players (Gouttebarge & Zuidema, 2018).

The understanding of the multifactorial nature of risk factors and their relationship to injuries has evolved over time. Sports medicine research has shifted from a dynamic yet direct multifactorial model of sports injury aetiology (Meeuwisse, 1994) towards a less linear relationship through a complex web of determinants model (Bittencourt et al., 2016). It is now acknowledged that a multitude of factors act simultaneously with modifiable, non-modifiable, intrinsic, and extrinsic factors contributing to injury.

2.3.4 Coaching influence on injury occurrence

In team sports, there is often a hierarchy of leadership. Staff and players become a team, under the guidance of the coach or manager. Depending on the level of the team, there may be technical coaches, performance analysts, medical staff, sport scientist, skills coaches, and logistics staff among others (Ekstrand et al., 2019). Whether the coach, as the leader, has a direct influence on injury is disputed within the literature.

Their ability to greatly influence the training schedule of the players has been shown to influence potential injuries due to increased workloads (Frank, Register-Mihalik, & Padua, 2015). The primary focus of the coach is not to prevent injuries, but rather to achieve maximal performance, and ultimately positive results from the team. However, it can be postulated that performance is affected by injury (Hagglund et al., 2013); therefore, it may be in the best interest of the coach to consider factors that may affect injury into the preparation and planning of training and competition.

Despite research reporting evidence in support of injury prevention programs reducing the burden of injury, implementation into the team environment is often poor (McCall et al., 2016). One reason for this may be that coaches do not realise their impact on player behaviour and the occurrence of injury. In a study of South African rugby coaches and referees, a significant correlation was reported between coaches' education on injuries and a decreased occurrence of injury in non-professional rugby (J. C. Brown et al., 2018). In a study of elite European football, it was reported that the leadership style of the coach, as well as their beliefs surrounding training loads and volumes, correlates to the amount of injuries observed (Ekstrand et al., 2019). Therefore, collaboration between health professionals and coaches is recommended to bridge the gap between injuries and performance (Gabbett & Whiteley, 2017). The role of the coach in influencing injury has been acknowledged by SAHA in their outcomes for coaching levels. Although concise, all levels of the SAHA coaching course include a basic understanding of the role of sport science, psychology, and nutrition in the health of players (SAHA, 2013).

In South Africa, most field hockey coaches do not have access to medical teams and sport scientists. Therefore, their understanding of managing players to decrease injury burden is imperative. The association between coaches' knowledge of player-safety influencing injury has already been established in South African rugby (J. C. Brown et al., 2018).

A coaching degree that includes up to date medical modules could be beneficial in guiding the decision-making process of the coach. Various national and international coaching levels are available within field hockey. The FIH defines its international coaching levels as: development coach, development coach grade 1, high performance coach, high performance grade 1, and master coach (FIH, 2019). To complete the FIH qualifications, participants must have reached their respective countries highest coaching level. The SAHA coaching structure is based on the Netherlands Hockey Association "De Koninklijke Nederlandse Hockey Bond (KNHB)." In 2013, SAHA developed the "Long Term Coaches Development Plan 2013," defining four different SAHA coaching levels (level 0 to 3; SAHA, 2013).

The core knowledge outcome required to obtain coaching level two and three includes to "*identify sport science to provide support*" (Level 2) as well as to "*identify and understand sport science to provide athlete support*" (Level 3; SAHA, 2013). As 'sport science' remains undefined in the SAHA coaching level description, it is unclear which aspects of sport science are to be understood and implemented by coaches, particularly as a result of coaching courses facilitated by coaches without reference of sport science or medically trained professionals. An evident lack of scientific or medical knowledge regarding basic physiology or anatomy could potentially provide a risk for the occurrence of injury due to coaching methods (Drew & Purdam, 2016).

In team sports, the head coach often decides, in consultation with other technical staff members, on team preparations, player selection for matches/tournaments, daily schedules during the tournament phase, and how much time each player will spend on the field (Ekstrand et al., 2019). Decision making processes of coaches is a product of their experience, qualifications, and educational level. However, compliance in the implementation of injury prevention strategies is not always consistent and may influence the incidence of injuries seen in team sports (Frank et al., 2015).

The evaluation of a South African educational program for coaches and referees in Rugby Union, "BokSmart," identified that player behaviour is influenced by coaching education (J. C. Brown et al., 2018). Therefore, research investigating the disconnect between coaches' knowledge, implementation of prevention strategies, and the role of auxiliary technical team members in injury incidence is recommended. This sentiment is particularly applicable to South African field hockey, where there is no existing research into the role of coaches or medical staff in injury occurrence.

2.4 Outcome measures and recording of injuries in field hockey

Outcome measures in field hockey research vary greatly. Throughout the present review, the primary focus has been injury incidence, surveillance, and risk factors associated with injuries. However, it is important to note that there are currently studies researching specific technical components of field hockey and their relationship to regional injuries (Ibrahim, Faber, Kingma, & van Dieën, 2017). An example of this is research into the cause of lower back pain in hockey players (Bussey et al., 2016). In the following sub-sections, both the instrumentation tools used in all field hockey injury research, as well as outcome measurements used in existing incidence studies will be explored.

2.4.1 Injury reporting and recording

Studies included in the present review have made use of self-reporting of injury at some point (Hollander et al., 2018; Naicker et al., 2007). Whether only at baseline or during follow up throughout the season, self-reporting from participants in observational studies is common practice.

Self-reporting has its own unique benefits and drawbacks: while it allows larger populations to be studied and reduces the amount of data handling assistants, the risk of misinterpretation, cross-contamination of participants, and subjectivity of mood, motivation, and memory can all affect the data collected (Brutus & Wassmer, 2013). Self-reporting is primarily used for collecting background information on participants with regards to demographics, playing position, years of experience playing field hockey, and previous injury history.

These are either recorded through online surveys (Hollander et al., 2018) or in hardcopy surveys when investigating smaller and more defined populations in a team or organisation (Ng et al., 2018). None of the studies reviewed made use of alternative forms of self-reporting, such as focus group discussions or verbal reporting to investigators. However, self-reporting is not the sole method of gathering injury data.

Alternative methods of injury reporting have been utilised in field hockey and team sport related literature. An observational study of FIH tournament injuries during the 2013 international season did not gather any self-reported information from players (Theilen et al., 2016). The authors chose to only record injuries which caused stoppage in play, as per the definition of injury for their study. Injuries here were recorded by the tournaments technical table and coded with events surrounding the stoppage in play (i.e. short corners, open play, and attacking circle) as well as the mechanism of injury and site. This method may contribute to underreporting of injuries, as minor injuries not resulting in stoppage of play would not be documented. It may create an additional burden for the table officials whose role is to officiate the matches and not to capture injury data. It also requires additional training and explanation of documenting procedures for these officials.

One of the largest studies investigating injury incidence over a season employed a combination of players' self-reporting questionnaires at baseline, exposure time collected from coaches, and injury occurrence from medical staff (or coach if no medical staff were involved at the club; Hollander et al., 2018). This is the only season-long study that utilised three different methods of injury reporting within a large population (n = 257). The benefit of this method creates greater reliability of reporting as there are methods to exclude irrelevant information or corroborate observed reporting. The same study also reported utilising the Strengthening Reporting Observational Studies in Epidemiology (STROBE) guidelines (von Elm et al., 2007), as well as the Orchard Sports Injury Classification System (Rae & Orchard, 2007).

The Orchard Sports Injury Classification System is utilised by researchers to code injuries seen during observational sport injury studies. There are various layers to the Orchard classification system. It has the benefits of categorising injuries either specifically or broadly, and is of particular use to researchers without electronic databases for capturing and classifying injuries (Rae & Orchard, 2007).

The elite Dutch field hockey season study also made use of the Orchard classification (Barboza, Nauta, et al., 2018), as well as the Oslo Sports Trauma Research Questionnaire (Clarsen & Bahr, 2014). The Oslo Sports Trauma Research Questionnaire was used in non-epidemiological studies, for research into the prevalence of injury in field hockey players performing the "drag-flick" skill (Ng et al., 2018). In both examples, the questionnaire is completed by athletes to collect information regarding their current health, training loads, participation, and injury status - which has been shown to be a valid and reliable outcome measure (Clarsen, Rønsen, Myklebust, Flørenes, & Bahr, 2014). These three outcome measures: the STROBE, the Orchard Sports Injury Classification System, and the Oslo Sports Trauma Research Questionnaire are all examples of validated standardised tools used for injury reporting, which have been used in field hockey research. This would play a vital role in standardising injury surveillance in field hockey, as has been carried out in team sports such as cricket and soccer (Fuller et al., 2006; Orchard et al., 2016).

2.4.2 Time-Loss injuries (severity and burden)

Time-loss injuries are also an important consideration for injury research. The definitions used to collect information, and the method of reporting can affect the burden and severity of injuries presented in the literature. This would also require that definitions should match the study population and research objectives, and may not be solved by a singular surveillance consensus statement (Clarsen & Bahr, 2014). Injuries are commonly recorded as time loss (training and matches) or match time loss (matches only), although this classification may be too narrow as not all injuries will result in time loss (Bahr, 2009a).

An important point to illustrate in the current literature is the differentiation between injury burden and injury severity. Injury burden is described as the amount of injuries resulting in time loss, presented as time loss per 1000 player-hours (Bahr, Clarsen, & Ekstrand, 2018). Injury severity is described as the mean or median days lost to injury reported with interquartile ranges (Bahr et al., 2020). Another suggestion for capturing injuries would be by registering "all physical complaints" or "receiving medical attention." However, this could possibly be too broad and may dilute the burden of reported injuries (Fuller et al., 2006).

The visual analogue scale is an outcome measure commonly utilised in research on musculoskeletal pain to evaluate burden of injury (Karcioglu, Topacoglu, Dikme, & Dikme, 2018). This outcome measure may not always be appropriate, depending on the aims and objectives of the study. The burden or severity of injury, illustrated by time lost from matches and practices, is often preferred to quantify the burden of injury in larger studies with a focus on injuries within teams – this is strengthened by the inherit objectivity of the time loss compared (Brutus & Wassmer, 2013; Williams et al., 2016).

The only systematic review of all injury literature on field hockey reported that 55% of the included studies used time loss to report injury burden. Other measures of injuries used were time loss, medical attention received, and any musculoskeletal complaint causing decrease in performance/participation (Barboza, Joseph, et al., 2018). The elite Dutch hockey study graded injuries on a continuous scale from 0-100 with cut off points for "substantial injury" and "severe injury" (Barboza, Nauta, et al., 2018). The authors subsequently categorised substantial injuries into those requiring medical attention or those resulting in time loss from competition or training.

The FIH tournament injury study of 2013 concluded that the injury burden in field hockey is low, although their study primarily considered incidence and the circumstances surrounding injury (Theilen et al., 2016). The study linked injuries to phases of the match such as short corner defence, section of the field, and body parts sustaining injury. Although the authors did not explicitly define injury burden, their injury definition of "only injuries resulting in stoppage of time" inherently classifies the observed injuries. These variations highlight how injury burden can differ between studies based on definitions, methods of data collection, and objectives of the study concerned. Therefore, the need for a consensus statement regarding surveillance research in field hockey is warranted. It should address the study methods used, injury definitions, injury capturing, classification, and subsequent reporting as injuries per player-match or player-field hockey hours (Bahr, 2009b).

2.4.3 Other outcome measures in injury research

Studies exploring the link between specific technical skills of field hockey and injuries, utilised more objective and reliable measurement tools as they were not merely observational studies (Clarsen & Bahr, 2014; Ng et al., 2018). Studies exploring the biomechanical components of the hit versus the drag flick, and its relation to potential lower back pain utilised tools such as Vicon three-dimensional analysis (Ng et al., 2018), surface electromyography, and the visual analogue scale (Bussey et al., 2016).

Although the Vicon system is regarded as the gold standard for three-dimensional kinematic analysis, it is susceptible to human error based on environmental factors simulating the actual sporting environment, as well as accuracy in the placement of the markers (Windolf, Götzen, & Morlock, 2008). Surface electromyography has been proven to be reliable in both isometric and ballistic exercises (Fauth et al., 2010), and was used in a study linking gluteus medius activation levels with lower back pain (Bussey et al., 2016). Isokinetic measurements have also been used in similar research pertaining to regional injuries, though its ability to predict injury has been shown to be poor (van Dyk et al., 2016).

There remains a proposed association of risk and isokinetic testing in a field hockey population in South Africa, with poor peak dorsiflexion being associated with ankle injuries in female hockey players (Naicker et al., 2007). Although these studies both present their merits, further research is required in field hockey with larger sample sizes and standardised methodologies to truly demonstrate this association.

Measures of limb symmetry (de Mille & Osmak, 2017), balance, proprioception, and postural sway (Undheim et al., 2015; Whittaker et al., 2017) have been increasingly researched due to their accessibility to all clinicians, without requiring access to highly specialised laboratory equipment. These include the limb symmetry index, balance error score, star balance excursion, and tandem stance positions which can be tested indoors or outdoors with little to no equipment or cost. There is growing support for these measures due to their accessibility. However, they test a multitude of factors simultaneously (i.e. balance, proprioception, postural sway, pain, and range of motion) and are often recommended as part of a functional testing battery (Grindem, Snyder-Mackler, Moksnes, Engebretsen, & Risberg, 2016).

2.5 Summary and critique of existing literature

Injuries have been and will continue to be associated with participation in sport. Due to their multifactorial and complex nature, continuous research will enable improved management of participants and mitigation of injuries and provide changes to rules and protective equipment that will keep the sporting population safe. Although parallels have been drawn between field hockey and football due to playing rules, surface type, and structure of the game; football has been more extensively researched in epidemiological studies when compared to field hockey. Field hockey as a sport has existed for a substantial period and has been included as an Olympic sport since 1980, with its own World Cup and other major international tournaments (Hollander et al., 2018). However, field hockey is still considered a growing sport. Changes to its rules and format of play have been extensive in comparison to football, to increase spectatorship and participation in the sport over time.

Research into field hockey in South Africa has been limited and published studies are scarce. This may be due to the non-professional status of the sport in South Africa or the relatively low rate of catastrophic injuries compared to other team sports such as rugby, which has been extensively researched (Starling, Readhead, Viljoen, & Lambert, 2019). One of the only South African studies on injury in field hockey devised a dual objective of relating ankle injuries to peak dorsiflexion strength, as well as documenting incidence of injuries in female club hockey in South Africa (Naicker et al., 2007). Although the research should be commended, more extensive studies should be undertaken to explore incidence of injuries per body part as seen in research from the FIH major tournaments (Theilen et al., 2016).

The role of coaches, medical staff, and sport science in relation to injury has been postulated and researched in sports such as rugby and football (Ekstrand et al., 2019). This is a worthy pursuit for sporting codes where coaches can influence modifiable risk factors such as training loads, schedule, and playing times of athletes. It has been reported that coaches can influence the amount of injuries sustained (Ekstrand et al., 2018), therefore additional research and resources should be directed in this field. Field hockey has not been as extensively researched as football, although they both share similar roles of the coach in influencing player workloads, which has been strongly linked to injury incidence (Hulin et al., 2016). There is no research to date on the role of coaches in influencing injuries in field hockey, either internationally or in South Africa.

In recent years, there have been increased international studies into injuries relating to field hockey, which is positive for the development of the sport. This includes a systematic review, which found an urgent need to standardise injury surveillance terminology in the sport (Barboza, Joseph, et al., 2018). While growing research in this field is certainly positive, there is a need to make data from populations around the world comparable.

Field hockey should follow the example of cricket and football, and its prominent researchers should collaborate to issue consensus statements for future research (Orchard et al., 2016).

Incidence studies have been shown to be the first step of injury prevention (van Mechelen et al., 1992), which has been used in similar team sport settings to minimise the burden of injury (O'Brien et al., 2019). Therefore, field hockey should take cues from rugby and football and implement standardised surveillance terminology or use existing reporting templates such as the Oslo Sports Trauma Research Questionnaire and the Orchard Sports Injury Classification System to quantify the burden of injury and implement subsequent measures to prevent injury in future; failing this – the researchers propose that research methods should clearly support their aim (Clarsen et al., 2014) and capture and classify injuries as objectively as possible.

Due to the growing nature of field hockey, and the increasing awareness of injury prevention, more research needs to be conducted globally, but also with urgency in South Africa regarding injury incidence, associative factors, and the implementation of injury prevention programs. Considering the current context of field hockey injury research, the present research study aimed to investigate the injury incidence, burden, and associated factors in the largest South African field hockey population to date.

CHAPTER THREE: METHODOLODY

3.1 Study design

The present study had a quantitative, descriptive, longitudinal research design. Incidence of injury and exposure of athletes over specific time frames was the foundation of the present research. When exploring literature regarding team sport (Clarsen & Bahr, 2014; Fuller et al., 2006) and field hockey injuries (Barboza, Joseph, et al., 2018), it was apparent that a study design would be best suited to address the proposed study objectives.

3.2 Participants

All players and coaches attending the 2018 South African Hockey Association men's and women's IPT were invited to enrol in the study and were recruited prior to the start of the respective tournament periods. All attending players participate in senior field hockey, either for club or university teams in their province. Each provincial hockey union selects their best available squad to represent them at the inter provincial tournament which comprises of three sections. Only the teams participating in the "A" sections were eligible for recruitment into the study as the senior national team is selected from this tier of provincial field hockey. The tournaments took place in Durban (females) and Pietermaritzburg (males) Kwa-Zulu Natal, and were comprised of the following provincial teams:

1. Female Teams: Western Province, Peninsula, Eastern Province, North West, Southern Gauteng, Wits, Mpumalanga, Northern Gauteng, KZN Raiders, Free State, SA u21, and KZN Mynahs.
2. Male Teams: Western Province, Peninsula, Eastern Province, North West, Southern Gauteng, Wits, Nuggets, Northern Gauteng, KZN Raiders, Free State, SA u21, and KZN Mynahs.

Enrolment of the participants took place prior to the tournaments in 2018. Identification of eligible teams and coaches was carried out by contacting SAHA and subsequently the provincial unions. Informed consent forms and the baseline questionnaires were sent by the participating unions to the eligible players via email, requesting the completed consent forms and questionnaires be returned to an email address provided. Participants who did not respond to the research invitation or who were unreachable prior to the tournament, were approached and recruited during a pre-tournament briefing at the tournament venue, in the days preceding the commencement of each of the tournaments.

3.2.1 Inclusion criteria

Any player or coach of the teams participating at the SAHA IPT 2018 in both the male and female sections were eligible to be included in the study. Only the "A" section players, teams, and coaches were considered, as this section is the top tier of provincial South African Hockey.

All teams in the "A" section were eligible for inclusion, regardless of the composition of their support staff (e.g. medical personnel or physiotherapists). The presence of health professionals in teams was recorded, however, they had no active role in data collection.

