THE FINANCIAL BURDEN OF INJURY AT AN ELITE SOUTH AFRICAN FOOTBALL CLUB DURING THE 2021-2022 PREMIER SOCCER LEAGUE SEASON

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Declaration

I, Andrew Coppin (CPPAND001), hereby declare that '*the financial burden of injury at an elite South African football club during the 2021-2022 Premier Soccer League season*' is my original work (except where acknowledgements 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 by candidate (Signature)

30 January 2024 (Date)

Acknowledgements

To my wife Charlotte and son Arthur. Thank you for all the love, patience, and support in this difficult time. May this be a permanent reminder of how you make me a better person, and that we can achieve anything together. I will do anything for you.

To my parents Antionette and Gavin, for always believing in me and helping me throughout my life. Your love has never wavered. Thank you being the perfect example of parents. Words cannot thank you for all you have done for me. I am because of you.

A special thanks to my supervisors Professors Mike Lambert and Theresa Burgess, for staying the course with me. I know this took longer than promised. Thank you for all your guidance and not giving up hope. We did it!

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List of Abbreviations

Abbreviation	Term
CI	Confidence Interval
ECIS	Elite Club Injury Study
FIFA	Federation Internationale de Football Association
F-MARC	FIFA Medical Assessment and Research Centre
HPCSA	Health Professions Council of South Africa
PSL	Premier Soccer League
SA	South Africa
SAFA	South African Football Association
UEFA	Union of European Football Associations
USD	United States Dollar ($)
ZAR	South African Rand (R)

Glossary of Terms

Research Term:	Definition
Direct medical costs:	Costs related to healthcare use e.g., consultations with sports physicians and surgeons, protective devices prescribed (braces, crutches etc) (Eliakim et al., 2020).
Exposure hours:	Total squad football exposure during the season, the sum of match and training exposure.
Injury burden:	A combined measure of the injury rate and severity (days absent). Injury burden is expressed as number of days missed (training or matches) per 1000 hours of football exposure (Bahr, Clarsen & Ekstrand, 2018a).
Injury definition:	Any physical complaint sustained by a player that results in a player being unable to participate fully in future football training or match play (Fuller et al., 2006) .
Injury incidence:	The number of injuries relative to exposure time. Injury incidence is expressed as a number of injuries per 1000 hours of exposure (Ekstrand, 2007) .
Indirect medical costs:	Lost productivity costs – costs related to loss of productivity and underperformance due to injury (Eliakim et al., 2020).
Injury severity:	The number of days that elapsed from the date of injury to the date of the players return to full participation in team training and availability for match selection (Fuller et al., 2006).
Match:	Play between teams from different clubs (Fuller et al., 2006) .

Research Term:	Definition
Match exposure:	Total squad match play exposure.
Match injury incidence:	Total number of match injuries per 1000 hours of match play exposure.
Time-loss injury:	Any injury that occurred during a scheduled training or match session that causes absence from the next training or match (Fuller et al., 2006).
Training exposure:	Total squad training exposure during the season comprised of field training, gym sessions and recovery training sessions.
Training injury incidence:	Total number of injuries per 1000 hours of training exposure (Ekstrand, Hägglund & Waldén, 2011a).
Training session:	Team training under the supervision of coaching staff (Fuller et al., 2006) .
Recurrent injury:	An injury to the same side and body part of the same injury type as an injury previously recorded as an injury but that had recovered (Fuller et al., 2006) .

Operational Definition

1. ZAR (R) is the currency of South Africa and the exchange value on 1 July 2022 was R 16.29 to the USD ($) and R 17.07 to the Euro (https://www.xe.com/currencycharts/). This exchange rate was used throughout this dissertation. The costs will be expressed in South African Rand – the conversion for R to $ is 0.061. All financial amounts reported will be rounded to whole numbers.

Abstract

Objective:

We sought to determine the injury incidence, athlete exposure, days lost to injury (burden) and financial cost of injury at a high-level professional football team during the 11-month South African Premier Soccer League season of 2021-2022.

Methodology:

Thirty-one (N=31) professional football players gave consent for their training attendance, medical notes, and injury history for the 2021-2022 football season to be analysed as per the research objectives. Total squad exposure hours (training and matches) for the season were calculated using the daily club training and match attendance register. The number of time-loss injuries for the season were determined using the injury report form and were analysed in conjunction with player exposure hours for injury incidence calculations. The total number of days lost to injury (injury burden) was calculated based on player absence caused by injury during the season. The total days lost to injury were analysed with financial cost and club salary data to calculate the financial burden of time-loss injuries to the team based on the total money paid by the club in terms of medical service utilisation (direct costs) and lost player wages (indirect costs).

Results:

Thirty-four (N=34) new time-loss injuries were sustained by players during 6 776 exposure hours in the 11-month 2021-2022 season. The overall injury incidence for the season was 5.0 time-loss injuries /1000 total exposure hours. Injuries were approximately 4 times more likely to occur in matches (13.1 time-loss injuries /1000 match exposure hours) than in training (3.6 time-loss injuries /1000 training exposure hours). The 34 time-loss injuries sustained during the season resulted in a player absence of 236 days. The injury burden for the season was calculated at 34.8 days absence/1000 football exposure hours. The team paid a total of R 353 611 ($ 21 570) in direct and indirect medical costs for the season ($ 3 183/1000 exposure hours). Most (93%) of these costs were due to lost wages paid to injured players. The average cost per injury was R 10 400 ($ 634). Muscle injuries to the thigh were the costliest to the team in terms of player absence and financial cost for the season.

Conclusions:

Injuries represented a considerable burden to professional football teams in terms of player absence (burden), the financial cost of medical services, and lost player wages. Our data shows that the financial cost of injury in South Africa is substantially lower than has been reported in high-level European leagues; this is likely due to a different injury profile (lower injury incidence and severity), difference in access to medical services and lower average player wages. We determined that teams need to budget for injuries carried over from the previous season, as they may carry substantial costs into the following season. Muscle injuries, particularly of the thigh, require urgent intervention to reduce their burden to this team. Our methodology provides a basis for the much-needed financial cost of injury research locally to help professional club stakeholders make fiscal budgeting decisions.

Key words:

Football, South African football, professional football, PSL, economic burden of injury, injury incidence, injury prevention.

Chapter 1: Introduction

The financial cost of injuries in professional football (soccer) clubs is a growing concern, as the impact of time-loss injuries can have far-reaching consequences for teams. Professional football players' costs are substantial if they cannot attend training or matches. These expenses have increased due to the high value of players in today's sports (Drawer & Fuller, 2002a; Öztürk & Kiliç, 2013; Pulici et al., 2023). Although there has been extensive research on injury epidemiology in professional soccer, we still need to learn about the cost of these injuries to teams. Our dissertation seeks to explore the financial impact of time-loss injuries on a high-level South African football club during the 2021-2022 Premier Soccer League season. In addition, the dissertation sought to describe the club's unique injury profile and epidemiology, identify the need for injury prevention interventions, and provide valuable data for club owners and stakeholders to aid in medical and player cost budgeting.

This chapter will introduce the dissertation by discussing the background and context, outlining the research problem, and presenting the aims and objectives. Additionally, we will discuss the significance, limitations, and scope of the research.

1.1 Background

Football is a globally recognised sport, generating billions of dollars annually. Modern-day football is more professional and lucrative than before, with higher demands on athletes and more money at stake for teams based on on-field results (Barnes et al., 2014). Locally, South African football is a multi-billion-rand industry reflecting its significance at the local level (Transfermarkt, n.d). According to international research, injuries in this sport are likely to result in significant costs (Öztürk & Kiliç, 2013; Howden Insurance Brokers Ltd, 2022; Pulici et al., 2023). Therefore, it's important to conduct further investigations locally to better understand the situation.

1.1.1 Impact of Injury in Professional Football

Injury is prevalent in professional football due to the sport's high-speed and contact nature. High-level athletes face an increased risk of injury due to the demanding training and match schedules and limited recovery time (Ekstrand, 2007). Research indicates that professional teams can expect an average of two time-loss injuries per player per season, resulting in substantial costs associated with medical care, player wages, and diminished team performance (Ekstrand, Hägglund & Waldén, 2011a; Misra, 2014; Pulici et al., 2023). Elite teams can incur millions of dollars in injury-related expenses each season (Eliakim et al., 2020). Football clubs need to understand the financial impact of injuries. This helps determine how serious the injury problem is for the team (Öztürk & Kiliç, 2013).

Previous research has focused primarily on the effects of the game's physical demands on injury incidence and prevention. The economic impact of injuries has received less attention. This knowledge gap is surprising, considering the substantial financial burden on teams (Walia & Boudreaux, 2020). To allocate resources effectively and evaluate the cost-effectiveness of injury prevention programs, it is essential to identify the injuries that impose the most significant financial burden on teams (Öztürk & Kiliç, 2013). While previous injury studies have answered many questions on player management and well-being, contemporary research is needed to answer questions associated with the modern game, particularly in South Africa.

1.1.2 Burden of Injury in South African Football

In the South African context, only a limited number of studies have documented football injuries (Calligeris, Burgess & Lambert, 2015; Bayne, Schwellnus, Van Rensburg, et al., 2018; Swart, Varekamp & Greyling, 2022), and there is a lack of data regarding the effects and estimated costs associated with the treatment of these injuries. Local research has shown that high-level teams in South Africa lose over 1000 squad days per season, leading to significant direct and indirect costs (Calligeris, Burgess & Lambert, 2015). However, no studies have addressed the cost of injuries for professional male footballers in South Africa. Moreover, the lack of adequate healthcare services in developing countries could exacerbate injury rates and expenses, underscoring the importance of conducting research in the region (Dvorak & Junge, 2015).

To reduce the expenses related to injuries in South African teams, it is important to conduct comprehensive research using reliable methodology to establish local injury burden data. This dissertation has been designed with this objective in mind and aims to fill the gap in understanding the financial expenses associated with injuries in high-level South African football. By identifying the unique injury profile of a South African football club during a competitive season, this study will contribute to filling the existing gap in the field and have both academic and practical applications. Moreover, integrating these findings with previous research will enable club medical staff to make informed decisions regarding injury prevention strategies and financial operations.

1.1.3 Financial Burden of Injury

The financial burden of injuries needs to be better understood. Without this information, it is challenging for teams to prioritise injuries from an economic standpoint. Players, coaches, and club owners all have a stake in understanding the full extent of the financial losses caused by injuries (Walia & Boudreaux, 2020) This knowledge is important for making decisions about squad size, budgeting, allocating medical staff, and insurance coverage (Hägglund et al., 2013).

Financial cost is an outcome measure that allows for comparisons between different injury types and has been recognised as one of the key indicators of injury severity (van Mechelen, Hlobil & Kemper, 1992; Polinder et al., 2016). Studies show that injuries that are more severe tend to incur higher financial costs (Gebert et al., 2020). As a result, injury costs are a crucial factor in evaluating the impact of injuries and provide valuable insights to guide and assess the effectiveness of injury prevention measures. Injury studies have recognised the importance of high-cost injuries, but they frequently overlook the specific cost information while concentrating on the nature and duration of recovery (Knowles et al., 2007; Brown et al., 2015; Gebert et al., 2020; Pulici et al., 2023).

To support the need for better injury prevention tactics, it is important to present the expenses associated with sports injuries to measure their impact. Moreover, evidence suggests that the most prevalent injuries may not necessarily result in the highest financial costs for organisations. Simply describing the injury risk without considering the financial costs provides an incomplete view, which underestimates the overall burden of injuries to organisations (Öztürk & Kiliç, 2013).

1.1.4 Economic Considerations of Injury Prevention

Implementing injury risk reduction programs at the elite level has revealed challenges, particularly in terms of player adherence (Eirale et al., 2013; Hägglund et al., 2013; McCall, Dupont & Ekstrand, 2016). These programs can be expensive to implement in terms of financial and time investment. Evidence suggests that these prevention programs can effectively reduce injury risk (Owoeye, VanderWey & Pike, 2020), their economic value and cost-benefit ratio remain poorly understood (Grygorowicz, Wiernicka & Wiernicka, 2021). This highlights a missing step in van Mechelen's injury prevention model (van Mechelen, Hlobil & Kemper, 1992) : determining the cost-effectiveness of implementing injury prevention programs alongside their impact on injury rates.

To maximise effectiveness in reducing injury risk at the team level, the focus should be on addressing the injuries causing the highest total burden (time-loss and financial) rather than targeting the most common injuries. Before teams adopt injury prevention strategies, it is imperative to have a comprehensive understanding of the injury burden specific to each team. This understanding informs the financial and time investments required for implementing prevention strategies and if they are worth implementing from a cost-savings standpoint. However, the financial burden of injury research methodology requires refinement, and studies on the economic burden of injuries should also be conducted in a local context to be of the most value (Lu et al., 2021).

1.2 Research Problem

Injuries impose a substantial burden on both professional football clubs and players. Despite the high financial stakes and performance implications of injuries in professional football, there is a lack of published data on the associated financial costs for professional South African football clubs. As a result, these clubs may struggle to make informed decisions about player and medical cost budgeting, potentially hampering both their on-field performance and business operations.

The lack of research on the financial impact of football injuries is not just limited to South Africa. This is a global issue. As football continues to become more professional and the value of players and teams increases, there is an urgent need for further research in this area. Such research will aid football clubs in making informed financial decisions about injuries and injury prevention strategies.

1.3 Research Aims and Objectives

This study will focus on determining the associated expenses because of injury for a high-level South African football club during a professional Premier Soccer League (PSL) season to better understand the financial cost of injury in high-level professional teams.

The specific study objectives will be to:

- Calculate the first team squad exposure during the 2021-2022 PSL season.
- Calculate the first team squad training and match exposure (all matches including league and Cup games) during the 2021-2022 PSL season.
- Measure the total number of time-loss injuries sustained by first team squad players during the 2021-2022 PSL season.
- Determine first team squad injury incidence during the 2021-2022 PSL season.
- Determine the total player days lost to the club because of injury.
- Calculate the average first team player weekly wages during the 2021-2022 PSL season.
- Calculate the total financial cost of injury during the 2021-2022 PSL season.
- Determine the cost of lost player wages paid to unavailable players during the 2021-2022 PSL season.
- Determine the total direct medical cost of injuries sustained by first team players during the 2021-2022 PSL season.
- Calculate the average cost per injury for injuries sustained by first team players during the 2021-2022 PSL season.

1.4 Research Significance

This research aims to contribute to the current body of knowledge in South African football by filling the existing gap in the economic dimension of sports injuries. By analysing the financial spending, injury incidence and unique injury profile of a professional South African football club over a competitive season, this study provides important information that can be applied in both academic and real-world settings.

Moreover, by combining these findings with previous epidemiological research in the field, club medical staff will have a better understanding of the injury burden to teams in the league and be better equipped to make informed decisions regarding injury prevention strategies. The prevention of injuries is beneficial to both player welfare and the football club. Increased player availability has been shown to positively affect results and end-of-season league ranking, making it beneficial for teams to implement prevention strategies. Additionally, the effectiveness and cost-benefit ratio of any future prevention strategies can be evaluated by determining the financial burden of injury over the season.

Sharing details about the cost of injuries can help stakeholders make better choices about their budgets for players and medical expenses during different seasons. This can improve their overall business operations. Optimising financial operations can positively impact on-field results, further underscoring the importance of this study's contributions to the field.

This research will contribute to the current knowledge gap surrounding the financial impact of sports injuries in football and provide a framework for future studies at both the local and global levels, thus establishing a critical foundation for advancing research in the economic dimension of sports injuries.

1.5 Scope of Research and Study Limitations

This study examines the financial burden of time-loss injuries among high-level male footballers at a professional South African club during the 2021-2022 professional football season. Only injuries occurring within the designated study period were considered for inclusion in the financial and injury burden calculations. Injuries sustained before the study period or injuries that occurred during national team camps or were non-football related were not included. It could be argued that injuries occurring at the national team level impact the overall injury burden on clubs. However, obtaining accurate data on player training exposure and the costs of direct medical care paid by national teams for such injuries is challenging and their accuracy is difficult to ascertain. Additionally, injuries that did not result in time loss were not factored into the burden calculations. This study marks the first of its kind in football in the country and aims to establish a methodological framework for future research in this field.

1.5.1 Methodological Issues

This research uses a retrospective cohort study design for practical reasons. Although a prospective cohort study design would have been preferable to minimise recall and misclassification biases, using injury data routinely recorded by the club's medical staff helped mitigate these biases. The data analysis was performed retrospectively, using real-time injury, training, and match-day records documented throughout the season.

1.5.2 Generalisability

This study focuses on registered footballers of a specific club in the Premier Soccer League of South Africa during the 2021-2022 professional football season. It is important to note that the results of this dissertation apply primarily to professional male footballers in South Africa. Specifically, the findings are relevant to this team for this specific season.

1.6 Structure

This dissertation is structured into six chapters to address the research objectives comprehensively. Chapter One serves as an introduction, providing a contextual overview of the study. It begins with a brief background of the topic, followed by a presentation of the research problem and the aims and objectives of the study. Additionally, the chapter discusses the significance of the research, outlines its scope, and acknowledges its limitations.

Chapter Two focuses on analysing and critiquing existing football injury research, specifically examining the burden of injuries on professional teams. This chapter critically evaluates previous studies to provide a comprehensive understanding of the current state of knowledge in the field.

Chapter Three outlines the methodology used in this research study. It includes the study design, participant description, procedures involved, measurement instruments utilised, and the data capture and analysis procedures. Ethical considerations, including the risks and benefits to participants, are also addressed in this chapter.

Chapter Four presents the results of the study. It provides a detailed description of the study participants. It presents calculations about the financial burden of injuries on the club, injury incidence and severity, and the specific injury locations and types that caused the greatest financial and time-loss burdens over the study period.

Chapter Five is the discussion chapter, where the research results are analysed and interpreted. This chapter explores the importance and implications of the findings and relates them to the existing literature. It provides insights into the financial burden of football injuries to professional teams and the implications for injury prevention and management in professional football.

Chapter Six addresses the study's limitations, outlining the constraints and potential sources of bias. Additionally, it discusses the practical implications of the current findings and offers recommendations for future research in the field. Finally, this chapter concludes the dissertation summarising the key findings and contributions of the study.

Chapter 2: Literature Review

2.1 Introduction

Professional football (soccer) is a big business. In the modern era, clubs and teams compete in terms of on-field performance and financial success. Professional football clubs have increased squad value exponentially to enhance their chances of winning on the field. Wages have been identified to be an important indicator of expected team success (Matesanz et al., 2018). Not surprisingly, research indicates a strong correlation between team financial strength and on-field performance. Wealthier teams can acquire better players, thus improving their chances of success (Lago-Peñas & Sampaio, 2015). While the magnitude of monetary investment and financial might of football teams may not guarantee success, it has been shown to increase the probability of success. Club football in South Africa is a multibillion-Rand industry with combined Premier Soccer League team squads valued at more than 142 million Euros (R 2,4 billion) (Transfermarkt, n.d). However, it is important to note this investment is not distributed equally between teams (Transfermarkt, n.d).

It is well-established that the risk of injury in football is high at both the amateur and professional levels (Ekstrand, 2007; Pfirrmann et al., 2016). The chances of injury to a professional football player are approximately 1000 times higher than other high-risk industrial occupations (Drawer & Fuller, 2002b). Player absence due to injury is considered a liability to club and player. Any injury causing time loss has the potential to result in financial loss, player unavailability, a decrease in team performance and a strain on club medical resources (Drawer & Fuller, 2002a; Hägglund et al., 2013; Eliakim et al., 2020). Modern-day football has become more professional and lucrative than before, placing higher demands on athletes and more money at stake for teams based on on-field results (Barnes et al., 2014). Injuries have been shown to negatively impact the on-field success of the team and club finances (Drawer & Fuller, 2002a; Hägglund et al., 2013). Injuries drain club finances via direct medical costs and wages paid to unavailable injured players (Korkmaz et al., 2014).

To football clubs, the seasonal cost of injury could be considered the most important indicator of the seriousness of the injury burden within the team (Öztürk & Kiliç, 2013). Thus, Stakeholders are vested in the overall burden and financial loss caused by injuries. This has implications for squad size, budgeting, medical staff allocation, and insurance purposes (Hägglund et al., 2013). Football injury incidence and burden have been well described in many countries (López-Valenciano et al., 2020). However, only three studies have documented injuries in South African football (Calligeris, Burgess & Lambert, 2015; Bayne, Schwellnus, Van Rensburg, et al., 2018; Swart, Varekamp & Greyling, 2022). Data on the effects and estimated costs associated with treating these injuries is lacking.

The literature review for this dissertation will explore injuries in professional male football, examining their associated burden and financial impact on teams. The review will encompass both international and South African research, facilitating a comparative analysis between the South African context and other football leagues worldwide. Initially, the review will provide an overview of the historical trajectory of injury research in professional male football, spanning both global and African perspectives. This historical context will be followed by an examination of current trends in the field. Furthermore, the review will explain the descriptive characteristics of injuries in football, including their definition and classification methodologies. Subsequently, it will delve into the risk factors associated with injuries among professional male footballers. Finally, the review will address the burden imposed by time-loss injuries on professional football teams, encompassing aspects such as player absence and the financial costs incurred. While injury prevention is not a focus of this review, we will outline the preventative strategies described in the literature and their effects on injury rate. This will provide important context for the need to determine cost benefit ratios of injury prevention programs implemented by professional teams. Through this comprehensive exploration, the literature review aims to provide valuable insights into the multifaceted nature of injuries in professional male football.

