Study of A Year in Football Injuries and Trauma

AND EVALUATION OF A

Handheld Uniform Recording Tool

(STAYFIT-HURT)

Project Number:

xxxxxxxxx

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Abstract

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Introduction

This project aimed to create a platform to research injury patterns during the Scottish Professional Football League Season of 2019/20, to investigate these patterns, and to demonstrate how this data could be captured by evaluating the feasibility of using a mobile uniform medical records tool.

Methods

The study was a prospective observational study which involved the recruitment of clinicians working in professional football clubs to record player injury data using the novel ScribePro® app on their mobile device. Anonymised data was then extracted from the app for analysis in line with General Data Protection Regulations (2018). An evaluation process was undertaken retrospectively with key participants generating personal incident narratives to evaluate key issues around effectiveness of the tool and the feasibility of a uniform medical records system.

Results

Volume of data collected was lower than predicted due to the global COVID-19 pandemic curtailing the researched season, limited club engagement and high levels of participant drop out. 122 significant injury episodes from 4 SPFL clubs were captured. Results of limited statistical significance include: no demonstrated difference between professional and semi-professional players, 1.44 injuries per player versus 1.43 (p-0.9446, CI -0.2953, 0.2753); higher injury rates in players aged 26-29; forward position players with fewer injuries, average 1.0 injury per player versus study mean of 1.428 for all playing positions; no increase in injury rate on artificial grass versus natural grass during matches, 0.500 injuries per match on artificial and 0.549 on natural grass (p-0.547, CI -0.122763, 0221664); and thigh and ankle injuries being the most common anatomy affected.

Discussion

The STAYFIT-HURT project demonstrated that reliable injury data can be collected using a mobile medical records app and important questions have been identified regarding the patterns of injuries, with the potential to inform player safety. Power calculations have been employed to indicate the quantity of data required to sufficiently power future similar research. The comprehensive introduction of such a system across Scottish Professional football faces significant logistical and cultural challenges but could make a major impact on clinical care, player welfare, help inform optimal utilisation of clubs' major resources (ie players) and provide a valuable research platform.

Contents

Appendices

Acknowledgements

STAYFIT-HURT Research Team

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Declaration

I declare that, except where specific quotation or reference is made to other sources, this thesis is the result of my own work and has not been submitted for any other degree at the University of Glasgow or any other institution.

Dr. Thomas F. Kaye

List of Tables

TEAM REPORT TABLES

List of Figures

List of Abbreviations

STAYFIT-HURT	Study of A Year in Football Injuries and Trauma and Evaluation of a Handheld Uniform Recording Tool
UEFA	Union of European Football Associations
FIFA	Fédération Internationale de Football Association
GDPR	General Data Protection Regulations
SOAP	Data entry acronym: Subjective, Objective, Assessment, Plan
SCAT	Sport Concussion Assessment Tool
FIELD	Football's InfluencE of Lifelong health and Dementia risk
CTE	Chronic Traumatic Encephalopathy
NFL	National Football League (USA)
SPFL	Scottish Professional Football League
GPS	Global Positioning System
OSIICS	Orchard Sports Injury and Illness Classification System
IOC	International Olympic Committee
NHS	National Health Service
GMC	General Medical Council
CSP	Chartered Society of Physiotherapists
PFA	Professional Footballers Association
STROBE-SIIS	STROBE Extension for Sport Injury and Illness Surveillance
NCAA	National Collegiate Athletics Association
ICD	International Classification of Disease
HTTPS	Hypertext Transfer Protocol Secure
PROMOTE	Practical Resus Of Medical Or Trauma Emergencies
SFA	Scottish Football Association
WADA	World Anti-Doping Authority
JRG	Joint Response Group
AI	Artificial Intelligence

Chapter 1 – Introduction

a. Aims / Background
b. Current Key Medical Issues in Professional Football
    i. Head Injuries
    ii. Artificial Pitches
    iii. Winter. vs Summer Football
    iv. Intensity of Fixtures
    v. Other Risk Factors for Injuries in Football
c. Types of injury and Injury Classification
d. Medical Records in Football
e. The UEFA Elite Injury Club Study

Chapter 1 Introduction

1.a. Aims / Background

Sport and Exercise Medicine is a rapidly burgeoning field within clinical medicine and research, with association football, the world's most popular sport (1), at the forefront. Football is ingrained in culture around the world and, according to the FIFA Professional Football report 2019, there are over 125,000 professional players worldwide. As ever more financial and media interest is attracted to football at the highest level, and hence revenue becomes increasingly linked to football club profile and competition success, there is an increased focus on the gains that can be made in optimising player performance. At the vanguard of this optimisation is the incorporation of a complex sport science platform and the management of the players' health. For the clinicians involved in providing this physical and mental health care the priority is the safety and wellbeing of their patients and there are multiple aspects of this care that require governance while meriting scrutiny and development. A secondary consideration of the clinicians is the players' fitness and availability to participate in football matches, often inextricably linked with their wellbeing. Both aspects of this developing clinical area represent an enormous opportunity for clinical research, the bedrock of which lies in high quality reproducible practice that is accurately documented to generate robust data.

There is recognition at the upper echelons of the major football governing bodies, most notably UEFA (the Union of European Football Associations) and FIFA (Fédération Internationale de Football Association), that medicine in professional football requires increased support and to generate specific expertise (2). As an illustration of the importance of injury to this significant population, an epidemiological research project in England suggested that male professional footballers were approximately one thousand times more likely to suffer injury than in other industrial occupations (3). In this study the overall injury frequency rate was 8.5 injuries per 1000 hours but the rate during matches was 27.7, significantly ($p < 0.01$) higher than that during training when it was 3.5. No confidence intervals were reported. Another systematic review and meta-analysis reported the rates of match injury are about 36 injuries per 1000 hours in elite male football (95% CI 31.3 to 40.8), and a training incidence of 3.7 (95% CI 3.1 to 4.4) (4). Comparison between studies is challenging due to variability in injury definitions, team circumstances and the type of exposure but in another large systematic review the incidence of injuries during matches in professional male footballers was reported as 30.64 injuries per 1000 hours (95% CI 20.36 to 40.92), and 3.97 (95% CI 2.62 to 5.32) in training (5).

Comparison with other sports is also difficult due to a lack of uniformity injury definitions, reporting and clinician involvement, however in elite rugby union injury rates appear higher. A large surveillance project that reported on 10851 time-loss injuries over 16 seasons of elite male professional rugby matches in England described 87 injuries per 1000 hours (95% CI 82 to 92) (6). A study looking at the Scottish national rugby teams over seasons 2017-2019, demonstrated match injury incidence was 120.0 injuries per 1000 hours in the men's team (7). There are fewer studies available for other team sports but rates in handball are reported as between 23.5 per 1000 hours (95% CI 17.8 to 30.4) (8), in field hockey matches as 9.7 per 1000 match hours (95% CI 6.8 to 12.7) (9), and in basketball as 9.8 per 1000 hours (95% CI 8.5 to 11.1) (10).

High quality clinical research of injury patterns in professional football is sporadic and within the professional and semi-professional game in Scotland it is rare. Only a single published study was identified looking specifically at professional football in Scotland (11), further evidence that research in this area is overdue. Perhaps most concerningly from a clinical perspective, recent analyses from 2014 and 2015 demonstrated many widely accepted practices in professional football, in terms of injury prevention, are not based on good quality evidence (12).

The limited use of a worldwide uniform injury recording strategy is a central reason for the restricted comparisons of injury incidence that currently exist (13). This comparison would underpin future surveillance and hence inform future prevention. Standardised injury data reporting systems do exist and have, for example, been developed at FIFA World Cup competitions since 1998 (14) but have not spread beyond elite competition.