3.2.2 Exclusion criteria

Any participant who did not provide informed consent to partake in the study or was younger than 18 years of age was excluded. Any player who did not complete the baseline questionnaire was excluded from the study. Any coach who did not provide informed consent or complete the baseline questionnaire was also excluded.

3.2.3 Sample size

The researchers used a sample of convenience to recruit all 24 teams (players and coaches) present at the tournament. During the 2018 data collection period, the format of the tournament changed, and the male and female tournaments took place at separate venues and times during the year due to the international hockey calendar. Due to the changes to the 2018 tournament, there were only 24 teams in the A section: 12 female teams and 12 male teams. The researchers thus used a sample of convenience to recruit all 24 teams (players and coaches) present at the tournament.

3.3 Measurement instrument

Coaches and players were asked to complete a self-designed questionnaire to gauge background information (Appendix B and Appendix C). For coaches, this related to their years of coaching experience, their coaching qualifications and tertiary education, as well as their access to medical support. For players, this included age, playing position, and previous injury history. The players were also asked to complete daily self-reporting of injuries during the tournament using a digital injury reporting form.

3.3.1 Coaches questionnaire

The coach's questionnaire and rationale are listed in Table 1 below. The reason for including this questionnaire was two-fold: the initial aim was to record the coaching experience and qualifications of the coaches, to be later analysed and compared to injuries during the tournament (Appendix B). Information regarding medical support for the team was also collected, including knowledge of free medical services throughout the tournament. This information was included to allow for an investigation of the association between coaching experience, medical staff presence, and injury. This could assist in making future recommendations to SAHA regarding player safety. It would also add to existing literature relating to injury, coaches, and medical staff (Ekstrand et al., 2019).

Table 1. Justification of items included in the coach's questionnaire.

Category	Items included and rationale
Demographic Information	Name and surname, age, contact email address. This is for coding and allocation to teams; this personal information was protected.
Tertiary Qualification	To classify the coaches as tertiary qualification (degree, diploma or none) and calculate association to the incidence of injuries in their teams.
SAHA Level	To assess coaching level (1, 2 or 3) attained in South Africa and if this was associated with injury.
FIH qualification	Does the coach have an international coaching level? IS this qualification associated with injury incidence?
First Aid	Does the coach has attended any basic life support training? Is having a first aid qualification associated with injury incidence. It also provided descriptive information about the coaches, if there was no health professional, and no first aid, who is responsible for the health of the players?
Years at IPT's as head coach	How experienced are the coaches as head coach at the IPT? This was a descriptive factor to gauge the experience in coaching this level of field hockey in South Africa.
Medical Staff	If any, which medical staff members are present within the coaches' team? This gives information about who might be responsible for the physical management of the players and/or if there is medical access for the players. This information was used to calculate association of health professionals with injury incidence.
Alternative arrangement for medical attention	If there is no medical staff, do the players still have access to medical care? This was a descriptive/knowledge question, as to how the teams with no medical support would provide care for their athletes.
Budget affecting medical team	This was a descriptive and subjective question. If finances are affecting access to medical care, should be the national body be responsible for providing medical support for the players.
Tournament medical services	This was a knowledge question. This information could be used to justify medical services being provided as part of the tournament fees in the future.
Roles within team	Who was responsible for the physical warm up and recovery of the players, clearing players to return from injury and strapping players if indicated?
Decision making in Return to Play (RTP)	The rationale for this question is to gauge the coaching or medical involvement in decisions around player availability and returning to play. Whether the coach decides. the players or medical staff.

To advise on possible sensitive information an "expert coach," Mr. Darren Gallagher (former men's National team player in the 2008 Olympic Games, under-21 men's national coach, and senior national men's selection panel member), was consulted to validate the questionnaire for content validity, as well as to evaluate the sensitivity of the questions as perceived by a coach. This process was conducted prior to submission of the questionnaires for ethical approval. Mr. Gallagher resigned from SAHA in 2016 as a selector and was not involved in IPT 2018 in any capacity. He is currently the director of sport at Hilton College in Kwa-Zulu Natal, South Africa.

3.3.2 Player questionnaire

The player questionnaire was utilised to collect background information (see Table 2 below), including their previous injury history, playing positions, time loss over the previous two years as a result of injury, as well as whether health professionals had been required to manage any previous injury (see Appendix C). This information was included to understand how many participants had experienced previous injuries and what the burden of time loss was prior to the 2018 tournament (Hagglund et al., 2013). Anatomical regions of injury were also observed so they could be compared to the distribution of anatomical injuries during the tournament week. This questionnaire was not third-party validated, and the limitations of this will be discussed in Chapter Five.

Table 2. Justification of items included in player questionnaire.

Category	Items included and rationale
Identifying information	Players were asked to submit their playing jersey number. This was for the researchers to cross-reference once participants were de-identified.
Demographic information	Name and surname, age, contact email address. This was for coding and allocation to teams; this personal information was protected, and participants were all de-identified.
Date of injury	Timeline of injury in relation to the current tournament. Only injuries two years prior to the tournament were documented. There is research indicating that severe injuries, requiring surgery and extensive rehabilitation, will take a maximum of 48 months to return to play (Ardern, Taylor, Feller, & Webster, 2014) hence this inclusion.
Time of injury	Which phase of previous matches did the player get injured, during warm up, training, or cool down? This allowed us to identify phases of the match in which players might be more susceptible to injury during the IPT or note differences between pre-tournament and tournament injuries.
Site of injury	This was to be able to describe the types and localize injury to specific anatomical regions. It allowed us to compare with tournament anatomical injury distribution.
Medical attention	Did the player require medical attention for their injury? This was used to compare to the medical attention required during the 2018 IPT and can support the justification of free medical services at future IPT's.
Medical service provider	Who did the player receive medical attention from? This provided insight into which professions are attending to injuries in field-hockey.
Time Lost from hockey	Was there training or match days missed as a result of this injury? This was recorded as days injured.

3.3.3 Injury reporting form

There is currently no consensus statement on injury surveillance for field hockey. Therefore, the questionnaire was developed based on the BokSmart injury surveillance forms (Starling et al., 2019); although the definitions of injuries were adapted to fit the purposes of the present study (Clarsen & Bahr, 2014; Fullller et al., 2016; Appendix D). The definition of injury for this study was: "Any physical discomfort resulting from hockey related activity, regardless of severity or need for medical attention as perceived by the player."

Incidence and burden of injury was documented throughout the tournament using a modified "serious injury reporting form" extracted from BokSmart 2009, which is a validated questionnaire used in South African literature (Starling et al., 2019) and quantified per the FIFA F-MARC definition of injury (Fuller et al., 2006).

The reason for a definition relating to "all injuries," "seeking medical attention," and "time loss," was as it captured players who sustained injury regardless of their access to medical attention and subsequent time loss. It is the broadest classification of injury reporting (Clarsen & Bahr, 2014) and due to the exploratory nature of this research, with very little previous research in South Africa, it was deemed necessary to capture as many injuries as possible. This served to allow for recommendations to the national body regarding policy on medical access at the venue for players without team medical staff, as the burden of all injury is thus quantified and categorised. The questionnaires were completed throughout the week by the athletes via an electronic platform post-match and were tabulated and analysed.

The electronic platform Surveymonkey *(https://www.surveymonkey.com/r/L5VMSKS*) was used to collect daily injury reporting. A weblink was sent directly to participants which allowed them access to the online form. The results of these were collected, de-identified, and coded for analysis.

3.4 Procedure

Ethical approval was obtained from the Human Research Ethics Committee of the University of Cape Town (HREC REF 117/2018; see Appendix E). Permission to conduct the research during the tournament and to inform the participating provinces of the study was obtained from the SAHA Chief Executive Officer (Appendix F).

Recruitment took place prior to the tournaments by contacting the individual unions and team managers of each the teams attending IPT. Informed consent (see Appendix A) was obtained from coaches and players; following this, they were sent a link to the digital baseline questionnaire. Outstanding baseline questionnaires and consent forms were obtained prior to the tournament at the pre-tournament briefing. Online confidentiality was maintained through password-protected folders.

The team managers and coaches were briefed at the "pre-tournament management meeting" chaired by the tournament director. The daily reporting form was distributed after teams played their match for the day. Only one temporary assistant was required to assist with data collection during a three-day period in August 2018 where the student researcher was obligated to write coursework examinations at the University of Cape Town. The student researcher completed data collection at the female tournament in May 2018; and for the first two days and last two days of the male tournament in August 2018. Due to clashes with Masters coursework requirements, a research assistant was used to collect data for three days during the male's tournament. The research assistant was trained in the use of the electronic platform as well as the definitions of injury and was instructed on how to answer any questions from participants.

There were no queries or obstacles to collection during this period, as the student researcher had already obtained consent from all participants, and the baseline questionnaires had been completed. In addition, the male's tournament day one and two injury reporting forms had already been completed and players were familiar with reporting requirements.

The student researcher was available to team managers, players, and the research assistant telephonically. Once all data were collected (pre-tournament and tournament data), the responses were de-identified, and all participants were issued study identification numbers. All participating teams, unions, coaches, and players received an "injury prevention" pamphlet at the end of the tournament (Appendix H).

3.5 Incidence calculation and statistical analyses

Injury incidence was captured for all injury, medical attention, and time loss. Incidence was to be calculated as follows: each team has 11 players on the field during a match, with a total match duration of 1h (four 15-minute quarters). The tournament was played over seven days and regardless of progression through the tournament, each team played on all seven match days. Player match hours was therefore calculated as: 11 players X 7 days X 1 hour per game = 77 player match hours. Incidence will be presented as injuries per 1000 player match hours.

Statistical analyses were performed using Statistical software IBM SPSS version 25 (Armonk, NY: IBM Corp). Normality of numeric data was evaluated with the use of the Shapiro-Wilk's test. Differences between sexes for numerical values were determined using the Mann-Whitney U test or an independent t-test for non-parametric and parametric data respectively. As per the study objectives, the results were analysed as follows:

1. Incidence of injury among players was represented as injuries per 1000 player match hours with 95% confidence intervals, in line with previous research carried out internationally and within South Africa.
2. The burden of acquired sport injuries was defined by time loss per 1000 player match hours with 95% confidence intervals.

3. Potential associations relating to injury incidence, as outlined in the study objectives (coaching experience, presence of medical staff and history of injuries) were described using the Chi-square test, odds ratios, and risk ratios. Any significant associations were further explored with logistic regression analysis.
4. Potential association between the presence of health professionals and injury incidence per team were described using the Chi-square test, odds ratios, and risk ratios. Any significant associations were further explored with logistic regression analysis.

3.6 Ethical considerations

The study was carried out in accordance with the World Medical Associations Declaration of Helsinki 2013 (World Medical Association, 2013). The study commenced once approval was obtained from the University of Cape Town's Faculty of Health Sciences Human Research Ethics Committee (HREC REF 117/2018). Informed consent was obtained from all participants, clearly outlined the objectives of the study and sought permission for information to be used confidentially without third-parties (including coaches or other participants) being informed of individual responses (Appendix A). The results of the study would be pooled and provided as feedback to the participants, unions, and the national body for the development of the sport in South Africa.

The information collected was considered highly sensitive and all forms were de-identified once the tournament had been completed and the data were entered in a password protected Excel spreadsheet. Hard copies were stored in a locked cupboard off site from the tournament (Appendix G).

3.6.1 Risk to participants

There was no physical risk to participants as no intervention took place. The information gathered from individual participants would not be distributed. Summarised results of the study would be shared with SAHA and/or any provincial unions, coaches, or hockey authorities who may consider using the findings to improve players' safety and increase participation.

3.6.2 Benefit to participants

There was no remuneration for involvement in this study; however, participants received an injury prevention pamphlet with evidence based pre-habilitation exercises adapted from validated tools of the South African Rugby Union (SARU, 2016) and World Football Federation FIFA 11+ (FIFA, 2006; see Appendix H).

The overall benefit of the study to SAHA and field hockey in South Africa is that the incidence of injury would be updated for this population on a greater scale, for the first time since 2007. It is hoped that the present study may also contribute to global initiatives to improve the game for all participants. Further, the study may lead to the development of policy documentation specific to injury prevention in South African field hockey. It also has the potential to include more specific modules of medical and sport science knowledge into the coaching qualification levels within SAHA.

CHAPTER FOUR: RESULTS

4.1 Study sample

For the present study, each of the male and female teams attending IPT were invited to participate. Each team consisted of 18 players per squad, resulting in a potential sample of 432 participants (i.e. 216 females and 216 males). In the female tournament, 163 participants completed the tournament injury reporting form; however, 23 participants did not provide consent to the study and their data was subsequently excluded. Seven participants were excluded due to being underage. In the male tournament, 168 participants completed the injury reporting form but 29 did not complete the consent form and their data were excluded from the study. Each tournament comprised of 12 participating teams, therefore there was an opportunity to recruit a total of 24 coaches. However, two coaches did not consent to partake in the study. Therefore, the combined sample size for the study was 272 player participants (i.e. 133 females, 139 males, and 22 coaches. The recruitment flowchart is presented in Figure 1.

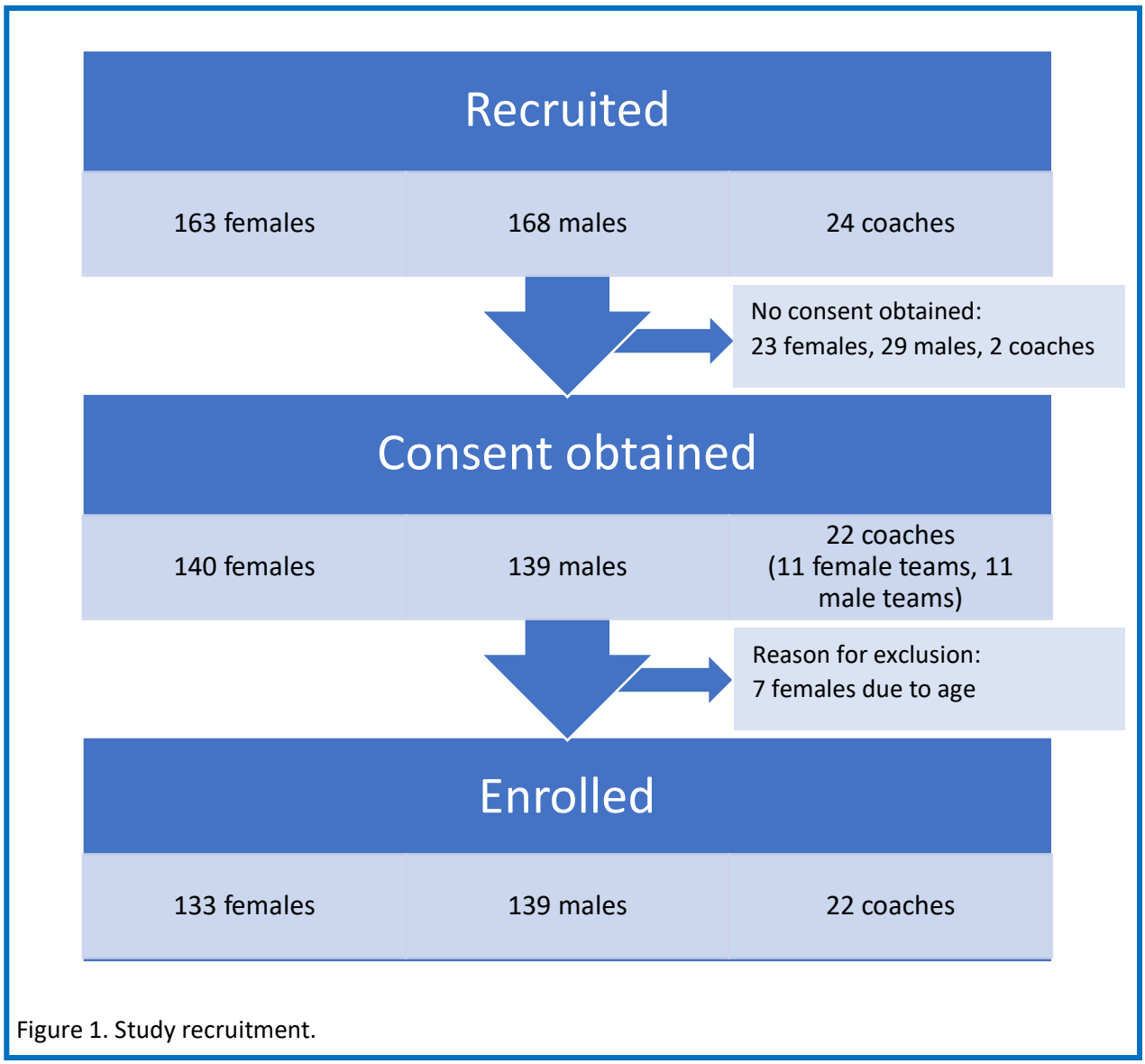


Figure 1. Study recruitment.

4.2 Descriptive characteristics of study participants

4.2.1 Coaches

The results of the coaches' questionnaire are summarised in Table 3. The male and female tournament coaches were compared, and no statistically significant differences between the two tournaments were found. The educational level of the coaches varied widely. Five male tournament coaches and three female tournament coaches held a university degree; however, seven coaches (three male tournament and four female tournament coaches) did not hold tertiary-level educational qualifications.

Coaching experience was similar between the male and female tournament coaches, with the respective median years of experience (IQR) of 3.00 (2.00-7.00) and 2.00 (1.00-4.00). The level of SAHA coaching qualifications was identical for both tournament groups; however, two male tournament coaches held FIH coaching qualifications.

Although no statistical differences were found between the tournaments regarding medical support; the male tournament had a greater number of physiotherapists present within the teams and only the female tournament had a chiropractor present in one of the teams. As there were no free medical services available at the tournaments, seven teams had to make use of local medical practices in case of emergencies or where health professional assistance was required.

Most coaches indicated that the responsibility for warm-ups was that of the players. The male tournament coaches ranked the responsibility in the following order: players, physiotherapist, then coaches; whereas the female tournament coaches ranked the responsibility as: players, coaches, then the physiotherapist.

With regard to the decision on player availability post-injury, 10 coaches (four female tournament and six male tournament coaches) responded that it was the coach's responsibility to decide who would be available to play, while another 10 (six female tournament and four male tournament) coaches reported that the decision was the responsibility of the medical staff.

Table 3. Coaches background questionnaire.