2.2 Injury Research in Football

The main contributors to global football research are the football governing bodies of Fédération Internationale de Football Association (FIFA) and the Union of European Football Associations (UEFA). FIFA and UEFA were instrumental in developing best practices in football injury research. They have contributed to standardising methodology and injury definitions, making them responsible for most international and elite club-level injury surveillance. Local independent studies from leagues worldwide make up the balance of the remaining football research. While less in number, this research has its place in the injury surveillance landscape and has demonstrated important differences in injury characteristics and incidences from different leagues and geographical locations (Eirale et al., 2017).

(1) FIFA, as the world governing body of football, is focused on international tournament and match research. The main contribution of FIFA to football research and science is establishing a database of international football tournament injuries (including women's and youth football tournaments) and developing the FIFA 11+ injury prevention program https://www.fifa.com/about-fifa/medical.

(2) UEFA is involved in research regarding high and elite-level European football clubs. In 2001, they developed the Elite Club injury study (ECIS), which is currently recognised as the largest and longest-running football injury surveillance project in the world (Ekstrand et al., 2021). The ECIS publishes annual reports and provides benchmark figures for clubs to compare their own injury data for the season. Moreover, it is responsible for numerous seminal and sub-study research papers regarding football injury epidemiology.

(3) Various regional studies have been conducted on local leagues and universities worldwide. These include independent research from the Premier League (England), La Liga (Spain), Bundesliga (Germany), and the developing research field in Qatar. The Premier Soccer League (South Africa) are included in this group. Although these studies have smaller cohorts and are generally more limited, they have shown differences in injury profiles based on league and geographical region. This emphasises the importance of ongoing local research (Eirale et al., 2017). The research structures are shown in Figure 1.

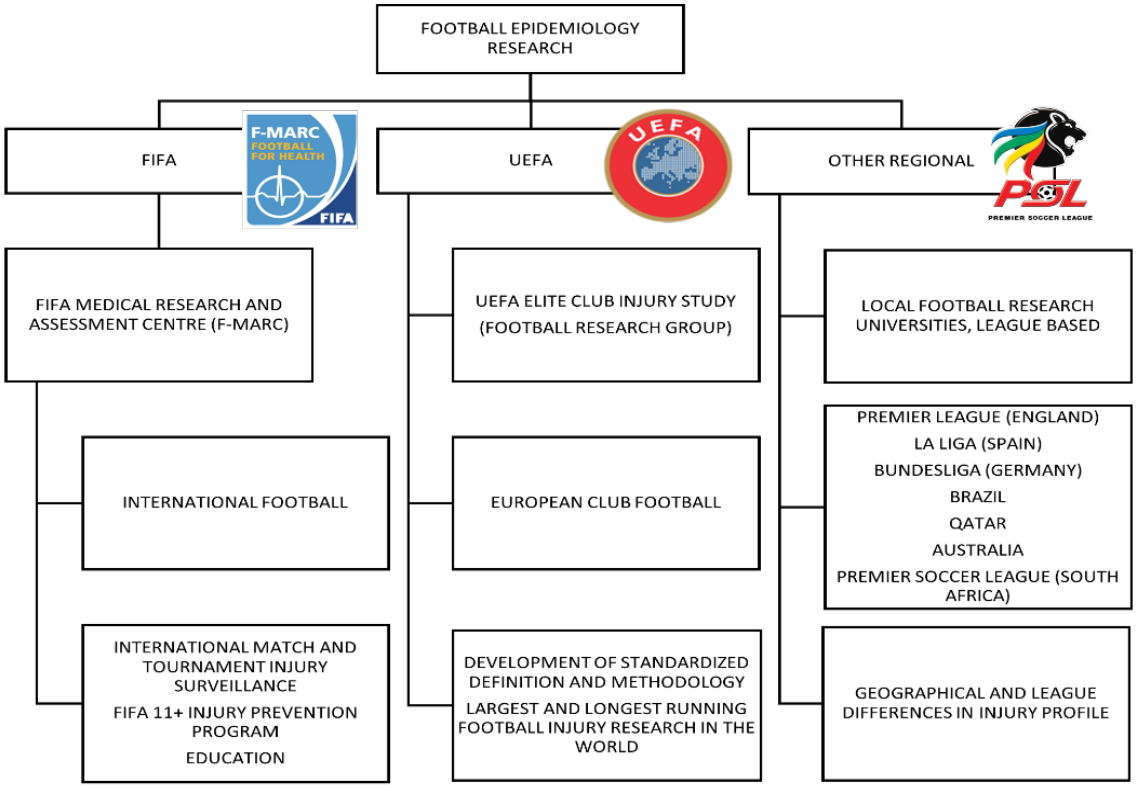

Figure 1. Summary of football injury research groups.

2.2.1 Football Injury Research – a History

To better understand the context of this research and to identify potential gaps, we must first establish the current body of knowledge available. Previously, football injury research has been primarily focussed on epidemiology, which aligns with the first step of the four-step injury prevention model developed by van Mechelen in 1987 – 'establishing the extent of the sports injury problem' (van Mechelen, Hlobil & Kemper, 1992) (Figure 2). Compared to other sporting codes, a large body of literature exists regarding football injury surveillance at all levels of competition, from amateur to professional. This is largely due to a drive in the early 2000s by the FIFA and UEFA football governing bodies to prioritise scientific research and investigate the demands on the modern footballer, aiming to increase player safety (Waldén et al., 2018).

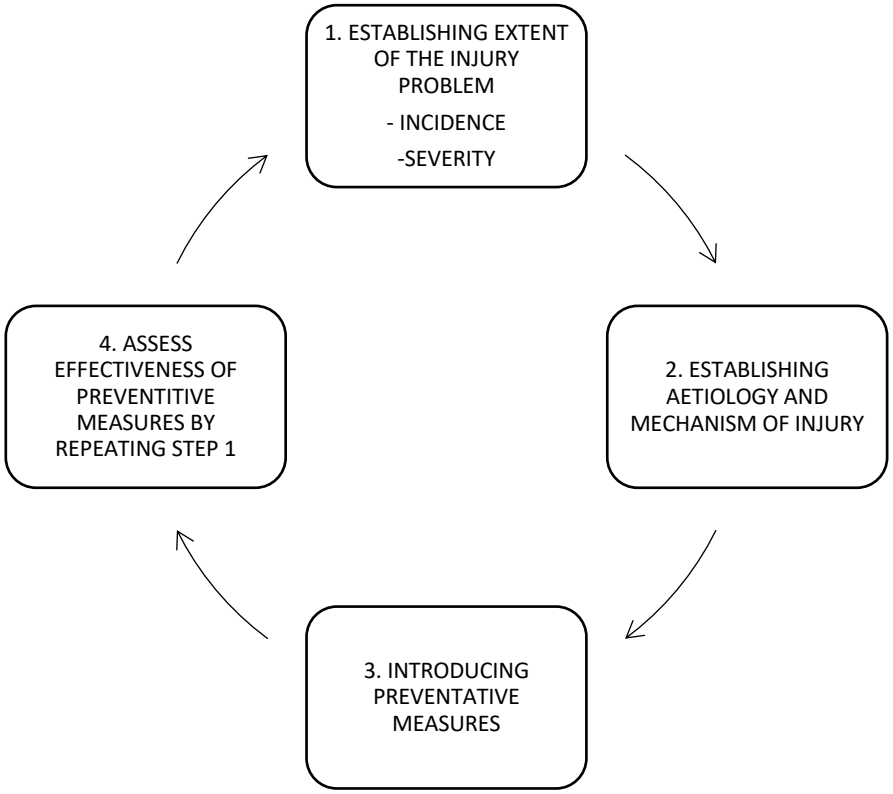

Figure 2. The sequence of prevention of sports injuries (van Mechelen, Hlobil & Kemper, 1992).

2.2.1.1 UEFA Elite Club Injury Study (ECIS)

From the emergence of science in football in the 1970s up until the 2000s, variations in definitions and methodologies meant that accurate inter-study comparisons of findings were not possible (Fuller et al., 2006). The inconsistency regarding definitions used and data collection methods of early research paved the way for a consensus for injury definitions and data collection procedures in football research by the UEFA Medical Committee in 2001. The methodological consensus included recommendations regarding study design, exposure factor, study period, data collection forms, study manual provision, contact person requirements, inclusion criteria, definitions of injury and measures of injury severity. These recommendations are still followed today (Hägglund et al., 2005).

Following two pilot studies in Sweden and Denmark, the UEFA Champions League injury study (later renamed the UEFA Elite Club Injury Study) was launched in July 2001 by the Football Research Group (FRG) under the leadership of Professor Jan Ekstrand (Waldén et al., 2018). Twenty-one years later, the ECIS is the largest and longest-running football injury surveillance study in the world, with a reported dataset of 69 elite teams from 20 European countries and over 24 000 recorded injuries over the course of 18 seasons (Ekstrand et al., 2021).

2.2.1.2 FIFA Medical Assessment and Research Centre (F-MARC)

F-MARC was established in 1994 and has built a database of player injuries during international tournaments since the 1998 World Cup. However, as outlined in the previous section, considerable differences in definitions and methodology led to problems in interpreting early football injury research study results. In 2005, the F-MARC established an Injury Consensus Group to standardise injury definition and data collection for football studies (Fuller et al., 2006).

The F-MARC consensus statement of 2005 built upon the UEFA model from four years prior and further defined injury with a more uniform diagnosis criterion. There has been much debate regarding the definition and classification of injury as it influences the interpretation of results in injury research. This will be discussed later in the chapter. The F-MARC consensus also provided standardised template documents for data collection (baseline report form, injury report form and football exposure form) and a checklist of what should be included in reports of football injury studies (Fuller et al., 2006; (Waldén et al., 2018) .

For the most part, the definitions and methodology suggested in the UEFA model were maintained, with the F-MARC consensus statement adding detail and refinement in terms of injury diagnosis and study reporting. The UEFA model, along with F-MARC consensus, laid the foundations for standardised football injury research in practice today (Waldén et al., 2018).

2.2.1.3 Football Research in Africa

Early injury studies were primarily conducted on European football players, with information regarding injury incidence, characteristics and causes of injuries to African players remaining scarce. Previous surveillance studies had indicated injury variations between countries, leagues, and geographical locations, illustrating a need for local research on the continent (Dvorak, 2015; Eirale et al., 2017). The few studies conducted on African players were of low quality and not comparable to findings in European literature (Dvorak, 2015).

A study in the Tunisian league showed similar injury statistics to European teams but demonstrated a higher re-injury rate, possibly due to decreased access to qualified sports injury care (Dvorak, Junge & Grimm, 2009). The large variation in results between teams in this study raises questions regarding injury reporting methods used, and the results should be interpreted with care. Another study conducted in Congo looked at injury incidence during the first round of competitive league matches during the 2006-2007 season and showed a higher rate of injuries in club competition in Africa than in the European literature (Dvorak, Junge & Grimm, 2009). This finding was supported by other research done in Nigeria and during CAF competitions (Hamzat et al., 2004; Ani, 2015).

It is noteworthy that study methodology at the time was not standardised according to the F-MARC consensus model and could contribute to the varying injury incidence results across studies. What was clear, however, was the need for more studies in Africa to balance the interpretation of these data. It has taken a long time for epidemiological injury research based on standardised methods to be conducted in Africa and pales in comparison to available literature in Europe and elsewhere. However, since 2010, local research from Nigeria, Rwanda and South Africa has begun to emerge and will help to give context to African football injury data based on the unique setting and challenges of the continent (Ani, 2015; Calligeris, Burgess & Lambert, 2015; Bayne, Schwellnus, Van Rensburg, et al., 2018; Ibrahimović et al., 2021; Swart, Varekamp & Greyling, 2022).

2.2.2 Football Injury Research - Current Trends

African injury epidemiology research based on consensus methodology began to emerge in 2010 with studies published from Nigeria, Rwanda, and South Africa. While delayed and sparse in relation to international research, this was positive for the continent and was the first step to meaningful injury prevention. At present, there are only three published studies on football injuries among professional male footballers in South Africa. However, these studies are outdated and limited, indicating a need for further research in this area (Calligeris, Burgess & Lambert, 2015; Bayne et al., 2018; Swart, Varekamp & Greyling, 2022).

Internationally, there has been a shift from professional male football injury epidemiology studies to research involving special groups such as women's, amateur and youth football. Also, there has been an emphasis on injury risk reduction. Studies regarding the development of 'injury prevention' programs, such as the F-MARC 11+ injury prevention program, have dominated recent research. Overall, the efficacy of these programs has offered a mixed bag of results, with many methods of reducing injury risk being suggested but few showing any meaningful change in injury rates (Sadigursky et al., 2017; Åman et al., 2018; Bisciotti et al., 2019; Ekstrand et al., 2021). A general conclusion is that injury rates have remained stable across the board, with the ECIS showing a slight decrease in injury rates over the last 5 years (Ekstrand et al., 2021). It is unclear whether injury prevention programs offer a positive cost-benefit ratio, making their economic feasibility uncertain (Grygorowicz, Wiernicka & Wiernicka, 2021)

Only a small subgroup of research is concerned with the economic burden of football injury. This is surprising because studies show that injuries have the potential to result in a significant performance and financial burden to teams, which is relevant to players, coaches, and club owners (Walia & Boudreaux, 2020). The methodology of this branch of research in football needs refinement. Also, studies on the economic burden of injuries must have a local context. To the author's knowledge, no evidence regarding the financial burden of football injuries to professional teams exists in South Africa. It follows that we need to accurately determine the economic impact of injuries in professional football in the South Africa to establish the cost-benefit ratio of any injury prevention strategies that may be implemented by clubs.

2.2.2.1 Football Injuries – Effects of COVID-19

Several studies have been published on the effects of COVID-19 on football injuries following the recent worldwide pandemic (Seshadri et al., 2021; Maestro et al., 2022; Waldén et al., 2022). Insurance reports have shown a high burden of illness to teams because players were unavailable due to COVID-19 (Howden Insurance Brokers Ltd, 2022). It is expected that player time-loss due to illness is associated with the same negative effect on team performance and finances as injuries (Howden Insurance Brokers Ltd, 2022). For the most part, small cohort research on the effects of COVID-19 on football injuries have demonstrated little to no increase in match injury rates compared to previous seasons (Waldén et al., 2022).

However, a study of injuries in the Bundesliga, Germany's primary football competition, showed that match injury incidence was 3 times higher than expected after the league resumed playing after the COVID-19 shutdown (Seshadri et al., 2021). This could be attributed to the compressed season and shorter time between games rather than the direct effects of the virus. Training injuries increased after the lay-off but have since returned to pre-pandemic values and may have been because of detraining. The Bundesliga was the first league competition to return to competition after the pandemic. The higher rate of match injury could be due to decreased physical conditioning after lockdown coupled with a shorter training period before competition. The study also used publicly available injury data and needs to be interpreted with caution as the accuracy of the data cannot be confirmed (Seshadri et al., 2021).

2.3 Descriptive Characteristics of Injury

2.3.1 Definition of Injury

Before sports injuries can be properly quantified and compared between studies, a standardised recording definition of injury must be established (Junge & Dvorak, 2000; Fuller et al., 2006; Eirale et al., 2017). Differences in injury definitions, as well as their potential effect on the results of football epidemiological studies, were identified in the literature as far back as the 1980s (Keller, Noyes & Buncher, 1987). One of the most common criticisms of football research has been inconsistencies regarding the definition of injury used (Junge & Dvorak, 2000).

The most used injury definitions in research are time-loss injuries (any injury that limits participation in football activities) and medical attention injuries (any injury that leads to health care utilisation). These definitions have strengths and weaknesses depending on the context and purpose of the research (Table 1). (Waldén, Hägglund & Ekstrand, 2005).

The recommendation following the consensus on football research methodology is for a time-loss definition of injury to be used for injury surveillance studies (Fuller et al., 2006). According to the time-loss definition of injury, a player is considered injured from the day of injury until cleared by the club medical staff for full football participation in team activities, including training and matches. The lay-off period for the time-loss injury is represented as the number of days from the date of injury until cleared by medical staff (Ekstrand et al., 2021). The definition of injury based on time loss may not be accurate for lower-level teams that do not have frequent training sessions. This could result in injuries healing between sessions and being underreported in the results. Furthermore, it is also possible that players return to full participation with remaining symptoms of the injury that may limit full playing ability (Ekstrand et al., 2021). A time-loss definition of injury is also ineffective for monitoring overuse injuries as this type of injury has been shown to result in pain and reduced playing ability, potentially impacting team performance (the characteristics of injury) before leading to time-loss (Bahr, 2009). Overuse injuries also do not have a clear date of onset, making the true 'layoff' period more difficult to calculate (Bahr, 2009).

There is a reduced likelihood of overlooking injuries if the medical attention definition of injury is used. However, this approach may lead to over-reporting of injuries, which could inflate the severity of the injury problem. Minor injuries that do not affect player performance or availability, and thus do not impact team finances and performance, might still be included in injury statistics. Injury rates are expected to be higher in settings with more access to medical personnel when using this definition (Arnason et al., 2004). Players may also withhold injury information from medical staff to be available for selection (Waldén, Hägglund & Ekstrand, 2005).

Another definition used in football literature is the tissue damage definition of injury which relies on a clinical or radiological assessment by medical practitioners to determine whether a player is injured or not, based on tissue pathology and stage of healing. A study by Waldén et al. (2005) found no significant differences in the number or risk of injury between the time-loss and tissue injury definition at the elite level. This is likely due to most tissue injuries also causing time-loss. However, this definition of injury would not be suitable for low-resource settings where access to imaging or medical services is limited.

When conducting injury research in Africa, using the tissue damage and medical attendance definitions may not be the best choice due to limited access to radiological imaging and medical services. Instead, defining injury based on a time-loss definition would be more suitable for studying injury burden at a high-level in this low-resource environment.

Table 1. Strengths and weaknesses of various injury definitions in football research (Junge & Dvorak, 2000; Arnason et al., 2004; Waldén, Hägglund & Ekstrand, 2005; Fuller et al., 2006; Bahr, 2009).

Injury recording definition	Strengths	Weaknesses
Time-loss *Any injury that occurred during a scheduled training or match session that causes absence from the next training or match.* (Waldén, Hägglund & Ekstrand, 2005)	- Training and match sessions missed should be recorded because of the impact on individual and team performance. - Severity of injury problem can be established (days missed not just number of injuries) - Recommended for use in UEFA studies, as it will allow for comparison between similar research studies. - Cheaper and more accessible in low resource settings than the tissue injury definition with similar results regarding number and risk for injury. - Suitable for high-level teams who have a high frequency of training, near daily sessions (not likely to miss minor injuries between session).	- May miss less serious injuries at amateur level as training and match frequency specific. - Players could still complete training or matches while injured at poor performance levels – this could introduce inaccuracy with injury reporting. - Medical treatment availability and importance of the player/match has been shown to affect participation. - Sport and position specific. A broken finger might not cause time-loss for an outfield player while a goalkeeper may miss considerable training and match time.

Table 1. Strengths and weaknesses of various injury definitions in football research (cont.) (Junge & Dvorak, 2000; Arnason et al., 2004; Waldén, Hägglund & Ekstrand, 2005; Fuller et al., 2006; Bahr, 2009).

Injury recording definition	Strengths	Weaknesses
Medical Attention *An injury is recorded based on the utilisation of medical services*	- Less expensive than the tissue injury definition which requires clinical evaluation and imaging. - Definition most likely to capture overuse injuries compared to tissue damage or time-loss definitions.	- The least suitable for lower-level teams as this relies on medical attendants to be present. - Teams with bigger medical teams would show higher risk of injury – as more injuries likely to be reported due to access. - May result in the overreporting of injury as minor injuries that would not fit the other two categories could be reported to medical staff (bruises, scrapes).
Tissue injury *Injury is based on clinical evaluation and medical imaging.* *E.g., Magnetic Resonance Imaging (MRI), X-ray, Diagnostic Ultrasound Scan (US)*	- Potentially the most objective definition in determining if an injury has occurred but depends on prompt and accurate medical diagnosis (MRI, US etc.) is performed.	- Dependant on medical team making correct diagnosis. - Clinical examinations must be performed close to the time of injury as minor tissue damage may heal quickly and be missed. - MRI and US costly and not always practical particularly in low resource settings. - Subjective reports of discomfort may not always have objective signs of injury such as in the case of the beginning of an overuse injury.

2.3.2 injury Classification

According to accepted football research methodology, injuries should be classified by anatomical location (body region), the structure involved (muscle vs joint vs bone etc.) and their severity (based on time-loss from full football participation) (Fuller et al., 2006).

2.3.2.1 Anatomical Location of Injury

It is recommended that the body be divided into four main categories for injury recording: head and neck, upper limbs, trunk, and lower limbs each with relevant regional sub-divisions (groin, thigh, ankle etc.) (Fuller et al., 2006). This allows epidemiological studies to identify which regions of the body are most affected by injury during football participation and indicate where injury risk reduction is required (Pulici et al., 2023).