The top four tiers of Scotland's male football pyramid comprise the Scottish Professional Football League. Forty-two professional and semi-professional teams are divided into four leagues. The number of players used in each club's first team squad may reach thirty to forty individuals in more senior clubs. In a single season the total number of players involved across all of these clubs' first team squads is likely to be over a thousand, and individual clubs can play as many as sixty games across various competitions. A study of injuries in a single football season that could capture all these individual injury profiles has the potential to produce very substantial impactful data. If high quality information regarding player injuries could be harnessed from each of the above clubs, the potential research platform to optimise future care would be 'game-changing'. Practical methodology and process for collecting this data did not exist at the outset of the STAYFIT-HURT project.

The aim of this prospective observational study is to demonstrate a method by which this research platform could be reached using a uniform data entry system and hence display injury data that could be achieved in a comprehensive surveillance model. It is hoped that sufficient data from Scottish football clubs may help to investigate a number of themes related to injury prevalence, discussed in more detail below, and help to inform future best clinical practice. A demonstration of the potential for data capture could therefore act as springboard for Scottish Football to become a world leader in injury surveillance and clinical research.

1.b. Current Key Medical Issues in Professional Football

As a feature of Scottish culture that is reflected throughout the world, there is near constant debate about all aspects of professional football conducted in both mainstream media and the sports medicine community alike. An injury surveillance project offers the opportunity to inform this debate and is particularly applicable to Scottish football which has a high number of professional and semi-professional clubs for a country of its size and population. There are several key issues concerning player welfare that are particularly pertinent to this research including: head injuries and concussion, artificial playing surfaces, the benefits of a winter or summer football season, and the intensity or number of fixtures that players are involved in. These issues were identified during planning discussions between the research group clinicians who had extensive clinical experience in professional football. The basis for the discussion of these issues is anecdotal rather than scientific. Another key current issue is player mental health and, although this project is not designed to investigate this specifically, all these aspects require robust research.

1.b.i. Head Injuries

The ongoing FIELD study (Football's InfluencE of Lifelong health and Dementia risk) by the Glasgow Brain Injury Research Group is an example of high-profile research that has sought to investigate the incidence and impact of traumatic brain injury in the development of chronic traumatic encephalopathy (CTE) later in the life of footballers using a retrospective cohort study (15). As evidence in this area develops the necessity for safe protocol in managing head injuries is becoming increasingly apparent. A usable platform to manage and document these assessments timeously would be a critical aid for clinicians in a number of ways. This would have contemporaneous benefit; a facility to monitor SCAT5 (Sport Concussion Assessment Tool 5 – see appendix 11) observations after a head injury episode; and would provide some retrospective history of injury and management. There is certainly a likelihood of increased scrutiny in sporting head injury management in the future with the potential for retrospective litigation. The most prominent example of this being in American Football in 2013 when, in the face of building CTE evidence, the NFL (National Football League) agreed to an initial settlement of $765,000,000 with the players and families affected by concussion during professional playing careers (16). There are also ongoing UK lawsuits from recently retired professional rugby union players, most recently a group based in Scotland, that have been diagnosed with cognitive impairment related to head injuries. How directly applicable these examples are to association football is not clear but is surely further substantiation that an injury data reporting and monitoring tool is essential.

The prevalence and management of head injuries in Scottish football has become a key player welfare and governance issue that is under ongoing review in 2022 with additional 'concussion substitutes' being introduced in SPFL season 2021/22. These are intended to allow a clinician to undertake a standardised head injury assessment and remove the player suspected of concussion from the field of play without the penalty of the player's team losing one of their allocated substitutes. It is therefore highly likely that these head injury / concussion assessments will need to be fed back in a reliable reproducible format to ensure this facility is not abused tactically during a match.

Existing research regarding head injuries in professional football remains relatively sparse but is building quickly with projects like the FIELD study. A prospective cohort study published in 2013 investigated head injury rates and risk factors between 2001/02 and 2009/10 in elite European clubs (17). Of the 136 head and neck injuries recorded (2.2% of the total injuries), the injury rate was 0.17 per 1000 hours although the risk was far higher during competitive matches compared to training sessions. The mean time that players were unavailable to play was 10.5 days after a concussion but over a quarter had returned within 5 days of a documented concussion suggesting some variability in clinical management, not in keeping with consensus guidance. A further study of the 2017/18 German Bundesliga season matches reported a head injury rate of 2.9 per 1000 hours (95% CI 2.0 to 4.1) (18).

The management of concussion in professional football is also rapidly evolving. In 2015 Scotland was the first country to produce national concussion guidelines to be implemented from grassroots football to the professional game, and indeed across multiple sporting platforms (19). There is also international consensus about the diagnosis and management of this condition which has led to the aforementioned SCAT tool, to be used to assess potential concussion in athletes over 13 years of age (a different child SCAT exists for children). The current version of this tool is the SCAT5, so named after the 5th Concussion in Sport International Conference in 2016, the consensus statement from which has numerous key management points for clinicians to follow (20). This paper is displayed in the format of answering key questions under the headings of Recognise; Remove; Re-evaluate; Rest; Rehabilitation; Refer; Recover; Return to sport; Reconsider; Residual effects and sequelae; Risk reduction. Each question formulated was scrutinised with a formal systematic review (published separately), with the consideration of approximately 60000 relevant publications. This provides the current evidence-based foundation for the diagnosis and management of head-injury or concussion in professional football.

1.b.ii. Artificial Pitches

Artificial pitch surfaces in all professional sport, not only in football, are controversial. Synthetic pitches have steadily advanced in popularity and technology since the 1980s as various professional clubs have decided to adopt these as a solution to pitch maintenance problems, climatic challenges or simply to maximise available revenue by a stadium becoming available for other uses. In general terms these pitches consist of an engineered sub-base, a rubber shock-absorbing elastic layer, then third generation (3G) synthetic polyethylene grass fibres over 40mm in height surrounded by loose rubber infill particles. These surfaces are regulated in the professional game by either the '*FIFA Quality Concept for Artificial Turf'* or the *'International Artificial Turf Standard'*. FIFA standards are based on testing the height of ball bounce and the 'rounding test' which measures the distance of travel seen in a ball dropped at 45 degrees. Surface resistance and shock absorption is also measured but no direct assessment is made of either human or footwear contact with the pitch. Further generations of synthetic pitch remain in development but are not yet FIFA-approved.

There has long been speculation that injuries in football may be surface-related and linked to the pattern of friction with footwear (21). Early research from Sweden in the 1970s conducted on first generation surfaces reported increased injury rates when players wore studded footwear (22). Another early Norwegian study that is cited extensively in the literature but is not available online or in English investigated injury rates over a 2-year period in the mid 1980s in 16 clubs, finding 30 injuries per 1000 hours on artificial turf compared to 20 injuries per 1000 hours on natural grass (23). However, the conclusions from this study are limited by small numbers and measures of variance are not available. The application of such evidence to more modern synthetic surfaces may be limited. Ekstrand *et al.* also discuss the potential importance of alternating between different playing surfaces (21).

A current discussion of artificial surfaces must also consider the emergence of the 'hybrid' playing surfaces which are increasingly common at the highest level of professional football with, for example, 19 of the current 20 clubs in the wealthy English Premier League having such a pitch installed during the season 2019/20. The emergence of these pitches has been predominantly driven by the clubs' desire to avoid pitch degradation but there is very limited evidence to suggest if there could be an impact on player welfare. This could develop as an important area to research in the future. The exact composition of different patented companies' hybrid surfaces differs, but most are based on over 95% natural grass grown on a specific network of plastic polypropylene fibres inserted at various spaces and depths to add to pitch stability. The cost for installation of a hybrid surface varies between company but is reported well in excess of £500,000 and up to £1,500,000, prohibitive for most clubs in Scotland. In 2020 there were three clubs in Scotland with hybrid playing surfaces. For the purposes of this project these clubs will be considered as playing on natural grass.