Coaching Characteristics		Female tournament (n = 11)	Male tournament (n = 11)	Statistical and p- value
Education	University Degree	3	5	$X^2 = 0.786$
	Diploma	4	3	P= 0.939
	No Tertiary Education	4	3	(Yates correction)
SAHA Coaching Level	Level 1	2	2	$X^2 = 0.000$
	Level 2	4	4	P= 0.789
	Level 3	5	5	(Yates correction)
FIH Coaching Level	Yes	0	2	$X^2 = 2.200$
	No	11	9	P= 0.476
				(Fisher exact)
First Aid Qualifications	Level 1	3	4	$X^2 = 2.200$
	Level 2	2	3	P= 0.476
	Level 3	0	0	(Yates correction)
	No First Aid	6	4	
Medical Staff in Team	Physio	4	7	$X^2 = 1.918$
		1	0	P= 0.890
	Chiro	1	1	(Yates correction)
		4	3	
	Bio			
	No Medical Staff			
Warm-ups managed by	Physio	2	6	$X^2 = 1.373$
	Bio	1	1	P= 0.870
	Players/Captain	8	9	(Yates correction)
	Coach	4	4	
Player availability after injury decided by	Coach	4	6	$X^2 = 0.800$
	Medical staff	6	4	P= 0.705
	Player	1	1	(Yates correction)
Numbers of years of IPT coaching in Median (IQR)	Male and Female tournament	2.00 (1.00-4.00)	3.00 (2.00-7.00)	P = 0.195 Man-Whitney U

4.2.2 Players

The study participants completed a baseline questionnaire that recorded their personal information, playing information, as well as their previous injury history. The players' ages across the two tournaments were not normally distributed ($W = 0.90$, $p < 0.01$), with the median age of the males: 22.00 (IQR 20.00-26.00) and females: 21.00 (IQR 19.00-25.00). There was a statistically significant difference between the ages of players participating in the two tournaments ($p = 0.011$).

The players were asked to provide the position on the field in which they most often played, which was categorised into goalkeepers (GK), defenders (DEF), midfielders (MID), and forwards (FWD). Field hockey, as with other team sports, has specialist positions (such as goalkeepers); however, "in-field" positions may often interchange based on the required formations on the field. Both tournaments had the largest number of players in the midfield and defensive groups. There were also more goalkeepers recruited in the study from the male tournament than the female. These results are summarised in Figure 2.

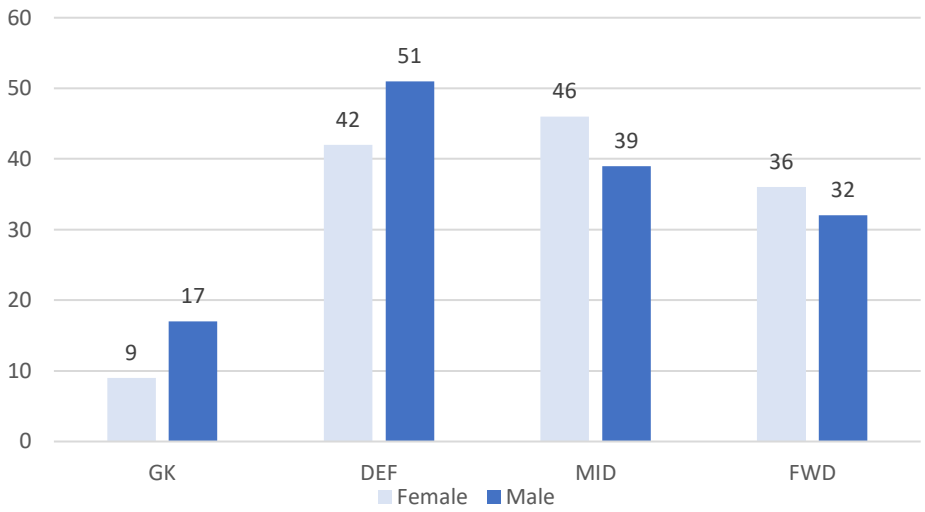


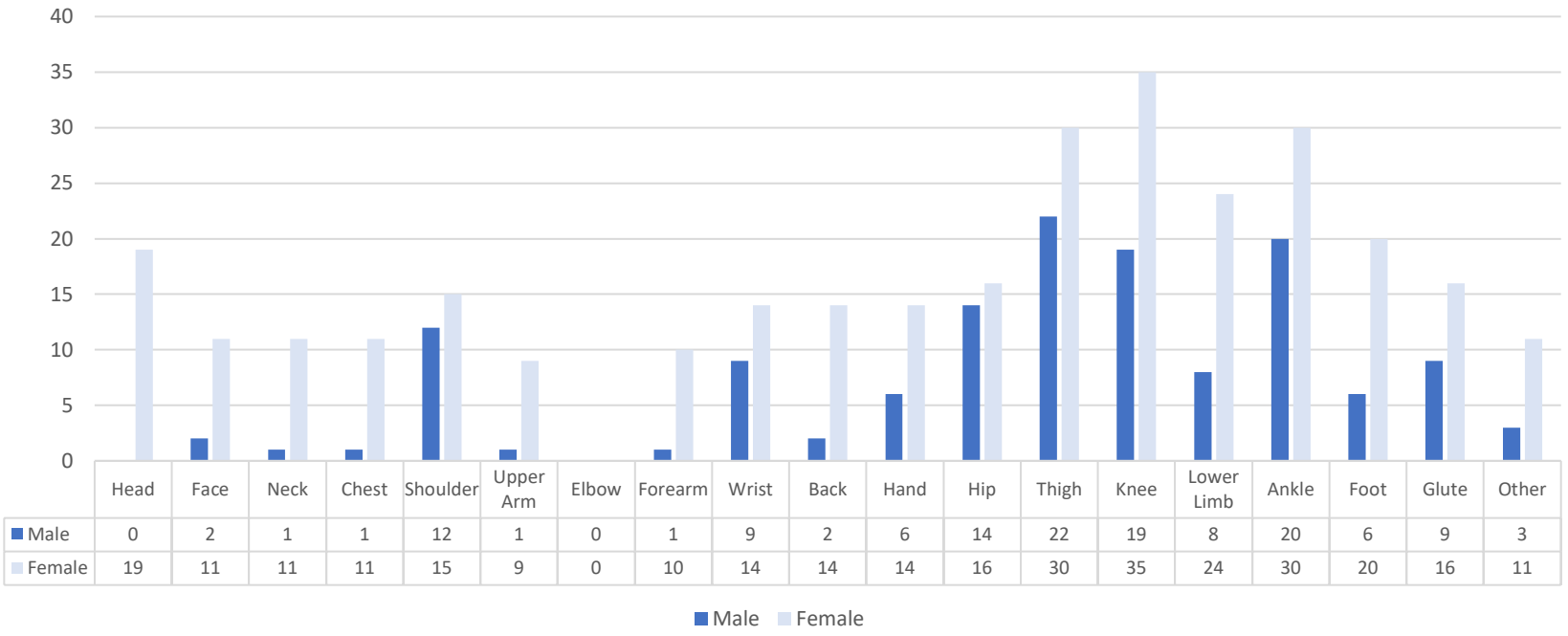
Figure 2. Player positions reported during the tournament.

The players were asked to report on whether they had sustained any pre-tournament injuries over a period of two years prior to the commencement of the tournament, as well as the event inciting their injuries (Table 4). In both the male and female groups, training injuries accounted for most of the inciting events. Players were able to input up to three pre-tournament injuries into the questionnaire.

Table 4. Pre-tournament injuries.

Pre-Tournament Injuries		Female	Male
	Number injuries reported	334	341
Injury occurred During:	Training	204	185
	Match	117	134
	Warm Up	1	3
	Other	12	19

The participants were asked to indicate the anatomical region of their previous injuries (Figure 3). Players were able to input up to three pre-tournament injuries into the questionnaire. Both groups reported a predominance of lower extremity injuries prior to the tournament. The regions with the most reported involvement for the females was the knee, followed by the thigh, and ankle. The males reported their most affected region as the ankle, followed by the thigh, and then the knee. Head injuries were the cause of 19 reported injuries for the females, while the males did not report any pre-tournament head injuries. The females also reported more injuries involving the face compared to the males.



	Head	Face	Neck	Chest	Shoulder	Upper Arm	Elbow	Forearm	Wrist	Back	Hand	Hip	Thigh	Knee	Lower Limb	Ankle	Foot	Glute	Other
Male	0	2	1	1	12	1	0	1	9	2	6	14	22	19	8	20	6	9	3
Female	19	11	11	11	15	9	0	10	14	14	14	16	30	35	24	30	20	16	11

Figure 3. Anatomical regions of injury prior to tournament.

The number of previous injuries requiring pre-tournament medical attention are displayed below (Figure 4). Players were able to input up to three pre-tournament injuries into the questionnaire. For both male and female participants, physiotherapy was the predominating health profession that assisted with injuries, followed by doctors and biokineticists. Females reported twice the amount of chiropractor assistance for injury, whereas the males reported twice the amount of sport science assistance for their injuries.

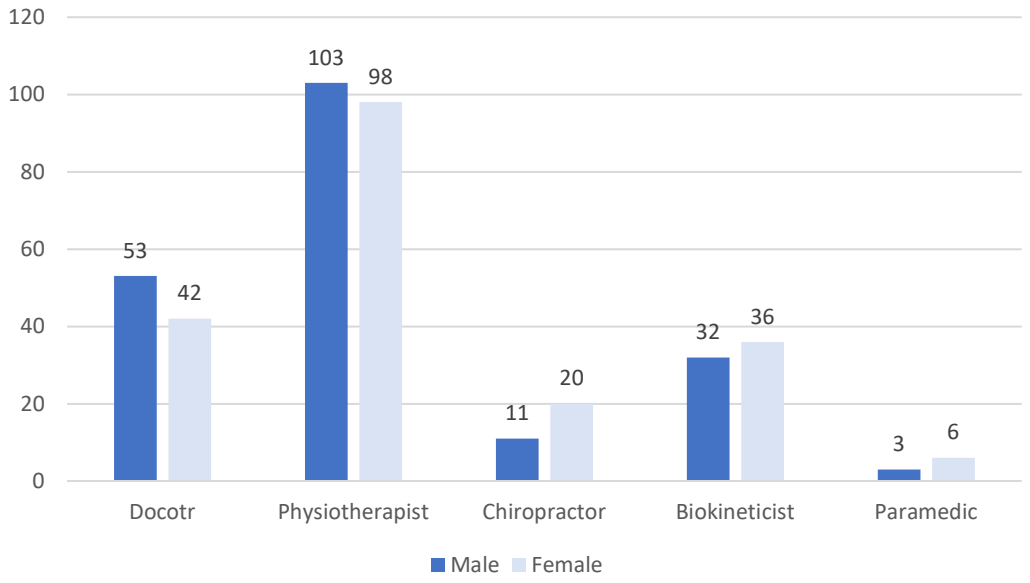


Figure 4. Number of previous injuries addressed by health care professionals.

4.3 Tournament results

4.3.1 Response rate

The results of the study were reliant on the participants completing their daily injury report forms. The variation in response rate per tournament day is presented in Figure 5 below. The male participants' reporting began with 93 responses on day one (67% of recruited sample), and steadily decreased to 52 (37% of recruited sample) on the final day of the tournament. The female participants began with 74 responses (55% of recruited sample), increased to 86 (64% of recruited sample) on day two, and then decreased to 70 (52% of recruited sample) for day three. The lowest response day for both tournaments was day seven, with 52 (37%) and 31 (23%) responses respectively. The female tournament averaged 57 responses per match day, while the male tournament averaged 71 responses per match day. Overall there were 64 responses per day for the combined tournaments.

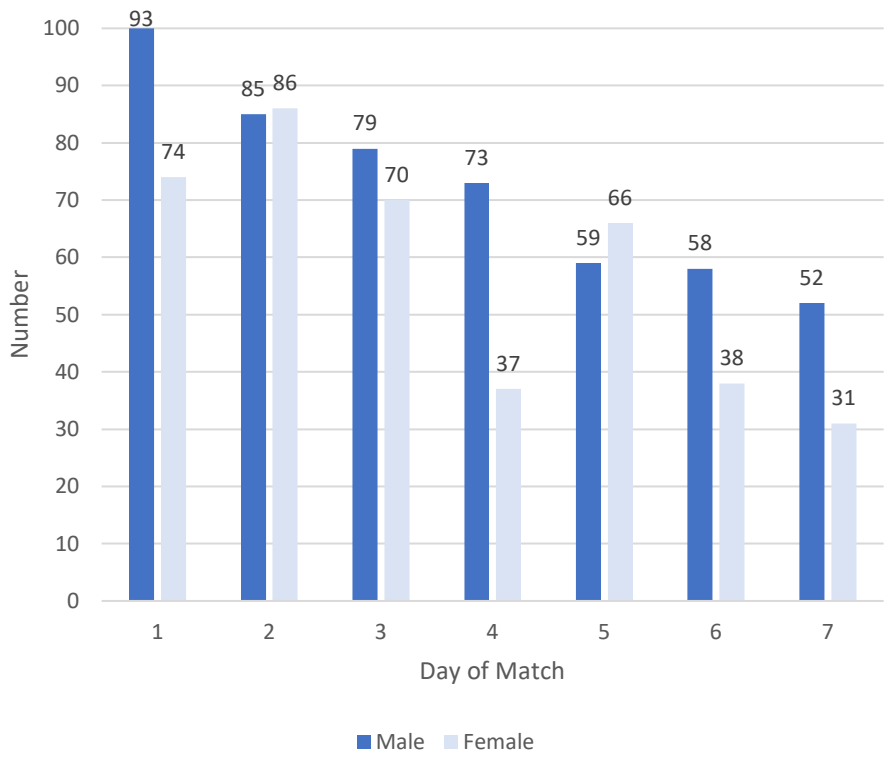


Figure 5. Number of completed injury report forms per match day.

Table 5 illustrates how participants defined their daily injury status as per the definition used in the study. As the daily responses received fluctuated, the adjusted percentage of injuries reported compared to daily responses was calculated. There were no clear trends to suggest an increase of injuries as the tournament progressed with the males; however, during the female tournament, injuries became more apparent as the tournament progressed, with a small decrease on day five. Day seven had the lowest amount of injuries reported, as well as the lowest response rate across both tournaments.

Table 5. Injury reporting per match day.

		Injury Reporting							
		Female				Male			
		No	Yes	Total responses	% with injuries	No	Yes	Total Responses	% with injuries
Match Day	1	57	17	74	22.9%	72	21	93	22.5%
	2	65	21	86	24.4%	64	21	85	24.7%
	3	46	24	70	34.2%	62	17	79	21.5%
	4	24	13	37	35.1%	47	26	73	35.6%
	5	46	20	66	30.3%	47	12	59	20.3%
	6	24	14	38	36.8%	44	14	58	24.1%
	7	23	8	31	25.8%	43	9	52	17.3%

4.3.2 Incidence of injury

In the female tournament, a total of 72 injuries were reported, with 48 requiring medical attention, and four resulting in time loss (see Table 6). The incidence calculated per 1000 player match hours was 77.9 (95% CI: 47.1 - 108.1) for the overall female tournament, with 51.9 (95% CI: 32.3 – 71.5) injuries per 1000 player match hours requiring medical attention, and 4.32 (95% CI: 1.04 – 9.7) injuries per 1000 player match hours resulting in time loss. It is important to note that duplicated injury reports of match days were removed for the incidence calculation but included in Table 5.

Table 6. Female tournament injury incidence.

Injury data are presented as individual team and total injury numbers and incidence rates per 1000 player match hours.

Team	Number of Injuries	Incidence per 1000 player match hours	Medical Attention Needed	Medical attention Incidence per 1000 player match hours	Time Loss	Incidence of Time Loss per 1000 player match hours
Eastern Province	10	129.8	7	90.9	0	0
Free State	4	51.9	3	38.9	0	0
KZN Mynahs	10	129.8	5	64.9	1	12.9
KZN Raiders	0	0	0	0	0	0
Mpumalanga	13	168.8	5	64.9	1	12.9
North West	5	64.9	2	25.9	0	0
Northern Blues	8	103.8	8	103.8	2	25.9
Peninsula	6	77.9	6	77.9	0	0
SA u21	5	64.9	4	51.9	0	0
Southern Gauteng	2	25.9	1	12.9	0	0
Witsies	5	64.9	3	38.9	0	0
Western Province	4	51.9	4	51.9	0	0
Total	**72**	**77.9 (95% CI: 47.1 - 108.1)**	**48**	**51.9 (95% CI: 32.3 – 71.5)**	**4**	**4.3 (95% CI: -1.04 – 9.7)**

A total of 92 injuries were reported in the male tournament, with 65 injuries requiring medical attention and seven resulting in time loss. The incidence of injuries for the males tournament was 99.5 (95% CI: 71.9 – 127.1) injuries per 1000 player match hours, the incidence of medical attention needed was 70.3 (95% CI: 46.1 – 94.4) injuries per 1000 player match hours, and the incidence of time loss was 7.5 (95% CI: -0.7 – 15.75) injuries per 1000 player match hours (Table 7). It is important to note that duplicated injury reports of match days were removed for the incidence calculation but included in Table 5.

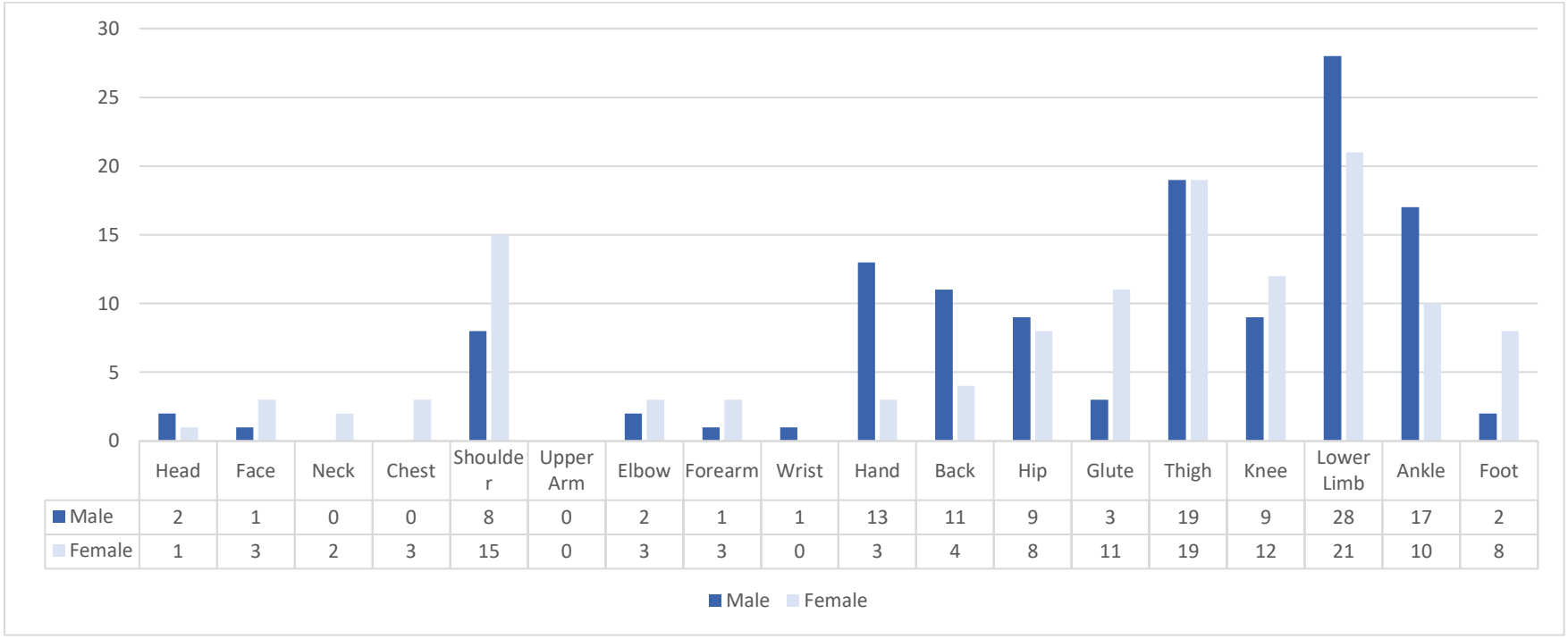
Table 7. Male tournament incidence.