Football injuries occur mainly to the lower body (Ekstrand, Hägglund & Waldén, 2011a). This is likely due to the nature of the sport (repeated high-intensity running, direction changes at speed and contact between players) (Barnes et al., 2014). According to a recent meta-analysis on injury in elite male footballers, injuries to the lower body have an incidence rate of 6.8 injuries per 1000 football exposure hours. This means that lower body injuries account for approximately 75% of all football injuries (López-Valenciano et al., 2020). To further illustrate this point, an ECIS follow-up article by Ekstrand et al. (2020) showed that 78% of time-loss injuries could be attributed to the 31 most common time-loss injury diagnoses (Ekstrand et al., 2020). Twenty-nine of the 31 most common diagnoses (93%) involved injuries to the lower limb, highlighting the need for targeted lower limb injury prevention interventions (Ekstrand et al., 2020).

The thigh is the most affected anatomical structure, with hamstring, quadriceps, and groin complex muscle injuries being the most prevalent (Ekstrand, 2007). The available South African research supports these findings regarding muscle injury but shows a higher ankle injury incidence than reported internationally (Calligeris, Burgess & Lambert, 2015). A possible reason for this is the nature and type of the game in South Africa which is characterised by less high-speed running activities and more direction changes (Calligeris, Burgess & Lambert, 2015).

Knee injuries represent considerable time loss and medical cost burden. In one previous South African study the knee was the most common injured structure associated with time-loss (Bayne, Schwellnus, Van Rensburg, et al., 2018). In this study, knee injuries were responsible for 42% of all time-loss injuries, and about 75% of player loss days were associated with knee injuries. This raises questions regarding where injury risk reduction strategies should be targeted. To determine where targeted injury risk reduction interventions are of most value to teams, an understanding of the benefits of mitigating the most common injuries, such as those affecting the thigh and ankle, versus injuries that impose the highest overall burden to teams in terms of both cost and time-loss to players and clubs must be established.

2.3.2.2 Injured Structure

Football injuries can further be classified by the type of structure injured. In football, the most injured structures include muscle (strains), ligament (sprains), skin (bruises and lacerations), bone (fractures) or brain (concussion). More than half (57%) of all injuries affect muscles or ligaments (Ekstrand et al., 2021). Most football injuries are muscle strains and European players can expect 0.6 muscle injuries per season (Ekstrand, Hägglund & Waldén, 2011b) . For a team with a squad of 30 players, this equates to 18 muscle injuries, potentially resulting in a considerable time-loss burden. The muscles most affected by injury include the hamstrings, groin complex and quadriceps muscles (López-Valenciano et al., 2020).

One South African study showed conflicting results and reported more frequent joint injuries than muscle injuries (Calligeris, Burgess & Lambert, 2015). This was attributed to the nature of the game in South Africa and decreased frequency of games. Short turnaround between games is believed to be a risk factor for muscle injuries (Bengtsson, Ekstrand & Hägglund, 2013). However, a study by Swart et al. (2020) that focused on non-contact injuries in the South African PSL showed results comparable to non-contact injuries from research on European players. The study reported that the muscle/tendon was the most injured structure, responsible for 85% of all non-contact injuries, with the hamstring (48%), groin complex (23%) and quadriceps (12%) the most affected muscles (Swart, Varekamp & Greyling, 2022).

It is worth noting that non-contact injuries account for less than 9-35% of all injuries (Swart, Varekamp & Greyling, 2022). This raises questions about the mechanisms behind the other injuries sustained and possible reasons for the differences in body structures that are injured between South African and European results. Further research is necessary to explore this topic. The injured structure is associated with the expected amount of time-loss due to injury (Ekstrand et al., 2020) and may give an indication regarding the time-loss burden and financial impact that a particular injury may have on teams. For example, knee anterior cruciate ligament injuries are responsible for considerable time off football and have high medical costs when compared to general muscle injuries. This information should help guide injury risk reduction programs to be the most effective at reducing injury burden to teams (Bayne, Schwellnus, Van Rensburg, et al., 2018; Ekstrand et al., 2020).

2.3.2.3 Severity of Injury

In studies considering the burden of injuries, the severity of injury is arguably the most important injury classification. The severity of the injury has been described in the literature both in terms of cost of injury (financial) and time loss (van Mechelen, Hlobil & Kemper, 1992). While no set categories for the cost of injury are described, a more severe injury will generally result in higher financial burden to teams. The period of time-loss is from the date of presentation (first day of inability to complete team training) until full return to play in all football activities and cleared by the club medical staff (Fuller et al., 2006).

Injuries can be classified as either *minimal* (1-3 days), *mild* (4-7 days), *moderate* (8-28 days) or *severe* (>28 days) based on the amount of time-loss caused as a result (Fuller et al., 2006). A *severe* injury will result in longer time-loss and a higher financial burden to clubs regarding medical costs and lost player wages. The most prevalent injuries do not necessarily result in the highest financial costs or most days lost to clubs during the season . Most injuries are *mild* (42%) or *moderate* (56%), with only 2% classified as *severe*. While relatively infrequent (between 2-16% of all injuries), *severe* injuries have the potential to impact player availability and represent a considerable burden for teams (Ekstrand, Hägglund & Waldén, 2011a). It is, therefore, important to consider injury frequency and burden (time-loss) to determine the impact of various injuries on teams (Bahr, Clarsen & Ekstrand, 2018).

In South Africa, research has pointed to a higher proportion of severe injuries when compared with other geographical locations (Calligeris, Burgess & Lambert, 2015; Bayne, Schwellnus, Van Rensburg, et al., 2018). The proportion of time-loss caused by severe injuries (taking more than 28 days to recover) is reported to be 30-56% of all time-loss injuries and is a larger proportion than reported elsewhere. This could indicate problems regarding the rehabilitation practices of clubs in South Africa or decreased access to medical services (Calligeris, Burgess & Lambert, 2015). Future research is required to determine whether factors unique to the South African environment are responsible for longer time-loss compared to other leagues globally.

Considering that throughout a season, severe injuries have the potential to result in more time-loss to the team than any of the other severity categories, reducing the number of severe injuries should then be the priority of club medical departments to limit the financial and performance cost to teams. Injury risk reduction programs should then aim to reduce the incidence of severe injury diagnosis, particularly of the knee and associated ligaments. It is worth noting that five of the injuries with the longest time-loss are knee injuries (Ekstrand et al., 2020),which should prompt future research into the reduction and cost-benefit of preventing these injuries.

2.4 Football Injury Risk

The intense physical demands of training, competition, and contact between players place footballers at a high risk of injury (Hägglund et al., 2005). High-level European teams, with a squad of 25 players, can expect about 50 time-loss injuries per season. This translates to about 12% of the squad being unavailable due to injury during the season (Ekstrand, Hägglund & Waldén, 2011a). This is associated with a high financial burden to the team. To reduce injury risk and prepare for competition, teams have traditionally implemented high training loads, but sharp increases in training loads have been linked to an increased risk of overuse injury (Bahr, 2009; Junior et al., 2015; Gabbett, 2016). Inadequate training loads, on the other hand, may also increase the risk of injury and restrict optimal performance (Ehrmann et al., 2016). This review will focus primarily on injury to the professional male footballer. The author acknowledges that injury rates differ between high-level male footballers and subgroups such as women's and youth football and amateur and semi-pro players (Vasileiadis, 2021). It is beyond the scope of the review to cover each subgroup in detail.

2.4.1 Injury Nomenclature

Injury incidence (injury risk) is reported as the number of injuries sustained per 1000 hours of football exposure (Fuller et al., 2006). The population at risk and population exposure time must be used in calculations, as the number of injuries alone does not measure the burden of injury (Junior et al., 2015; Bahr, Clarsen and Ekstrand, 2018). Differences in population size, match, and training exposure may lead to differing results regarding the injury risk of footballers under investigation (Ekstrand et al. 2011; Bayne, Schwellnus, Van Rensburg, et al., 2018). Therefore, it is important to standardise the expression of incidence using players' exposure as the denominator. The injury rate can be separated into the number of injuries sustained during training or match exposure (each expressed as the number of injuries that occur during either training or matches per 1000 hours of relative exposure). Increased football match exposure has resulted in a higher likelihood of developing an injury when compared to training (Pfirrmann et al., 2016). The formulas for calculating injury incidence (overall, match and training) as per are presented below (López-Valenciano et al., 2020a)

Overall injury incidence = (total number of injuries x 1000)/ total exposure h
Match injury incidence = (total number of match injuries x 1000)/total match exposure h
Training injury incidence = (total number of training injuries x 1000)/total training exposure h

2.4.3 Injury Risk in Professional Male Footballers

Injury risk has been reported to be 7-10x higher in matches than in training, owing mainly to the increased physical demands of competition compared to training (Ekstrand et al., 2021). This has raised questions regarding the optimal training load for players during training and whether they should be training harder to replicate game demands to reduce the number of injuries suffered during games (Gabbett, 2016). The type of injury can also be expected to differ with more acute and traumatic injuries in matches than the overuse injuries that occur during training (López-Valenciano et al., 2020).

A recent meta-analysis of football injury epidemiology in elite male footballers reviewed 44 eligible studies and showed an overall injury incidence of 8.1 injuries / 1000 total exposure hours across 29 991 total injuries (López-Valenciano et al., 2020). The incidence rate of match injuries was 36 injuries/1000 match exposure hours, while the incidence rate of training injuries was 3.7 injuries/ 1000 training hours. This shows the injury rate in matches is about 10 times higher than in training (López-Valenciano et al., 2020a).

2.4.4 Injury Risk in Professional Male Footballers in South Africa

The limited data from South African studies have shown a large variation in overall injury rates at the professional level. The three published papers that reported on injury rate show the overall seasonal injury rate to be between 1.6-13.4 injuries / 1000 total exposure hours (Calligeris, Burgess & Lambert, 2015; Bayne, Schwellnus, Van Rensburg, et al., 2018; Swart, Varekamp & Greyling, 2022). The large difference in findings is most likely due to differences in study methodology, particularly the injury definition used (the 2015 study by Calligeris et al., which had the highest reported injury rate, used a medical attention injury definition while the other two studies used a time-loss definition of injury).

All three South African studies have shown muscle injuries to be the most frequent type and a higher injury risk during matches compared to training (Calligeris, Burgess & Lambert, 2015; Bayne, Schwellnus, Van Rensburg, et al., 2018; Swart, Varekamp & Greyling, 2022). The differing results suggested by this local research indicates the need for more South African football research to be based on a consistent methodology. Results from multi-seasonal and multi-team studies would provide more accurate findings as this would remove outliers (such as seasons with unusually high/low injury rates). Also, if certain teams have consistently higher injury rates over multiple seasons, a detailed analysis could provide possible reasons. Fixture congestion and shorter turnaround time between games is associated with increased muscle injury rates (Bengtsson, Ekstrand & Hägglund, 2013). Data also indicates that injury rate and burden remain relatively similar within the same teams and leagues across different seasons (Ekstrand et al., 2011). However, geographical and league differences in these parameters have been found, and results and conclusions from previous international research cannot be directly applied to South African football (Eirale et al., 2017). Therefore, an important need exists for local football research that draws upon internationally accepted research methodology.

Table 2 shows a summary of papers reviewed regarding exposure, study population, number of time-loss injuries and injury incidence (match and training). As mentioned previously two of the three previous studies conducted in professional South African football show a large variation with one being considerably higher and one considerably lower than European standard injury rates (Calligeris, Burgess & Lambert, 2015; Bayne, Schwellnus, Van Rensburg, et al., 2018; Swart, Varekamp & Greyling, 2022) .

It may be true that epidemiological studies are a prerequisite for describing a sports injury profile, however, it can be argued that this has already been established with the ongoing FIFA and UEFA injury surveillance databases. With the addition of similar injury surveillance projects based on sound methodology initiated across all 6 of the confederations of FIFA, researchers could focus more on innovation regarding injury risk reduction programs and their efficacy, such as cost-benefit ratios in different football settings - instead of re-reporting what has already been established.

Table 2. Summary of papers reviewed regarding exposure, study population, number of time-loss injuries and injury incidence (match and training).

	Calligeris et.al (2015)	Bayne et.al (2018)	Swart et.al (2022)	Ekstrand et. al (2021)	Lopez-Valenciano et al. (2020)	Stubbe et al. (2015)	Sprouse et al, (2020)
Study population	Male Professional Premier Soccer League footballers in South Africa	Male Professional Premier Soccer League footballers in South Africa	Male Professional Premier Soccer League footballers in South Africa	Male Professional football players in Europe	Systematic review, Male Professional football players globally	Male Professional football players in the Netherlands	Men's international football (English Football Association
Sample size	32	56	34	Not reported	Not reported	217	2743
Exposure hours (match exposure in brackets)	18 162 (1834)	20 361 (1089)	Not reported	1 780 000	Not reported	46 194	25 564 (4000)
Number of injuries reported*	130	33	52	11 820	29 991	286	216 (186)
Injury incidence**	13.4	1.6	3.7	6.6	8.1	6.2	8.44
Match injury incidence**	88.9	16.5	24.8	23.8	36	32.8	31.8
Training injury incidence**	6.6	0.8	1.96	3.4	3.7	2.8	3.8

** Study used a medical attendance definition of injury*
***Injuries per 1000 hours of relative exposure*

2.5 Burden of Injury in Football

Burden is the collective measure of the overall impact of a health problem within a specific population (Bahr et al., 2020). Burden allows different health problems to be compared and is often expressed as financial cost, mortality, or morbidity in public health (Bahr et al., 2020). Regarding the burden of sports injury, previous research has reported injury burden as the number of days of time loss per 1000 hours of player exposure (Bahr et al., 2020). This differs from incidence (discussed earlier) and measures the consequences of the injuries sustained. Burden provides a clearer indicator of the injury problem to teams than injury incidence alone (Bahr, Clarsen & Ekstrand, 2018). Injuries impact football teams negatively regarding financial loss and performance cost due to player unavailability (Hägglund et al., 2013; Eliakim et al., 2020).

Sports injuries also result in a considerable financial burden to teams and individuals due to the substantial direct and indirect costs associated (Misra, 2014). In professional sports, there is potential for great financial loss to the team when highly paid players are injured. It has been reported that each season, professional sports teams spend millions of dollars in wages for players side-lined with injuries. These injuries also negatively impact team performance (Eliakim et al., 2020). The high financial stakes demonstrate the need for evidence-based, effective injury prevention and return-to-play protocols (Korkmaz et al., 2014). By determining the injuries that cause the most financial burden, teams can better allocate resources and determine the cost-effectiveness of injury prevention programs implemented (Öztürk & Kiliç, 2013).

A limited number of small cohort studies on the costs associated with injury have been conducted in other sports and at amateur football levels. These studies show significant financial costs associated with injury in youth rugby (Brown et al., 2015; Ross et al., 2022). These results were supported by a recent systematic review regarding the cost of injury in high-level European male footballers, which showed the serious financial consequences of injury to professional club economies (Pulici et al., 2023). No cost of injury studies exists in South Africa for high-level professional male footballers. The following section will demonstrate the important link between injuries, team financial success and team performance and outline the methods suggested in the literature for quantifying the financial and performance costs of injuries.

2.5.1 Economic Dimension of Injury in Football

2.5.1.1 Direct Financial Burden of Football Injury

Financial cost is an outcome measure that allows comparison between different injury types and has been described as one of the six injury severity indicators of injury since 1980 (van Mechelen, Hlobil & Kemper, 1992; Polinder et al., 2016). The other five severity indicators include the (1) nature of the injury, (2) duration of injury, (3) sporting time lost, (4) working time lost, and (5) permanent damage caused due to injury (van Mechelen, Hlobil & Kemper, 1992). A more severe injury will generally result in a higher financial cost (Gebert et al., 2020). It follows that costs of injury are an important descriptor of injury burden and provide information to drive and evaluate the effectiveness of injury prevention methods. It has been suggested that injury prevention efforts should consider injuries with high costs associated. However, studies have generally not reported the specific details of these costs and have instead focused on the length of recovery time and player absence (Knowles et al., 2007; Brown et al., 2015; Gebert et al., 2020).

A 2012 report on the burden of sporting injury in the European Union found that soccer injuries accounted for 70% of the total sports-related injury costs on the continent (Kisser & Bauer, 2012). These findings were supported in a 2020 study that examined costs resulting from non-professional soccer injuries in Switzerland (Gebert et al., 2020). This study showed that soccer injuries accounted for 64% of all ball game injuries in the country and represent a high economic burden to society of approximately € 153 million (R2,6 billion). Despite the magnitude of the financial burden associated with football injuries, few studies describe the financial cost of injuries at the professional level.

Professional football is big business, and the greatest burden of injury is arguably financial. Injuries negatively impact team finances via costs of medical services (treatment cost), wages paid to unavailable players (lost wages) and potential team underperformance (performance cost) due to injury (Eliakim et al., 2020). For professional teams, describing the injury burden without the associated monetary costs paints an incomplete picture, leading to the financial burden of injury being underestimated (Öztürk & Kiliç, 2013). Sports injury costs as a measure of injury burden must be reported to advocate investment into improved injury prevention strategies.

A team's total financial injury burden can be calculated by adding the direct and indirect costs of injury for the season. Direct medical costs can be defined as costs related to healthcare use, while indirect costs comprise wages paid to unavailable players and team underperformance. Direct medical costs are easier to quantify and are a more straightforward representation of a team's financial injury burden as it does not consider player wages or team underperformance cost estimations (Junior et al., 2015).

In 2000 Jiri Dvorak calculated that the average cost of medical treatment for a football injury was about 150 US dollars (R 2 443) (Dvorak & Junge, 2000). By correcting for inflation using the US inflation calculator (www.usinflationcalculator.com), the average injury cost would be $ 255 (R 4 154) on 1 July 2022. Similar results were reported in a 1981 study regarding the cost of high school soccer injuries, which determined that, on average, insurance claims due to soccer injury totalled 127 dollars (R 2 069) (Pritchett,1981). Correcting for inflation (www.usinflationcalculator.com), the average injury cost would be $ 409 (R 6 663) on 1 July 2022. In this study, minor injuries accounted for 75% of the 436 injuries but they only contributed to 49% of the total medical cost. This is in comparison to knee injuries which represented 12% of all injuries but were responsible for 28% of medical costs paid. This illustrates that the most prevalent injuries do not necessarily result in the highest financial cost to organisations and that knee injuries represent a major financial risk.

It is worth noting that these results are over 20 and 40 years old, respectively, and it can be assumed that medical costs of injury have increased exponentially since these initial reports. Furthermore, it is interesting to consider that Dvorak's study population was high-level footballers, and after correcting for inflation, his study found a lower cost per injury than Pritchett found in high school athletes (Dvorak, 2015). This is likely to have changed in the modern game, with top clubs willing to pay large amounts of money to have their athletes receive the latest and most comprehensive medical care.

There are very few studies available on the direct injury cost to professional teams, as most of them are focused on the sub-elite level (Gebert et al., 2020; Ross et al., 2022). Medical costs and level of care are also likely dependent on access and geographical location. It is clear, however, that the highest direct medical costs have been attributed to lower limb fractures and knee injuries (Polinder et al., 2016).Teams have the potential to reduce costs by preventing these injuries. Injuries can result in considerable monetary costs and pose a significant burden to team financial operations. It is important to note that medical treatment costs are not the only way injuries impact teams financially. Indirect injury costs also represent a substantial financial risk to teams (Eliakim et al., 2020).

2.5.1.2 Indirect Financial Burden of Football Injury

Indirect costs associated with injury include wages paid to unavailable players and estimated team underperformance. Lost player wages are easy to determine and are calculated by multiplying the players' daily wage and days lost to injury to give a total monetary cost. There is a correlation between the financial power of clubs and the total amount spent on injured players, with greater potential financial loss due to injury for teams with larger player wages (Howden Insurance Brokers Ltd, 2022).

This means that teams with similar injury time-loss burdens may have considerably different financial injury burdens based on their respective player wage bills. One example is the Howden injury report which revealed that Paris Saint-Germain, a French team, had fewer injuries compared to other teams. However, their lost wages were considerably higher due to the higher individual player wages. This resulted in a greater amount of wages lost due to injury (Howden Insurance Brokers Ltd, 2022). When it comes to sports teams, if a high-earning player gets injured, the financial burden of their injury is likely to be higher compared to if a lower-earning player was injured (Ekstrand et al., 2011).

Hickey et.al. (2014) studied the financial cost of hamstring injuries to clubs in the Australian Football League (not to be confused with European football/soccer) and nullified this confounder by using an average squad weekly wage method. The average weekly wage was analysed with total team days lost to injury to estimate the lost player wages for the season. The authors of the paper acknowledge that the financial cost of injury may be underestimated by using this method. Older more experienced players are likely to be paid more and are at a higher risk of injury. It follows that time loss of these players will thus result in a greater financial impact to teams (Hickey et al., 2014). While there is potential for inaccuracy by using this strategy it provides a clearer overall picture of the injury burden within the squad and protects the players as individual player salaries are not required. The results of the research indicate that hamstring injuries result in lost player wages equal to one player's average salary for the season (Hickey et al., 2014). When one considers that this is due to hamstring injuries alone, it illustrates the severe potential financial burden of injuries to professional clubs.