The existing evidence surrounding fully synthetic pitches is often contradictory but there is little high-quality indication that artificial turf is associated with more injuries. One identified meta-analysis from 2013 in professional football identified eight studies that included exposure time and injury occurrence (24). The conclusion was that the overall injury rate ratio comparing artificial turf and natural grass was 0.86, ($p < 0.05$), suggesting a significantly lower overall injury risk on artificial turf. It is worth noting that one limitation of the research analysed is that there was no consideration in any of the papers given to environmental or weather conditions. It would seem a key intuitive aspect to consider given the different impact that climate and weather will have on different pitch surfaces. Only one of the studies addressed any difference between contact and non-contact injury; and none investigated the degradation of the surface. In fact, in the existing evidence, the age or intensity of use of an artificial surface is rarely considered as a specific risk factor. Another review paper in 2011 looked at 11 experimental papers that gave strong evidence of comparable injury rates between new generation artificial surfaces and natural grass with a notable exception that ankle injury rates were higher on more recent generation artificial surfaces (25). One type of injury rarely investigated in the comparison between artificial and natural grass pitches is that of an overuse type or a more chronic breakdown. One paper from the 1970s did show more of this type of injury on artificial grass although this was small in size and examined an older type of synthetic surface as previously discussed (26).

16 of the 42 clubs (38%) in Scotland were using an artificial 3G surface to play their competitive matches in the SPFL during season 2019/20. As a result, in the SPFL pyramid an alternation between artificial and natural grass playing surfaces is very common, both in sequential competitive matches and, with many clubs, training on a different surface to that they use for matches. In Scotland many professional footballers believe artificial pitches may contribute to injury and prefer to play on grass (27). These facts alone suggest that investigation of whether pitch surface-type correlates with football injuries in Scotland is overdue.

1.b.iii. Winter vs Summer Football

There is significant interest in many sports in optimising the playing calendar. In reality there are very significant commercial pressures related to television broadcasting deals, spectator experience and scheduled international football tournaments that are most likely to dictate the decisions made at the upper echelons of football. However, player welfare and injury rates that may relate to ambient climate or temperature are an important epidemiological consideration. The SPFL football season begins in August and ends in May (although pre-season and cup competitions mean clubs play competitive games from June) with fixtures played throughout a northern European winter, games often taking place in temperatures below 0°C. Playing in these temperatures depends on match officials deeming that the playing surface is safe, perhaps more likely on an artificial pitch. In a study of the 2009-10 Dutch premier league, 8 teams (217 players) were followed in a prospective cohort study of football injuries and weather conditions were documented as an important factor in 6% of overall injuries (28). A further study which examined regional injury rates within Europe described overall incidence was higher for teams in northern Europe with cold winters than for those in southern Europe (29). This study suggested that traumatic and overuse injuries were more common in northern Europe although a notable exception was non-contact ACL injury which was more common in the South. Ekstand *et al.* also describe regional differences including climate are an important factor to consider when studying elite teams over 7 seasons (30)

Investigating whether ambient temperature directly impacts on injury risk is challenging due to the multiple other confounding factors such as playing surface and early season bias in injury rates that may relate to player fitness (31). This review paper reports that '*The most impressive association is that the early-season bias is most often reported in football competitions that are played on natural grass surfaces in temperate climates over an autumn-to-winter season'.* An epidemiological study of four professional clubs in England also suggested a steady decline in injury rates throughout the season between August and May (3). The same group also reported an increased rate of injury in youth players at start and end of season, potentially explained by firmer playing surfaces in warmer weather. A Finnish study from the early 1990s described an early season bias towards increased injury, the season starting in an Arctic spring, and hence they described frozen ground may be an important environmental factor (32). The normal Scottish Premiership season does include a scheduled 2-week winter break which did occur during the season 2019/20, however this has been devised to ease fixture congestion rather than to avoid inclement weather.

1.b.iv. Intensity of Fixtures

The concept of athlete load crosses the barriers between sports science and sports medicine and is one of the key aspects in maintaining player fitness and injury avoidance. Both the intensity of training and number of games played by an individual are critical. Before the FIFA World Cup in 2002 held in Korea and Japan, Ekstrand *et al.* suggested a correlation between number of matches played during the preceding season and rates of injury and underperformance during the tournament (33). The same authors provided another example of fixture intensity being implicated in injury aetiology with a 13-year longitudinal study that suggested a steady annual increase in hamstring injuries at the elite level. Their analysis showed an average 2.3% annual increase in the total hamstring injury rate (95% CI 0.006 to 0.041, p=0.015) and the average injury burden was 19.7 days per 1000 hours (annual average increase 4.1%) (95% CI 0.010 to 0.072, p=0.014) (34).

As mentioned previously, a winter break has been one method by which the pressure of fixture congestion can be temporarily relieved. A recent study described that elite teams without a winter break lose an average of 303 player days per season when compared with teams that do (30). The length of winter break is variable between European leagues but a paper that reported on a shortened winter break (6.5 to 3.5 weeks) in the top two German professional football leagues in 2009/10 did not reveal an overall change in injury incidence although there were more training and severe injuries reported (35).

One of the few projects that was undertaken within Scottish Football was undertaken between 1990-93 and followed one specific professional club (11). Despite the small number of players, they reported that the number of matches played did not significantly affect injury rate. This finding was supported by another study which looked at two French Ligue 1 clubs (36). This French paper also reported that injury incidence was not associated with the number of days separating games. These findings however are contradicted elsewhere. Hägglund *et al.* described that fixture congestion was associated with increased muscle injury rates over an 11-year follow-up of elite European teams (37). Another smaller project which analysed 32 elite players over 2 seasons between 2007 and 2009 suggested injury rate was significantly higher for players playing 2 games per week versus 1, 25.6 vs 4.1 injuries per 1000 hours of exposure (38).

Separating density of scheduled competitive football matches from training load as a risk factor for injury in individual players is complex, however there is evidence that players are more likely to suffer acute injuries during matches (4). An optimal injury surveillance programme could fully detach these injury contexts provided adequate data was integrated from clinicians at clubs. This is likely to necessitate a crossover into sports science measurements such as GPS tracking during training although simple recording of injury context would be valuable. A high-quality universal data collection tool could easily integrate such data from different sources.

1.b.v. Other Risk Factors for Injuries in Football

There are a multitude of further risk factors for injury in professional football, both modifiable and non-modifiable, some that merit brief discussion and may be measurable within the STAYFIT-HURT project. The SPFL encompasses clubs ranging from those involved in the most elite club competitions in the world to small semi-professional teams with very limited resources. Therefore, there is the opportunity to investigate a wide spectrum of levels within the professional and semi-professional ranks. Hawkins *et al.* looked at the frequency and severity of injury at three levels of football, international, Premier League in England and the second tier of professional league football (39). No significant difference in injury rate or severity was identified based on the level of competition, however in reality all these populations were fully professional and could be considered elite.

Previous research however has suggested a higher injury incidence at higher levels of competition (40,41). One prospective paper in the Czech Republic reporting on multiple levels of football followed nearly 400 players over 1 year (42). They identified that multiple factors influenced the occurrence of severe injuries including: age, physical conditioning, previous injuries, inadequate treatment or rehabilitation, amount of training and playing field conditions, some of which could be related to level of competition.

A player's age is an interesting variable to consider, although open to confounding given a higher likelihood of previous injury over time. Existing evidence of age as a risk factor is limited although a systematic review has suggested that older players may be at high risk of hamstring injury (43). Another paper which focused on anterior cruciate ligament injury found no significant correlation with age a risk factor (44). The Scottish prospective three-year study limited to a single Scottish premier league team in the early 1990s suggested that players over the age of 26 were more likely to be injured but clearly this is limited to a small cohort (11). A further paper originating from the UEFA Elite Club Injury Study, found that among the factors identified to increase the likelihood of muscle injury in the lower limb was older age, although this seemed to only be relevant for calf injuries (45).

Closely tied with player age is a history of previous injury. There is good evidence that occurrence of specific injuries raises the risk of the same injury recurring. Hence a facility within a medical records system to specify injury recurrence would be both clinically useful and significant for future injury analysis. Examples of this include: previous hamstring injury significantly increases the risk of further hamstring injury (46); and similarly those with a history of anterior cruciate ligament injury (44).