Injury data are presented as individual team and total injury numbers and incidence rates per 1000 player match hours.

Team	Number of Injuries	Incidence per 1000h player match hours	Medical Attention Needed	Medical attention Incidence per 1000 player match hours	Time Loss	Incidence of Time Loss per 1000 player match hours
Eastern Province	5	64.9	2	25.9	0	0
Free State	4	51.9	3	38.9	1	12.9
KZN Mynahs	8	103.8	4	51.9	0	0
KZN Raiders	10	129.8	5	64.9	0	0
Nuggets	6	77.9	3	38.9	0	0
North West	12	155.8	7	90.9	2	25.9
Northern Blues	2	25.9	2	25.9	0	0
Peninsula	10	129.8	8	103.8	0	0
SA u21	13	168.8	11	142	1	12.9
Southern Gauteng	8	103.8	7	90.9	0	0
Witsies	5	64.9	4	51.9	0	0
Western Province	9	116.8	9	116.8	3	38.9
Totals:	**92**	**99.5 (95% CI: 71.9 – 127.1)**	**65**	**70.3 (95% CI: 46.1 – 94.4)**	**7**	**7.5 (95% CI: -0.7 – 15.8**

4.3.3 Description of injuries during the tournaments

The anatomical regions of injury reported in both tournaments are presented in Figure 6. As with the pre-tournament anatomical regional injuries, injuries to the lower extremity was reported more frequently than those to the upper body. In the lower extremity, the lower limb region was the most reported area of injury for the male and female tournament. Of all the injuries of the lower extremity, the lower limb, thigh (quadriceps and hamstrings), as well as ankles and knees are identified as the most frequently reported regions. The female tournament reported shoulder injuries as their third most reported anatomical region, where the males reported the ankle. The female tournament reported less head, but more face, neck, and chest injuries than the males. There were also considerably less head injuries reported by the female tournament compared to their pre-tournament anatomical region. Females reported more knee injuries than the males, while the males reported more ankle injuries. It is important to note that entries by players reporting the same region of injury were removed from this figure as duplicates, however players could input multiple regions of injury for their injury input.



	Head	Face	Neck	Chest	Shoulder	Upper Arm	Elbow	Forearm	Wrist	Hand	Back	Hip	Glute	Thigh	Knee	Lower Limb	Ankle	Foot
Male	2	1	0	0	8	0	2	1	1	13	11	9	3	19	9	28	17	2
Female	1	3	2	3	15	0	3	3	0	3	4	8	11	19	12	21	10	8

Figure 6. Anatomical regions of injury during the tournament.

The number of injuries requiring medical attention was observed and categorised per health professional (Figure 7). As seen for pre-tournament injuries, physiotherapists were the most utilised health profession, followed by biokineticists. Teams comprised of various health professionals, but also sought help from local practitioners (within the tournament region) in the case of injury or illness where they had no health professional within their team. It is common practice for the tournament organisers to list health services within the tournament area in case of emergency.

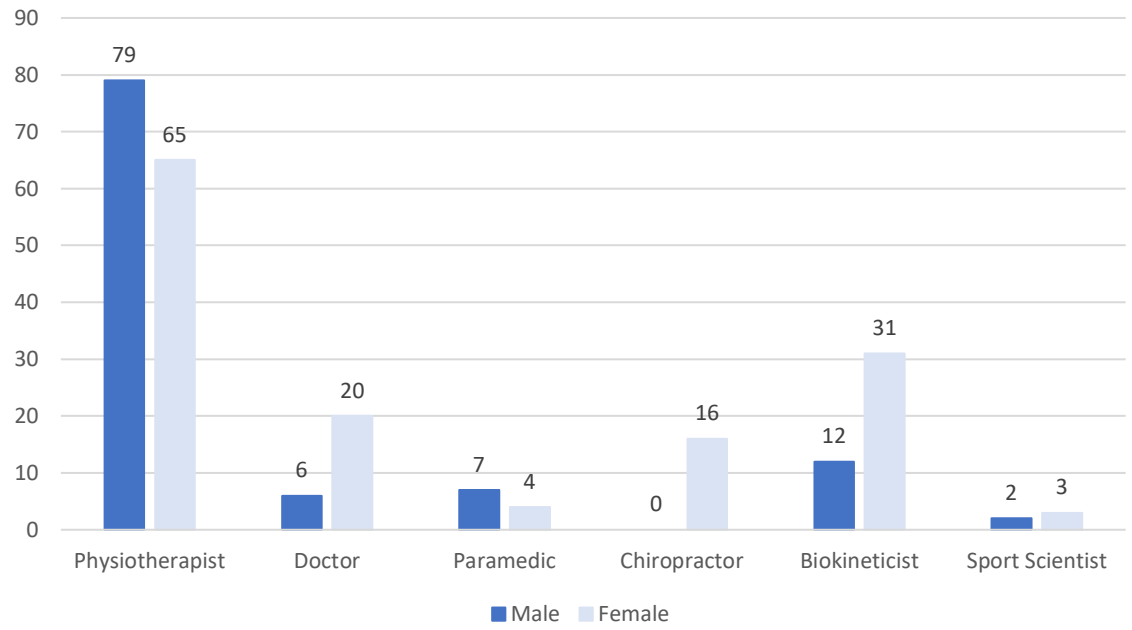


Figure 7. Number of injuries attended to by health professionals.

Figure 8 shows match situations during which injuries occurred as classified by the players. The majority of injuries occurred during open play for both males and females. Open play is defined as free-running play and not a re-start from stoppage or ball out of play. Injuries resulting from short corners were not common, while warm-ups and the "other" category made up the remainder of the match situations resulting in injury.

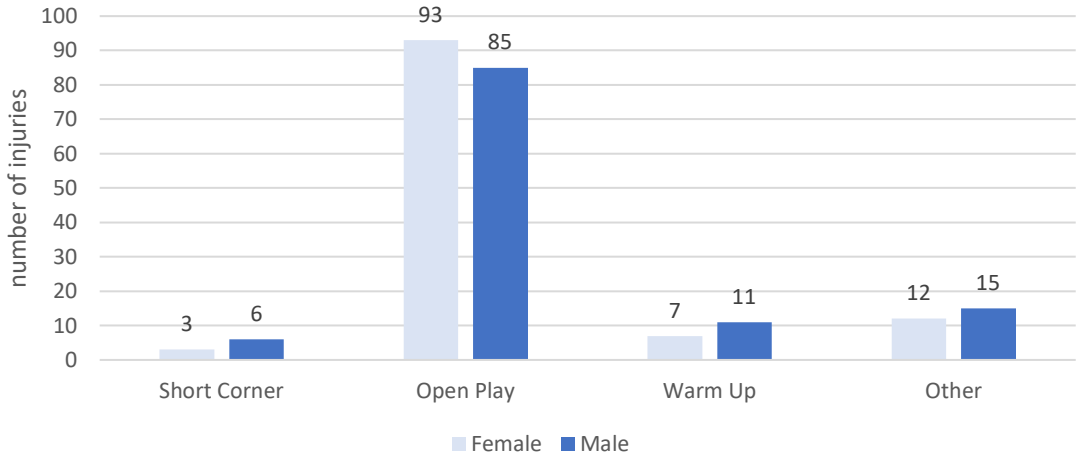


Figure 8. Match situations reported for injury during the tournaments.

4.3.4 Associated factors for injury

The study explored associations between injuries and various factors during the tournament, including the presence of medical staff, the coach's tertiary education and coaching qualifications, player gender, playing position, and previous injuries. Chi-Square analysis, odds and risk ratios revealed significant associations between: injuries and the coaches having a FIH qualification ($p = 0.015$; OR = 0.188; RR = 0.618), injuries and previous injury in the preceding one year ($p < 0.0001$; OR = 3.548; RR = 1.861) and two years ($p < 0.0001$; OR = 4.997; RR = 1.768); gender and seeking medical attention ($p = 0.046$; OR = 2.380; RR = 1.491), as well as previous injury in past two years and seeking medical attention ($p = 0.046$; OR = 4.020; RR = 3.341). There was no statistically significant difference observed between male and female injuries during the tournaments ($p = 0.390$). Table 8 (below) includes a summary of associations, odds and risk ratios and statistically significant findings.

Table 8. Associations with tournament injuries.

Factor	Subcategory	Not injured during tournament	Injured during tournament	Statistical and p-value
Presence of medical staff	No Yes	39 78	31 64	X^2= 0.12 p= 0.914
Coaches' education	None Diploma Tertiary education	41 46 52	32 16 24	X^2=3.38 p= 0.180
Level of coaching degree	1 2 3	22 37 80	10 20 42	X^2= 1.11 p= 0.570 (Yates X^2 correction)
Coaching Qualification FIH	No Yes	105 12	93 2	X^2= 5.65 p=0.015 (Fisher exact) Odds Ratio (95% CI) = 0.188 (0.41 – 0.863) Risk Ratio (95% CI) = 0.618 (0.481 – 0.795)
Coaching and first aid	No Yes	60 57	38 57	X^2 =2.68 p = 0.101
Coach's Level of first aid	0 1 2	60 30 27	38 36 21	X^2 = 3.99 p = 0.136
Position played	Goalkeeper Defender Midfielder Forward	16 46 36 27	8 32 37 28	X^2= 2.48 p= 0.477
Previously injured in past 2 years	No Yes	49 76	12 93	X^2= 22.58 p < 0.0001 Odds Ratio (95% CI) = 4.997 (2.481 – 10.065) Risk Ratio (95% CI) = 1.768 (1.450 – 2.119)
Previously injured in past 1 year	No Yes	92 32	47 58	X^2 = 20.645 p < 0.0001 Odds Ratio (95% CI) = 3.548 (2.034 – 6.190) Risk Ratio (95% CI) = 1.861 (1.375 – 2.519)
Gender	Female Male	56 69	53 52	X^2 = 073 p = 0.390

Table 8 continued.

Factor	Subcategory	Not injured during tournament	Injured during tournament	Statistical and p-value
		Male	**Female**	$X^2 = 3.95$
Gender and seeking Medical attention	No	20	11	p = 0.046 Odds Ratio (95% CI) = 2.380 (1.002 – 5.682)
	Yes	32	42	Risk Ratio (95% CI) = 1.491 (1.031 – 2.185)
		Injury past 2 years (no)	**Injury past 2 years (yes)**	$X^2 = 3.95$
Previous injury 2 years and seeking Medical attention	No	7	24	p = 0.046 Odds Ratio (95% CI) = 4.020 (1.167 – 13.881)
	Yes	5	69	Risk Ratio (95% CI) = 3.341 (1.148 – 9.726)
		Injury past 1 years (no)	**Injury past 1 years (yes)**	
Previous injury 1 year and seeking medical attention	No	17	14	$X^2 = 1.806$ p = 0.178
	Yes	30	44	

[1]*Significant findings

A forward stepwise logistic regression analysis was subsequently performed based on the associations and odds ratios recorded in Table 8 and is presented in Table 9 below. Logistic regression modelling revealed a predictive relationship between injury occurrence and previous injury (over the past 1-2 years), which significantly increased likelihood of obtaining an injury ($p < 0.001$), and FIH coaching level, which significantly decreased injury occurrence ($p = 0.040$, likelihood = -128.205).

[1] Significant associations are highlighted in red.

Table 9. Logistic regression analysis of associated factors and injury incidence.

Variables in the Equation							
		Intercept	Standard Error	Wald chi-square	Degrees of freedom	P-Value	Exp(B) Odds Ratio
Step 1[a]	**Previous injury in past 2 years** (0no 1yes)	1.555	.375	17.231	1	**0.0001**	4.735
	Constant	-1.431	.336	18.172	1	.000	.239
Step 2[b]	**FIH coaching level** (0no 1yes)	-1.630	.795	4.205	1	**0.040**	.196
	Previous injury in past 2 years (0no 1yes)	1.558	.378	16.995	1	**0.0001**	4.748
	Constant	-1.344	.338	15.766	1	.000	.261
Step 3[c]	**FIH coaching level** (0no 1yes)	-1.543	.801	3.714	1	**0.054**	.214
	Previous injury in past 2 years (0no 1yes)	1.192	.418	8.112	1	**0.004**	3.293
	Injured less than 1 year ago? (0no 1yes)	.699	.343	4.139	1	**0.042**	2.011
	Constant	-1.346	.338	15.823	1	.000	.260

a. Variable(s) entered on step 1: Previous injury in past 2 years (0no 1yes).
b. Variable(s) entered on step 2: FIH coaching level (0no 1yes).
c. Variable(s) entered on step 3: Injured less than 1 year ago? (0no 1yes).

CHAPTER FIVE: DISCUSSION

5.1 Summary of main findings

The primary aim of the present study was to investigate the incidence of injury in field hockey during the senior male and female provincial tournaments of 2018. The main findings of the study revealed all injury incidence of 99.5 (95% CI: 71.9 – 127.1) injuries per 1000 player match hours for males, and 77.9 (95% CI: 47.1 - 108.1) injuries per 1000 player match hours for females. The incidence of medical attention injuries observed was 70.3 (95% CI: 46.1 – 94.4) and 51.9 (95% CI: 32.3 – 71.5) injuries per 1000 player match hours for males and females respectively. The incidence of time loss for the study is reported as 7.5 (95% CI: -0.7 – 15.75) injuries per 1000 player match hours for males, and 4.3 (95% CI: -1.04 – 9.7) injuries per 1000 player match hours for females.

The most predictive factors for player injury during the tournament were previous injury (over the past 1 and 2 years) as well as their coach holding a FIH coaching level qualification. A significant association was found between coaches with a FIH qualification and tournament injury, with players being less likely to sustain injuries where their coach held an FIH qualification (OR = 0.188; RR = 0.618). Players who were previously injured (past 1 and 2 years), were 3.5 – 5.0 times more likely to sustain re-injury during the tournament. Female players were also 2.4 times more likely to seek medical attention compared to male players, and players who were injured in the past two years were also 4 times more likely to seek medical attention (OR = 4.020; RR = 3.341).

5.2 Generalisability of the study results

The study was the largest observational study conducted in South African field hockey and the first, to our knowledge, that investigated both male and female inter provincial tournament formats. The participants at both tournaments were well matched for age with a median (IQR) age of 22 (20-26) and 21 (19-25) years for males and females respectively as well as for numbers enrolled (male, n = 139 and female, n = 133).

Participants were recruited from teams across the country and both tournaments consisted of seven matches played over seven consecutive days in identical match formats of four quarters of 15 minutes each. Therefore, the results of this study are generalisable to South African field hockey and its annual senior inter provincial tournament.

Previous research in South African field-hockey comprised of smaller samples of only female participants playing club, provincial, and national matches and collected injury information retrospectively after a full season (Naicker et al., 2007). The present study may be used as an updated record of observational injury incidence for South African field hockey, which should be improved upon over time. When comparing the present study to existing literature, the definition of injury used, study methodologies, and format of the tournament should be considered.

The injury definition used in this study, "any physical discomfort resulting from hockey related activity, regardless of severity or need for medical attention," was broad enough to capture all physical complaints and subsequently categorise them by time-loss and whether medical attention was required. This is in line with the consensus statement for football injuries, which the researchers deemed to be a sport similar to hockey in physical and tactical game play (Fuller et al., 2006). This all-encompassing definition is supported by literature criticising the "one size fits all" approach in injury research (Clarsen & Bahr, 2014). The rationale behind using an "all complaints" (Bahr, 2009a) definition with self-reported data was due to the large sample size in combination with the lack of resources for data collection. It was less time and resource consuming to have participants self-report through a questionnaire, without the use of third-party data collectors. It should therefore be acknowledged that the present study only allowed for an estimate of injuries experienced at the 2018 IPT.

There is an evident lack of consensus in surveillance terminology for international field hockey. In one of the largest international field-hockey studies (Theilen et al., 2016), the researchers only documented injuries that resulted in stoppage of the match for players to be removed from the field.

Similarly, the largest female high school and collegiate field hockey study, which took place over ten years (Lynall et al., 2018), only documented injuries that occurred during field hockey related activity, required medical attention, and resulted in more than one day of missed participation in field hockey (Lynall et al., 2018). The recently published first systematic review on field hockey injuries concluded that the lack of consensus in injury definitions and study methodologies should be addressed for research to become comparable (Barboza, Joseph, et al., 2018).

The format of the tournaments in the present study was seven consecutive days of fixtures for all participating teams, regardless of playoffs and finals. This is not common practice in international field hockey, with tournaments such as the summer Olympics and World Cup taking place over several weeks with teams playing every alternate or third day at most. In South Africa, field hockey is not played at a professional level, therefore the condensed tournament format reduces the financial cost of travelling, accommodation, and time away from employment commitments for both coaches and players. It is hypothesised that the format of the tournament has an influence on observed injuries for both male and females in field hockey. This has been explored in other team sports including cricket, rugby, and football. In football, it has been reported that congested periods of fixtures can affect the between match recovery of players (Penedo-Jamardo, Rey, Padrón-Cabo, & Kalén, 2017). In the present study, both the tournaments played daily which left a very small window of recovery in-between matches. This may present challenges when comparing injury rates with other tournaments or seasonal field hockey research. Internationally, cricket has called for a review of its consensus statement on injury definitions to account for the growth of the "T20" (condensed) format of the game (Orchard, James, Kountouris, & Portus, 2010). Currently, field hockey exists in both four by four quarters, as well as two-half formats depending on the level, season, or tournament – which poses a further challenge when comparing literature.