Using the previous injury epidemiology studies conducted in the South African PSL in 2015 and 2018 respectively, local teams can expect time loss of between 1 040 – 1 224 days per season (Calligeris, Burgess & Lambert, 2015; Bayne, Schwellnus, Van Rensburg, et al., 2018). Analysing these data with an average player's daily wage amount illustrates the potential for considerable financial impact of lost player wages on teams, even before the direct medical and performance costs are added.

The performance cost of injury is more difficult to quantify. In professional football, injury and performance are closely linked, and injuries have the potential to influence team performance negatively (Hägglund et al., 2013). Previous research has reported contradicting results on the impact of player injuries on team performance (Eirale et al., 2013; Lu et al., 2021) however, Carling et al., (2015) found that a team's championship-winning season was associated with lower injury burden and higher player availability (Carling et al., 2015). Injuries are associated with a decrease in team performance defined by the number of league points obtained, final team ranking, goal differences, and match losses. The decrease in performance may result in a considerable financial impact on teams (Eliakim et al., 2020). The on-field success of teams impacts the financial performance of their clubs (Alaminos, Esteban & Fernandez-Gamez, 2020). A positive team balance sheet allows clubs to purchase better players while keeping performing players (Matesanz et al., 2018). By extrapolation, the link of how injuries ultimately lead to decreased team financial success and potential decreased team performance in following seasons is demonstrated below in Figure 3.

$$injuries \ = \downarrow team\ performance$$

$$\downarrow$$

$$\downarrow team\ performance \ = \downarrow team\ financial\ success$$

$$\downarrow$$

$$\therefore \boldsymbol{injuries} \ = \downarrow \boldsymbol{team\ financial\ success}$$

$$\downarrow$$

$$\downarrow team\ financial\ success \ = \downarrow team\ performance\ (following\ seasons)$$

Figure 3. Demonstration of how injuries effect team performance and team financial success. This in turn leads to football teams being unable to attract and keep the best players resulting in decreased team performance in following seasons.

A multi-season study evaluating team underperformance in the English Premier League (EPL), showed that injuries result in a worse than predicted end of league table ranking (Eliakim et. al 2020). The study results indicate that for every 136 days lost to injury during the season, teams lose 1 final league table point, and every 271 days lost resulted in losing one league position ranking. In this study, the financial deficit for the loss of one final league ranking was estimated at £6.9 million (R136 million) (Eliakim et. al 2020). However, the variation in EPL end-of-season ranking was reported to be only 21% due to player availability and highlights the multifactorial nature of team performance. This was confirmed in a study on Australian soccer players, which concluded that although injuries are associated with team performance parameters, these associations are small (Lu et al., 2021).

Some methodological issues are apparent in the study by Eliakim et al. (2020). For example, the validity of the equations used during statistical analysis was questionable, and there were concerns relating to the quality and accuracy of the data. Regardless of these limitations, this study illustrates the significant potential monetary burden of injury and its impact on team performance. The study estimated that injuries cost each team £45 million (R 2,8 billion) in indirect injury costs for the season. This amount comprised £9 million (R 182 million) for lost wages paid to unavailable players, while the balance was expected financial losses due to team underperformance. This is a remarkable amount considering that the calculation did not include direct medical costs of the 1 151 individual injuries. It is worth noting that while the EPL is the richest league in the world and that indirect costs of injury are expected to be considerably less in smaller leagues, injuries still have the potential to result in heavy financial losses to teams (Eliakim et al., 2020).

Comparatively, in South Africa, all teams in the PSL had a chance of winning R 36 million during the 2021/2022 football season in all league and cup competitions. End-of-season league performance money, often referred to as ‘merit money’ is the monetary amount paid to teams based on their final league ranking. The reported prizemoney for the 2021/2022 for teams in the DSTV Premiership is presented in Table 3 and shows the potential financial implications of team underperformance and worse league ranking due to injury (News24, 2020).

Table 3. Prize money teams stand to earn based on end of season final league table ranking (News24, 2020).

League Position	Prize Money (ZAR)	Prize Money (USD)
1st	R 15 000 000	$ 915 000
2nd	R 7 500 000	$ 457 500
3rd	R 3 750 000	$ 228 750
4th	R 2 500 000	$ 152 500
5th	R 1 800 000	$ 109 800
6th	R 1 560 000	$ 95 160
7th	R 1 320 000	$ 80 520
8th	R 1 200 000	$ 73 200
9th	R 885 000	$ 53 985
10th	R 825 000	$ 50 325
11th	R 750 000	$ 45 750
12th	R 690 000	$ 42 090
13th	R 620 000	$ 37 820
14th	R 565 000	$ 34 465
15th	R 495 000	$ 30 195
16th	R 440 000	$ 26 840

The exact performance cost of injury to teams (in monetary terms) is nearly impossible to calculate and requires multi-season, league-wide, injury and team performance data. Even with accurate data, questions arise regarding the validity of the data modelling and statistical analysis processes used to arrive at this team underperformance value. Team underperformance is also multi-factorial and is not based on player unavailability alone (Eliakim et al., 2020; Lu et al., 2021). Furthermore, many factors need to be considered (Williams et al., 2015) such as:

(i) importance of side-lined player contribution and impact on team performance over the season
(ii) the monetary cost of relegation and promotion to teams
(iii) the potential financial benefits of qualification for competitions based on league ranking.

(iv) losses in individual player transfer fees due to individual and team underperformance
(v) the potential team performance cost in future seasons resulting from a decreased ability to attract and purchase better players.
(vi) losses in merit money associated with a lower end-of-season league ranking.

In summary, injury results in considerable financial costs for clubs as businesses due to the associated direct and indirect monetary costs. It follows that there should be a focus on reducing the occurrence of injuries. Player unavailability while injured is associated with team underperformance. The magnitude of this effect depends on the player and the role the player has in the team. By reducing injury and improving player availability, teams can improve on-field results and maximise potential success for the season (Eirale et al., 2013; Hägglund et al., 2013; Ekstrand et al., 2018; Eliakim et al., 2020; Lu et al., 2021).

It is important to note that while this review is focused only on the immediate effects of injuries and their implications for teams in terms of financial loss and performance cost, the burden of injury has potentially long-term and far-reaching effects for the individual players concerned. Injuries have been shown to negatively impact individual players physically and mentally and may be associated with shortened playing careers, depression and future pain and disability due to medical problems such as osteoarthritis (Arundale, Silvers-Granelli & Snyder-Mackler, 2018; Paget et al., 2020; Carmody et al., 2022).

2.6 Injury Prevention

Injury prevention is a widely studied topic in sports medicine because it can reduce injury rates across different sports and settings (Grygorowicz, Wiernicka & Wiernicka, 2021). In professional sports, injury prevention aims to reduce associated medical costs and improve player availability which has a positive association with both the club financial balance sheet and team performance (Ekstrand, 2019). To be most effective at the team level, injury risk reduction should focus on the injuries causing the highest total burden (time-loss and financial) over the season and not necessarily the most prevalent injuries. Prevention should be prioritized, and it is even more important in low-resource settings where access to treatment may be limited (Dvorak & Junge, 2015).

2.6.1 Factors Influencing Injury Risk

Injuries occur because of complex interactions between various factors. To reduce the risk of injury, it is important to identify and address factors that may contribute to the likelihood of injury. Modifiable injury risk factors shown to affect injury rate include the coach's leadership style, quality of internal communication, player training load, and proper rehabilitation of previous injuries (Arnason et al., 2004; Ayala et al., 2019; Owoeye, VanderWey & Pike, 2020; Ekstrand et al., 2021). Rehabilitation of a previous injury is important in the prevention of future injuries. Prevention of re-injury is important as re-injury is often associated with longer time loss and therefore increased medical costs (Ekstrand et al., 2020). This illustrates the importance of sound rehabilitation and access to medical care.

A recent systematic review identified the five most effective injury prevention methods in football as being FIFA 11+, foam rolling techniques, strength training for injury prevention, pre-activation routines and core training (Owoeye, VanderWey & Pike, 2020). This has been supported by other studies (Vasileiadis, 2021). Despite the implementation of various prevention methods, the injury rate at the professional level remains high. The literature reports only a slight reduction in injury risk after an intervention (Ekstrand et al., 2021). This has led to the suggestion that focusing solely on preventative strategies targeting player-related injury risk factors may not be sufficient to effectively lower the risk of injuries at the elite level. Poor adherence to these programs (particularly from players) in the elite football environment has been identified as a potential reason for the decreased effectiveness of these interventions at reducing injuries (Eirale et al., 2013; Hägglund et al., 2013; McCall, Dupont & Ekstrand, 2016).

2.6.2 Financial Dimension of Injury Prevention Programs

To align with the study's aims and objectives the literature review will focus on the financial aspect of injury risk reduction programs. The review will specifically analyse the cost effectiveness of these programs, rather than examining their overall impact on reducing the risk injury. The details regarding these effects are presented elsewhere (Sadigursky et al., 2017; Åman et al., 2018; Owoeye, VanderWey & Pike, 2020).

Financial cost-benefit ratios of injury reduction strategies should rank highly when determining the effectiveness of injury risk reduction programs. However, this information is sparse, especially at the elite-level (Grygorowicz, Wiernicka & Wiernicka, 2021). Other viable methods have been described in the literature specifically for the sports setting such as cost-benefit of time investment of athletes and derived benefits of prevention programs (Fuller, 2019). These methods have merit and will impact adherence to programs within the professional sports setting. However, this was considered outside the scope of this review.

Considering the financial aspect of injury prevention programs, one randomised control trial study evaluating the cost-effectiveness of the FIFA 11 program on injury-related costs in Dutch adult male amateur footballers found that implementation of the program resulted in reduced overall costs associated with injury (Krist et al., 2013). Interestingly, the proportion of injured players, injury rate and direct medical costs did not differ between the control and experimental groups in the study. The reduced overall medical costs in the intervention group were because of lower indirect medical costs suggested due to differences in injury location. There were fewer knee injuries in the intervention group. These injuries are associated with high direct and indirect medical costs. While there were no significant differences in the injury rate or proportion of injured players, evidence suggests cost-savings associated with injury in the study population with implementing the FIFA 11 program (Krist et al., 2013). It was reported by the New Zealand Accident Corporation Company that implementing the 'FIFA 11+' can also reduce medical costs and that each dollar (R 16.29) invested in the program would result in an $ 8 (R 130) saving in medical costs (Dvorak & Junge, 2015). Implementation of the 'FIFA 11+' therefore is suggested to result in an 8-fold return on investment.

Another study in 2016 by Marshal et al., concerning injuries at the youth level showed that savings of $ 499 (R 8 129) per 1000 player exposure hours could be achieved due to fewer injuries and suggested that neuromuscular training may be less costly and more effective than a standard warm-up (Marshall et al., 2016). The problem with the limited research on the financial cost-effectiveness of injury prevention programs is the need for standardisation of outcome measures. This was highlighted in a recent systematic review which showed that the eligible RCT studies included in the review used different units as outcome measures (Grygorowicz, Wiernicka & Wiernicka, 2021). Some studies used cost savings per 1000 player training hours (Marshall et al., 2016), while others used the difference in cost of the number of injuries per player between the groups (Krist et al., 2013). The differences in outcome measures used are likely to affect inter-study comparisons.

The financial burden of injuries to the team could be used to garner support from board-members and stakeholders for injury prevention programs. By illustrating the negative economic effects of injuries and the financial benefits of prevention, clubs may be more willing to back the proposed injury prevention programs (Ekstrand, 2013). Future research aims should shift from randomised control trials to determine the efficacy of these programs (this has been sufficiently demonstrated) to a financial cost-benefit focus. Future research and establishing standardised financial cost-effectiveness outcome measures are urgently required for inter-study comparisons to be drawn.

2.7 Summary and Critique of Current Literature

Modern professional football has become more lucrative, with more money at stake for teams and players. This has resulted in the players being exposed to greater physical demands than in the past (Barnes et al., 2014; Matesanz et al., 2018; Eliakim et al., 2020). To date, the research focus has been primarily on the consequences of the increased demands, such as the risk of injury, prevention of injuries and recovery after an injury. This is surprising, particularly since injury imposes a large financial burden on the team (Walia & Boudreaux, 2020). There needs to be more focus on the impact of the increased financial turnover associated with the game. While the injury studies have answered many questions on player management and well-being, contemporary research is needed to answer questions associated with the modern game.

Time loss due to injury is a liability to club and player. Any injury causing time-loss can result in financial loss, player unavailability, decreased team performance and a strain on club medical resources (Eliakim et al., 2020). Previous research in South Africa shows that high-level teams can expect over 1000 squad days lost over the season with high direct and indirect costs of injury associated (Calligeris, Burgess & Lambert, 2015; Bayne, Schwellnus, Van Rensburg, et al., 2018). The significant financial and performance costs associated with injuries should motivate football clubs to implement injury risk reduction programs and invest in a robust medical structure (Ekstrand, 2013). Several injury risk reduction methods have been described in the literature with varying effectiveness in reducing injury risk in professional footballers (Vasileiadis, 2021).

Despite introducing injury risk reduction methods, the burden of injury has remained stable, with only slight decreases in overall injury incidence in elite football (Ekstrand et al., 2021). Studies relating to the burden of injuries conducted recently indicate that current methods of injury reduction at the elite level are insufficient to curtail the increasing economic and performance burden of football injuries. The explanation for this is the players' poor adherence to the programme . The poor compliance can be addressed, but it has financial implications. This suggests a missing step in van Mechelen's injury prevention model. This step should determine the cost-effectiveness of the implemented injury prevention programs and their effect on injury rates. There is sufficient evidence that these prevention programs are effective at reducing injury risk (Owoeye, VanderWey & Pike, 2020). However, we need to know if they provide a favourable return on investment from an economic standpoint for them to be implemented at the different levels of football.

Our current knowledge of the financial burden of football injuries and its implications in Africa is negligible. We cannot simply assume that the same burden as described in other geographical regions and football leagues is the same in Africa and South Africa (Eirale et al., 2017). For example, Africa has a higher injury incidence than European and international settings. At face value, this suggests a higher burden of injury in Africa (Hamzat et al., 2004). However, Africa consists of mainly developing countries with unique challenges, such as limited healthcare access and lower financial means than football in Europe (Lubega, 2000).

To reduce the costs of injury in our teams, we first need to establish local injury cost data. This requires research with robust methodology to be conducted in the local setting. Results regarding the risk of injury to the professional footballer in the limited number of South African studies vary considerably due to the small cohorts (single team) and short study periods (all single season studies) when compared with the multi-year and multi-team data from European leagues (Calligeris, Burgess & Lambert, 2015; Bayne, Schwellnus, Van Rensburg, et al., 2018; Swart, Varekamp & Greyling, 2022).

Considering the current context of football injury research and identified shortcomings to date, the present dissertation aimed to investigate the financial burden of injury at a professional football club in South Africa.

Chapter 3: Methodology

3.1 Study Design

The present study followed a retrospective cohort study design to examine injury incidence, athlete exposure, days lost due to injury, and financial cost of injury during the 11-month PSL season of 2021-2022 According to the consensus statements on football injury epidemiological studies (Hägglund et al., 2005; Fuller et al., 2006), a prospective cohort study design would have been preferred to limit recall and misclassification biases. However, we contained these biases by using injury data routinely captured by medical staff. Although the data analysis was done retrospectively, the injury, training and match data entries captured were made daily throughout the season and were not captured retrospectively.

3.2 Participants

Thirty-one professional male footballers contracted to the Cape Town City Football Club's (CTCFC) first team squad for the 2021-2022 season were recruited for the study (N=31). All players were above 18 years of age, proficient in the English language (both reading and writing) and were healthy individuals of sound mind.

3.2.1 Procedure

Permission to analyse the data was obtained from the Human Research Ethics Committee of the University of Cape Town (HREC REF 512/2022; see Appendix A: HREC approval). Institutional approval to conduct the research was obtained from the CTCFC CEO Mr Michel Comitis (Appendix B: Club permission letter). Enrolment of participants took place during a team-scheduled meeting before a club training session on the 15 September 2022 at the CTCFC Training facility. All players who were first-team club contracted players for the previous season (2021-2022) were invited to attend. At the meeting, a prepared PowerPoint presentation explained the purpose of the study, research methodology, data review process, storage, and handling procedures as well as risks and benefits to participants.

The informed consent form (Appendix C: Informed consent form) was distributed for completion at this time. Players no longer at the club or who were unable to attend this meeting were contacted telephonically. The informed consent form was distributed to these three players via WhatsApp using the last recorded contact details on file. To mitigate any undue influence on the enrolment of prospective participants due to the position held by the researcher at the club, team manager Mr. Moenier Davids agreed to distribute and collect the informed consent forms. Mr. Davids was responsible for distributing the informed consent forms to the players that attended the meeting and contacting those players who were unable to attend.

3.2.2 Inclusion Criteria

In the study, we included 31 CTCFC soccer players who had a first-team contract and were registered to play in the 2021-2022 PSL season (from July 5, 2021, to May 21, 2022). If any players were added or removed from the club roster during the season, we only considered their exposure and injury statistics for the time they were registered as a contracted soccer player at the club, in accordance with the consensus statement (Fuller et al., 2006). Players with pre-existing injuries at the start of the study period (5 July 2021) were included, however, the existing injury was excluded from injury statistics, and exposure time for the player was not included until he was fully cleared by club medical staff to participate in all training and match activities (Fuller et al., 2006).

3.2.3 Exclusion Criteria

Players were excluded from the study if they could not be contacted or failed to complete the informed consent form. The study did not include any contracted players who were loaned to other clubs before the start of the 2021-2022 season (5 July 2021). Injuries unrelated to football were not included in the injury portion of the study.

3.2.4 Sample Size

The sample size fluctuated minimally (between 23-27 players) during the study period due to player transfers in and out of the club. This was factored into player and team exposure calculations according to the guidelines of the consensus paper (Fuller et al., 2006). Exposure was only included when a player was a contracted CTCFC player as per the exclusion criteria.

3.3 Measurement Instrument

3.3.1 Study Information and Informed Consent Form

Prospective participants were provided with a face-to-face study information presentation to explain the purpose and format of the study. At this time each prospective participant was given an informed consent form (Appendix C: Informed consent form). Participants were given the form to complete within 14 calendar days and return it to Mr. Davids at the CTCFC training facility to participate in the study. Players no longer at the club were asked to return the form via email or WhatsApp.

3.3.2 Player Baseline Information Form

The standardised FMARC player baseline information form (Fuller et al.,2006; see Appendix D: Player Baseline Information form) was used to collect player baseline values at the start of the 2021-2022 season. This information is regularly collected during pre-season player assessments and fitness testing and can be used mainly to identify study participants and their risk of injury. The form allows for the coding of study participants to protect player confidentiality. The randomly assigned player-specific study number was used to remove any identifying factors at this time. The form captured information such as playing position, age (years), stature (cm), body mass (kg), dominant leg (left, right or both) and details of any previous major injuries.

3.3.3 Club Training and Match Attendance Register

Throughout the season, the club medical staff kept a daily player attendance register, as outlined in Appendix E: Club training and match attendance register, which was modified in accordance with FMARC documentation. This register tracks player attendance, missed days, reasons for absence (injury, illness, or other), and training/match exposure (Fuller et al., 2006) . To maintain confidentiality, player names were replaced by the unique player code numbers assigned according to the previously described player baseline information form.

3.3.4 Injury Report Form

In accordance with Health Professions Council of South Africa guidelines, all player injuries and treatment sessions were recorded as medical notes in the player's individual medical file. These notes were then routinely summarised in the first team squad injury register (Appendix F: Injury report form), providing an overview and comprehensive record of injuries sustained by players throughout the season. To maintain participant confidentiality, the unique player code number was utilised to identify the player in question. The recorded injury characteristics were consistent with the consensus statement (Fuller et al, 2006). These characteristics included date of injury, affected body part/region, type of injury, diagnosis, date of return to full training and match participation, days lost, matches missed, training days missed, new/re-injury status and total medical costs per injury.

For this study, we decided to use the time-loss definition of injury, which only includes injuries to players resulting in limited football participation due to the injury. This definition is consistent with most football injury epidemiological studies recommended by the UEFA model (Hägglund et al., 2005). The time-loss definition is preferred at the professional level as it relies on a high frequency of training sessions to minimise the risk of missing less severe injuries. Furthermore, this definition of injury aligns with the aims and objectives of this study, as missed training and matches can result in potential performance and financial burdens to clubs (Hägglund et al., 2013; Eliakim et al., 2020).

According to the time-loss definition of injury, a player is considered injured from the day of injury until cleared by the club medical staff for full football participation in team activities, including training and matches. The lay-off period for the time loss injury is represented as the number of days from the date of injury until cleared by the medical staff, irrespective of whether a training session or match was scheduled on the days missed (Ekstrand et al., 2021).

3.4 Data Capture and Analysis

3.4.1 Data Capture Procedure

To collect data for this study, the standardised baseline player information form (Appendix D: Player baseline information form) was completed at preseason fitness testing on the first day of preseason 2021-2022 (5 July 2021). All participants in the study agreed to include their information in the data analysis process. Throughout the season (5 July 2021- 21 May 2022), the club medical staff routinely captured daily player attendance, football exposure, and injury data using the club's training and match attendance register (Appendix E).

The collected data were analysed retrospectively in accordance with the study's aims and objectives. Only players who signed the informed consent form were added to the study data. Once ethics approval and informed consent were obtained, coded player data were stored on the student researchers' personal password-protected laptop and backed up on a OneDrive account that only the student researcher could access. The data will be kept for a period of at least five years after the completion of this research project.