Player position is another area that can be scrutinised with simple injury data collection although individual playing styles within positions can certainly confound this. Hawkins *et al.* described no significant difference in injury rates based on player position in England (39). The above single club Scottish study suggested that midfielders where more prone to injury with 39% of the total (11). A much larger study from Ekstrand *et al.* concentrated on rates of lower limb muscle injury and, perhaps unsurprisingly, identified that goalkeepers were much less likely to sustain these, but no other specific player positional variation was identified (45). This lack of specific variation is corroborated elsewhere (47), but with a suggestion that strikers may be at increased risk of injury during matches. Some research also reports that specific types of injury seem to be more prominent for certain playing positions, for example head and neck injuries have been reported as more common in defenders (17). An Iranian study also suggested that defenders sustain a higher proportion of overall injuries (48).

The physical condition of individual players would seem to be intuitively linked with the risk of sustaining injury. This might account for the previously discussed early season bias in injury rates. Injury prevention strategies are a mainstay of many professional clubs but based on variable evidence. A randomised trial in the early 1980s reported 75% reduction in injuries when players were exposed to a prophylactic programme including optimised training, controlled rehabilitation, and physiotherapy / doctor supervision (49). Bespoke proprioceptive and eccentric strength training have also been shown to reduce subsequent ankle, knee and hamstring injuries (50,51,52). A descriptive epidemiological study over 15 years also showed that a more extensive pre-season with a higher number of training sessions was associated with fewer injuries during the competitive season (53). The key to measuring these injury rates against athlete conditioning is robust data and hence definition of injury types. More recent research includes factors beyond what the STAYFIT-HURT project can examine such as communication between club coaching and medical staff and even coaching styles (54, 55). As an example of this impact Ekstrand et al discussed transformational leadership where coaches communicated a positive vision to players and staff. This was reinforced with encouragement of innovating thinking, trust, and cooperation. With this coaching ethos, fewer severe injuries were reported, a negative correlation reported as ($rho=-0.248$; $n=77$; $p=0.030$) (55).

1.c. Types of Injury / Injury Classification

There has been a longstanding recognition of the importance of standardising football injury terms and definitions, but also an understanding of desirable data collection methodology calibration (56). In the 2006 consensus statement on injury classification and data collection the accepted definition of an injury episode is as follows:

'Any physical complaint sustained by a player that results from a football match or football training, irrespective of the need for medical attention or time loss from football activities. An injury that results in a player receiving medical attention is referred to as a "medical attention" injury, and an injury that results in a player being unable to take a full part in future football training or match play as a "time loss" injury.' (57)

The types of injuries sustained in football, a contact sport, are extensive with a variety of mechanisms. From the UEFA Elite Club Injury Study, Ekstrand *et al* demonstrated that on average a footballer would sustain 2.0 injuries each season, the most common type of injury being a thigh strain, comprising 17% of the total injury number (58). In this study the estimated impact on individual clubs was that 12-14% of players would be injured and unavailable at any time. Interestingly a re-injury represented 12% of the total injuries. Indeed, a further recent prospective cohort study from the same group showed that fewer training sessions between return from injury to first match was associated with an increased injury rate (59). The Czech study over a single season gave the following percentages as pertaining to 113 severe injuries: Joint sprains 30%, fractures 16%, muscle strains 15%, ligament ruptures 12%, meniscal tears and contusions 8% (42). Anatomically knee injuries were most prevalent 29%, followed by injuries to the ankle 19% and spine 9%.

The precise mechanics and terminology of injury data collection are discussed in the methodology section but the justification for injury classification is an important introductory topic. One of the best recognised, highly developed, and most widely used systems for sports injury classification is the Orchard Sports Injury and Illness Classification System (OSIICS). This was most recently revised in 2020 (60), in response to the IOC (International Olympic Committee) Consensus Statement (61). Of note, there is consensus that enhanced focus is merited on illness and overuse pattern injuries and the above current systems reflect this. Within the Orchard system each injury is given a unique 3 letter/digit code which is used to specify affected anatomy and diagnosis, further explored in the later methodology. Provided the STAYFIT-HURT project collected data that coded injuries according to these recognised terms, used by such groups as the UEFA Elite Club Injury Study, direct comparisons of data could be facilitated. A usable platform that engages the relevant clinicians to provide this data in an anonymised manner is the foundation for the project method.

A key departure from previous research that the STAYFIT-HURT project aimed to explore was that players may return to play still suffering symptoms of injury. The above consensus statements define injury episodes as resolved when a player returns to full training, potentially inadvertently concealing clinically important ailments. There are perhaps specific types of injury that this is most pertinent to, for example those that result in a gradual onset of symptoms from a biomechanical issue.

1.d. Medical Records in Football

A unified medical records system that produced a standardised player record would seem a cornerstone to delivering effective care to this population of professional adults. Indeed, it would be unthinkable in other areas of medical care in the United Kingdom for this not to exist. This record would include a detailed injury history with each care episode and player-clinician contact documented. It would also include key aspects of medical history such as important illness and allergy and some more features aligned with sports medicine such as pre-participation cardiac screening or drug testing history. Information sharing would be key and with player consent this medical record could pass between employing football clubs, or indeed international teams, as a means of ensuring player welfare and continuity. Such a ‘player passport’ could provide some key assurance to both players and clubs that player acquisitions were subject to appropriate governance.

There are several highly developed bespoke medical records systems designed for working in sport, but the cost of this software is prohibitive for most football clubs in Scotland and there is a lack of uniformity in detail and structure. There are multiple existing medical records platforms designed for professional sport and the most used in Scotland are Kitman® and The Sports Office®. These however are based on a personal computer platform rather than a mobile app. Many individual clinicians in Scottish clubs are using paper notes or simple electronic templates to document their clinical work.

As many professional, and more especially semi-professional, players in Scotland may simultaneously be cared for by NHS (National Health Service) services and their employing football club, a means of confidential data transfer to other clinicians would also be a highly desirable outcome of any medical records system. Hence with appropriate legal compliance, a data sharing system would also maximise safety and promote good transparent care. Another facet of a uniform medical records system would be the obvious benefit to the clinician in an era of professional sport where litigation and scrutiny is increasingly prominent. An inadequate medical record to justify clinical practice would expose the clinician to justifiable criticism and weaken any defence they may have should retrospective action be sought.

In the United Kingdom medical practice for doctors is governed by the General Medical Council (GMC) and for physiotherapists the Chartered Society of Physiotherapy (CSP). In the case of doctors when providing care, it is their responsibility to maintain clear and accurate notes that reflect clinical findings, decisions made, and treatment prescribed or administered. Records should be made as soon as possible after patient care episodes which is often challenging in the football environment. Therefore, a system that could help clinicians achieve these aims with validated diagnostic terms and anatomy would be of great benefit to them. Some parts of the UK suggest the football governing bodies may even scrutinise players records to ensure good practice. The Football Association in England state that:

> *'Each Club shall keep medical records in respect of its Contract Players and Students in accordance with the requirements of the Medical Committee of The Football Association and shall, from time to time, make these available for inspection by Doctors appointed by The Football Association, for the purpose of monitoring.'*

No such specific comment is made by the Scottish Football Association, but it has been discussed as a key to justifying concussion substitutes, as mentioned previously.

The GMC states that medical records are owned by the practitioner working in private practice, as clinicians working in football in Scotland are. However, patients (or players) should have access to their records under the Data Protection Act 1998. Confidentiality can be maintained between these parties as part of the patient-doctor relationship. This picture can become much more complicated in the professional sporting arena when clinicians are employed by a club to provide care for their players and may commonly give rise to a conflict of interest. Furthermore, much of the care provided for these professional athletes occurs in the public domain, often with thousands of spectators as witness (62). It is therefore of even greater importance that any current system of data capture adheres to the strictest principles possible of confidentiality and is compliant with the General Data Protection Regulation 2018 (GDPR).