The evident variation in current surveillance terminology and methodologies for field hockey makes comparisons between the present study and existing literature inappropriate. The present study can therefore not be directly compared to existing literature, highlighting the need for the international body (FIH) to standardise surveillance terminology, allowing for field hockey research to be comparable in future research. Despite the heterogeneity of definitions, methodologies, and formats in research, the researchers maintain that the results of this study are an estimate of all injuries observed in the tournament format of field hockey for senior participants within South Africa. The methods and definitions used in the present study also lends to comparison between genders which has not been explored in the literature previously. This study should incite discussions regarding the need to standardise surveillance terminology and methodology in field hockey for future research.

5.3 Incidence of injury

The incidence rates in the present study are higher than those found in literature investigating the FIH international tournaments of 2013 (Theilen et al., 2016), who found that injury incidence ranged between 26.0 – 29.1 per 1000 player match for females and between 20.8 – 90.9 per 1000 player match hours for males. Not only was the injury definition vastly different to that in the present study, their method of capturing injury data relied on the training of the tournament officials (who already manage the team sheets, document substitutions, and manage the scoreboard and match time). Further investigation is needed into the reasons for South African injury incidence being higher than international literature.

The present study captured all self-reported injuries regardless of subsequent time loss or need for medical attention and it was expected to observe higher incidence rates as a result of this definition. The FIH 2013 tournaments study only captured injuries that required stoppage in play, causing the removal of the player from the field (Theilen et al., 2016).

These injuries were recorded by match officials, with players and team medical staff not involved in any input of injury information in the study. The number of injuries resulting in time loss or players receiving medical attention was not reported in the study.

The only other South African study available investigated ankle strength, proprioception, and injury incidence in a sample of 47 female provincial hockey players (Naicker et al., 2007). Although their method of capturing injuries also utilised self-reporting, their injury definition only included injuries resulting in time-loss from field hockey for five days or more, and relied on participant recall, as their survey was conducted at the end of the observed season. Their incidence of injury of 6.32 per 1000 player match hours is partially comparable with the present study's time loss injury incidence of 4.3 (95% CI: 1.04 – 9.7) per 1000 player match hours for females. However, it is inappropriate to draw meaningful comparisons between the two studies, for the reasons outlined above. The incidence of time loss injuries in the male tournament of 7.5 (95% CI: -0.7 – 15.75) per 1000 player match hours cannot be compared to other research in South Africa, as no available studies have investigated injury incidence in males.

A study on American female collegiate field hockey observing players over a period of ten years, reported an overall incidence of injury of 5.36 per 1000 player field hockey hours (training and competition), and 8.49 per 1000 player match hours for competition only (Lynall et al., 2018). Injuries in this study were defined as injury caused by field hockey, requiring medical attention, and resulting in at least one day of missed training or match participation. Although the definition of injury in this study once again varies, there is a comparable time-loss incidence rate during matches in the female tournament of the present study.

The literature referenced in this section applied injury definitions which included either medical attention and or time loss from field hockey. For the methods used in the present study, medical attention and time-loss will be discussed separately in the following section.

The researcher believes it was important, in the current context of South African field hockey surveillance, to capture injuries broadly within this study's resource capacity. The present study recorded a high incidence of self-reported injury; however, further research is required to classify these injuries. It is also acknowledged that the premise of our injury incidence interpretation assumes that the non-respondents within the tournament are not injured, which may not have reflected injury incidence accurately and possibly underestimates the actual incidence of the tournament. The findings of injury incidence within the tournaments will allow for the development of strategies to improve participant safety and long-term health as the current self-reported injury burden is high.

5.4 Injury burden

The present study thus observed a decrease in number of self-classified, medical attention required, and subsequent time loss injuries. The burden of time loss injury was low in both tournaments with females reporting 4.32 (95% CI: -1.04 – 9.7) per 1000 player match hours and 7.5 (95% CI: -0.7 – 15.7) per 1000 player hours for males. This supports the views of international research in that time-loss from field hockey is relatively low (Barboza et al., 2019).

Less medical attention and time loss was observed in the female tournament compared to the male, however no statistically significant differences were found regarding injury burden between the tournaments. The overall number of self-reported injuries was considerably high, which suggests that future research should also investigate injuries not resulting in time loss. The observation of the low time-loss with high injury incidence warrants explanation, and hypotheses will be explored in the remainder of this subsection.

It was also observed that previous injury during the previous one and two years was significantly associated with injury reporting during both tournaments. The effect of overuse and acute-on-chronic injuries in field hockey may be a reason for this observation, as players evidently experience physical complaints (reported as injuries) as a result of participation.

However, these symptoms are either benign or exacerbated during participation and may require medical attention to prevent time loss (Williams et al., 2016). It may be argued that the large amount of self-reported injuries is insignificant as they do not result in time loss; however, it does indicate that many players experience musculoskeletal complaints during participation, which may affect performance and is therefore a threat to player safety (Hagglund et al., 2013).

Very few studies in field hockey have specifically explored the prevalence of overuse injuries. Overuse is reported at 28.7% of all injuries in female high school field hockey, and at 17% of all injuries in female collegiate field hockey (Lynall et al., 2018). In male and female club hockey, it is reported that chronic/overuse injuries are 20% more frequently reported than acute injuries (Barboza, Joseph, et al., 2018; Lynall et al., 2018). In a German study comparing indoor and outdoor field hockey, outdoor hockey reports combined overuse for males and females as a combined 53.4% of all reported injuries (Hollander et al., 2018). This supports the theory that the burden of overuse injuries is often greater than observed. The present study was not able to identify or classify overuse or contact/non-contact injuries – which will be discussed further in the limitations for the study.

Another hypothesis for the injury/time-loss mismatch is the competitive nature of athletes and the level of participation in the present study (Bahr & Holme, 2003). After participating in the senior IPT, the male and female national teams are selected, and there are major FIH events such as the Field Hockey World Cup and the Olympics that players may be selected for. This may have led to participants "playing through injury" (Hammond et al., 2013).

Although there are no direct associations between "playing through injury" and match outcomes, there are certainly long-term health concerns for participants who use this approach. There have been several rule changes and the introduction of improved protective equipment over the past decades (Hollander et al., 2018), which may account for the decreased number of time loss injuries seen over extended decades of field hockey incidence research.

There is a considerable decrease from total injuries reported to medical attention required, and to injuries causing time loss. This highlights the possible role of overuse and acute-on-chronic injuries in field hockey which has not been explicitly independently investigated. Future research should focus on the largest burden of injury in line with injury prevention models (Emery & Pasanen, 2019) to address the causes of injuries not resulting in time loss from field hockey.

5.5 Anatomical regions for injury

The findings of the present study support existing literature reporting that the lower extremity experiences the largest amount of injuries reported by field hockey players. In the present study, the lower extremity was affected in 70% of all anatomical regions reported in the female tournament and in 69% of all injuries in the male tournament. This is supported by existing literature in field hockey, reporting that the lower extremity is more prone to injury than the upper body (Barboza, Joseph, et al., 2018; Hollander et al., 2018; Lynall et al., 2018; Murtaugh, 2001). The lower extremity was grouped as the anatomical region from the hips to the foot with the glutes, thigh, knee, lower limb (knee to ankle), ankle, and foot making up the collective regions in the questionnaire. The rationale for this grouping was to include the major joints and not exclude the associated muscular regions. As there is no consensus of surveillance terminology, the anatomical regions used to classify lower extremity may differ compared to the literature; however, the lower extremity is synonymous with the anatomical region below the trunk (Murphy, Connolly, & Beynnon, 2003).

The anatomical regions most affected with injury were the lower limb (16%), thigh (15%), and shoulder (11%) for females, and the lower limb (22%), thigh (15%), and ankle (13%) for males. Although the incidence of lower extremity injuries varies across research, it is the most affected body part in field hockey and should therefore be targeted with specific injury prevention interventions (van Mechelen et al., 1992). To date, there have been attempts to implement lower extremity injury reduction strategies in field hockey (Barboza et al., 2019; Gouttebarge & Zuidema, 2018).

This follows the lead of FIFA (FIFA, 2006), the International Cricket Council (ICC; Orchard et al., 2016), and the South African Rugby Unions injury prevention strategies (Starling et al., 2019). It is vital for incidence studies such as the present study to precede these interventions (Finch, 2006; O'Brien et al., 2019; van Mechelen et al., 1992), so that implementation takes aim at true injury burdens.

The present study reported a low incidence of head and facial injuries in the male tournament, with marginally higher incidences seen in the female tournament. Head, face, and neck injuries accounted for 4.7% of the female injuries, while they were only 2.3% of all injuries reported by the males. This is in line with studies reporting facial injuries for field hockey between 3% and 5% (Barboza, Joseph, et al., 2018; Hollander et al., 2018). There was a decrease in the amount of head injuries reported by the females pre-tournament, though it is important to consider the time period for reporting previous injury was up to two years prior to the questionnaire, and the tournament observed was only seven days in duration.

Contrary to these findings, the study by Murtaugh (2001) recorded a higher head and facial injury rate of 34% in female field hockey. The latter was an older published study and highlighted an anatomical injury burden representative of its time. Since its publication, there have been several rule changes which have increased player safety regarding head and facial injuries. Notably, gum guards have become mandatory for all players participating in field hockey; additionally, face masks have become compulsory for penalty corner defenders (Mukherjee, 2012). These rule changes can explain the lower incidence of head and facial injuries observed when comparing current research to studies conducted in 2001.

Lower back pain has been assumed to be a common injury related to field hockey, due to the crouch gait associated with dribbling, resulting in large amounts of time spent with simultaneous ankle, knee, and hip flexion (Bussey et al., 2016). The present study recorded that in the male tournament, "back" injuries were only reported by 8.7% of the participants.

In the female tournament, it was reported by 3.1% of the participants. This suggests that the burden of lower back pain is not as severe as commonly thought and that male participants experienced greater back pain than their female counterparts. The injury rates reported by Murtaugh (2001) revealed an incidence of back injury, more in line with that recorded during the male tournament. In female field hockey studies, lower back pain is reported as 6.8% (Hollander et al., 2018).

Fewer injuries affect the upper than the lower extremity; however, of the upper extremity injuries, the shoulder made up most upper extremity injuries seen during the tournament. In the male tournament shoulder injuries account for 6.3% of all injuries, and 11.9% of all female injuries. The higher amount of shoulder injuries reported in the female tournament warrant further investigation in research, as it is an outlier compared to the predominance of lower extremity injuries.

Six regions were listed as part of the upper limb in the present injury reporting questionnaire: shoulder, upper arm, elbow, forearm, wrist, and hand. Existing literature reported shoulder and arm injuries to be a low proportion of field hockey injuries in both females and males (Hollander et al., 2018) which has been confirmed with the results of this study.

The anatomical regions of injuries reported during the present study are in line with the existing literature and highlights the importance of injury prevention efforts being aimed at the lower extremity. The results of this study suggest that future research explore the nature of injuries in the lower extremity to distinguish acute injuries from overuse injuries and the anatomical structures involved in injury. The use of a classification tool for categorizing anatomical regions would have strengthened the results of this study, this is further discussed in section 5.9.2 Limitations of the study.

5.6 Medical staff

The results of the present study demonstrate that there is no statistically significant relationship between the presence of medical staff in the team and the incidence of injury. Where there was a health professional present in the team there was no significant decrease of injury, suggesting that health professionals influence on injury within a team is unknown according to these results. There were 65 medical attention injuries in the male tournament and 48 in the female tournament, with physiotherapy as the predominating health profession sought for injuries sustained both before and during the tournaments.

The role of the health professional has not been extensively explored in the literature, although there has been some well-designed research and commentary on the communication between medical and coaching staff with regards to injuries (Ekstrand et al., 2019), their effect on team performance (Hagglund et al., 2013), and the influence of medical staff in the team (Ekstrand, 2013). Established literature suggests that medical presence is a requirement for all teams attending the national IPT, however their influence on injury is unknown according to this study. The researchers are not able to comment on the presence of medical staff in relation to team performances or match outcomes as it was outside the scope of this study. It is also acknowledged that there are multiple variables which affect the incidence of injury in this setting and it is challenging for any single factor to be related to injury incidence due to the complex web of concurrent determinants which cause injury (Bittencourt et al., 2016).

With the current global emphasis on injury prevention to improve health outcomes and safe participation in sport (Emery & Pasanen, 2019), the findings suggest that health professionals, particularly physiotherapists, were the most required profession for injuries during the tournament. The tournament coaches also reported that the presence of a health professional within their teams is limited due to funding limitations.

Therefore, the results of the present study lead to a recommendation that physiotherapists be available at future senior IPT's in South Africa. Access to this could be built into the tournament fee for all participating teams, while teams with health professionals could still use their own clinicians. This would allow for access to medical care for all teams. Based on current trends in the literature exploring injury prevention, rule changes and player safety, as well as injury and performance, the role of the health professionals in field hockey should be further investigated.

5.7 Coaches

The present study hypothesised that various personal factors relating to team coaches could affect injury occurrence in players. The coach's tertiary education level (i.e. the possession of a university degree or diploma or no tertiary qualification) and first aid qualification was not significantly associated with injury during the tournament ($p = 0.18$ and $p = 0.10$ respectively). The coaches SAHA level (i.e. 1, 2, or 3) was also not significantly associated with injury during the tournament ($p = 0.57$). However, coaches holding a FIH qualification was significantly associated with injury occurrence ($p = 0.015$). Additionally, odds and risk ratio calculation revealed that in teams with coaches holding a FIH qualification, a lower odds and risk of injury was present (OR = 0.188; RR = 0.618). This was confirmed with logistical regression analysis indicating that where the coach held a FIH qualification a significant decrease in tournament injuries ($p = 0.04$) was observed.

The FIH coaching qualification is not a pre-requisite qualification for South African coaches, and acquisition of this qualification is through invite only. Coaches with these qualifications are usually involved in coaching the junior or senior national teams or have coached semi-professional field hockey outside of South Africa, and there were only two coaches in the present study holding this qualification.

Reasons for this observation may be explained by coaches with FIH qualification overseeing teams where players have access to health professionals, sport scientists, and structured programs throughout the year. A criticism of this finding is that due to the sample size of coaches, the effect of this association is magnified in the analysis.

There is established literature supporting the hypothesis regarding the coach's ability to affect injury incidence. The coach of the modern sports team has a significant role in influencing the microsystems within the team. These include: managing training volume, players well-being, the internal team communication, and leadership style (Ekstrand, 2013). This underpins the psychological contribution of leadership, personal characteristics, and beliefs of the coach in the outcomes of injury and team performance which was found to have a negative relationship with injury – where coaches exhibited transformational leadership, there was decreased injury burden ($p = 0.020$) as well as increased attendance at training and match availability (Ekstrand et al., 2018). There is also an established correlation between the coaches quality of communication with medical staff and low injury burden ($p = 0.007$; Ekstrand et al., 2019). In the present study's questionnaire administered to the coaches, it was reported that all coaches listed warm-ups as the responsibility of the players, whereas decision making regarding player availability was listed as the decision of the coach. Half of the coaches indicated it was the players responsibility to decide whether they were available for selection, and the other half indicated that it to be the team health professional's role to make this decision. This is influenced by the presence of a health professional in the team, but also provides an insight into the coaches self-perceived role and the overlap between injury and performance decision making.

The coach also has the ability to drive player and staff buy-in with regard to injury prevention programs (McCall et al., 2016), which have an effect on team performance (Ekstrand, 2013). The knowledge held by the coach regarding player safety and injury prevention has also been reported to reduce injuries (J. C. Brown et al., 2018).

With emerging literature highlighting the influence of the coach, there is a need for coaches, medical staff, and researchers to engage in meaningful ways to address their interdependence (Gabbett & Whiteley, 2017). Anecdotally, the presented study observed that teams whose coaches did not partake in the study had lower response rates compared to other teams, supporting the theory of coaches driving player buy-in. Future research should explore the coaches' characteristics in injury incidence as a primary objective. For the development of field hockey in South Africa, coaching education regarding injuries and player safety should also be more explicitly outlined within the SAHA coaching qualifications.

5.8 Players

The present study did not find statistically significant differences between injury incidence for males and females ($p = 0.390$). This is in line with the study by Hollander et al. (2018) which reported that, during a full indoor and outdoor hockey season, no significant difference in match injuries were observed between males and females.

It was observed that female players sought medical attention significantly more often than males, although their access to health professionals was comparable (i.e. six health professionals compared to eight respectively). Although the absolute incidence rates of injury, medical attention, and time loss are lower in females than males, it was revealed that females were 2.4 times more likely to seek medical attention for an injury. This may account for their lower incidence of time loss when compared to males, as they proactively investigated injuries and mitigated worsening injuries. Lower injury incidence rates are also observed in international tournaments, where female rates are reported at 29.1 per 1000 player match hours, compared to 48.3 per 1000 player match hours for males (Theilen et al., 2016). To our knowledge, this is the first study to observe gender differences in seeking medical attention.

The identical tournament format for both genders in the present study allowed for these types of observations to be made. Future research exploring gender differences should identify similar tournaments where injury epidemiology between males and females are comparable.

There was a greater time loss observed in the male tournament, 7.5 (95% CI: -0.7 – 15.7) per 1000 player match hours compared to in the female's 4.32 (95% CI: -1.04 – 9.7) per 1000 player match hours). Our data, however, was affected by the reporting rates, where more daily reporting forms were completed during the male tournament for six out of the seven tournament match days compared to during the female tournament - which could affect the gender differences observed. This emphasises the need to standardise surveillance methods and terminology to allow for comparisons across the literature and highlights a limitation of the present study.

Previous injury, occurring in the past one to two years, was found to be a significant risk to injury during the tournament. A criticism of this study could be the lack of comparison between specific previous regional injuries with injuries occurring during the tournament. The researchers acknowledge that they may only report that all previous injury in the two years prior to the tournament significantly increased all injury risk during the tournament, which may seem to be a weak observation. This could be a beneficial for medical staff in emphasising the importance of requesting a thorough history of all the players to decrease injury risk to participants (Bahr, 2016b).

No association was observed between playing position and injury. The nature of hockey, with rolling substitutions and frequent team formation changes, makes it difficult to classify players as defenders, midfielders, or forwards (Reilly & Borrie, 1992). Player positions frequently change and meaningful information on player position and match-loads would be better observed by using external load measures such as distance covered, and sprints performed per match.

Previous injury sustained in the past two years was found to be associated with increased seeking of medical attention, but this was not the case for injuries sustained over the past 12 months. Reasons for this observation may be that players with injuries sustained in the last year might be able to recall more minor injuries that did not cause significant time loss (and have less influence on their tournament injury), while for injuries sustained in the past two years perhaps only the significant injuries which caused time loss could be recalled (Bell, Ward, Tamal, & Killilea, 2019). Therefore, our method of previous injury reporting is subject to recall bias. The previous injury time frame was capped at two years, in line with the literature that supports major trauma such as ankle and knee injuries, which require up to two years for complete rehabilitation (Nagelli & Hewett, 2017), however this time frame also increases the risk for recall bias.