3.4.2 Statistical Analysis

The data were summarised and tabulated in Microsoft Excel and descriptive statistics were calculated for the injury data and the number of training and match sessions missed (total and per player). Calculations were performed to determine which injury types, in terms of structure and location, resulted in the most time-loss and which injuries were the costliest in terms of the financial cost. A confidence interval of 95% (CI=95%) was used to describe the team's seasonal injury incidence (injuries per 1000 hour of exposure time) and injury severity (days missed per 1000 hours of exposure) for both matches and training sessions (Fuller et al., 2006).

The team's average training exposure was calculated according to the football research consensus statement (Fuller et al., 2006). Training data were collected on a group basis. The:

(1) number of training sessions
(2) duration of each of these sessions
(3) number of players that attended each session

were recorded using the club daily training and match attendance register (Appendix E: Club training and match attendance register).

Training exposure was calculated using the following equation:

- Training exposure = $P_T \times D_T/60$ (Fuller et al., 2006).

Where P_T = Number of players attending the training session and D_T /60 = Duration of the training session in minutes. This was done for all team training sessions throughout the season, resulting in a total team training exposure time.

Match exposure was calculated using the following equation:

- Match exposure = $(N_M * P_M * D_M)/60$. (Fuller et al., 2006)

Where N_M represents the number of matches played for the week, P_M is the number of players on the team (normally 11), and D_M is match duration in minutes (normally 90) (Fuller et al., 2006). This was done for all team matches against opposing teams, including friendlies, league, and cup matches. Although less specific than adding up individual player minutes, a team average match exposure is sufficient for the aims and objectives of this study since the analysis is conducted on a team basis rather than individually.

3.5 Ethical Considerations

The study was conducted in accordance with the World Medical Associations Declaration of Helsinki (World Medical Association, 2013). After receiving ethics approval (HREC REF 512/2022; See Appendix A: HREC approval), individual written informed consent was sought and obtained from all club players who met the inclusion criteria.

Information regarding the research aims and study rationale, data handling, and any risks and potential benefits was shared in the informed consent form (Appendix C: Informed consent form) which was distributed to players after the presentation and sent to players no longer contracted to the club. Players were reminded that they have the right to refuse participation and withdraw from the study at any time without prejudice. All players were above 18 years of age, proficient in the English language (reading and writing) and healthy individuals of sound mind and therefore considered low risk.

The student investigator serves as the head of the medical department at CTCFC. Concerns were identified about the potential for undue influence on participants due to the patient/physiotherapist relationship. To mitigate this, a person not involved in team care was nominated to obtain informed consent for the study. Mr. Moenier Davids, in his capacity as CTCFC team manager, volunteered to be responsible for obtaining informed consent by distributing and collecting the informed consent forms. In this way, the researcher was only responsible for the participant recruitment and study education portions of the informed consent process. Excluding him from the informed consent process aimed to eliminate undue influence on player participation.

As a club employee and head physiotherapist, the student researcher is primarily involved in the medical treatment of players and daily data capture. The student acknowledges the inherent conflict of interest and possible bias introduced by being involved in the data capture and the researcher. He was not receiving any financial or other benefits for submitting his research paper; it was solely intended for his master's dissertation. The student researcher hereby confirms that data to be used for the project is routinely collected during the season.

3.5.1 Risk to Participants

No physical risks were identified for participants, as no intervention was involved. Sensitive player injury data such as the number of injuries, time loss due to injury, and the team's average player wages were used for injury burden calculations. The research was conducted in accordance with recommended best practices, and the investigator ensured that all steps were taken to sufficiently anonymise personal identifying information, preventing it from being traced back to the individual participants. The researchers did not have access to individual player's personal salary information, and the pre-calculated average weekly player wages were provided directly from the club finance department. The utmost confidentiality was maintained throughout the project's data collection and reporting phases, and no information gathered from individual participants was shared. Participants were informed that they had the right to refuse participation without negatively impacting their position at the club.

3.5.2 Benefit to Participants

While there were no direct benefits for participants in the study, its findings aimed to contribute to the safety of soccer players in South Africa. These results will be available to participants and club stakeholders (board members, insurers, medical team) and could benefit players by guiding future injury prevention programs. The findings of the project will be presented to participants and club stakeholders during the post-study presentation (expected Preseason 2024-2025). These findings will play a crucial role in the medical budgeting meeting for the 2024-2025 season. They will be utilised to enhance the precision of the club's resource allocation towards injury prevention, medical staff, and equipment. For the soccer player community, improved and specific injury prevention programs may lead to fewer injuries. Decreased injury risk has been shown to benefit both clubs and players. On a player level, fewer injuries could increase performance and prolong soccer careers, maximising player earning potential.

Chapter 4: Results

4.1 Study Sample

In conducting the current study, we extended an invitation to all contracted first team players registered to participate in the 2021-2022 PSL season, totalling 31 individuals. These 31 high-level professional male football players were approached, and all provided their consent for their data to be utilised in the research.

The squad began the season with 25 players, however three of the players that reported to the first day of pre-season training were not eligible for inclusion at that time due to injuries sustained before the start of the study period (pre-July 2021). These three players were included in the exposure and injury calculations only after they were declared fit by club medical personnel for all football activities as per the consensus statement (Fuller et al., 2006).

Eight players were transferred out of the club and six players joined the squad during the season, their exposure and injury data were included only for the time that they were club-registered squad players.

4.2 Study Participants - Descriptive Characteristics

According to the club standard operating procedure, the FMARC 'player baseline information form' was completed for each player in the squad. This is routinely done during pre-season testing or when a new player joins the squad. This document provides baseline individual player data relating to gender, age, leg dominance, stature (height), body mass (weight), playing position and details of any previous major injuries. The player baseline information form also gives each player a unique study reference number for identification and confidentiality purposes.

The age of the players ranged from 18 to 37 years old, with an average squad age of 26 years. Eighty per cent of players in the squad were younger than 29 years old, with the greatest proportion (39%) of players aged between 25 and 29 years of age. The age distribution of players in the sample is shown in Table 4.

Table 4. Age distribution of players.

AGE	NUMBER OF PLAYERS	% OF SAMPLE
18-19	3	10
20-24	10	32
25-29	12	39
30-34	4	13
35-39	2	6
TOTAL	***31***	***100***

Sixty-eight percent of the players were right-foot dominant and the remaining 32 % of players in the squad left-footed. The squad ranged in height from 165-191 cm with a mean height of 177 ± SD cm. The body mass of the players ranged from to 60.2-89.6 kg with a mean squad mass of 73.1 ± SD kg. Most players in the squad were midfielders (n=14, 45%), followed by defenders (n=8, 26%). The number of players and playing position distribution is shown in Table 5 below.

Table 5. Number of players per playing position.

PLAYING POSITION	NUMBER OF PLAYERS	% OF SAMPLE
GOALKEEPERS	5	16
DEFENDERS	8	26
MIDFIELDERS	14	45
FORWARDS	4	13
TOTAL	***31***	***100***

4.3 Quantification of Player Exposure

For the purposes of this study, football exposure is separated into either training or match exposure. Over the 11-month 2021-2022 season, players were subjected to a total squad football exposure time of 6 776 hours (219 hours per player). The squad spent 85% (5 781 hours) of their time training and the remaining 15% (995 hours) time playing matches. Considering the aims and objectives of the study, we decided to use squad totals for exposure calculations and not individual training and match exposure data. Only player exposure (from training and matches) at the club was included and no external match or training data were included in exposure calculations. This was done due to problems obtaining and verifying data from external sources (national team camps etc. The highest total squad football exposure was recorded in the preseason, July 2021 (789 hours). Interestingly, the lowest total exposure documented was during May (425 hours) the last month of the season (Figure 4)

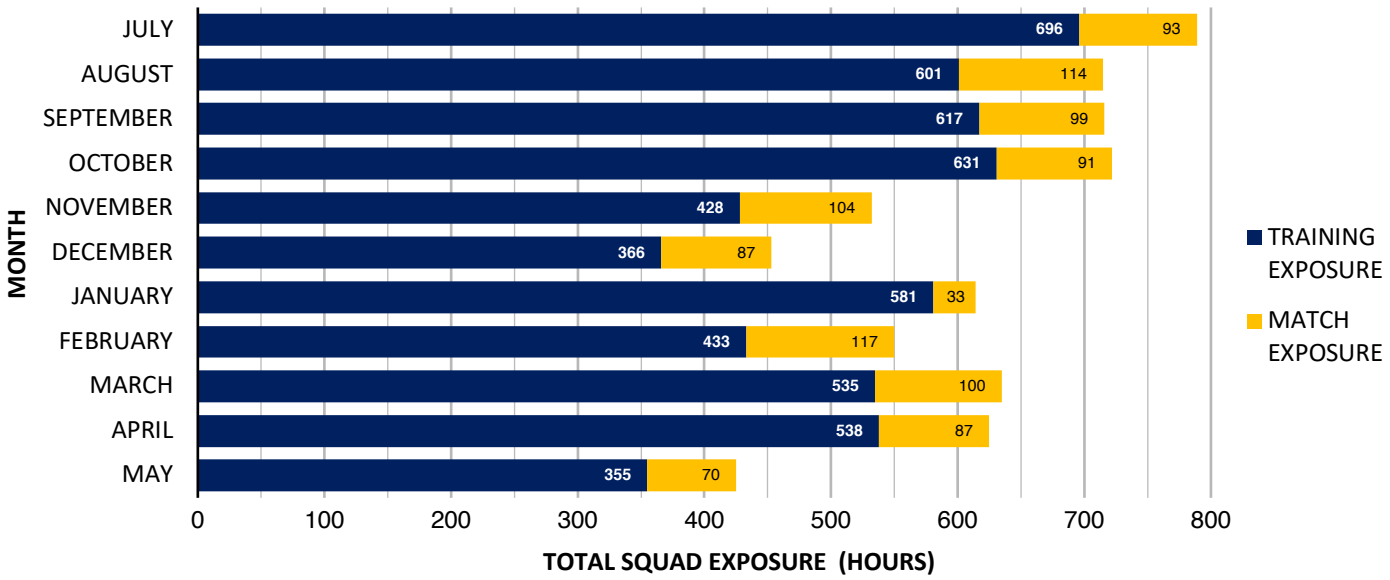

Figure 4. Total squad exposure (training and matches) each month during the 2021/2022 season.

4.3.1 Training Exposure

Players in the squad were exposed to a total of 5 781 hours of football training (186 hours per player). As per the football injury consensus statement, all training sessions were considered team training and are included in team exposure calculations (Fuller et al., 2006). Team training is divided into field training, gym strength training and recovery sessions. There were 280 training sessions for the season, 225 field training sessions, 32 gym and 23 recovery sessions. During the season, players in the squad spent 88% (5 077 hours) of training time on the field, 9% (513 hours) performing strength training in the gym, and 3% (191 hours) engaged in team recovery training sessions.

On an individual-player basis, this equates to 164 hours (9 828 minutes) of field training, 17 hours (990 minutes) of strength training and 6 hours (370 minutes) of recovery exposure for a total mean individual training exposure of 186 hours (11 188 minutes) per player. It is important to consider that this is a mean value and that not all players were subject to the same number of training sessions, and therefore individual training exposure would differ between players. There were multiple reasons for this, including but not limited to individual player periodisation, injury, illness, and missing squad training for national camps, etc. The monthly breakdown of training exposure is represented in Figure 5.

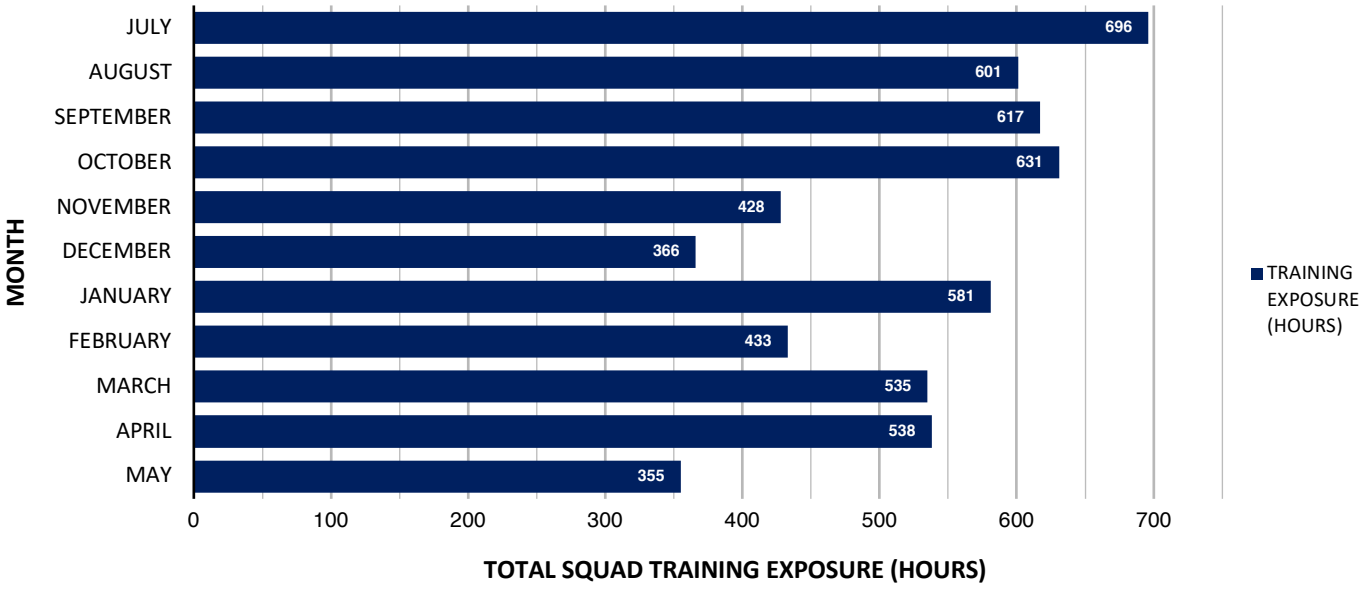

Figure 5. Total squad training exposure each month during the 2021-2022 season.

The highest squad training exposure was recorded in the first quarter of the season (July-October 2021) with the highest monthly training exposure of 696 hours in the first four weeks of the preseason period. Individual player training time forming part of a player's rehabilitation from injury was not included in training exposure. Pre-match warm-up was also not included in this study as training exposure. This can be easily quantified by multiplying the warm-up duration by the number of players involved and then by the number of matches for the season. Only starting line-up players are involved in a structured pre-match warm-up before matches, while the substitute players receive a shorter warm-up before going onto the field. Therefore 35 x (0.4 x 11) = 154 hours of structured pre-match warm-up exposure. However, it was decided that as this was not true training time and that because no injuries in the season occurred during match warm-up it would skew training injury data and result in potential underreporting of training injury incidence.

4.3.2 Match Exposure

Match exposure comprises a combination of competition matches (in-season league and cup matches), and any friendly matches played against an opposing team. During the 2021-2022 football season, players in the squad were exposed to 995 hours of match exposure. Of this exposure, 62% (616 hours) were during the 35 competitive matches played during the season, while the remaining 38% (377 hours) were from 23 friendly matches against external opposition. Internal friendly match exposure was not included and was instead classified as training exposure (Fuller et al., 2006).

On average, players in the squad were exposed to 32 hours (1 925 minutes) of match exposure over the season. Players are expected to have differing match exposure profiles. For example, better players are expected to have more competition game time by being regular starting players for the team and would likely be rested during the friendly games. Friendly games offer a chance to provide game time to players who are on the fringes.

Ninety per cent (28/31) of the squad was exposed to competitive match play at some point in the season, with only 3 squad members not getting any playing time in competition matches. A breakdown of the number of players by match exposure time category is presented in Table 6 below. This shows that a quarter of the squad was exposed to more than 30 hours of match exposure over the season. Notably not all players were at the club the entire study period, with 8 players transferring out and 6 transferring in during the season. This would affect individual game time.

Table 6. A breakdown of the number of players by match exposure time category.

AMOUNT OF MATCH EXPOSURE	NUMBER OF PLAYERS	% OF SAMPLE
> 39 hours	6	19
30 – 39 hours	2	7
20 – 29 hours	5	16
10 – 19 hours	8	26
< 9 hours	10	32
TOTAL	***31***	***100***

The highest amount of squad match exposure was recorded in August 2021 (114 hours) and February 2022 (117 hours), with the least amount of match exposure in January 2022 (33 hours). The months with the most competition matches were December 2021 and April 2022 with 5 matches each. This means that the months with the highest match exposure hours were due to a combination of friendly and competition matches rather than a high competition match load. Figure 6 shows team match exposure during the season

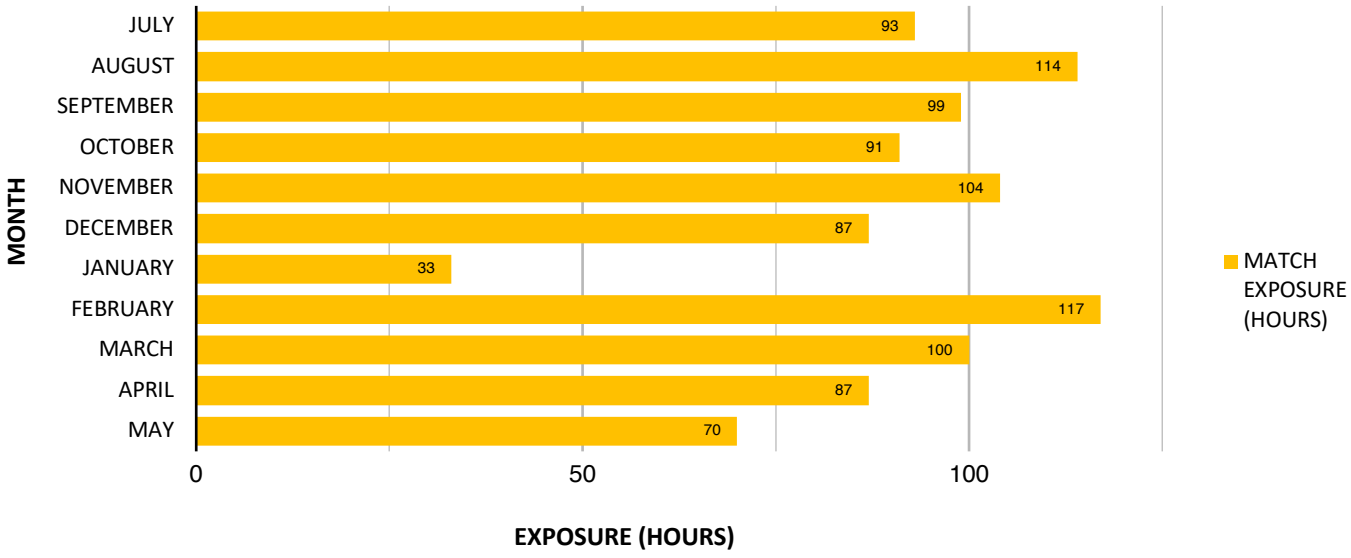

Figure 6. Match exposure (competition and friendly) each month during the 2021/2022 season.

4.4 Injury

In accordance with the aims and objectives of this study, a time-loss definition of injury was used. The consensus statement on injury definitions and data collection procedures in football defines time loss injury as: 'any physical complaint sustained by a player that results in a player being unable to take full part in future football training or match play' (Fuller et al., 2006). A player is considered injured from the day of injury until cleared by club medical staff for full football participation. Injuries unrelated to football activity or any prior to the study period were not recorded. For the 2021-2022 football season, the clubs' most costly injuries (n=3) in terms of financial burden and time-loss occurred before the start of the season and were not included in injury calculations. Had these injuries been included results would have differed considerably.

Thirty-four (n=34) injuries met the inclusion criteria and were recorded by club medical staff during the season. Ten injuries occurred during the preseason phase (5 July 2021 – 7 August 2021) and 24 were recorded during the season (8 August 2021 – 21 May 2022). Based on these findings, it can be concluded that 29% of all injuries were sustained in the one-month preseason period.

The highest number of injuries recorded in any month was 6, which occurred twice in the first two months of the new season. The mean time loss injury rate was 3.1 injuries per month, with 70% of all time-loss injuries recorded in the first 6 months of the season (July-December 2021). February 2022 was the only month in which no new time-loss injuries were recorded. Generally, more training injuries than match play injuries occurred per month; however, August, March and April saw more match injuries than training injuries. Table 7 provides a breakdown of new training and match injuries by month during the 2021-2022 season. Table 8, 9 and 10 show the number of injuries by player exposure type per month. These tables are presented only as observational references of injuries sustained throughout the season as the mechanistic association between load and injury incidence is outside the scope of this study.

Table 7. New training and match injuries by month during the 2021/2022 season.

MONTH	MATCH INJURIES	TRAINING INJURIES	TOTAL NEW INJURIES
JULY	2	4	***6***
AUGUST	4	2	***6***
SEPTEMBER	1	1	***2***
OCTOBER	0	3	***3***
NOVEMBER	0	4	***4***
DECEMBER	1	2	***3***
JANUARY	0	2	***2***
FEBRUARY	0	0	***0***
MARCH	2	1	***3***
APRIL	2	1	***3***
MAY	1	1	***2***
TOTALS	***13***	***21***	***34***

Table 8. Training exposure vs injury by month during the 2021/2022 season. The incidence and 95% confidence interval for each month are included.