The General Data Protection Regulation came into force in May 2018 in the European Union and European Economic Area. The full legal document and its enforcement is very comprehensive and beyond the remit of this project to explain in detail, but the pertinent aspects will be explored within the methodology section. The principle on which the framework is based is that individuals have the right to control their own data. In brief, the regulations are based on the following seven principles:

Lawfulness, fairness and transparency; Purpose limitation; Data minimisation; Accuracy; Storage limitation; Integrity and confidentiality (security); and *Accountability*.

Adherence to GDPR is not only a legal requirement of the STAYFIT-HURT project but a mainstay of current research data protection and management.

Table A

Summary of Key Benefits of Medical Records System in Scottish Professional Football
Standardisation of clear clinical records - clinical benefit and protective in retrospective litigation
Standardisation of diagnostic terms / coding of injuries for data interrogation
Possibility of clinical audit of records
Possibility of driving clinical standards and ensuring good GDPR compliant practice in documentation
Potential for creation of national injury database - allowing research and clinical governance
Transfer of medical data between clubs at time of player transfer or loan
Improve player safety by having detail such as allergy / cardiac screening information available
Integration of clinical tools such as concussion monitoring systems

The STAYFIT team's understanding of the barriers to an injury surveillance system developed during the study and form a large part of the discussion in chapter 6. At the outset it was clear to the team that a lack of uniformity of purpose among clubs and the financial costs to them would be key hurdles to recognise. It was also felt a surveillance system may be seen as a threat, inviting unwanted scrutiny of player care. When considering the teams at the top of the SPFL pyramid it was felt that persuading them to share data from an existing medical records system or trying to advertise the benefit of using an alternative system would be challenging. And while it was hoped that the benefits to smaller clubs at the base of the pyramid would be obvious, there was a concern that sparse personnel and lower levels of professionalism may create obstacles. These themes are picked up in Chapter 6.

1.e. The UEFA Elite Club Injury Study

The gold-standard ongoing research platform in European football is the UEFA Elite Club Injury Study, initiated in 2001 and reporting annually to its elite participating football clubs (63). Professor Jan Ekstrand and his team has generated some of the flagship research that has investigated injury pattern and incidence in elite football over the last 20 years. By providing much of the foundation for the existing evidence base, the UEFA study also forms a structure around which further studies can be built. Comparisons in methodology and outcomes with the STAYFIT-HURT project are essential. However, to capture the kind of data that the UEFA study has done in Scotland is challenging.

The majority of football clubs in the SPFL have neither the resources nor staff to engage fully with the necessary manual electronic injury form completion that the UEFA elite clubs provide. This form is an extensive electronic document to be completed on every player. Although ultimately beneficial for the club, this task is both time-consuming and inefficient in terms of manpower (and resultant cost), requiring an appropriate clinician's time to complete it regularly as an additional task. The personnel challenges are numerous and explored further in chapter 6. Methodology must therefore be novel and feasible for participating clubs in Scotland. Inevitably therefore the STAYFIT-HURT project is not a direct comparison to the UEFA study but may offer strategies for innovation in method.

Research in Scottish football provides an opportunity to develop further some themes from the UEFA study such as: fixture congestion; climate and seasonal variation (which varies much more across a European study than it would do in Scotland); and full-time compared to part-time contracted players. It is hoped the methodology of this research will also further develop the understanding of players who are playing matches while still receiving regular treatment for ongoing injury episodes. A further specific new angle that this research will benefit from is the increased comparison of playing / training surface and will look to add to the debate regarding the risks or benefits of artificial playing surfaces.

Perhaps critical to the success of the UEFA Elite Club Study, participation in the research from clubs playing in the UEFA Champions League is mandatory. It is unlikely this represents a significant workload to major European clubs with significant financial resource. The STAYFIT-HURT literature review included some scrutiny of some high-profile wealthy football clubs in world football which have their own bespoke medical research teams that integrate closely with sport science to produce models to optimise player production and performance. No such clubs exist in Scotland and hence this model is of limited application to this project. However, the research output from these enterprises is significant and influential, these clubs having sufficient resources to have their own specialised research staff and collaboration with illustrious sports medicine companies. An example of this model would be the collaboration between the FC Barcelona medical team, the Duke Sports Science Institute in the USA and the Aspetar Hospital in Qatar.

The above discussion outlines the key principles to justify and explain the STAYFIT-HURT project. By introducing a new methodology in football injury data capture, using existing coding and injury definition systems, it is hoped this project may move the field of football injury research forward. The project also aspires to enhance clinical care in professional football by improved documentation and clinical governance. The legal and research principles contained in the methodology will form an important route for future large-scale research.

Therefore, the STAYFIT-HURT project aims are:

To Investigate the Feasibility and Methodology of a Uniform Medical Records System in Scottish Football

To Investigate Injury Patterns in Scottish Football

Chapter 2 – Methodology

a. Study Design
b. Research Proposal
c. Excluded Populations
d. GDPR
e. Pilot study
f. Ethical Approval
g. Data Collection
    i. Injury Classification
    ii. Data Protection Impact Assessment
    iii. Data Management Plan
    iv. Data Sharing agreement
    v. Data Collection Process
h. Club Recruitment / Engagement Process
i. COVID 19 Pandemic
    i. Contingency Plan
    ii. Data Protection Impact Assessment
    iii. Data Management Plan
j. Generation of Team Reports
k. Research Process. Comparisons and Statistics

Chapter 2 Methodology

2.a. Study Design

The STAYFIT-HURT project takes the form of a prospective observational study which aimed to encompass a sample size of 42 professional and semi-professional clubs playing in Scotland's professional football leagues. The aims were to *investigate the feasibility and methodology of a uniform medical records system in Scottish football* and to *generate a unique anonymised database of player injuries and demographics to investigate potential patterns of injury* and hence address future risk and prevention. Data were to be collected for the duration of the football season 2019-20. The project had the opportunity to utilise a unique data collection platform, the ScribePro® medical records application ('app'), that could be universally applicable to any clinician working in professional sport who has access to an internet-connected device.

The project plan and design were conceived by the research group in 2018. The key injury themes of interest were discussed and the existing evidence surrounding these themes explored using a web-based literature review on PubMED and Google Scholar. A review of the background subject literature is included in the introduction section. With respect to '*investigate the feasibility and methodology of a uniform medical records system in Scottish football',* the following searches terms were used: soccer injury documentation, football injury documentation, football injury documentation Scotland, soccer medical records, football medical records, football medical records Scotland, soccer injury reporting, football injury reporting, football injury reporting Scotland, medical records Scotland. With respect to *player injuries and demographics,* a detailed PubMed and Google Scholar literature review was undertaken across a breadth of search terms listed in Appendix 1.

The key themes around injury reporting are discussed in the introduction. The evidence base for medical records systems in football is sparse but not without any precedent. The NCAA that governs American Collegiate sports has a long-standing Injury Surveillance Program that includes 'soccer' (64) and the methods for data collection and management are being regularly refined. As a whole this program acknowledges the need for staying abreast of technological adaptations in injury-tracking software and their system is designed to accommodate a wide variety of commercially available systems (65). An app which would be compatible across a range of handheld electronic devices may be a key innovation. A standardised easy to use injury-reporting system has also been implemented during FIFA football tournaments and the Olympic Games (66). Previous consensus statements by Fuller *et al* in 2006 (57) on data collection procedures may now be outdated with respect to up-to-date technology.

The gold standard injury surveillance research was deemed to be the ongoing UEFA Elite Club Injury Study which would form the key basis for comparison with the STAYFIT-HURT project and this helped to define how injuries would be classified using standardised anatomy and description.