Due to the observational nature of the present research, it is challenging to rationalise the reasons for the observed differences between the two tournaments. There are multiple variables affecting gender specific injuries which were not explored in this study (Mountjoy et al., 2018). The present study did investigate and compare gender differences but did not explore each tournament in depth; therefore, it is recommended that future research into player injuries should study males and females separately. Additionally, future research should unpack the circumstances surrounding injury and explore injuries over longer time frames. Web-based surveillance systems have been used with success in American field hockey for female populations only (Lynall et al., 2018), and there have been some repeatable studies during full seasons in Europe (Hollander et al., 2018) which should be used to replicate research comparing genders for field hockey. Ultimately, the goal of all injury research carried out in field hockey is to reduce the injury burden for players and improve player safety. It is positive to witness this already occurring with the first injury prevention intervention taking place in Dutch field hockey (Gouttebarge & Zuidema, 2018).

5.9 Strengths and limitations

5.9.1 Strengths of the study

The present study included the largest sample observed in South African field hockey to date and combines both male and female data. It is the first study in South Africa to capture male injury incidence, and one of few existing studies exploring male field-hockey players. Previous research relating to incidence of field hockey injuries was published in 2007 with sample of 47 female field-hockey players; the present study adds to the findings of this research and serves as an updated snapshot of incidence in this population (Naicker et al., 2007).

The injury incidence observed in the present study should form part of long-term injury prevention for South African field hockey participants. This is in line with the sequence of injury prevention proposed in 1992, in which incidence was noted as the first step towards injury prevention (van Mechelen et al., 1992). There have been subsequent models since the original "sequence of prevention" was introduced, namely: the 'Translating Research Into Prevention Practice' (TRIPP) framework (Finch, 2006), and the 'Team Sport Injury Prevention' (TIP) cycle (O'Brien et al., 2019), which have been extensions of the injury prevention paradigm and consist of guidelines for research, as well as real world application for the team sport setting. Through each addition to the injury prevention paradigm, injury surveillance remains the foundation on which prevention is built. The present study hopes to be used as a part of the foundation on which injury prevention in South African field hockey will be formed.

The definition of injury utilised in the present study is both a strength and a limitation. It allowed the researcher to capture all injuries experienced by participants as a result of its all-encompassing definition. Much of the current literature captures only injuries causing time-loss or removal from field of play as their identification of injury (Theilen et al., 2016).

The use of time-loss in the identification of injury would have yielded a limited amount of data compared to what was collected with the current definition. The use of self-reporting allowed the study to explore a large sample, albeit with limited resources (i.e. data collection assistants). It also allowed for the classification of the reported injuries into medical attention and time loss categories and has allowed the study to substantiate the need for the availability of health professionals at future tournaments. This method, combined with the broad injury definition, allowed the study to observe injury and association through a wide lens to reveal more data than required by the study objectives; however, in the current context of this research being the first of its kind in South Africa – an overview was warranted so that subsequent research can further explore the main findings of this study.

The association observed between the coaches FIH qualifications and tournament injuries allowed the study to recommend improved dialogue between coaches and health professionals to positively influence the coach's role in injuries, injury prevention, and their subsequent effect on performance (J. C. Brown et al., 2018; Ekstrand et al., 2019; Ekstrand et al., 2018; Frank et al., 2015; McCall et al., 2016). The association between previous injury and tournament injury supports the recommendation for the screening of players by health professionals prior to tournaments to prevent injury and improve player safety. The anatomical regions of injury observed strengthens the recommendations for injury prevention programs to address the lower extremity - specifically the knee, ankle, and thigh for both males and females in accordance with the findings of the present study.

5.9.2 Limitations of the study

The use of a self-reporting questionnaire as the method of injury reporting is a limitation to the present study (Brutus & Wassmer, 2013). The subjectivity of self-reported injuries can lead to over or under-reporting of injuries, and although participants were guided by the injury definition, there remained a constant potential input error. The wording of the injury reporting questionnaire may have also contributed to capturing more acute than overuse or chronic injuries.

The completion rate of the injury questionnaire was also a limitation to this study, and during both tournaments the rate of responses declined throughout the week. This limited the ability of the data collected to reflect the actual injury incidence of the players during the tournament as we assumed that the nonresponses represented non injury, which does not reflect the tournament incidence accurately. This poses a challenge for future research to create a follow up protocol or use third-party data collection to mitigate the decline in response rate as the tournament progresses. The use of independent third-party researchers was unavailable to the researcher due to funding restrictions, and the student researcher was the only investigator on site to assist teams, answer questions, collect data, and subsequently code and perform the analysis.

While the injury definition used in the present study led to capturing and categorising all injuries (i.e. all injuries, medical attention, and time-loss), it did not make use of existing injury classification systems such as the Oslo sports trauma research questionnaire (Clarsen et al., 2014) or the Orchard classification system (Rae & Orchard, 2007), which could have strengthened the external validity of the study. The researcher acknowledges that the grouping of lower extremity and upper extremity is broad, and the regions included in the questionnaire, such as “lower limb” are ambiguous and should be improved upon in future research. This is a limitation in the methodology applied in this study.

The seven-day format of the tournament and short observation period, combined with the study’s inclusive injury definition and self-reporting design, may have led to overreporting of the incidence of injury compared to existing literature. Furthermore, this may have led to the under-estimation of the role of overuse injuries being part of the high incidence rate recorded. Although it was postulated that certain injuries not resulting in time-loss would fit into an acute-on-chronic pattern or be caused by previous injury or overuse, the researcher cannot objectively comment on this based on limitations in the present classification of injuries.

The study was also unable to categorise injury mechanisms, and it is unknown whether contact or non-contact mechanisms are related to the injuries observed.

The findings of the present research are only applicable to the South African field hockey IPT in the seven matches in seven days format in South Africa. Tournaments are only one format of field hockey, and surveillance should be compared to an entire season to ascertain whether consecutive days of field hockey matches places players at a greater risk of injury (Barboza, Joseph, et al., 2018; Hollander et al., 2018).

5.10 Recommendations for future research

The results of the present study suggest future research should be aimed at developing South African field hockey's own injury prevention program, allowing the game to be safer for all participants and decreasing the incidence of injury. This recommendation would need to be endorsed by SAHA. Collaboration between the national body and a tertiary research institution such as UCT could serve as a useful endeavour to strengthen research in South African field hockey. A collaboration of this nature may be able to solve resource limitations and allow for third party researchers to improve on the limitations of this study.

Based on the personal experience of conducting the study, the researcher recommends the exploration of web-based surveillance for future research, as it enables nationalised databases for injury surveillance (Lynall et al., 2018). This method is already employed by national bodies for cricket and rugby within South Africa (Starling et al., 2019) and would allow SAHA to track trends and patterns of injury over extended periods of time and in different formats of the game.

There is an evident need for the SAHA coaching qualification coursework component to contain specific information in sport science and sport medicine. The present study has illustrated that FIH qualified coaches are associated with less team injuries, and the influence of coaches in injuries has been clearly established in existing literature (J. C. Brown et al., 2018; Ekstrand et al., 2019; Ekstrand et

al., 2018; Frank et al., 2015; McCall et al., 2016). It is therefore crucial that we work with SAHA and its coaches to provide information relevant to decreasing player injury and encourage safe participation.

Seasonal surveillance may also reveal additional information regarding the incidence of overuse injuries, which were overlooked in the present study due to the narrow time frame of observation. It is therefore recommended that future research explore different formats of field hockey, including club seasons, national team tournaments, and different levels of field hockey participation.

Internationally, a clear consensus statement for field hockey research must be issued by the FIH to standardise future research (Barboza, Joseph, et al., 2018; Barboza et al., 2019; Barboza, Nauta, et al., 2018; Hollander et al., 2018; Lynall et al., 2018). The consensus statement should include a definition of injury for field hockey, standardised methodologies for research, and recommend an injury classification tool. This would be required for the future of field hockey so that research may be comparable.

CHAPTER SIX: SUMMARY AND CONCLUSION

The present study aimed to observe the incidence of injury and associated factors at the South African senior provincial IPT tournaments for males and females. The findings of this study addressed the following aims and objectives listed in Chapter One:

To determine the incidence of injuries seen at a senior provincial field hockey tournament for males and females.

The incidence of injuries during the tournament was observed to be 99.5 (95% CI: 71.9 – 127.1) per 1000 player-match hours for males and 77.9 (95% CI: 47.1 - 108.1) per 1000 player match hours for females. In the male tournament, medical attention injuries were recorded at an incidence of 70.3 (95% CI: 46.1 – 94.4) per 1000 player match hours; while in the female tournament medical attention injuries were recorded at an incidence of 51.9 (95% CI: 32.3 – 71.5) per 1000 player match hours. The incidence of time loss injuries was lower in both groups at 7.5 (95% CI: -0.7 – 15.7) per 1000 player match hours in the male tournament, and 4.3 (95% CI: -1.04 – 9.7) per 1000 player match hours in the female tournament.

To assess the associative factors related to injury: coaching qualifications, presence of medical staff, and other non-modifiable risk factors.

Coaches holding a FIH qualification were significantly associated with injury occurrence, revealing a lower risk of injury in teams with FIH accredited coaches. Coaches tertiary education level, SAHA coaching level, and first aid qualification were not significantly associated with injury during the tournament. There was also no significant relationship between the presence of medical staff in the team and the incidence of injury. The most predictive factors for injury during the tournament were coaches holding a FIH qualification, and previous injury over the previous one to two years.

To compare the injury incidence, injury burden and distribution of anatomical injuries between males and females.

Females were 2.4 times more likely to seek medical attention compared to males. Furthermore, players reporting previous injury (within past 1-2 years) and injury during the tournament were 3.5-5 times at greater risk of sustaining an injury during the tournament. The findings of the present study supports the existing literature (Hollander et al., 2018; Lynall et al., 2018) reporting that the lower extremity experiences the largest amount of injuries reported by field hockey players. In the present study, the lower extremity was affected in 69% of all injuries reported in the male tournament, and in 70% of all injuries in the female tournament.

To our knowledge, this was the largest observational study conducted in South African field hockey that included both male and female players. High incidence rates of all injuries and medical attention injuries were identified compared to international field hockey tournaments (Theilen et al., 2016). However, the incidence of time loss injuries was much low in concord with existing literature (Barboza et al., 2019). It is possible that players were continuing to participate in matches despite injuries requiring medical attention; that medical support staff may not limit match participation for injured players adequately; or that players seek reassurance from medical support staff for minor injuries. In addition, previous injury history was identified as a significant risk factor for injury, which is aligned with findings from injury monitoring studies in various team sports. The findings of this study highlight the need for consensus on injury definitions in field hockey. Further research is critical to determine injury prevention strategies for male and female field hockey players.

REFERENCES

Alentorn-Geli, E., Mendiguchía, J., Samuelsson, K., Musahl, V., Karlsson, J., Cugat, R., & Myer, G. D. (2014). Prevention of anterior cruciate ligament injuries in sports—Part I: Systematic review of risk factors in male athletes. *Knee Surgery, Sports Traumatology, Arthroscopy, 22*(1), 3-15. doi:10.1007/s00167-013-2725-3

Ardern, C. L., Taylor, N. F., Feller, J. A., & Webster, K. E. (2014). Fifty-five per cent return to competitive sport following anterior cruciate ligament reconstruction surgery: an updated systematic review and meta-analysis including aspects of physical functioning and contextual factors. *British Journal of Sports Medicine, 48*(21), 1543-1552. doi:10.1136/bjsports-2013-093398

Bahr, R. (2009a). No injuries, but plenty of pain? On the methodology for recording overuse symptoms in sports. *British Journal of Sports Medicine, 43*(13), 966. doi:10.1136/bjsm.2009.066936

Bahr, R. (2009b). No injuries, but plenty of pain? On the methodology for recording overuse symptoms in sports. *Br J Sports Med, 43*(13), 966-972. doi:10.1136/bjsm.2009.066936

Bahr, R. (2016a). Author response to the letter from Dr Hewett. *British Journal of Sports Medicine, 50*(21), 1353-1354. doi:10.1136/bjsports-2016-096499

Bahr, R. (2016b). Why screening tests to predict injury do not work—and probably never will…: a critical review. *British Journal of Sports Medicine, 50*(13), 776-780. doi:10.1136/bjsports-2016-096256

Bahr, R., Clarsen, B., Derman, W., Dvorak, J., Emery, C. A., Finch, C. F., . . . Chamari, K. (2020). International Olympic Committee consensus statement: methods for recording and reporting of epidemiological data on injury and illness in sport 2020 (including STROBE Extension for Sport Injury and Illness Surveillance (STROBE-SIIS)). *British Journal of Sports Medicine, 54*(7), 372. doi:10.1136/bjsports-2019-101969

Bahr, R., Clarsen, B., & Ekstrand, J. (2018). Why we should focus on the burden of injuries and illnesses, not just their incidence. *British Journal of Sports Medicine, 52*(16), 1018. doi:10.1136/bjsports-2017-098160

Bahr, R., & Holme, I. (2003). Risk factors for sports injuries — a methodological approach. *British Journal of Sports Medicine, 37*(5), 384-392. doi:10.1136/bjsm.37.5.384

Barboza, S. D., Joseph, C., Nauta, J., Mechelen, W., & Verhagen, E. (2018). Injuries in Field Hockey Players: A Systematic Review. *Sports Medicine, 48*(4), 849-866. doi:10.1007/s40279-017-0839-3

Barboza, S. D., Nauta, J., Emery, C., van Mechelen, W., Gouttebarge, V., & Verhagen, E. (2019). A Warm-Up Program to Reduce Injuries in Youth Field Hockey Players: A Quasi-Experiment. *Journal of Athletic Training, 54*(4), 374-383. doi:10.4085/1062-6050-79-18

Barboza, S. D., Nauta, J., van der Pols, M. J., van Mechelen, W., & Verhagen, E. (2018). Injuries in Dutch elite field hockey players: A prospective cohort study. *Scandinavian Journal of Medicine and Science in Sports, 28*(6), 1708-1714. doi:10.1111/sms.13065

Bell, A., Ward, P., Tamal, M. E. H., & Killilea, M. (2019). Assessing recall bias and measurement error in high-frequency social data collection for human-environment research. *Population and Environment, 40*(3), 325-345. doi:10.1007/s11111-019-0314-1

Bittencourt, N. F. N., Meeuwisse, W. H., Mendonça, L. D., Nettel-Aguirre, A., Ocarino, J. M., & Fonseca, S. T. (2016). Complex systems approach for sports injuries: moving from risk factor identification to injury pattern recognition—narrative review and new concept. *British Journal of Sports Medicine, 50*(21), 1309-1314. doi:10.1136/bjsports-2015-095850

Boddington, M. K., Lambert, M. I., & Waldeck, M. R. (2004). Validity of a 5-meter multiple shuttle run test for assessing fitness of women field hockey players. *Journal Of Strength And Conditioning Research, 18*(1), 97-100.

Brown, J. C., Gardner-Lubbe, S., Lambert, M. I., van Mechelen, W., & Verhagen, E. (2018). Coach-directed education is associated with injury-prevention behaviour in players: an ecological cross-sectional study. *British Journal of Sports Medicine, 52*(15), 989-993. doi:10.1136/bjsports-2016-096757

Brown, J. C., Viljoen, W., Lambert, M. I., Readhead, C., Fuller, C., Van Mechelen, W., & Verhagen, E. (2015). The economic burden of time-loss injuries to youth players participating in week-long rugby union tournaments. *Journal of Science and Medicine in Sport, 18*(4), 394-399. doi:https://doi.org/10.1016/j.jsams.2014.06.015

Brutus, S., & Wassmer, U. (2013). Self-Reported Limitations and Future Directions in Scholarly Reports Analysis and Recommendations. *Journal of Management, 39*, 48-75. doi:10.1177/0149206312455245

Bussey, M. D., Kennedy, J. E., & Kennedy, G. (2016). Gluteus medius coactivation response in field hockey players with and without low back pain. *Physical Therapy in Sport 17*, 24-29. doi:https://doi.org/10.1016/j.ptsp.2015.03.002

Clarsen, B., & Bahr, R. (2014). Matching the choice of injury/illness definition to study setting, purpose and design: one size does not fit all! *British Journal of Sports Medicine, 48*(7), 510-512. doi:10.1136/bjsports-2013-093297

Clarsen, B., Myklebust, G., & Bahr, R. (2013). Development and validation of a new method for the registration of overuse injuries in sports injury epidemiology: the Oslo Sports Trauma Research Centre (OSTRC) overuse injury questionnaire. *British Journal of Sports Medicine, 47*(8), 495-502. doi:10.1136/bjsports-2012-091524

Clarsen, B., Rønsen, O., Myklebust, G., Flørenes, T. W., & Bahr, R. (2014). The Oslo Sports Trauma Research Center questionnaire on health problems: a new approach to prospective monitoring

of illness and injury in elite athletes. *British Journal of Sports Medicine, 48*(9), 754. doi:10.1136/bjsports-2012-092087

Crossway, A. K., Games, K. E., Eberman, L. E., & Fleming, N. (2017). Orchard Sports Injury Classification System 10.1 Plus: An End-User Study. *International journal of exercise science, 10*(2), 284-293.

de Mille, P., & Osmak, J. (2017). Performance: Bridging the Gap After ACL Surgery. *Current Reviews in Musculoskeletal Medicine, 10*(3), 297-306. doi:10.1007/s12178-017-9419-2

Dick, R., Hootman, J., Agel, J., Vela, L., Marshall, S., & Messina, R. (2007). Descriptive Epidemiology of Collegiate Women's Field Hockey Injuries: National Collegiate Athletic Association Injury Surveillance System, 1988–1989 Through 2002–2003. *Journal of athletic training, 42*, 211-220.

Drew, M. K., & Purdam, C. (2016). Time to bin the term 'overuse' injury: is 'training load error' a more accurate term? *British Journal of Sports Medicine, 50*(22), 1423-1424. doi:10.1136/bjsports-2015-095543

Ekstrand, J. (2013). Keeping your top players on the pitch: The key to football medicine at a professional level. *British Journal of Sports Medicine, 47*, 723-724. doi:10.1136/bjsports-2013-092771

Ekstrand, J., Lundqvist, D., Davison, M., D'Hooghe, M., & Pensgaard, A. M. (2019). Communication quality between the medical team and the head coach/manager is associated with injury burden and player availability in elite football clubs. *British Journal of Sports Medicine, 53*(5), 304. doi:10.1136/bjsports-2018-099411

Ekstrand, J., Lundqvist, D., Lagerbäck, L., Vouillamoz, M., Papadimitiou, N., & Karlsson, J. (2018). Is there a correlation between coaches' leadership styles and injuries in elite football teams? A study of 36 elite teams in 17 countries. *British Journal of Sports Medicine, 52*(8), 527-531. doi:10.1136/bjsports-2017-098001

Ellapen, T., Abrahams, S., Desai, F., Narsigan, S., & Van Heerden, J. (2011). Prevalence of musculoskeletal pain among the South African female fenior national hockey players. *Advances in Rehabilitation 25*(2).