MONTH	TRAINING EXPOSURE (HOURS)	NEW INJURIES	INCIDENCE
JULY	696	4	5.7 (0.1 to 11.4)
AUGUST	601	2	3.3 (0 to 7.9
SEPTEMBER	617	1	1.6 (0 to 4.8)
OCTOBER	631	3	4.8 (0 to 10.1)
NOVEMBER	428	4	9.3 (0.2 to 18.5)
DECEMBER	366	2	10.9 (0.2 to 21.6)
JANUARY	581	2	3.4 (0 to 8.2)

MONTH	TRAINING EXPOSURE (HOURS)	NEW INJURIES	INCIDENCE
FEBRUARY	433	0	0
MARCH	535	1	1.9 (0 to 5.5)
APRIL	538	1	1.9 (0 to 5.5)
MAY	355	1	2.8 (0 to 8.3)
TOTALS	***5781***	***21***	***3.6***

Table 9. Match exposure vs injury by month during the 2021/2022 season. The incidence and 95% confidence interval for each month are included.

MONTH	MATCH EXPOSURE (HOURS)	NEW INJURIES	INCIDENCE
JULY	93	2	21.5 (0 to 51.3
AUGUST	114	4	35.1 (0.7 to 69.5
SEPTEMBER	99	1	10.1 (0 to 29.9)
OCTOBER	91	0	0
NOVEMBER	104	0	0
DECEMBER	87	1	11.5 (0 to 34.0)
JANUARY	33	0	0
FEBRUARY	117	0	0
MARCH	100	2	20 (0 to 47.7)
APRIL	87	2	23 (0 to 54.9)
MAY	70	1	14.3 (0 to 47.3)
TOTALS	***995***	***13***	***13.1 (6.0 to 20.2)***

Table 10. Total exposure vs injury by month during the 2021/2022 season. The incidence and 95% confidence interval for each month are included.

MONTH	TOTAL EXPOSURE (HOURS)	NEW INJURIES	INCIDENCE
JULY	789	6	7.6 (1.5 to 13.7)
AUGUST	715	6	8.4 (1.7 to 15.1)
SEPTEMBER	716	2	2.8 (0 to 6.7)
OCTOBER	722	3	4.2 (0 to 8.9)
NOVEMBER	532	4	7.5 (0.2 to 14.9)
DECEMBER	453	3	6.6 (0 to 14.1)
JANUARY	614	2	3.3 (0 to 7.8)
FEBRUARY	550	0	0
MARCH	635	3	4.7 (0 to 10.1)
APRIL	625	3	4.8 (0 to 10.2)
MAY	425	2	4.7 (0 to 11.2)
TOTALS	***6776***	***34***	***5.0 (3.3 to 6.7)***

4.4.1 Injury Incidence

Based on the aims and objectives of this research, the decision was made to use a team-based exposure value for training and match sessions and injury incidence instead of relying on individual exposure calculations. Overall injury incidence for the study period was determined using the total number of time-loss injuries (n=34) and total squad exposure (6 776 hours) for an overall injury exposure of 5.0 time loss injuries per 1000 hours of player exposure. Training injury incidence was 3.6 injuries per 1000 training hours, while match injury incidence was 13.1 injuries per 1000 match play hours.

4.4.2 Injury Classification

Most injuries (n=30, 88%) recorded during the season resulted from a clearly identified and specific event and are thus classified as traumatic injuries. The remaining injuries had no identifiable event before the onset of injury and are classified as overuse injuries. Twenty-one (62%) were non-contact injuries while the rest were due to contact with the ball or another player.

More injuries affected the right-hand side of the body (n=18, 53%) than the left (n=15, 44%). The one concussion was not included as a right or left-sided injury. Seventy-six per cent (n=26) of recorded injuries were index injuries, with the remaining 8 injuries (24%) being recurrent injuries. According to the consensus statement, a recurrent injury is defined as: 'an injury of the same type and site as an index which occurs after a player's return to full participation after an index injury' (Fuller et al., 2006).

Injuries are further classified by the type of football exposure that caused the injury (training vs match). During the season 21 injuries (62%) were because of training exposure while 13 (38%) occurred during match play. This study indicates that the present team can expect an average of 1 training injury every 13 training sessions (0.075 injuries per training session) and 1 match play injury every 2.7 matches played (0.37 injuries per game).

4.4.1 Location of Injury

The most common injury by location was the thigh accounting for 35% (12/34) of injuries during the season. Thigh injuries were equally likely to occur in training and matches with 6 recorded in training and 6 in matches. Only 2 of these were recurrent injuries, with the balance being index injuries. Eighty-three per cent (10/12) of thigh injuries were classified as non-contact and all were due to a traumatic mechanism of injury.

The next most prevalent injury location was the hip/groin (n=5, 15%). All hip/groin injuries were traumatic and non-contact in nature. Forty percent occurred in matches and 60% were recorded during training.

The third greatest number of injury cases defined by body region were due to ankle injuries (n=6, 18%). All injuries were traumatic in nature and 50% were caused by contact with another player while the rest were recorded as non-contact injuries. Most ankle injuries (5/6) resulted from training and only 1 ankle injury happened during a match.

Foot/toe injuries were the next most common with 4 cases (12%). All foot and toe region injuries were due to contact and were traumatic. Fifty per cent of foot/toe injuries occurred in training and 50% in matches. Three of these injuries were index injuries with one classified as a recurrence.

There were 3 injuries to the knee region (9% of injury cases). All were new injuries and they occurred during training. Knee injuries resulted in a total time loss of 13 days (5.5% of total time loss). Two knee injuries were caused by overuse and non-contact, while one was due to a traumatic contact. A summary of the number of time-loss injuries per body location is presented in Figure 7.

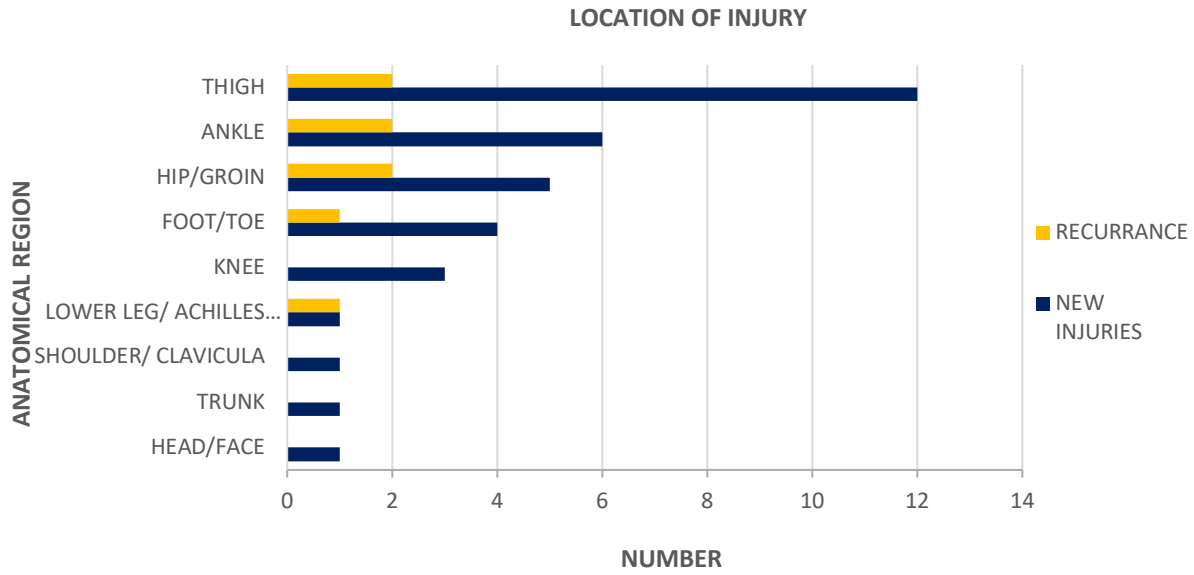

Figure 7. Summary of time loss injuries according to body location.

4.4.2 Type of Injury

The most common injury type during the study period was muscle rupture/strain injuries, with 18/34 (53%). The next most prevalent injury type was sprains/ligament injuries, accounting for 7/34 (21%) of cases, followed by synovitis/effusion injuries (9%). There were 2 cases each for lacerations and haematoma/contusions (6% each). There was one concussion and one other bone injury during the season. The figure below (Figure 8) shows a summary of injuries by the injury type and the number of cases.

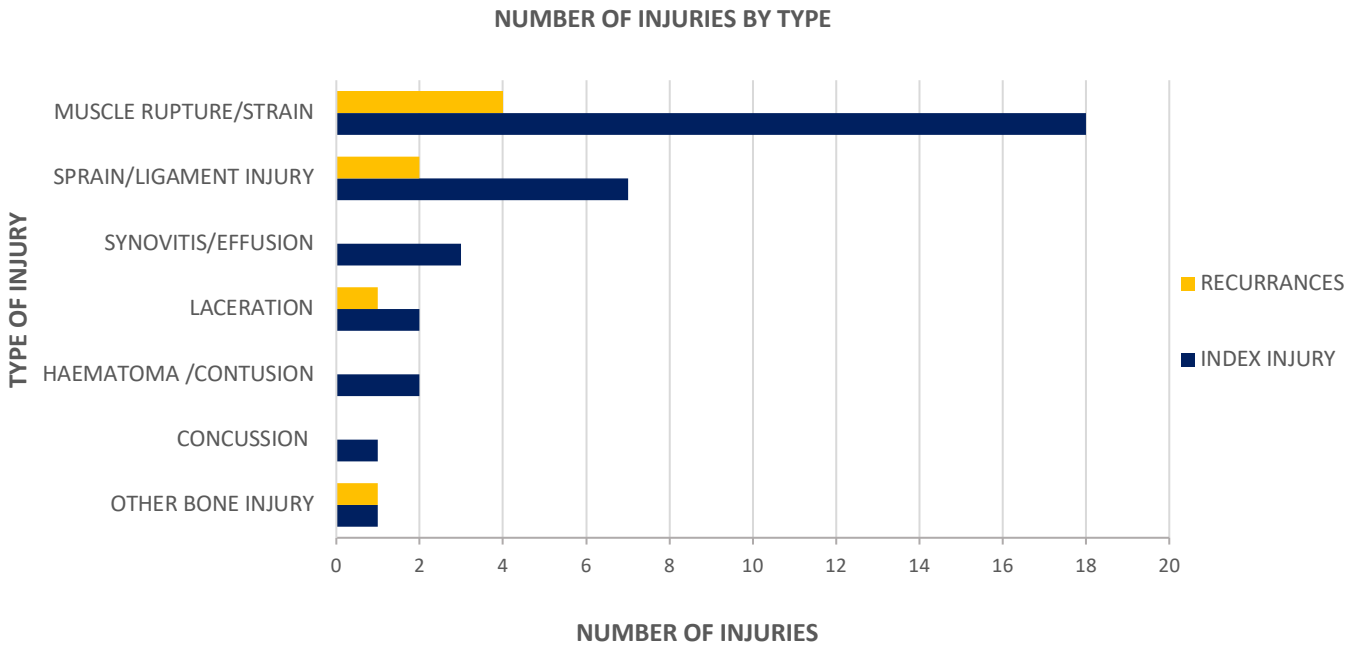

Figure 8. Summary of time loss injuries according to injury type.

4.6 Burden of Time-loss Injury

Burden is the collective measure of the overall impact of a health problem within a specific population (Bahr et al., 2020). Burden allows different health problems to be compared and is often expressed as financial cost, mortality, or morbidity in public health (Bahr et al., 2020). Burden of sports injury is concerned with the consequences of injuries sustained as opposed to their rate of occurrence.

Injuries that cause players to miss time can have a major impact on professional teams (Hägglund et al., 2013; Eliakim et al., 2020; Howden Insurance Brokers Ltd, 2022). Regarding the burden of sports injury, previous research has reported injury burden as the number of days of time loss per 1000 hours of player exposure (Bahr et al., 2020). This differs from incidence (discussed earlier) and is a measure of the consequences of the injuries sustained. Burden provides a clearer indicator of the injury problem to teams as opposed to injury incidence alone.

A major consequence of injury to teams is financial cost. The financial cost of injuries incurred by professional sports teams indicates the level of burden those injuries place on the organisation. This metric also makes it possible to compare between different clubs and seasons. Furthermore, it allows for the evaluation of cost-effectiveness of any injury prevention programs that are implemented within the team.(Öztürk & Kiliç, 2013). In the present study the financial burden of injury has been determined by calculating the direct medical costs (treatment costs) and cost of lost wages (indirect costs) of injury for the season.

The 34 time-loss injuries recorded over the season in this study resulted in a total seasonal time-loss of 236 days to the squad. The period lost due to injury included 183 training sessions and 26 competitive matches. This results in an average time-loss of 6.9 days per injury. Injury burden per 1000 exposure hours was calculated using [total days-absence x 1000]/ [total athlete- hours of exposure] (Fuller, 2023) for a seasonal injury burden of 34.8 days per 1000 exposure hours.

Injury severity is defined as: 'the number of days that have elapsed from the date of injury to the date of the players' return to full participation in team training and availability for match selection' and are grouped as either *minimal* (1-3 days), *mild* (4-7 days), *moderate* (8-28 days) or *severe* (>28 days) based on the number of time loss days resulting from the injury (Fuller et al., 2006; Bahr et al., 2020). The amount of time loss is calculated in calendar days from the date of injury until full return irrespective of whether there were training sessions scheduled to take place on that day or not.

Overall, 44% (15/34) of injuries were considered *minimal* and resulted in time-loss of 3 days or less. *Mild* severity injuries were the next most common, totalling 32% (11/34) of all injuries. There were 7 *moderate* injuries (21%) and only one *severe* (3%) injury case during the season. These results indicate that in 76% of cases injuries lasted 7 days or less.

To identify the injury locations and types that caused the most time loss burden over the season, the present study classified time loss injuries based on their severity, as well as their location and type. Table 11, depicting time loss injury severity by location, indicates that thigh injuries, which accounted for 53% of all time loss days, also resulted in the greatest number of *minimal* (n=5), *mild* (n=3), *moderate* (n=3) and *severe* (n=1) cases.

Furthermore, thigh injuries resulted in 53% of total days lost (n=124), this included 91 training days and 16 matches missed. Hip/groin injuries resulted in 36 missed days (15%). The days missed by players due to hip/groin injuries included 33 training sessions and 3 matches. It is worth noting that a case that caused major time-loss and financial burden due to hip/groin injury was not included, as this injury occurred before the start of the study period while the player was on national team camp. Despite being the third most common type of injury, ankle injuries resulted in the fourth highest number of days missed due to injury (n=15, 6%). This included 11 training sessions and 2 matches missed. Foot/toe resulted in a total loss of 32 days (23 training sessions and 4 matches). One of these cases, resulting in 1 index injury and 1 reoccurrence, was responsible for the most days missed in this region (n=24, 75%). Head/face, trunk, shoulder, and lower leg/Achilles all had 1 injury each and together were responsible for 16 days lost (7%).

Table 11. Time-loss injury severity by location.

		SEVERITY				
ANATOMICAL LOCATION	**N INJURIES (%)**	**MINIMAL (1-3 D)**	**MILD (4-7 D)**	**MODERATE (8-28 D)**	**SEVERE (>28 D)**	**TOTAL DAYS LOST (%)**
HEAD/FACE	1 (3)			1		8 (3)
TRUNK	1 (3)		1			4 (1)
SHOULDER	1 (3)	1				3
HIP/GROIN	5 (15)	2	1	2		36 (15)
THIGH	12 (35)	5	3	3	1	124 (53)
KNEE	3 (9)	1	2			13 (5)
LOWER LEG/ ACHILLES TENDON	1 (3)	1				1
ANKLE	6 (18)	4	2			15 (6)
FOOT/TOE	4 (11)	1	2	1		32 (13)
TOTAL	***34 (100)***	***15***	***11***	***7***	***1***	***236 (100)***

Time-loss injury severity by injury type indicates that muscle rupture/sprain caused the most time loss (172 days) and was responsible for the greatest number of *minimal* (n=6), *mild* (n=6), *moderate* (n=5), and *severe* (n=1) cases. A summary of time-loss injury severity by type is presented below in Table 12.

Table 12. Time-loss injury severity by injury type.

		SEVERITY				
INJURY TYPE	**N INJURIES (%)**	**MINIMAL (1-3 D)**	**MILD (4-7 D)**	**MODERATE (8-28 D)**	**SEVERE (>28 D)**	**TOTAL DAYS LOST (%)**
SPRAIN/LIGAMENT INJURY	7 (21)	4	3			20 (8)
MUSCLE RUPTURE/STRAIN	18 (53)	6	6	5	1	172 (73)
HAEMATOMA /CONTUSION	2 (6)	2				2 (1)
OTHER BONE INJURY	1 (3)	1				1
SYNOVITIS/EFFUSION	3 (9)	2	1			9 (4)
CONCUSSION WITH/WITHOUT LOSS OF CONSCIOUSNESS	1 (3)			1		8 (3)
LACERATION	2 (6)		1	1		24 (10)
TOTAL	**34 (100)**	**15**	**11**	**7**	**1**	**236 (100)**

4.6.1 Direct Cost of Time-loss Injury

The 34 recorded time loss injuries for the season resulted in a cumulative direct financial cost of R 24 155 to the club. These costs included R 2 500 paid for consults with doctors and sports physicians, R17 100 for musculoskeletal scans and radiology and R 4 555 for doctor-prescribed orthotic devices in the treatment of time-loss injury.

An important side note is that 3 injuries that occurred before the study period were responsible for considerable direct financial cost to the club during the current season due to the injuries being carried over into the present season. One of these previous injuries required surgery during the study period, another player required an intra-articular injection and the last of the three required follow up appointments with the surgeon who conducted the surgery the previous season. The total direct financial cost of these injuries R 159 229. While these costs are not included in the results due to the study methodology, the magnitude of their costs requires a mention.

Therefore, the club in question spent a total sum of R 183 384 in direct medical costs with R 24 155 (13%) of this cost due to the 34 time-loss injuries that occurred within the study period. A cost breakdown of total direct and indirect costs is presented in Table 13.

In relation to direct medical costs, the most expensive injury location was the thigh, accounting for 63% of all direct injury costs of the season. This was followed by ankle injuries (19%) and foot/toe injuries (10%). The most expensive injury type was muscle strains/ruptures (63%) followed by sprain/ligament injury (19%) and lacerations (10%).

4.6.2 Indirect Cost of Time-loss Injury

Indirect costs of injury were determined by calculating lost player wages due to player unavailability resulting from injury. The researchers were supplied with a monthly average wage per player directly from the club finance department. This was pre-calculated by dividing the total club wage bill per month by the number of players in the squad for that month. This pre-calculation and averaging were done to protect individual players so that no member of the research team had access to individual player earnings.

The average player salary was R 509 697 per annum. (R 42 475 monthly, R 1396 per day). This means that for every day lost per injury the club essentially paid R1 396 to the unavailable player. The total wages paid to unavailable players was R 329 456 (R1 396 player daily wage x 236 days lost). The average injury cost the club R 9 716 (R1 396 x 6.96 days) in lost wages.

In terms of indirect costs of injury, the most expensive injury locations were the (1) thigh (R 173 157), (2) hip/groin (R 50 271) and (3) foot/toe injuries (R 44 686). By far the costliest injury type were muscle rupture/sprain resulting in R 240 186 (73%) of indirect costs followed by lacerations (R 33 514, and ligament sprains, R 27 929). The three major injuries that were not included resulted in 325 days lost and considerable indirect costs of R 453 700 however, as mentioned previously, these are not included in the present study.

4.6.3 Total Financial Cost of Time-loss Injury

Total financial cost is calculated by adding the direct and indirect costs of time loss injury for the season. Direct costs for the season were R 24 155 (7%) while indirect costs had a value of R 329 456 (93%) resulting in a total financial cost of injury of R 353 611 ($ 21 570). A cost breakdown is presented in Table 13 below. When analysed with player exposure the team can expect R 52 186/1000 exposure hours ($ 3 183/1000 hours).

Table 13. A cost breakdown of total direct and indirect costs for the season.

	TREATMENT COSTS (DOCTORS, SCANS, ORTHOTIC DEVICES)	LOST WAGES	TOTALS
DIRECT COSTS	R 24 155	-	R 24 155
INDIRECT COSTS	-	R 329 456	R 329 456
NOT INCLUDED*	R 159 229	R 453 700	R 612 929
TOTALS	***R 183 384***	***R 783 156***	***R 966 540***

**Injuries sustained outside the study period*

In terms of the anatomical location of injury, thigh injuries were the costliest injury location R 188 357 (53%) followed by hip/groin R 52 171 (15%) and foot/toe injuries R 47 186 (13%). The distribution of total costs by injury location is represented in the table below in Table 14.

Table 14. Distribution of total injury costs by anatomical location.