The project was designed as a prospective observational study based on rolling real-time clinical data collection. This design is important to limit risks of recall bias, well established as a concern in previous epidemiological injury studies (67). In the case of injury risk factor determination, it has been reported that a prospective cohort study is more powerful than a case-control design (68) and should include an entire season to encompass variations in injury throughout the season (69). A key facet of injury epidemiology identified by Hagglund *et al* is 'exposure factor' which is a demonstration of injury per time exposed to injury risk, in the case of football, usually during training or matches. If captured, this data could allow a more detailed analysis that acknowledges different playing / training loads in players with different characteristics. Hence a mechanism for measuring accurate individual training and playing time was incorporated into the data collection plan.

By using the ScribePro® app the STAYFIT-HURT project sought to demonstrate that data collection could be streamlined to a user-friendly rolling individual medical record which could also provide research data. This replaces the concept of a baseline medical form, then separate forms to record the exposure factor and specific injury episodes respectively. The detail of how these specific injury episodes or exposure factor is recorded with the app, and critically how this differs from the UEFA Elite Injury Club Study, is included later in this methodology section.

2.b. Research Proposal

The STAYFIT-HURT study was conceived between the research group during 2018 following, as discussed in the introduction, clinical recognition of limited research and clinical governance in Scottish professional football. The group included a physician working in club football, the Scotland national team doctor, a University of Glasgow scientist with multiple clinical roles including coordinating the national cardiac screening programme for football, and a University of Glasgow Academic. Particular pertinent themes were identified, as previously discussed, and an initial proposal sent to the University of Glasgow. No funding was sought, nor conflicts of interests identified beyond the clinical roles identified above.

The project was accepted as part of a part-time Medical Doctorate degree project to begin in academic year 2018/19. The first year of this project was designated for project design and for lead researcher Dr. Kaye to undertake relevant University training modules, and submission to the University Ethics Committee. The key aspect of data collection was the ScribePro® app, early in its development at this stage. As a result, the decision was taken among the research team to undertake an initial pilot study for 3 months focusing on a small number of professional players to ensure the data collection and management process was effective, GDPR compliant and safe. The pilot study is further discussed below.

2.c. Excluded Populations

There are some key population exclusions that were considered. The women's professional and amateur game was growing steadily in Scotland and with a thriving national team there was a marked research potential within this cohort of players. At a generic club level however, it was felt that medical provision is not sufficient to allow regular and reliable data generation and capture. Despite this it is hoped that this may form a key expansion group in the future. The same argument can be applied to football at a level below the SPFL, including Highland and Lowland leagues. Only players over 16 years old will be included in data collection.

2.d. GDPR (General Data Protection Regulations 2018)

One aspect in which the STAYFIT-HURT project marks an evolution from previous injury surveillance is with respect to the General Data Protection Regulations (GDPR), the legal framework that dictates data privacy law, applicable to all EU states since 25th May 2018. This is a key property of the methodology in a project that would obtain and process personal data about professional footballers. GDPR applies to any information relating to an identifiable person and training on this area at the University of Glasgow was undertaken. The regulations were reviewed in detail and key relevant aspects taken from these regulations are quoted in Appendix 2. Based on these aspects of the GDPR and the subsequent recitals, the research group was satisfied that all lawful considerations had been respected. It was based on these that the project proceeded in its methodology to ethical submission and subsequent scrutiny by the University of Glasgow data protection services.

2.e. Pilot study

During the planning phase of the project the research team discussed several methods of data capture and contact was made with one of the Scotland national team doctors who was part of a team developing a pitch-side medical records tool, later to become the ScribePro® app. At the time of planning the STAYFIT-HURT project this tool was early in its development and required testing and as a result the tool was provided without charge. It was decided that the best means to test data capture and test the new app was to plan a pilot phase to the project. It was also recognised that as the 2018/19 football season had already started, planning for a full 2019/20 season data capture was more valid. The key aims of this pilot were threefold: to ensure the functionality of the app as a means for clinicians to create medical records and record data; to ensure the legal, data and ethical considerations were examined in full and in practice before the full study began; and to ensure data could be appropriately captured.

One of the research team was employed as a club doctor for a full-time professional club and was in a good position to provide this testing as well as network with other club clinical colleagues. It was initially intended that this pilot phase would extend to a trial of the app at 4 identified professional and semi-professional clubs across the different tiers of the Scottish leagues. Ethical approval was required before progressing to live data collection, discussed in more detail later. This application required diligence and education around GDPR (as previously discussed), consent, and the project cornerstone of data considerations. The key processes that were detailed and completed in terms of data were a data impact assessment, a data management plan, creation of a legal data sharing agreement and providing specifics of the data collection process. These are explored in full later in the methodology section.

Ethical approval for the pilot study was received on 1/4/2019 (Appendix 4). Unfortunately, this was delayed by an unforeseen online administrative error. The research team believed the application had been completed in November 2018, but the application required further finalising on the University of Glasgow system before being sent to committee. Before approval, re-drafting of participant information and consent forms was required and further work on data impact assessment. In effect this completion was too late for effective data capture during the 2018/19 football season but provided approximately one month for the lead researcher to test the app from a clinician's perspective working in professional football at one club and ensure the functionality. This ethics application process did however provide a pathway for ethical submission for the full study.

The key issues for discussion around ethics were consent, maintaining anonymity as much as possible, and data ownership. It was key that each player or clinician involved in the project completed the bespoke University of Glasgow consent forms (included in Appendix 3) along with reading the participant information sheets and receiving their privacy notice regarding how their confidential data would be utilised. The pilot phase therefore provided a means by which to test these aspects too. Ethical approval for the pilot phase of the project was granted on 1st April 2019. This meant that the team member working in football had fixtures between 2nd April 2019 and 4th May 2019 to test the app which encompassed 6 fixtures and the relevant training sessions between. During this time records were duplicated, and the previous hand-written system continued to ensure there was no risk of data loss.

Some minor issues in using the app were identified and fed back to the development team as the app evolved to a more stable platform for use throughout the season 2019/20. Key amongst these issues were logging in issues, difficulties in saving entries and the differences in how medical records are usually documented by doctors compared to physiotherapists or sports therapists. No concerns were identified regarding data security although the in-built app consent and privacy notices were enhanced.

2.f. Ethical Approval

In keeping with the declaration of Helsinki (version 2013), this research project was necessarily subject to external ethical approval. Ethical approval was sought for both the pilot phase and full

STAYFIT-HURT study, as discussed above, a copy of the full ethical submission is enclosed (Appendix 3). Relevant research ethics training was also undertaken. The key principles related to this project surrounded informed consent of clinical participants and research subjects; and optimising the anonymity and confidentiality of the results obtained, with a recognition that much of the information being scrutinised would be freely available in the public domain (for example a high-profile footballer injuring his knee on television with extensive subsequent media coverage), and hence total anonymity would not be possible. It was also central that participants have their right to withdraw made very clear.

The key measures taken to ensure informed consent rest on the participant information document and consent form (see appendices 3a,b and c), both that provided in paper form and that built into the app at the time of player record creation. Anonymity and confidentiality are paramount and described in detail in the following data management section and preceding description of app security.

Full ethical approval for the STAYFIT-HURT project was received from the MVLS College Ethics Committee (project number xxxxxxxxx) on 25th June 2019 (Appendix 5)

2.g. Data Collection

Hagglund *et al* (69) described data collection of sports injuries in three phases, beginning with a baseline form that records required simple data such as age, playing position and previous injuries. Then a secondary form that describes exposure, in the case of football represented by attendance at training sessions and participation in matches, which can then be augmented by weather conditions or playing surface etc. The third form is to record injury episodes and the relevant details such as injury type, anatomical location and measure of severity.

These principles are somewhat circumvented with the development of an injury reporting platform such as the ScribePro® app where all these parameters can be recorded and stored in one place, with evolving information about an injury episode recorded timeously. However, this also means that all the eventualities for data collection must be considered at once. Central to this is considering the data impact.