Emery, C. A., & Pasanen, K. (2019). Current trends in sport injury prevention. *Best Practice and Research: Clinical Rheumatology*. doi:10.1016/j.berh.2019.02.009

Espí-López, G. V., López-Martínez, S., Inglés, M., Serra-Añó, P., & Aguilar-Rodríguez, M. (2018). Effect of manual therapy versus proprioceptive neuromuscular facilitation in dynamic balance, mobility and flexibility in field hockey players. A randomized controlled trial. *Physical Therapy in Sport, 32*, 173-179. doi:10.1016/j.ptsp.2018.04.017

Fauth, M. L., Petushek, E. J., Feldmann, C. R., Hsu, B. E., Garceau, L. R., Lutsch, B. N., & Ebben, W. P. (2010). Reliability of Surface Electromyography During Maximal Voluntary Isometric Contractions, Jump Landings, and Cutting. *The Journal of Strength and Conditioning Research, 24*(4), 1131-1137. doi:10.1519/JSC.0b013e3181cc2353

FIFA. (2006). The 11+ Booklet, FIFA. In FIFA (Ed.), *FIFA.COM*.

FIH. (2019). Coach education pathway. Retrieved from http://www.fih.ch/inside-fih/fih-hockey-academy/coach/coach-education-pathway/

Finch, C. (2006). A new framework for research leading to sports injury prevention. *Journal of Science and Medicine in Sport, 9*(1-2), 3-9; discussion 10. doi:10.1016/j.jsams.2006.02.009

Frank, B. S., Register-Mihalik, J., & Padua, D. A. (2015). High levels of coach intent to integrate a ACL injury prevention program into training does not translate to effective implementation. *Journal of Science and Medicine in Sport, 18*(4), 400-406. doi:10.1016/j.jsams.2014.06.008

Fuller, C. W., Ekstrand, J., Junge, A., Andersen, T. E., Bahr, R., Dvorak, J., . . . Meeuwisse, W. H. (2006). Consensus statement on injury definitions and data collection procedures in studies of football

(soccer) injuries. *Scandinavian Journal of Medicine and Science in Sports, 16*(2), 83-92. doi:10.1111/j.1600-0838.2006.00528.x

Gabbett, T. J. (2016). The training—injury prevention paradox: should athletes be training smarter and harder? *British Journal of Sports Medicine, 50*(5), 273. doi:10.1136/bjsports-2015-095788

Gabbett, T. J., & Whiteley, R. (2017). Two Training-Load Paradoxes: Can We Work Harder and Smarter, Can Physical Preparation and Medical Be Teammates? *International Journal of Sports Physiology and Performance, 12*(s2), S2-50-S52-54. doi:10.1123/ijspp.2016-0321

Gouttebarge, V., & Zuidema, V. (2018). Prevention of musculoskeletal injuries in recreational field hockey: the systematic development of an intervention and its feasibility. *BMJ Open Sport and Exercise Medicine, 4*(1), e000425. doi:10.1136/bmjsem-2018-000425

Grindem, H., Snyder-Mackler, L., Moksnes, H., Engebretsen, L., & Risberg, M. A. (2016). Simple decision rules can reduce reinjury risk by 84% after ACL reconstruction: the Delaware-Oslo ACL cohort study. *British Journal of Sports Medicine, 50*(13), 804-808. doi:10.1136/bjsports-2016-096031

Hagglund, M., Walden, M., Magnusson, H., Kristenson, K., Bengtsson, H., & Ekstrand, J. (2013). Injuries affect team performance negatively in professional football: an 11-year follow-up of the UEFA Champions League injury study. *British Journal of Sports Medicine, 47*(12), 738-742. doi:10.1136/bjsports-2013-092215

Hammond, L., Lilley, J., Pope, G., & Ribbans, W. O. B. (2013). The impact of playing matches while injured on injury surveillance findings in professional football. *Scandinavian Journal of Medicine and Science in Sports, 24*. doi:10.1111/sms.12134

Hewett, T. E. (2016). Response to: 'Why screening tests to predict injury do not work—and probably never will…: a critical review'. *British Journal of Sports Medicine, 50*(21), 1353. doi:10.1136/bjsports-2016-096388

Hewett, T. E. (2017). Prediction of Future Injury in Sport: Primary and Secondary Anterior Cruciate Ligament Injury Risk and Return to Sport as a Model. *The Journal of Orthopaedic and Sports Physical Therapy, 47*(4), 228-231. doi:10.2519/jospt.2017.0603

Hewett, T. E., Ford, K. R., Xu, Y. Y., Khoury, J., & Myer, G. D. (2017). Effectiveness of Neuromuscular Training Based on the Neuromuscular Risk Profile. *The American Journal of Sports Medicine, 45*(9), 2142-2147. doi:10.1177/0363546517700128

Höglund, K., & Sundberg, R. (2008). Reconciliation through Sports? The Case of South Africa. *Third World Quarterly, 29*(4), 805-818.

Hollander, K., Wellmann, K., Eulenburg, C. Z., Braumann, K. M., Junge, A., & Zech, A. (2018). Epidemiology of injuries in outdoor and indoor hockey players over one season: A prospective cohort study. *British Journal of Sports Medicine*. doi:10.1136/bjsports-2017-098948

Hulin, B. T., Gabbett, T. J., Caputi, P., Lawson, D. W., & Sampson, J. A. (2016). Low chronic workload and the acute:chronic workload ratio are more predictive of injury than between-match recovery time: a two-season prospective cohort study in elite rugby league players. *British Journal of Sports Medicine, 50*(16), 1008-1012. doi:10.1136/bjsports-2015-095364

Ibrahim, R., Faber, G. S., Kingma, I., & van Dieën, J. H. (2017). Kinematic analysis of the drag flick in field hockey. *Sports Biomechanics, 16*(1), 45-57. doi:10.1080/14763141.2016.1182207

Karcioglu, O., Topacoglu, H., Dikme, O., & Dikme, O. (2018). A systematic review of the pain scales in adults: Which to use? *American Journal of Emergency Medicine, 36*(4), 707-714. doi:10.1016/j.ajem.2018.01.008

Lynall, R. C., Gardner, E. C., Paolucci, J., Currie, D. W., Knowles, S. B., Pierpoint, L. A., . . . Kerr, Z. Y. (2018). The First Decade of Web-Based Sports Injury Surveillance: Descriptive Epidemiology of Injuries in US High School Girls' Field Hockey (2008-2009 Through 2013-2014) and National

Collegiate Athletic Association Women's Field Hockey (2004-2005 Through 2013-2014). *Journal of Athletic Training, 53*(10), 938-949. doi:10.4085/1062-6050-173-17

McCall, A., Dupont, G., & Ekstrand, J. (2016). Injury prevention strategies, coach compliance and player adherence of 33 of the UEFA Elite Club Injury Study teams: a survey of teams' head medical officers. *British Journal of Sports Medicine, 50*(12), 725. doi:10.1136/bjsports-2015-095259

Meeuwisse, W. H. (1994). Athletic Injury Etiology: Distinguishing Between Interaction and Confounding. *Clinical Journal of Sport Medicine, 4*(3), 171-175.

Mountjoy, M., Sundgot-Borgen, J. K., Burke, L. M., Ackerman, K. E., Blauwet, C., Constantini, N., . . . Budgett, R. (2018). IOC consensus statement on relative energy deficiency in sport (RED-S): 2018 update. *British Journal of Sports Medicine, 52*(11), 687. doi:10.1136/bjsports-2018-099193

Mukherjee, S. (2012). Head and Face Injuries During the Men's Field Hockey Junior World Cup 2009. *The American Journal of Sports Medicine, 40*(3), 686-690. doi:doi:10.1177/0363546511426697

Murphy, D. F., Connolly, D. A. J., & Beynnon, B. D. (2003). Risk factors for lower extremity injury: a review of the literature. *British Journal of Sports Medicine, 37*(1), 13. doi:10.1136/bjsm.37.1.13

Murtaugh, K. (2001). Injury patterns among female field hockey players. *Medicine and Science in Sports and Exercise, 33*(2), 201-207. doi:10.1097/00005768-200102000-00005

Nagelli, C. V., & Hewett, T. E. (2017). Should Return to Sport be Delayed Until 2 Years After Anterior Cruciate Ligament Reconstruction? Biological and Functional Considerations. *Sports Medicine, 47*(2), 221-232. doi:10.1007/s40279-016-0584-z

Naicker, M., McLean, M., Esterhuizen, T. M., & Peters-Futre, E. M. (2007). Poor peak dorsiflexor torque associated with incidence of ankle injury in elite field female hockey players. *Journal of Science and Medicine in Sport, 10*(6), 363-371. doi:https://doi.org/10.1016/j.jsams.2006.11.007

Ng, L., Rosalie, S. M., Sherry, D., Loh, W. B., Sjurseth, A. M., Iyengar, S., & Wild, C. Y. (2018). A biomechanical comparison in the lower limb and lumbar spine between a hit and drag flick in

field hockey. *Journal of Sports Sciences, 36*(19), 2210-2216. doi:10.1080/02640414.2018.1445440

O'Brien, J., Young, W., & Finch, C. F. (2017). The delivery of injury prevention exercise programmes in professional youth soccer: Comparison to the FIFA 11+. *Journal of Science and Medicine in Sport, 20*(1), 26-31. doi:10.1016/j.jsams.2016.05.007

O'Brien, J., Finch, C. F., Pruna, R., & McCall, A. (2019). A new model for injury prevention in team sports: the Team-sport Injury Prevention (TIP) cycle. *Science and Medicine in Football, 3*(1), 77-80. doi:10.1080/24733938.2018.1512752

Orchard, J. W., James, T., Kountouris, A., & Portus, M. (2010). Changes to injury profile (and recommended cricket injury definitions) based on the increased frequency of Twenty20 cricket matches. *Open Access Journal of Sports Medicine, 1*, 63-76. doi:10.2147/oajsm.s9671

Orchard, J. W., Ranson, C., Olivier, B., Dhillon, M., Gray, J., Langley, B., . . . Finch, C. F. (2016). International consensus statement on injury surveillance in cricket: a 2016 update. *British Journal of Sports Medicine, 50*(20), 1245. doi:10.1136/bjsports-2016-096125

Penedo-Jamardo, E., Rey, E., Padrón-Cabo, A., & Kalén, A. (2017). The impact of different recovery times between matches on physical and technical performance according to playing positions. *International Journal of Performance Analysis in Sport, 17*(3), 271-282. doi:10.1080/24748668.2017.1331576

Pepe, M. S., Janes, H., Longton, G., Leisenring, W., & Newcomb, P. (2004). Limitations of the Odds Ratio in Gauging the Performance of a Diagnostic, Prognostic, or Screening Marker. *American Journal of Epidemiology, 159*(9), 882-890. doi:10.1093/aje/kwh101

Rae, K., & Orchard, J. (2007). The Orchard Sports Injury Classification System (OSICS) version 10. *Clinical Journal of Sport Medicine, 17*(3), 201-204. doi:10.1097/JSM.0b013e318059b536

Reilly, T., & Borrie, A. (1992). Physiology applied to field hockey. *Sports Medicine, 14*(1), 10-26. doi:10.2165/00007256-199214010-00002

Rishiraj, N., Taunton, J. E., & Niven, B. (2009). Injury profile of elite under-21 age female field hockey players. *The Journal of sports medicine and physical fitness, 49*(1), 71-77.

SAHA. (2013). *Coaching Education Overview*. Retrieved from https://www.sahockey.co.za/documents

SAHA. (2016). PHL takes SA hockey into a bright new future. Retrieved from http://premierhockeyleague.co.za/2016/10/03/phl-takes-sa-hockey-into-a-bright-new-future/

SARU. (2016). Safe Six Injury Prevention. In.

Sport24.co.za, I. (2018). SA hockey causes a stir with "volunteer coaching". Retrieved from https://www.sport24.co.za/OtherSport/South-Africa/sa-hockey-causes-stir-with-volunteer-coaching-ad-20180920

Starling, L., Readhead, C., Viljoen, W., & Lambert, M. (2019). The South African Rugby Union Youth Weeks Injury Surveillance Report 2018. *South African Journal of Sports Medicine, 31*(1). doi:10.17159/2078-516X/2019/v31i1a6365

Theilen, T.-M., Mueller-Eising, W., Wefers Bettink, P., & Rolle, U. (2016). Injury data of major international field hockey tournaments. *British Journal of Sports Medicine, 50*(11), 657-660. doi:10.1136/bjsports-2015-094847

Undheim, M. B., Cosgrave, C., King, E., Strike, S., Marshall, B., Falvey, É., & Franklyn-Miller, A. (2015). Isokinetic muscle strength and readiness to return to sport following anterior cruciate ligament reconstruction: is there an association? A systematic review and a protocol recommendation. *British Journal of Sports Medicine, 49*(20), 1305-1310. doi:10.1136/bjsports-2014-093962

van Dyk, N., Bahr, R., Whiteley, R., Tol, J. L., Kumar, B. D., Hamilton, B., . . . Witvrouw, E. (2016). Hamstring and Quadriceps Isokinetic Strength Deficits Are Weak Risk Factors for Hamstring

Strain Injuries. *The American Journal of Sports Medicine, 44*(7), 1789-1795. doi:doi:10.1177/0363546516632526

van Mechelen, W., Hlobil, H., & Kemper, H. (1992). *Incidence, Severity, Aetiology and Prevention of Sports Injuries: A Review of Concepts* (Vol. 14).

von Elm, E., Altman, D. G., Egger, M., Pocock, S. J., Gøtzsche, P. C., & Vandenbroucke, J. P. (2007). Strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *British Medical Journal, 335*(7624), 806-808. doi:10.1136/bmj.39335.541782.AD

Whittaker, J. L., Booysen, N., de la Motte, S., Dennett, L., Lewis, C. L., Wilson, D., . . . Stokes, M. (2017). Predicting sport and occupational lower extremity injury risk through movement quality screening: a systematic review. *British Journal of Sports Medicine, 51*(7), 580-585. doi:10.1136/bjsports-2016-096760

Williams, S., Trewartha, G., Kemp, S. P. T., Brooks, J. H. M., Fuller, C. W., Taylor, A. E., . . . Stokes, K. A. (2016). Time loss injuries compromise team success in Elite Rugby Union: a 7-year prospective study. *British Journal of Sports Medicine, 50*(11), 651. doi:10.1136/bjsports-2015-094798

Windolf, M., Götzen, N., & Morlock, M. (2008). Systematic accuracy and precision analysis of video motion capturing systems—exemplified on the Vicon-460 system. *Journal of Biomechanics, 41*(12), 2776-2780. doi:https://doi.org/10.1016/j.jbiomech.2008.06.024

Wong, P., & Hong, Y. (2005). Soccer injury in the lower extremities. *British Journal of Sports Medicine, 39*(8), 473-482. doi:10.1136/bjsm.2004.015511

World Medical Association. (2013). World medical association declaration of helsinki: Ethical principles for medical research involving human subjects. *JAMA, 310*(20), 2191-2194. doi:10.1001/jama.2013.281053

APPENDICES

Appendix A: Informed consent

University of Cape Town, Department of Health and Rehabilitation

Faculty of Health Sciences

Division of Physiotherapy

F45 Old Main Building, Groote Schuur Hospital

MSc. Sports and Exercise Physiotherapy, "Incidence of injury and associated factors in a senior provincial hockey tournament".

INFORMED CONSENT

Dear Participant,

I am a master's student at the University of Cape Town. I will be conducting a study on the incidence of injuries during a senior provincial field hockey tournament, and the associated factors contributing to injury. The information I obtain from this study will be used to complete my minor dissertation and obtain my master's degree in sports and exercise physiotherapy. This study (after time of final proposal approval) has been approved by The Human Research Ethics Committee, Faculty of Health Sciences, University of Cape Town.

Why do we need to do this study?

The tournament format of hockey is one of the most studied formats of the game regarding injury statistics globally, yet there is little known about the incidence rate in South Africa, with our last study indirectly documenting female injuries in 2004. With the professionalization of hockey in South Africa underway, there is a need to improve all aspects of performance, including injury prevention and in line with prevention, the investigation of injury incidence and associated factors. You will be asked to participate in this study because you are either a player for or coach of your provincial team.

What is expected from you?

This study will take place during the six days of the Interprovincial Tournament.

You will be asked to complete a questionnaire with your demographic information (such as your gender and age), as well as injuries you might have sustained prior to the tournament commencing. This questionnaire will be sent to you via email to complete before the start of the tournament or given to you at the tournament briefing meeting. This questionnaire will only take approximately less than five minutes to complete. You will then also be asked to complete a daily report, which will give us information on injuries you might have sustained during the day and associated factors that might have led to this injury. This daily report will be done via an app and will only take maximum two minutes each day.

Potential Risks to participants:

There is no physical risk for you, as you will not undergo any tests or treatments. We do know that some of the information asked in the questionnaire might be sensitive for some participants, however this information will not be made known to anyone except to the researchers (student and supervisor).

Potential Benefits to participants:

There is no remuneration for participation in this study as it is not funded, although you will be issued with a pamphlet providing injury prevention exercises which are evidence based and adapted from validated prevention programs.

Participants are asked to view this research as part of the development of hockey in South Africa. This the findings of this thesis study may result in the future injury prevention programs for South African field hockey. Findings could highlight the need for inclusion of sport science and sports medical modules within the South African Hockey Association coaching qualifications. It may highlight the need for mandatory medical access during the provincial tournaments, leading to better player care, and potentially increasing performance.

Voluntary participation:

Participation in this study is voluntary. It is your choice whether you want to take part or not. There will be no consequences if you decide not to participate. Even when you decide to participate, you can withdraw at any stage during the tournament, without repercussions.

Confidentiality:

The study acknowledges and accepts responsibility for keeping sensitive information. All information gathered during the study will be kept confidential throughout the study. Your identity will be kept to track your injury status throughout the tournament, but once the tournament is complete, and the analysis of the data commences, your information will be "de-identified". Your injury information prior or during the tournament will not be disclosed to any coach (including your team coach), player, official or South African Hockey staff member during the tournament.

Disclaimer:

The University of Cape Town and the study investigators will not be responsible for compensation or intervention if injury occurs.

Contact details:

If there are any queries, please feel free to contact any of the researchers listed below.