ANATOMICAL LOCATION	INDIRECT COSTS	DIRECT COSTS	TOTALS
HEAD/FACE	R 11 171	R -	R 11 171
TRUNK	R 5 586	R -	R 5 586
SHOULDER	R 4 189	R -	R 4 189
HIP/GROIN	R 50 271	R 1 900	R 52 171
THIGH	R 173 157	R 15 200	R 188 357
KNEE	R 18 154	R -	R 18 154
LOWER LEG/ ACHILLES TENDON	R 1 396	R -	R 1 396
ANKLE	R 20 946	R 4 555	R 25 501
FOOT/TOE	R 44 686	R 2 500	R 47 186
TOTAL	***R 329 557***	***R 24 155***	***R 353 712***

In terms of total financial loss by injury type, muscle strains were responsible for R255 386 (72 %) of total financial costs, this was followed by lacerations R 36 014 (10%) and sprain/ligament injuries R 32 484 (9%). The distribution of total injury costs by injury type is represented by the table below in Table 15.

Table 15. Distribution of total injury costs by injury type.

INJURY TYPE	INDIRECT COSTS	DIRECT COSTS	TOTALS
SPRAIN/LIGAMENT INJURY	R 27 929	R 4 555	R 32 484
MUSCLE RUPTURE/STRAIN	R 240 186	R 15 200	R 255 386
HAEMATOMA /CONTUSION	R 2 793	R 1 900	R 4 693
OTHER BONE INJURY	R 1 396	R -	R 1 396
SYNOVITIS/EFFUSION	R 12 568	R -	R 12 568
CONCUSSION WITH/WITHOUT LOSS OF CONSCIOUSNESS	R 11 171	R -	R 11 171
LACERATION	R 33 514	R 2 500	R 36 014
TOTAL	***R 329 557***	***R 24 155***	***R 353 712***

Not included in these calculations were the direct and indirect financial costs associated with the injuries that were not eligible for inclusion but still resulted in an economic burden for the club for the study period. These amounts were R 159 229 direct costs and R 453 700 wages paid to the unavailable players for a total of R 612 929. Should these injuries have met the inclusion criteria and been included in the study the total financial burden of injury for the club for the season would have totalled R 966 540 (Table 13). It is important to consider this total as even though these injuries occurred before the study period, the club still paid these costs during the present season.

4.7 Summary of Results

The key research findings relevant to the aims and objectives of the dissertation are presented below:

- 31 Professional football players were followed during the 11-month 2021-22 professional football season in South Africa.
- There were 280 training sessions for a total squad training exposure of 5 781 hours (187 hours per player).
- There were 35 competitive and 23 friendly matches for a total squad match exposure of 995 hours (32 hours per player).
- The total squad exposure for the season was 6 776 hours (219 hours per player).
- A total of 34 time-loss injuries were recorded during the study period for an average of 3.1 time-loss injuries per month.
- 29% of all injuries were sustained in the one-month preseason period.
- 88% of all injuries were traumatic in nature.
- 62% of injuries were non-contact.
- The most common injury locations were the (1) thigh, (2) groin and (3) ankle.
- The most common injury types were (1) muscle strains/ruptures, (2) sprains/ligament injuries followed by (3) joint synovitis and effusions.
- There were 26 index injuries during the season and 8 recurrences.
- There were 21 training injuries for a training injury incidence of 3.6 time loss injuries per 1000 exposure hours.
- There were 13 match injuries for a match injury incidence was 13.1 time loss injuries per 1000 exposure hours.
- The overall injury incidence was 5.0 time loss injuries per 1000 exposure hours.
- The 34 time-loss injuries resulted in 236 days lost (6.9 days per injury)

- The overall squad seasonal injury burden was calculated at 34.8 days lost per 1000 exposure hours.
- Study results indicate that in 76% of cases, injuries lasted 7 days or less.
- The club spent R 966 540 in direct medical costs and lost wages all-inclusive. Sixty-three per cent of these total costs were due to injuries that were carried over from the previous season.
- The club spent a total of R 24 155 on direct costs due to the 34 time-loss injuries that occurred within the study period.
- The total wages paid to unavailable players during the season was R 783 156. Of this total, R 329 456 (42%) was because of injuries sustained during the study period.
- Total financial cost of injuries sustained during the season was R 353 611 which was comprised of 93% indirect and 7% direct medical costs. The team can expect a financial loss of R 52 186 /1000 exposure hours ($ 3 183 /1000 exposure hours).
- The average financial cost per injury was R 10 400 ($ 634 per injury).
- Other costs resulting from time loss injuries sustained before the current season but paid by the club within the study period that were not included amounted to R 612 929 with direct costs of R 159 229 and lost player wages amounting to R 453 700.
- The costliest injury type was muscle sprains/ruptures, responsible for R255 386 (72%) of total financial costs; this was followed by lacerations R 36 014 (10%) and sprain/ligament injuries R 32 484 (9%).
- The costliest injury location was the thigh, with a total cost of R 188 357 (53%), followed by hip/groin R 52 171 (15%) and foot/toe injuries R 47 186 (13%).

Chapter 5: Discussion

In this chapter, we will examine the study findings in detail, drawing comparisons to previous research in the field. Specifically, we will discuss the financial burden of injuries to the club, injury incidence and severity, and the injury locations and types that caused the most financial and time-loss burden over the study period. Additionally, we will outline and provide considerations for future research in this area. By thoroughly analysing these findings, we aim to contribute to the broader understanding of the financial cost of football injury to professional teams in South Africa.

During the 2021-2022 South African Premier Soccer League season, the team of 31 players sustained 34 new time-loss injuries. These injuries represented an injury burden of 236 player days lost to the team, with an injury burden of 34.8 days/ 1000 hours of football exposure. The areas of injury causing the highest amount of time-loss to the team were the thigh, groin, and ankle, with muscle strains being the most burdensome injury type.

The total financial spend on injuries and lost wages for the season was R 966 540 ($ 58 959), with R 612 929 ($ 37 389) of these costs due to injuries carried over from the previous season. The financial cost of injury for injuries during the season was R 353 611 ($ 21 570) at R 10 400 per injury (or $ 634 per injury). Our data suggests that the cost to the team for injuries sustained during the study period was R 52 186 /1000 exposure hours ($ 3 183 /1000 hours). The costliest injury type was muscle strains, accounting for R 255 386 ($ 15 579) (72%) of the total financial burden. The most expensive injury location was the thigh region, responsible for a total cost of R 188 357 ($ 11 490) (53%). From here onwards the costs will be expressed in South African Rand – the conversion for R to $ is 0.061.

5.1 Injury Risk

5.1.1 Playing Exposure and Injury Incidence

The initial finding of this study revealed 34 new time-loss injuries during the season. The 31-man squad accumulated a total football exposure of 6 776 hours (averaging 219 hours per player) during the 11-month season. Players spent approximately five times more time in training than in actual match play. This observed trend of a higher training-to-competition ratio aligns with patterns seen in other professional football teams and is documented in existing literature (Ekstrand, 2007; Ekstrand, Hägglund & Waldén, 2011a; Calligeris, Burgess & Lambert, 2015; López-Valenciano et al., 2020).

The overall injury incidence for this team was calculated at 5.0 time-loss injuries per 1000 exposure hours, suggesting a comparatively lower risk of injury than reported in previous studies in high-level European football teams. Injury incidence was higher than the 2.2 time-loss injuries /1000 exposure hours rate reported by Bayne et al. (2018) in a prior South African PSL study, but lower than 13.4 time-loss injuries/1000 player hours as suggested by Calligeris et al. (2015). A possible reason for the high injury rate as reported by Calligeris et al. (2015) could be differences in injury definitions used. In this study, a medical attention definition of injury was used, and therefore, medical attention injuries were reported rather than time loss injuries, which may have led to an overreporting of injuries.

Generally, high-level European football has exhibited a higher injury rate than the South African PSL, with potential reasons for the lower injury risk including longer recovery times between matches, fewer matches played, lower match intensity, and the ratio of training to match exposure (Ekstrand, Hägglund & Waldén, 2011a; Calligeris, Burgess & Lambert, 2015; Bayne, Schwellnus, Van Rensburg, et al., 2018). Other factors contributing to the low injury rate might involve training strategies and methods implemented by the team (Gabbett, 2016). Future research requires data from multiple seasons to be used to discern the reasons behind the observed lower injury rate in this study and South African PSL football in general.

Injuries during a season are more common during matches than during training sessions. This is because matches involve more physical intensity, contact, and fatigue than regular training. According to our research, the incidence of injury during matches was 13.1 time-loss injuries/ 1000 exposure hours, which is notably lower than the 23.8 time-loss injuries / 1000 exposure hours reported in high-level European football (Ekstrand et al., 2021). There are insufficient data to determine what causes the higher rate of injury in European football, but it could be related to a higher intensity and level of competition in Europe compared to SA or that players could be required to play a larger number of games during the season with shorter turn-around times between matches.

Training injury incidence was 3.6 time-loss injuries / 1000 training exposure hours, demonstrating a lower rate than in matches. When comparing training injury incidence with other high-level leagues globally, the difference in incidences is less pronounced than when comparing match injury incidence. This team's athletes might be at lower risk of injury during competitions due to their high-intensity and load of training, which may make them more resilient to the demands. While there is some data that supports the theory of using training as an injury prevention strategy in football (Gabbett, 2016), it is important to exercise caution in their interpretation, as the support for this theory is currently insufficient. The table below provides a comparison with previously published research on football injury incidence.

Table 16. Comparison between this study and previous research and represents the overall, training and match injury incidences reported in previous published literature on football injury epidemiology.

EXPOSURE TYPE	CURRENT STUDY	CALLIGERIS ET AL., 2015**	BAYNE ET AL., 2018	EKSTRAND ET AL., 2021	LÓPEZ-VALENCIANO ET AL., 2020
OVERALL*	5.0	13.4	2.2	6.6	8.1
TRAINING*	3.6	6.6	0.9	3.4	3.7
MATCH*	13.1	88.9	24.8	23.8	37.0

** Time-loss injuries / 1000 relative exposure hours (training, matches or overall)*
*** the study used a medical attendance definition of injury which explains the inflation of injury rates.*

On average, high-level European teams usually have approximately two injuries per player throughout the season (Ekstrand et al., 2011), and English professional football teams can expect 1.3 injuries per player per season (Hawkins et al., 2001). Upon initial evaluation of the data from this study, the number of injuries recorded this season (N=34) appears relatively low (one injury per player). However, this numerical representation of injury per player does not convey the complete picture and overlooks player exposure. Therefore, injury incidence serves as a more accurate indicator of the risk of injury to players for the season.

5.1.2 Location of Injury

The second finding from our data was that the vast majority of injury cases affected the lower limbs, which is consistent with previous research (Ekstrand, Hägglund & Waldén, 2011a, b; López-Valenciano et al., 2020). The most frequent injury locations in our study were the (1) thigh, (2) groin and (3) ankle. The thigh muscle region is the most injured body location in football (Waldén, Hägglund & Ekstrand, 2005; Ekstrand, Hägglund & Waldén, 2011a, b; Calligeris, Burgess & Lambert, 2015; López-Valenciano et al., 2020b). The percentage of thigh injuries in our study was 35%, which is higher than previous studies that have reported the thigh to account for between 17% to 25% of all injuries. Other investigations have shown injuries to the knee region as having the most injury burden with the highest mean economic burden (Pulici et al., 2023). An interesting finding was that there were only three knee injuries during the season which accounted for only 9% of injuries. It is well established that knee injuries cause significant burden and represent up to 75% of all major injuries, and their prevention is therefore paramount. The low number of knee injuries this season should, therefore, have a positive effect on the seasonal injury burden for this team. However, the cause of the lower knee injury incidence is unclear from our data.

5.1.3 Type of Injury

The third finding of this study was that the most common injury types were (1) muscle strains/ruptures, (2) sprains/ligament injuries, and (3) joint synovitis and effusions. It is important for teams to have a clear understanding of the types of injuries expected over the season, as the injured structure is associated with the expected amount of time loss due to injury and possibly financial cost (Ekstrand et al., 2020; Pulici et al., 2023). The high percentage of muscle strains is consistent with European research. These injuries cause the most loss of playing time on the club throughout the season (Hawkins et al., 2001; Pulici et al., 2023). In Europe, a team of 25 players can expect 18 muscle injuries a season, which averages 0.7 muscle injuries per player per season (Ekstrand, 2007). Other studies have reported similar findings (Hägglund, Waldén & Ekstrand, 2013). It is important for teams to minimise the number of muscle injuries to decrease the overall burden on the team.

Ligament injuries are often more severe, with longer lay-off periods and higher financial loss (Ekstrand et al., 2020; Pulici et al., 2023). Our study showed conflicting results with the average muscle strain resulting in 9.5 days of absence compared to 2.9 days of player absence for ligament injuries. However, this is likely due to the low number of ligament injuries, particularly to the knee, during the current season.

The type and location of injuries may depend on the nature and style of play in a league and can indicate how long the injury may take to heal (Calligeris, Burgess & Lambert, 2015; Ekstrand et al., 2020). Further research is required to draw any meaningful conclusions on the differences in injury profiles between South African players and players from other regions. A larger dataset of multiple teams over multiple seasons is required. These data can be useful in identifying high-risk areas that require targeted intervention to reduce overall time loss due to injury. Future research should focus on the burden of injury and not only incidence to help researchers better establish their impact on teams.

5.2 Injury Burden

Injury burden, defined as the product of incidence and severity, is expressed as the number of days of absence per 1000 hours of exposure (Drawer & Fuller, 2002a). Burden is the most comprehensive indicator of the injury problem within a team (Bahr, Clarsen & Ekstrand, 2018) as it offers a deeper understanding than solely focusing on injury incidence as has been the case in previous epidemiological studies (Bahr, Clarsen & Ekstrand, 2018; Pulici et al., 2023). If we are concerned with the true negative effects of injury to a professional organisation, burden cannot be omitted.

5.2.1 Player Absence Due to Injury

The 34 time-loss injuries resulted in 236 player days lost at an average of 6.9 days per injury. The mean time of absence was similar to the 8 days reported in another South African PSL study (Calligeris, Burgess & Lambert, 2015). European and English leagues have shown a higher mean time of absence of between 18.0 and 24.2 days (Hawkins et al., 2001; Ekstrand, Hägglund & Waldén, 2011a). It is possible that the reason for a lower average time off per injury might be due to fewer severe injuries and better rehabilitation practices, but the actual cause is not yet clear. It is evident that prolonged player absences due to injury can have significant negative effects on the team, including underperformance (Hägglund et al., 2013; Eliakim et al., 2020; Pulici et al., 2023).

5.2.2 Injury Severity

The injury severity profile is consistent with previous research in football, which indicates that most football injuries can be classified as *minimal* and *mild*. In our study, 76% of injuries sustained during the season resulted in a time loss of 7 days or less and were considered either *minimal* (1-3 days lost) or *mild* (4-7 days lost). The high percentage of *minimal* and *mild* injuries compared to *moderate* and *severe* injuries is a possible factor for the low seasonal time-loss burden. The types and locations of injury would also have influenced the severity of injuries and could be a factor for the low injury severity for most injuries sustained. For example, the low number of knee ligament injuries would have reduced the overall injury burden for the season (Bayne, Schwellnus, Van Rensburg, et al., 2018; Ekstrand et al., 2020).

One previous single-season study in SA football shows a higher percentage of severe injuries than the current study and European football research (Calligeris, Burgess & Lambert, 2015). This could be due various factors such as individual club factors, quality of rehabilitation, the definition of injury used, or the study could have occurred during an outlier season with more severe injuries.

5.2.3 Seasonal Injury Burden

The overall injury burden was calculated at 34.8 days absence/1000 total exposure hours. This is lower than the previously reported injury burden in the South African PSL of 63.5 days absence/1000 total exposure hours (Bayne, Schwellnus, Van Rensburg, et al., 2018). European studies have suggested a much higher burden of up to 130 days absence /1000 total exposure hours (Hägglund et al., 2013). The data we collected shows a lower overall injury burden, consistent with a lower injury rate, and less severe injuries resulting in fewer total days missed.

Injuries resulted in a higher burden on European teams than in the present study. For example, one hundred and seventy-two (76%) of the 236 total days of absence were because of muscle injuries, and the muscle injury burden of 25.4 days absence /1000 total exposure hours was lower than high-level clubs in Europe. One systematic review concerned with European football reported a burden due to muscle injuries of 34.7 days absence /1000 total exposure hours (Pulici et al., 2023). European data also suggests a higher burden of ligament injury of 37.9 days absence /1000 total exposure hours (Pulici et al., 2023) compared to the 3 days absence /1000 total exposure hours found in the South African PSL team in the current study.

The fact that ligament injuries in Europe usually result in a higher burden than muscle injuries suggests that the most prevalent injuries do not necessarily result in greatest burden to the clubs over the season (Ekstrand et al., 2020; Pulici et al., 2023). Our study did not follow this trend as the most prevalent injury type (muscle strains) also caused the most time-loss burden to the team, possibly due to the low proportion of ligament injuries sustained during the season.

The importance of reducing the burden associated with injuries cannot be overstated. A lower burden of injury has been shown to favourably impact the end-of-season measures of team success in football and other sports (Hägglund et al., 2013; Carling et al., 2015; Williams et al., 2015). If interventions are aimed at injuries that result in the most player absence to decrease overall burden, we must first be able to determine which injury leads to greater player absence (Pulici et al., 2023). A shift from injury incidence to burden is required in future football research to calculate the effects of injuries on organisations and not only their risk. The impact of injury as a measure of days lost provides a simple and standardized measure that can be compared easily between teams.

5.3 Injury – Financial Cost

The team paid a total of R 966 540 ($ 58 959) in direct and indirect medical costs during the season. Of this figure R 353 611 ($ 21 570 or 36%) were due to injuries sustained during the current season. The high percentage of economic costs carried over from the previous season highlights the need for teams to budget additional resources for the financial impact of injury over and above the costs expected for that current season. A strong argument could thus be made for future research to include all injury costs to the team over the season irrespective of when the injuries occurred, as these are still costs for which the team is liable. However, it was decided to include only injuries from the current season so that injury incidence, burden, and financial cost as a measure of exposure could be calculated.

For this team, 93 % of the financial costs associated with injury were due to lost wages paid to injured players and 7% were direct medical costs paid for medical service utilisation. This shows that most economic costs associated with injury are due to player absence rather than medical expenses. The team should focus their efforts on reducing injury-related absences to decrease overall economic costs.

While the low direct costs of medical services may be true for the team in our study, each professional football club will have a unique medical protocol regarding injury diagnosis and treatment based mainly on their available personnel and resources. For example, the club in this study uses diagnostic ultrasound imaging of muscle injuries and only sends players for MRI when injuries are suspected to be severe and not responding to conservative management. This approach significantly reduces the direct medical costs of injury. Teams with greater financial resources may prefer to send players for routine MRI studies as soon as an injury occurs for accurate diagnosis. Some teams may also need to outsource rehabilitation which would carry greater costs. It could be argued that the team should allocate more financial resources towards the diagnosis and treatment of injuries. This could potentially reduce player absences, which may result in decreased overall financial losses due to injuries over the season.

The economic loss that comes with an injury is primarily because the player is absent from the game, rather than due to medical services being utilised. This means that teams with higher average salaries can expect higher financial costs if their players get injured. Additionally, it is important to note that teams with the most injuries or burden (time-loss) do not automatically incur the highest financial loss for the season (Howden Insurance Brokers Ltd, 2022).

For example, in European football where average player wages are substantially higher, the economic burden of injuries is expected to be considerably more than in African leagues. Financial losses to teams competing in the top five European leagues are estimated on average at six million euros per season ($ 630 000) (Pulici et al., 2023). Teams in Africa incur lower financial losses due to lower player salaries compared to Europe. However, it can be argued that players who live in areas with limited access to medical care may potentially miss more time per injury. The lack of available epidemiological and economic research in African leagues highlights the need for more research.

For ease of comparison, the financial cost of an injury can be represented as USD /1000 total exposure hours. According to our data, injuries sustained during the season cost the team R 52 186 /1000 total exposure hours ($ 3 183 /1000 total exposure hours). Comparative information is scarce, making it difficult to draw meaningful deductions about this amount. However, this information can be used in future financial burden studies for comparison. This amount is important as it provides arguably the best tool for estimating injury-related costs to the team over the season based on team exposure.

The most expensive injury type was muscle strains, accounting (72%) of the total financial costs. This is not consistent with previous research in European leagues which reported ligament injuries as the most financially costly. As expected, data from the 5 top European leagues showed a much higher economic burden for muscle injuries (Pulici et al., 2023). The low number of ligament injuries particularly to the knee joint this season is a possible reason for the decreased player absence associated with ligament injuries and the lower economic burden of ligament injuries in this study.

The costliest injury location was the thigh region. Thigh injuries also caused the highest financial cost in top European clubs (Pulici et al., 2023). Muscle injuries, particularly of the thigh region, should thus be the priority of the team to reduce the overall time-loss and economic burden associated.

On average, the financial cost per injury was R 10 400 ($ 634). Lower average player salaries, low injury incidence, number of low severity injuries as well as the club not having to outsource rehabilitation services are possible reasons for the lower financial burden of injury. No operations and no MRI scans were required during the study period as most injuries were soft tissue and not injuries to the joint. This would have been a further factor contributing to the low medical costs this season.