The specific data that was planned to be collected would form the basis for the data impact assessment and GDPR considerations. To investigate the themes outlined in the introductory section a variety of data was identified by the research team as valuable. These are broken down below with regards to the themes being explored:

<u>Player / match demographics and how this relates to injury patterns:</u>

- Player age
- Player position
- Number of cumulative games played at the time of injury
- Number of minutes on the pitch
- Match frequency / intensity
- Part-time vs full-time contracted players
- Injury occurring during match or during training

<u>Pitch surface:</u>

As well as looking at simple injury rates on artificial surfaces versus natural grass, there are distinct groups of players as follows:

- Training on artificial surface / playing matches on natural grass
- Training on artificial surface / playing matches on artificial surface
- Training on natural grass surface / playing matches on natural grass
- Training on natural grass surface / playing matches on artificial surface
- Can injury rates on artificial surfaces be associated with the precise type of artificial pitch and when this was installed?

<u>Seasonal variation:</u>

- Player injuries in the four different annual climate seasons / ambient temperature at time of injury
- Is there a pattern of seasonal variation in injury that depends on pitch surface?

<u>Type of Injury:</u>

- A review of incidence of different anatomical injuries (related to above variables but also tabulated to correspond to individual clubs)

- A review of incidence of different injury mechanisms including contact or non-contact (related to above variables but also tabulated to correspond to individual clubs)
- A review of injury severity – measured by number of days unavailable and hence 'injury burden'.

Injury rehabilitation and head injuries:

- Adherence to national head injury guidelines
- Do recovery rates vary depending on above variables

2.g.i. Injury Classification

Injury classifications are visited in the introduction but a key feature in the ScribePro® app was the terminology utilised to describe injury specifics. Unrelated to the STAYFIT-HURT project, the app development team elected to use the Orchard Sports Injury and Illness Classification System (OSIICS), mentioned and referenced above (60). As a result, the medical terminology used mirrored the anatomical breakdown and terms used in the UEFA Elite Club Injury Study. The Orchard system, first published in 1993, is free to use and uses injury codes specific to sports medicine. It was an especially appropriate coding tool for this project given the breadth of its use worldwide and its stated purpose for injury surveillance systems. During the football season 2019/20 a new version, 13.1, was released to reflect new codes related to the COVID-19 pandemic but at the time of pre-project app development version 12 was in use. Each injury has a 3-digit code applied in the Orchard system and an example of the coding in the most up to date version is included in the appendices (Appendix 9) by way of illustration.

The Orchard system uses a clear structure to categorise injuries by affected body part, tissue type, pathology type and medical system or aetiology if classifying illness; with a correlation to ICD coding (International Classification of Disease) versions 9, 10 and 11, and previous Orchard versions. The list of codes is extensive and provides a far-reaching platform for uniformity in sports medicine reporting. There are however recognised deficiencies in this method and key among these is the concept of injury and how this is defined. Traditionally this may have been defined by being unfit to play but this approach under-reports injuries that do not prevent participation. Eliminating observer bias among involved clinicians is also impossible and the data entry is clearly dependent on the correct diagnosis being made, especially challenging as diagnoses often evolve and may be replaced or discarded over time. An appropriate and functional platform to complete the real-time coding of these injuries is also absent in most professional sport. The Orchard system, in keeping with other injury classification systems, is also limited by a lack of data regarding injury severity, chronicity or recurrence – central to a system that would be useful for clinicians, even if this data may be more challenging to interpret and more open to observer bias.

The research team recognised that a key step in data collection methodology was to bridge the gap between real-life clinical practice and injury data collection. In clinical practice diagnoses and treatments evolve with the addition of new signs and investigations over time. Functional data on a player's symptoms (such as degree of pain) and a recognition of differing approaches to assessment and documentation within a multi-disciplinary clinical team were key. The ScribePro® app provided a truly unique opportunity to build this bridge and hence these issues were fed back to the app development team during testing.

The ScribePro® app, while addressing many of the above issues in usability, would therefore inevitably store data that was beyond the remit of the STAYFIT-HURT project so a very clear description of exactly which anonymised data the research team would receive was detailed in advance.

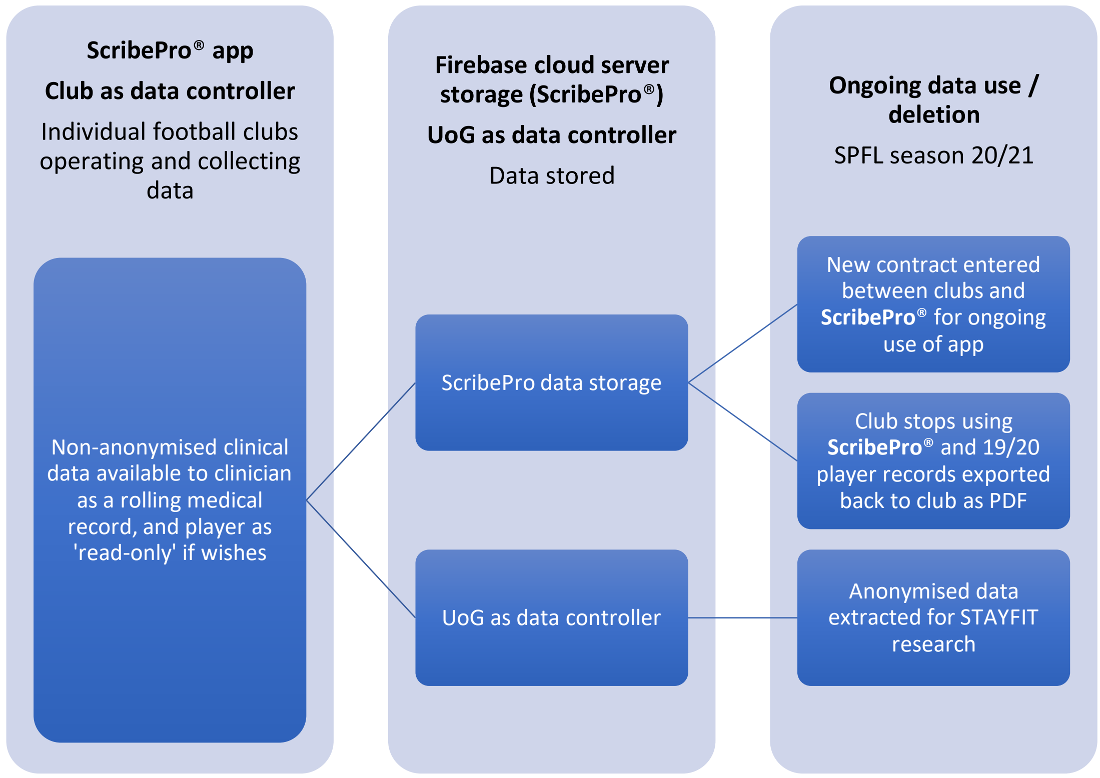
The data reporting and analysis was intended to differ significantly from previous research to move the field forward in some of the previously described new variables such as playing surface type, professional status, and ambient temperature. Overall, it is well recognised that 'injury burden' and hence player availability, rather than simple injury rate, is perhaps the key information that impacts on football club performance and finance. So, in this element, the intention was to be able to provide a direct comparison to the UEFA study. UEFA define injury burden as a combined measure of the injury rate and severity, measured by days´ absence, and expressed as days absent for every 1000 hours of exposure.

2.g.ii. Data Protection Impact Assessment

During the planning phase of the STAYFIT-HURT project it was recognised that the key aspect of methodology would be data management and safety. Discussed with the University of Glasgow research governance team, the first process was a data protection impact assessment (Appendix 6), initially with respect to the pilot phase. The project aims were outlined and hence the need for an impact assessment. For the pilot phase the key aspect was to evaluate the effectiveness of medical information gathering and anonymised data extraction on a small cohort of players. The types and content of data were explored between the research team, ScribePro® team and University with respect to impact. The following processing factors were identified as potentially 'high risk': data regarding health and injury parameters, a potentially large database encompassing up to 1000 players, variation in data input at a club level and consideration of vulnerable groups. In this respect it was decided early that data would only be collected on fully consented players 16 years old and over.