Investigator:	Supervisor:
Nick Pereira	Dr. Lieselotte Corten
072 545 0367	071 588 3729
nspereiraphysio@gmail.com	l.corten@uct.ac.za

If you have any concerns about your right and welfare during the study, please contact the Human Research Ethics Committee:

Prof. Marc Blockman

021 4066496

Please sign below if you consent to being involved in this study:

"I have read the above information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate in this study."

Participant Name and Surname _____

Date _____

Signature _____

Researcher Name and Surname_____

Date _____

Signature_____

Appendix B: Coaching background questionnaire

1. COACHES INFORMATION

(Please tick all applicable)

Name:

Surname:

Date of Birth: ☐☐ / ☐☐ / ☐☐☐☐ Age:

Gender: ☐ Female ☐ Male

Email address:

Provincial Team:

Tertiary Qualification:

SAHA Level Qualification: ☐ 0 ☐ 1 ☐ 2 ☐ 3

FIH Coaching Qualification: ☐ Yes ☐ No *(If yes, specify):*

First Aid Qualification: ☐ Yes ☐ No *(If yes, which level?):*

Number of IPT's as Head Coach:

Staff Medical Team at IPT:

☐ Physiotherapist ☐ Doctor

☐ Chiropractor ☐ Sport Scientist

☐ Biokineticist ☐ Massage Therapist

☐ Medic

Where do, your players receive medical attention if there is not a staff medical team?

Is your staff medical team affected by budget? ☐ Yes ☐ No

Are you aware if there are free medical services available at IPT? ☐ Yes ☐ No

Who is responsible for warm-up/cool-down?

Who decides on player availability? (Following injury or illness) ☐ Coach ☐ Player

☐ Medical Staff

Appendix C: Player baseline questionnaire

1. PLAYER BACKGROUND INFORMATION (PRINT CLEARLY)

(Please tick all applicable)

Name: ☐

Surname: ☐

Date of Birth: ☐☐ / ☐☐ / ☐☐☐☐ Age: ☐

Gender: ☐ Female ☐ Male

Provincial Team: ☐

Playing Position: ☐ Defender ☐ Midfielder ☐ Forward ☐ Goal Keeper

2. HISTORY OF PREVIOUS INJURIES IN PAST 2 YEARS (PRINT CLEARLY)

(Please tick all applicable)

Injury number 1:

Date of Injury: ☐☐ / ☐☐ / ☐☐☐☐

Injury Occurred during: ☐ Match ☐ Training ☐ Warm up

Site of Injury: ☐ Head ☐ Neck ☐ Chest ☐ Upper Limb ☐ Hip

☐ Thigh ☐ Lower Limb ☐ Foot ☐ Glute

☐ Other (Specify): ☐

Medical Attention Needed: ☐ Yes ☐ No

Medical Service Provider: ☐ Doctor ☐ Sport Scientist

☐ Physiotherapist ☐ Biokineticist

☐ Chiropractor ☐ Medic

Time Lost from Hockey: *(Specify number, example; 1 month, 2 days)*

☐ Years ☐ Months ☐ Days

Continued. HISTORY OF PREVIOUS INJURIES IN PAST 2 YEARS (PRINT CLEARLY)

(Please tick all applicable)

Injury number 2:

Date of Injury: ☐☐ / ☐☐ / ☐☐☐☐

Injury Occurred during: ☐ Match ☐ Training ☐ Warm up

Site of Injury: ☐ Head ☐ Neck ☐ Chest ☐ Upper Limb ☐ Hip

☐ Thigh ☐ Lower Limb ☐ Foot ☐ Glute

☐ Other (Specify): ☐

Medical Attention Needed: ☐ Yes ☐ No

Medical Service Provider: ☐ Doctor ☐ Sport Scientist

☐ Physiotherapist ☐ Biokineticist

☐ Chiropractor ☐ Medic

Time Lost from Hockey: *(Specify number, example; 1 month, 2 days)*

☐ Years ☐ Months ☐ Days

Injury number 3:

Date of Injury: ☐☐ / ☐☐ / ☐☐☐☐

Injury Occurred during: ☐ Match ☐ Training ☐ Warm up

Site of Injury: ☐ Head ☐ Neck ☐ Chest ☐ Upper Limb ☐ Hip

☐ Thigh ☐ Lower Limb ☐ Foot ☐ Glute

☐ Other (Specify): ☐

Medical Attention Needed: ☐ Yes ☐ No

Medical Service Provider: ☐ Doctor ☐ Sport Scientist

☐ Physiotherapist ☐ Biokineticist

☐ Chiropractor ☐ Medic

Time Lost From Hockey: *(Specify number, example; 1 month, 2 days)*

☐ Years ☐ Months ☐ Days

Appendix D: Injury reporting form

INJURY REPORTING FORM

1. PLAYER INFORMATION (PRINT CLEARLY)

(Please tick all applicable)

Name: _____

Surname: _____

Provincial Team: _____

Playing Position: ☐ Defender ☐ Midfielder ☐ Forward ☐ Goal Keeper

2. *INJURY (PRINT CLEARLY)*

Please note, injury is defined as: "Any physical discomfort resulting from hockey related activity, regardless of severity or need for medical attention as perceived by the player"

(Please tick all applicable)

Date of Injury: ☐☐ / ☐☐ / ☐☐☐☐

Injury Occurred during: ☐ Match ☐ Training ☐ Warm up

Site of Injury: ☐ Head ☐ Neck ☐ Chest ☐ Upper Limb ☐ Hip

☐ Thigh ☐ Lower Limb ☐ Foot ☐ Glute

☐ Other (Specify): _____

Event Causing Injury: ☐ Open Play ☐ Short Corner

Time of Injury: ☐ Warm up ☐ 1st Half ☐ 2nd Half ☐ Cool Down

Injury Status: ☐ Injured - did not play ☐ Injured - played

☐ Not injured - played ☐ Not injured - did not play (illness)

Medical attention required: ☐ YES ☐ NO

Appendix E: HREC approval

HREC REF: 117/2018

Dr L Corten
Health & Rehab Sciences
Division of Physiotherapy
Old Main Building

Dear Dr Corten

PROJECT TITLE: INCIDENCE OF INJURIES AND ASSOCIATED FACTORS IN A SENIOR-INTER-PROVINCIAL FIELD HOCKEY TOURNAMENT (MSc candidate- Nicholas Pereira)

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 28th February 2019.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

We acknowledge that the student Mr Nicholas Pereira will be involved in this study.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval before the research may occur.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE
Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

FHS016: Annual Progress Report / Renewal

HREC office use only (FWA00001637; IRB00001938) This serves as notification of annual approval, including any documentation described below.			
☑ Approved	Annual progress report	Approved until/next renewal date	30.11.2020
☐ Not approved	See attached comments		
Signature Chairperson of the HREC		Date Signed	18/4/2019

Comments to PI from the HREC

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	14/11/2019		
HREC REF Number	117/2018	Current Ethics Approval was granted until	28th Feb 2019
Protocol title	Incidence of injuries and associated factors in a senior inter-provincial field hockey tournament		
Protocol number (if applicable)			
Are there any sub-studies linked to this study?	☐ Yes √ No		
If yes, could you please provide the HREC Ref's for all sub-studies? **Note:** A separate FHS016 must be submitted for each sub-study.			
Principal Investigator	Dr. Theresa Burgess, Student: NS Pereira PRRNIC008		
Department / Office Internal Mail Address	Division of Physiotherapy, F45 OMB, GSH		

(Note: Please complete the Closure form (FHS010) if the study is completed within the approval period)

Appendix F: National body approval

david.viney@belgotex.co.za Mon, Jan 15, 2018, 10:17 AM
to me

Hi Nick,

Compliments of the New Year.

No objections from SAHA HP.
Have you decided on a topic yet?

Hockey Injury Masters Study

Inbox x

nicholas pereira <nspereiraphysio@gmail.com> Mar 7, 2018, 8:31 AM
to Marissa, david.viney

Good Morning Marissa and Dave

I'm very pleased to report that my research has been approved by the University of Cape Town, SSISA and ESSM departments - the reference number for my study is HREC REF NO: 117/2018

Going forward, I would like to pursue my first data capturing at woman's IPT in Durban - with your approval. It leaves me little time to get things in order, but I believe it can be done, with your help. The next step for me is to get in touch with all the individual unions and start to recruit players and coaches into the study.

Would you possibly be able to provide me with a list of all the union contact emails or phone numbers please?

The second data collection will be at men's IPT in PMB, and I can re-use the union contact details to recruit players at that point. Please advise if you could assist me with this going forward.

The research will hopefully add to the strength of our hockey in years to come, and I appreciate your support in this matter.

Regards
Nick Pereira Physiotherapy T/A

ENHANCED PHYSIOTHERAPY

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BSc. Physiotherapy - Stellenbosch University
MSc. Sports and Exercise Physiotherapy Candidate - University of Cape Town
HPCSA PT 0115673 PR. 0720000644767

Marissa Langeni <marissahock@icon.co.za> Mar 7, 2018, 12:24 PM
to me, david.viney

SOUTH AFRICAN HOCKEY ASSOCIATION

Hi Nick

Trusting that you are keeping well.

Congrats on your approvals for your research project.

Our Member contacts can be found here https://www.sahockey.co.za/about-us/members

Kind regards,
Marissa

Appendix G: Data confidentiality

Data Confidentiality agreement

This research project forms part of my master's studies at the University of Cape Town. We will be conducting a study on the incidence of injuries during a senior provincial field hockey tournament, and the associated factors contributing to injury. The information we obtain from this study will be used to complete my minor dissertation and obtain my master's degree in sports and exercise physiotherapy. This study has been approved by The Human Research Ethics Committee, Faculty of Health Sciences, University of Cape Town (reference number).

Thank you for volunteering to assist with data collection for this study – due to the nature of the study and the information being gathered we require a signed commitment to keep all data gathered confidential. By signing below, you agree to:

Respect and maintain the privacy of all participants.

Use the password protection and outlined data management procedures to the best of your ability.

Not to reveal the results of participants to other research assistants or anyone outside of the investigator and supervisor.

Research assistant name and surname: Neil Van Biljoen

Investigator: Dr. L Corten

Research student: NS Pereira

Appendix H: Injury prevention pamphlet

6 Steps to Hockey Injury Prevention

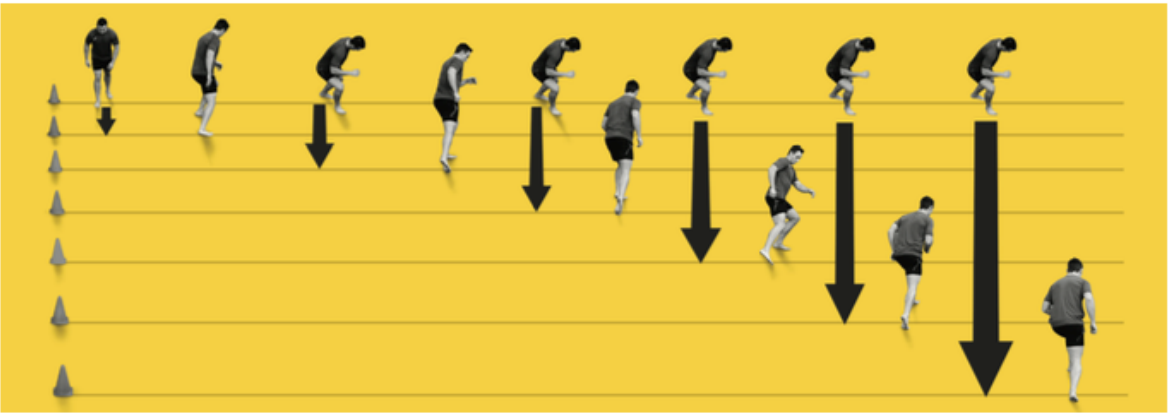
Hockey sporting injuries are avoided by performing validated exercises, which show good evidence as prevention methods in sports similar to hockey.

A thorough warm-up should be conducted prior to the execution of these exercises – use them as a part of your daily hockey warm up.

If you have any current injuries or are concerned in any way, please consult a medical professional before participating on this programme.

1. Six Meter Shuttle Run

Benefits for dynamic hip, ankle and knee stability



- Measure out seven cones, (including a "start" cone, at 1m intervals apart from each other.)
- Athletes perform the shuttle by running from the start cone to the 1m mark, then returning to start. Then from the start to the 2m mark.
- Athletes continue with this pattern until they reach the 6m mark and return to "start"
- This is considered one full set.
- Athletes should perform two sets of this, and in total cover 84m

2. Nordic Hammy

Benefits for glutes, lower back, hamstrings and core, strength and stability

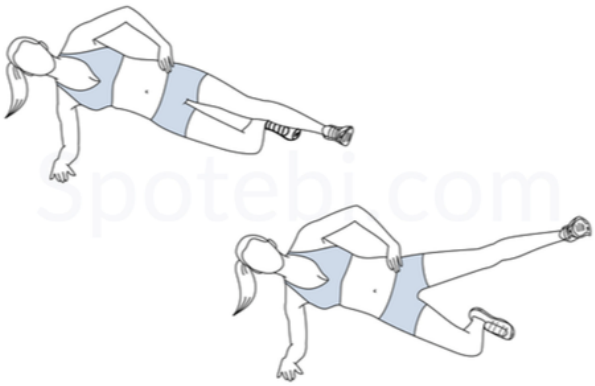
- Get into a kneeling position with arms folded over chest.
- Ask a team-mate to secure your ankles by kneeling behind you.
- Gradually lean forward in a controlled manner and try to resist falling as much as possible. When you are overcome by gravity, allow your upper body to fall into a pushup position and catch yourself.
- Perform six repetitions and swap with your team-mate!

Nordic hamstrings are a widely researched exercise in the prevention of hamstring tears as they increase eccentric muscle control. This is highly applicable for field hockey players.

If you have any current injuries or are concerned in any way, please consult a medical professional before participating on this programme.

3. Side plank Hip abduction

Strengthens the lateral abdominal muscles to improve core stability.



- Start by lying on your side with your bottom knee bent; ensure that the elbow and shoulder are at 90 degrees to the torso.
- Engage your bottom glute by lifting the hips off the ground from the starting position, then progress by lifting the top leg with a straight knee.
- Both glute medius (hip stability) muscles should work in this position.
- Perform 5 repetitions and 2 sets each side.

The hip stabilizing muscles and glute medius' play a key role in maintaining pelvic position during one-legged standing activities. The maintenance of this position is needed for optimal biomechanics of the lower limbs and the single leg stance or lunge position is a key movement for field hockey.

4. Dynamic Reach

Benefits for shoulder, hip, spine, pelvis, lower back, knee and ankle, stability, balance and control

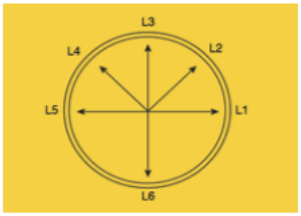
- Balance on one leg, shift the upper torso forward but keep the chest facing down.
- Reach forward with the arms above the head, and extend the non-standing leg.
- Hold this position for six seconds.
- Perform two sets of 3-second holds on each leg.

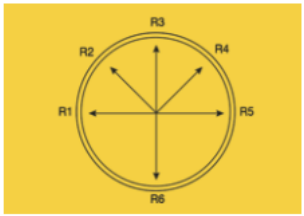
The benefit of maintaining balance in this position for hockey players is to be able to push/slap/hit while in transition with the ball without being at risk of lower limb joint instability.

If you have any current injuries or are concerned in any way, please consult a medical professional before participating on this programme.

5. Six-Point Lunge

Benefits for hip, pelvis, knee and ankle, strength and stability





Left leg lead

- Start with your feet together, hands placed on your hips.
- Take a large step forward and follow the above pattern with the left leg leading. L1-L6 in an anti-clockwise pattern, repeat for the right leg.
- Repeat 3 sets for each leg, six in total.

Right leg lead

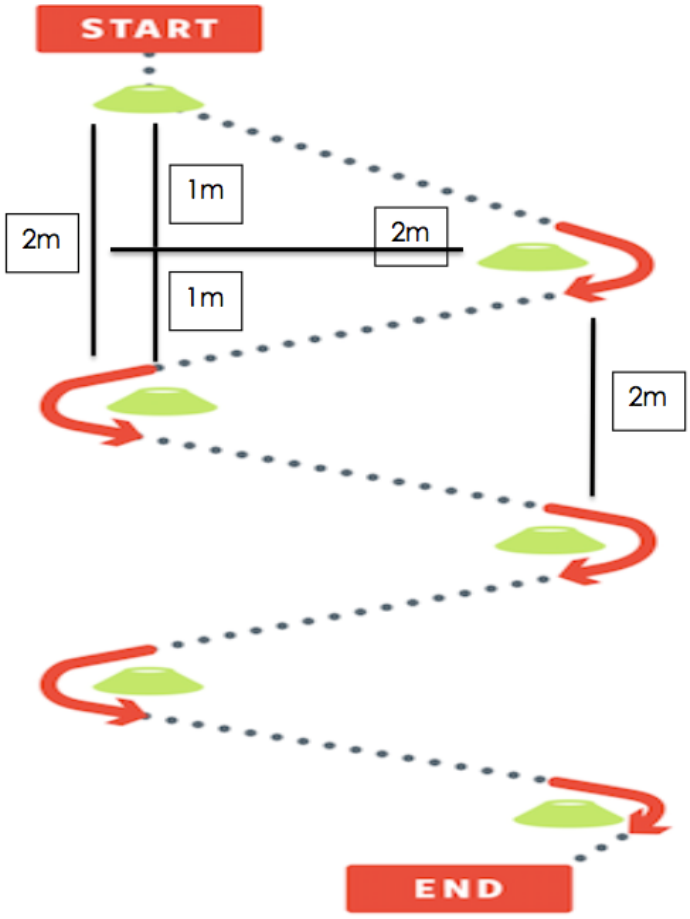
- Start with your feet together, hands placed on your hips.
- Take a large step forward and follow the above pattern with the right leg leading. R1-R6 in a clockwise pattern, repeat the next set.
- Repeat 3 sets for each leg, six in total.

This exercise utilizes a common stance position for hockey and includes aspects of balance, mobility, strength and coordination.

If you have any current injuries or are concerned in any way, please consult a medical professional before participating on this programme.

6. Side to Side ZigZag Shuffle

Improves coordination and jumping techniques



- Set out six beacons. Each three two meters apart, with the width of 2 meters and staggered by a meter.
- Begin by standing in a quarter squat, standing with your starting leg towards the first beacon. Side-shuffle from beacon to beacon in a zigzag fashion, making sure to stay on the outside of the beacons at all times.
- Complete 4 sets of this exercise, alternating which leg leads.

The quarter squat side shuffle closely mimics the defensive stance and jockeying position that hockey players undertake. It is a progression of the exercises performed prior to this with hip stability, running and hamstring preparation.

If you have any current injuries or are concerned in any way, please consult a medical professional before participating on this programme.