Injuries negatively impact the club economy. Over and above the effect of player injuries on playing performance, injuries result in high economic costs to clubs (Eliakim et al., 2020; Pulici et al., 2023). The exact financial costs are difficult to determine due to their multi-faceted nature and gaps in methodology for determining their fiscal effects. However, the rationale of calculating these financial costs has important benefits to the professional sporting organisation both in terms of determining the cost-benefit ratio of any injury prevention interventions implemented and for seasonal medical and player budgeting (Bahr, Clarsen & Ekstrand, 2018; Pulici et al., 2023).

Our research has shown that most economic costs are due to wages paid to unavailable players as opposed to medical service utilisation and that the total economic costs associated with injury is influenced by many individual factors such as: injury incidence, injury severity, injury burden, type and location of injury, player salaries and access to medical resources. Teams must budget for medical costs for the current season and injuries carried over from previous seasons.

The average financial cost of a time-loss injury for the season was R10 400 ($ 634). By extrapolation, clubs playing in the South African PSL should budget at least R10 400 per expected injury. However, teams with more severe injuries or with a higher ratio of ligament injuries (particularly of the knee) could expect substantially higher economic losses. The club would also need to factor in their own average salary with injury burden calculations to determine their unique seasonal cost of injury. It must be reiterated that our calculations did not include the financial cost of team underperformance due to injury. At the time of writing, the methods for accurately calculating this cost requires refinement, but novel research has shown overwhelming evidence to suggest that player absence due to injuries has the potential to result in heavy financial losses to professional football teams due to team underperformance (Eliakim et al., 2020). We therefore expect the true financial burden of injury to be underreported in this study. The aim of football teams should be to decrease player absence associated with injuries as this was associated with the greatest financial cost to teams as opposed to the direct medical costs of treatment. For this team reducing the number and burden of muscle injuries to the thigh region should be the priority of the club medical department.

5.4 Injury Prevention - a Strategic Approach

While a detailed exploration of preventive and rehabilitative strategies lies beyond the scope of this discussion, our insights offer a directional guide for South African football teams seeking to optimise their prevention efforts. Although a comprehensive analysis is deferred, a strategic focus emerges, indicating where interventions may be most impactful in reducing injury burden to professional teams.

Previous research on injury burden underscores that the most effective interventions should address the injuries causing the highest burden, rather than focusing solely on those that happen most frequently (Bahr, Clarsen & Ekstrand, 2018). Our data strongly suggests that to achieve optimal benefits in terms of lowering injury burden, SA teams should prioritise efforts to reduce the number of player absences due to muscle injuries, particularly to the thigh region. Implementation of targeted programs focusing on these types of injury potentially offer a favourable return on investment to teams from a financial standpoint. Studies point to the efficacy of various interventions such as stretching, eccentric strength training, core stability exercises, and multi-intervention programs like FIFA 11+. Notably, Nordic hamstring exercises and reverse Nordic exercises have demonstrated effectiveness in reducing thigh injuries (Ayala et al., 2019; Bisciotti et al., 2019). Crucially, these strategies require no specialised equipment and are particularly advantageous in low-resource settings.

The scope of targeted interventions should extend to reducing *moderate* and *severe* injuries, especially those affecting the knee joint, owing to the high burden associated with these injuries. Previous studies highlight the cost-saving benefits of neuromuscular training and the adoption of injury prevention programs like FIFA 11 and 11+ (Nouni-Garcia et al., 2019). By curbing the incidence of injuries and lessening seasonal injury burden, teams can concurrently reduce costs linked to injuries, enhance player availability, and potentially bolster team performance. The resultant cost savings may also fortify club operations, providing additional financial resources for facility improvements, player salaries, and other pivotal aspects.

5.5 Summary

Time-loss injuries exert a significant three-fold financial burden on professional football teams, lost player wages, incurred medical costs and effects of team underperformance due to player unavailability. While current South African injury data suggests a comparatively lower risk and burden than European football, the direct and indirect medical costs of injury emphasize the financial challenges faced by professional football organizations. Determining the financial impact of injury becomes even more critical in regions with limited medical resources, such as Africa. Access to appropriate care might be constrained, amplifying the burden on these teams.

Our research reveals that muscle strains, particularly of the thigh region are the costliest from a financial standpoint and efforts should be made to prevent these injuries. Reducing these injuries could lead to a positive return on investment and make the programs appealing to stakeholders.

Teams need to budget for new injuries and those carried over from previous seasons, particularly given their potential to impact the current season significantly. It's crucial to note that the full financial cost of injuries is not entirely represented in our data, as the methodology for accurately determining the costs associated with team underperformance requires further refinement.

Despite these limitations, the cost data are a valuable tool for stakeholders. It helps them make informed decisions about budgeting and understanding the broader impact of injuries on teams. The potential savings and performance enhancements offered by injury prevention programs highlight the urgency of refining methodologies. Refinement is crucial for stakeholders to make educated decisions about financial budgeting and implementing effective injury prevention strategies.

Chapter Six: Conclusion

6.1 Limitations and Recommendations for Future Research

This study was conducted in accordance with the consensus statement on injury definitions and data collection procedures in football injuries (Fuller et al., 2006). By doing so, we were able to improve the generalisability of the results. This research is expected to provide a methodological framework for future research at other clubs and leagues. The only difference was that the current study performed a retrospective analysis of pre-recorded injury data captured prospectively during the season. While every effort was made to ensure the accuracy of data by cross-referencing injury data with session GPS data and training attendance registers, future research should be done prospectively, as per the consensus statement, to ensure that no injuries resulting in time loss or financial cost are missed.

The small population size and the single-season study period constrain the generalisability of the study findings. While other teams may experience a similar incidence and profile of injuries, the results are contingent upon the characteristics of each team and its squad. Factors such as player exposure and squad size can influence the frequency and costs of injuries. Additionally, the financial burden of injuries is influenced by the unique wage structure of each team. Teams with higher salaries are more likely to have higher expenses due to losing player wages. To make accurate inter-team comparisons, a longitudinal database of injuries within the league is needed in South Africa. To establish this database of injuries, we suggest that the South African Football Association (SAFA) and the PSL implement standardised injury data capture practices across all professional teams in the country. This would ensure more meaningful findings applicable to the entire league, leading to educated decisions regarding injury prevention and team budgeting.

Individual clubs may have distinct injury protocols, including player referral for specialist consultations and imaging studies. There may be differences in resources among clubs, with some having access to a full-time doctor while others may need to pay extra to outsource these services. To gain a complete understanding, future research could include the wages of medical staff employed by the club and compare them to the findings of this study to provide a more comprehensive analysis.

It may be important for future studies to ensure an injury referral protocol is established to ensure uniformity and generalisability of results between teams. This would be difficult to implement at a league-wide level without financial assistance from football governing bodies due to discrepancies in access to medical care and finances. It is expected to be especially true in low-resource settings such as the African continent.

Not considered was the impact of personal medical aids and team medical insurance in softening the financial costs of injury to professional organisations. Future research could factor in the cost-benefit ratio of these policies. Also not considered are the costs of routine prophylactic medical supplies such as strapping/bracing and analgesic medication, which could influence injury rates and player availability. Future research should include all medical supplies and medications to determine a more accurate total economic cost associated with injuries and their prevention. These costs could be grouped with injury risk reduction/prevention strategies to determine the cost-benefit ratio of these interventions.

Furthermore, all injury rehabilitation is performed in-house by full-time club employees, reducing the costs of outsourcing these services to outside professionals. Other teams who may not have access to a full-time physiotherapist could expect higher costs associated with rehabilitation. Future research could determine the cost-benefit value of full-time rehabilitation professionals by assessing the number of treatment sessions performed during the season and what these would cost to outsource compared with the annual salaries paid by the club. However, based on rudimentary calculations, it can be expected to cost considerably more to outsource than to hire full-time employees.

Injuries occurring before to the study period and the impact of injuries on team performance were not included in the seasonal cost of injury calculations. Our data shows that these factors have the potential to increase injury costs substantially and may have resulted in underreporting of financial costs for the season. Professional clubs could, therefore, need to budget considerably more than expected for injuries that were carried over from previous seasons and a decrease in team performance.

It can also be argued that a true burden of injury cannot be accurately established by omitting team underperformance due to injury from the calculation. Future research should include these costs so that the estimates of the true financial burden of injury can be determined by teams. While groundwork research has been conducted in other sports, it must be refined for football. Building on and improving the current methodology could greatly benefit the football industry (Williams et al 2015, Higham et al.)

We recommend that similar studies be implemented at semi-pro and amateur levels and in other countries on the continent. In these low-resource settings, medical costs associated with injury are more impactful. Despite the methodological challenges faced, we believe this study has identified important gaps.

6.2 Concluding Summary

This study demonstrates that time-loss injuries result in considerable financial costs to professional football teams due to medical treatment costs and lost player wages. Teams should set aside a budget for injuries that occur during the current season and any injuries carried over from previous seasons to ensure financial stability. Despite this evidence, there is a lack of literature describing the financial impact of injuries to professional teams, both locally and internationally. There is an urgent need to determine and focus on the financial burden of injuries to football teams, given the professionalism and high financial stakes of the sport.

Financial data shows that for this team, muscle strains, particularly of the thigh region, are the most prevalent and result in heavy financial losses; this is in line with previous football epidemiological studies. Their prevention should thus be prioritised to have the largest effect on the overall injury burden to the team. Injury risk reduction programs such as the FIFA 11+ have shown beneficial effects on thigh injury rates and should be considered by the club concerned. It is important to note that while there were a limited number of knee injuries during the current study period, teams must continue to implement risk reduction strategies as any knee injuries have the potential to result in a significant financial burden to teams.

Not considered in this study were the expected financial losses due to team underperformance resulting from player unavailability because of injury. These losses are expected to result in a higher actual burden of injury to teams and need to be quantified for meaningful deductions. However, the methodology used in previous research to determine these costs needs further refinement. This highlights the importance of robust future research and finetuning of the current method regarding the financial aspect of injury burden in football.

Seasonal cost of injury information is vital for teams to make financial budgeting decisions. This information is also important to determine the need for, and cost savings related to, injury prevention strategies implemented. Research to date shows that these programs are effective at reducing injury risk when adhered to, but there is limited research to show their cost-saving and return on investment potential. For these programs to be implemented from a stakeholder level, the financial benefits must be clear. The present research highlights the importance of determining the real-world cost savings of injury risk reduction programs and demonstrates the insufficient literature in this area. The cost savings associated are shown to be sufficient to warrant future-focused research.

To the author's knowledge, this is the first study of its kind in South Africa. Although we understand that the results of this study cannot be applied to all football clubs in South Africa and worldwide, our research will play an essential role in future sports injury research, which has been previously neglected. Future research needs to build on the current methodology employing standardised injury reporting and statistical analysis with larger datasets over multiple seasons.

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List of Appendices

Appendix A: HREC Approval

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room 45 E-52-E-Floor- Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: hrec-submissions@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

30 August 2022

HREC REF: 512/2022

Prof M Lambert
Division of Physiological Sciences
SSISA, Newlands
Email: mike.lambert@uct.ac.za
Student: andrewcphysio@gmail.com

Dear Prof Lambert

PROJECT TITLE: THE FINANCIAL BURDEN OF INJURY AT AN ELITE SOUTH AFRICAN FOOTBALL CLUB DURING THE 2021-2022 PREMIER SOCCER LEAGUE SEASON- (MSC CANDIDATE-MR ANDREW COPPIN)

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee (HREC) 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 30 August 2023.

Please submit a progress form, using the standardised Annual Report Form (FHS016) 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)

The HREC acknowledge that the student: Mr Andrew Coppin will also be involved in this study.

Please quote the HREC REF 512/2022 in all your correspondence.

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

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

Yours sincerely

Signed by candidate

PROFESSOR M BLOCKMAN
CHAIRPERSON, FACULTY OF HEALTH SCIENCES HUMAN RESEARCH ETHICS COMMITTEE
Federal Wide Assurance Number: FWA00001637. Institutional Review Board (IRB) number: IRB00001938 NHREC-registration number: REC-210208-007

HREC/ref 512.2022

HUMAN RESEARCH ETHICS COMMITTEE
- 4 SEP 2023
HEALTH SCIENCES FACULTY UNIVERSITY OF CAPE TOWN

UNIVERSITY OF CAPE TOWN

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	30.10.2024
☐ Not approved	See attached comments		
Signature Chairperson of the HREC/ Designee		Date Signed	4/9/2023

Note: Please email this form and supporting documents (if applicable) in a combined pdf-file to hrec-enquiries@uct.ac.za.
Please clarify your plan for research-related activities during COVID-19 lockdown.
Please use the latest form found on our website:
http://www.health.uct.ac.za/fhs/research/humanethics/forms

Comments to PI from the HREC

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	30 August 2023		
HREC REF Number	512/2022	Current Ethics Approval was granted until	30 October 2023
Protocol title	The financial burden of injury at an elite South African football club during the 2021-2022 Premier Soccer League Season (MSC CANDIDATE MR ANDREW COPPIN)		
Protocol number (if applicable)	N/A		
Are there any sub-studies linked to this study?		☐ Yes	✓ No
If yes, could you please provide the HREC Reference number for all sub-studies? Note: A separate FHS016 must be submitted for each sub-study.	N/A		
Principal Investigator	Emeritus Professor Mike Lambert		

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

Appendix B: Club Permission Letter

CAPE TOWN CITY FOOTBALL CLUB

05 May 2022

To whom it may concern

This letter serves to confirm, in my capacity as CEO of Cape Town City F.C. that we are fully supportive of the audit of the injury and related financial data of the Cape Town City football team for the use in Andrew Coppin's Master's degree research project.

He has explained the type of data he will be analysing as well as expected outcomes, risks, and benefits to both the club and individual players. We believe that the findings of this type of research could assist the club for future seasons in terms of medical insurance, budgeting, and squad size calculations.

Andrew, as part of his job as club head of medical, routinely gathers this information about injuries and their cost to the club and has done so since joining us in 2019. I can therefore confirm that no new data capture protocols have been implemented purely for the purposes of this project.

Andrew has explained to us that the players will sign informed consent individually for the use of their medical/injury records to be audited and included as part of the research project and they have the right to refuse to participate. We as a club understand that while no identifying information of either club or players will be advertised during the study there is a potential for the club to be identified based on the analysis and results reported, we understand this risk and do not see it as a concern.

We wish him luck in the completion of his post graduate studies

Yours sincerely,

Signed by candidate

MICHEL COMITIS
CEO CAPE TOWN CITY FOOTBALL CLUB

DirectAxis

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Email: info@capetowncityfc.co.za
web: www.capetowncityfc.co.za

Address:
101 Greenmarket Place,
54 Shortmarket Street, Cape Town

Appendix C: Informed Consent Form

University of Cape Town
Department of Health and Rehabilitation Sciences
Faculty of Health Sciences
Division of Physiotherapy

F45 Old Main Building, Groote Schuur Hospital

THE FINANCIAL BURDEN OF INJURY AT AN ELITE SOUTH AFRICAN FOOTBALL CLUB DURING THE 2021-2022 PREMIER SOCCER LEAGUE SEASON

Dear prospective participant

The University of Cape Town Division of Physiotherapy is conducting a study to determine the financial cost of injury at an Elite South African football club during the 2021-2022 Premier Soccer League season. The study will use season injury statistics to calculate the cost of first team squad player injuries to the club, both in terms of direct medical costs (i.e., the cost of scans, doctors' appointments, surgeries etc.) and days lost due to injury. The information collected will be used in a final year student thesis for a Master of Science degree in exercise and sports Physiotherapy.

This is the first study to describe the financial cost of injuries in South African football and is of considerable importance as injuries have shown to pose a significant threat to club financial stability. This study will add to the scarce football literature in South Africa and can be used to guide squad selection and injury prevention strategies for future seasons. It can also be used as a reference for future research in this field.

You have been selected to participate as a First team squad member at Cape Town City Football club during the 2021-2022 Premier Soccer League season. Sensitive club data pertaining to injuries sustained during the season such as number, nature, and time-loss characteristics, as well as team average player wages will be used for cost of injury calculations. These data are routinely captured by club medical staff and were compiled throughout the 2021-2022 season. As such there will be no change in player or club day-to-day operations that may place participants at increased risk.

The research will be conducted in accordance with UEFA and FIFA recommended best practices and the investigator ensures that all steps have been taken to ensure that all personal identifying information will be sufficiently changed so that it cannot be traced back to the individual concerned. At no time will any of the researchers have access to your personal salary information and the pre-calculated average weekly player wages will be provided directly from the club finance department. The utmost confidentiality will be maintained throughout the data capture and reporting phase of the project. You have the right not to participate or to withdraw from the study at any point without prejudice.

Study findings will be made available to participating players and club stakeholders and could benefit clubs and players by informing targeted future injury prevention strategies. Decreased injury risk has been shown to benefit both players and teams and is of utmost importance considering the high rate and burden of football injuries.

*This project has received approval from the Human Research Ethics Committee (HREC) of the Faculty of Health Sciences, University of Cape Town and will be supervised by Professor Mike Lambert Division of Exercise Science and Sports Medicine (ESSM), Department of Human Biology, Faculty of Health Sciences, University of Cape Town.

Please feel free to contact either myself or my research supervisor at any time if you have any further questions related to the study.

Andrew Coppin 072 231 8967
cppand001@myuct.ac.za
Professor Mike Lambert 021 650 4558
mike.lambert@uct.ac.za

Thank you in advance for supporting research within the field of football sports medicine and performance.
Andrew Coppin (investigator)

Signed by candidate

BSc. Physiotherapy 2012 (UCT)
OMT 2016
Phone: 072 231 8967
Email: Cppand001@myuct.ac.za

By signing this document, it serves as confirmation that you are willing to participate in and have read and understand the aims and methods proposed in this study as well as their potential risks and benefits. You are reminded that it is your right to refuse participation and that you may withdraw from the study at any time

_____	_____	_____
Signature of Volunteer	Name (Please Print)	Date
_____	_____	_____
Signature of Witness	Name (Please Print)	Date
_____	_____	_____
Signature of Investigator	Name (Please Print)	Date

Appendix D: Player Baseline Information Form

FIFA F-MARC MEDICAL ASSESSMENT AND RESEARCH CENTRE
For the Good of the Game

Players' Baseline Information Form

Team-code No: _____

Logo

Player's code No.[1]	Playing position[2]	Age[3], years	Stature, cm	Body mass, kg	Dominant leg[4] (L/R/B)	Details of previous major injuries	Study specific variable	Study specific variable

Notes: [1] Use additional sheets if required [2] Goalkeeper, Defender, Midfielder, Forward [3] Age as at the start of season / year / tournament [4] Left, Right, Bilateral

Appendix E: Club Training and Match Attendance Register

May-22																														
SESSION DATE	1.5.2022		2.5.2022		3.5.2022		4.5.2022		5.5.2022		6.5.2022		7.5.2022		8.5.2022		9.5.2022		10.5.2022		11.5.2022		12.5.2022		13.5.2022		14.5.2022		15.5.2022	
SESSION TYPE	GYM	OFF	FIELD	OFF	OFF	GYM	PSL (27)		FIELD	OFF	FIELD	OFF	PSL (28)		OFF	OFF	OFF	OFF	FIELD	GYM	FIELD	OFF	FIELD	OFF	FIELD	OFF	PSL (29)		OFF	OFF
SESSION TIME	45	0	60	0	0	45	0	0	60	0	60	0	0	0	93	60	75	60	75	45	90	0	80	0	60	60	0	0	86	60
PLAYER	Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10	Column11	Column12	Column13	Column14	Column15	Column16	Column17	Column18	Column19	Column20	Column21	Column22	Column23	Column24	Column25	Column26	Column27	Column28	Column29	Column30
[redacted]																														
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	SUSPENDED	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	D1 (1)	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]																														
[redacted]	1	OFF	1	OFF	OFF	1	0	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]																														
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	0	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	D3 (1)	D3 (2)	D4 (3)	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]	1	OFF	1	OFF	OFF	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	1	OFF	OFF	OFF
[redacted]																														
[redacted]	1	OFF	1	OFF	OFF	0	0	OFF	0	OFF	1	OFF	0	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	0	OFF	OFF	OFF
[redacted]	0	OFF	1	OFF	OFF	0	0	OFF	0	OFF	1	OFF	0	OFF	OFF	OFF	OFF	OFF	1	1	1	OFF	1	OFF	1	OFF	0	OFF	OFF	OFF
P (TOTAL)	22	0	23	0	0	21	20	0	21	0	23	0	20	0	0	0	0	0	22	22	22	0	22	0	23	0	20	0	0	0
TRAINING EXPOSURE	990	0	1380	0	0	945	0	0	1260	0	1380	0	0	0	0	0	0	0	1650	990	1980	0	1760	0	1380	0	0	0	0	0
MATCH EXPOSURE	0	0	0	0	0	0	1034	0	0	0	0	0	1056	0	0	0	0	0	0	0	0	0	0	0	0	0	1034		0	0
							94						96														94			
TOTAL TEAM TRAINING SESSION TIME	1590																													
TOTAL TRAINING EXPOSURE	21305																													
FIELD	17345																													
GYM	3960																													
	21305																													
TOTAL MATCH EXPOSURE	4180																													

Appendix F: Injury Report Form

INJURY REPORT FORM

Player's Code No.	Date of injury	Body part/region	Type of injury	Diagnosis	Return to full training and match availability	Time-loss (days)	Matches Missed	Training days missed	Re-injury Yes/No	Total Direct Medical Costs incurred