The nature of data collection and processing was then explored and is detailed in the below data collection section. The key aspects of who controls and accesses data and the flow of this data is summarised in the below chart.

Figure 1 Data Flowchart



As was discussed in the GDPR section, this project revolves around the creation of a real time medical record and hence the collected data, although anonymised, should be considered as 'special category'. The extent and scope of this data was dependent on the degree of club engagement, but the amount of pilot phase data could be accurately predicted to include around 4 weeks at the end of the 2018/19 football season. It was initially intended that this would extend to 4 to 5 clubs but delays in ethical approval meant this focused on a single team. The expected extent of data during this time was to average around 20 players at each club with each player having a medical record created with basic information such as name, date of birth, height, weight, position, preferred foot, and a player photo. The number of injury episodes, illnesses or treatments to be entered for each individual during this short time could not be predicted. During the pilot phase this data was available to lead researcher Dr Kaye in its clinical format due to his role in professional football, and hence neither anonymised nor protected from his clinical bias. As a result, this would not be analysed in detail, but anonymous extraction could be tested.

The intended extent of data capture for the full project during season 2019-20 was far larger. All 42 League Clubs were invited to participate in the study through contact with medical staff. Therefore, this could have included as many as 1000 players having the above demographic information stored, as well as injury and illness episodes. The players involved were only to be those registered in Scotland although it was feasible that an injury may occur when playing or training abroad but representing a Scottish club or national team. All data was held within a European Economic Area server and anonymised data extracted for research was to be stored and deleted in line with university protocols, detailed later.

Other than the direct clinical contact that one of the research team would have with players at his club, the research team would have no direct relationship with the vast majority of research subjects. These subjects would have automatic permission to review but not edit data entered in their medical record as per GDPR. No vulnerable groups were identified beyond players below 16 years old, and these were excluded. Individual clubs would all be contacted, as discussed later, and club clinicians offered face-to-face training in use of the app. At no stage would research data be accessible to any person not affiliated with the University of Glasgow.

As previously explored, the central issues in data impact surrounded consent, IT security and confidentiality. Consent was obtained two stages. When creating a ScribePro® medical record on the app an electronic consent and privacy statement are completed by the subject, and a paper university consent and privacy statement were completed, as shown in the attached full ethical submission. The player consent form and participant information sheet are designed to minimise any coercive element to this process.

IT security was discussed in detail with the ScribePro® team and demonstrated to the University research governance department under the following key principles. Data would be stored encrypted on any device used (usually mobile phone which would also lock when not in use). Data transfer between device and server is also encrypted by data being sent over HTTPS, a secure version of web transfer protocol which means data is only decrypted once it arrives on the server. Described in more detail in Appendix 4, the server data security is ensured by hack defence, data encryption, data access principles, data anonymisation and data server separation. All case data was stored along with GDPR permissions built into the app with the appropriate defaults using the Firebase cloud-based server that is integrated into the Google platform and GDPR compliant (70). Firebase is an elastic cloud-based server with multiple centres worldwide. ScribePro® use the Europe-West3 base, physically located in Frankfurt, Germany. No data would be stored on any device permanently.

The research team consensus, as explored in the introduction, was that data from the full study could create an unprecedented database in professional football over one season and hence a valuable platform for research to move the field forwards. It was felt that this process was the only feasible means by which to collect robust unbiased injury data across a large population in professional football. The data extracted for the research team was limited to the intended parameters of the study only and hence there was no function creep.

The key risks and impact identified are as follows: firstly, that to research subjects and their clinical information being extracted for research purposes which may not be completely anonymous as described previously. This is because their injuries often occur and are reported in the public domain. It is likely therefore that researchers may be inadvertently able to identify an individual. It was felt as a result that the risk of this causing harm was low. Secondly, it was the intent of the research team to feedback a club injury summary at the end of season 19/20, as a means of internal club clinical governance. Such internal processes were felt to raise the possibility of internal club conflict. However, the overall risk of harm was also felt to be low. The third data risk identified surrounded data input and management by club clinicians which could be open to confidentiality breach when using a new system. This would be part of club responsibility as data controllers, as it would be with any previous medical records or care provided by their staff. Individual clinicians are governed by their own codes of practice and were briefed about the confidentiality features of the app at face-to-face training. This risk level was felt to be medium. Specific to this aspect the research lead and data processor has undertaken a University of Glasgow GDPR training module and data management modules.

A further key to data impact was that individual players who consented to involvement in the study and/or to having a ScribePro® record created had a legal access to see their own record although not to edit it. A means to this end was ensured by the ScribePro® team either by simply using the clinician's device or by providing an electronic copy by emailing the company.

2.g.iii. Data Management Plan

The safe methodology of the project depended on a robust data management plan. This was created after specific training with a University of Glasgow module completed and is attached as Appendix 7. The key constituents of this were an initial summary of the data being collected, as outlined previously, and the format in which this would be stored, in a Microsoft Excel Worksheet (.csv format). At the time of formulating the data management plan it was becoming clear that the number of clubs involved in submitting data was significantly fewer that the project was designed for and hence the format of data in spreadsheet form was projected to be much less than the suggested University limitation of 1TB.

Anonymised data would be documented and described as previously outlined, extracted for the research team on specific parameters as listed. Injuries were to be analysed and coded according to the standardised Orchard Injury Coding system. Interrogation and analysis of this data would use the Minitab® version 19 statistics programme. There was little precedent for similar projects since the advent of GDPR 2018 and, as described previously, the gold standard in this field of research is the UEFA Elite Injury Club Study. The UEFA group collect data by regularly submitted standardised documents rather than via a medical records system. As a result, their data flow and management was not a means for direct comparison.

The data ownership is detailed in the subsequent data sharing agreement between the University of Glasgow and ScribePro®**, the intellectual property of the project being owned by the STAYFIT-HURT research team. Ethical and legal considerations are explored in the above GDPR section. Received anonymised research data would be named and classified to a standard University naming convention with chronological ordering, then organised into working copy folders with**

Readme files attached. This data will be stored in the University of Glasgow OneDrive which performs automatic back-up. The ScribePro® team store data on a GDPR compliant encrypted cloud server, their security measures already described. During the project only the research team could have access to this data although the raw working clinical data will also be available to club clinicians and players should they wish, as is the case with standard medical records.

Some data would be retained long-term in keeping with good research practice. Raw data, statistical analysis and details of outcomes from statistical analysis would be retained for at least 10 years in the University of Glasgow repository, Enlighten. This anonymised data may be suitable for sharing from the University repository for future similar research. The responsibility for implementing this practice is with lead researcher Dr. T. Kaye.

2.g.iv. Data Sharing Agreement

In keeping with the previous GDPR and data management discussions, a robust data sharing agreement was necessary. This would exist between the University of Glasgow and the ScribePro® app owners and must be legally binding to protect all parties. The STAYFIT-HURT research project designated that the research team and the ScribePro® team would be shared data controllers during the study. The individual football clubs and clinicians involved in the research were also data controllers by virtue of the creation of a medical record. This position of club and clinician had not changed from previous practice, only the format of the record. This anonymised data was sent to the research team and lead researcher Dr. Thomas Kaye as data processor. The safe data collection, storage and processing is central to the previous data management section. This legal document was signed on 12th July 2019, see Appendix 8.

2.g.v. Data Collection Process

As the pivotal aspect of the STAYFIT-HURT project's methodology, the process for data collection merits further explanation. To move the field forwards and explore some of the new aspects that the project brings, it was necessary to create an evolving medical record which could accurately document the duration of injury episodes and whether a player continued to participate in training or matches despite an injury. This would capture a new cohort of players that had an injury but was not unavailable, shifting from the traditional definition of injury burden as an outcome measure and hence identifying more accurately when clinically significant injury episodes may be occurring. The STAYFIT-HURT project would use a system whereby an injury episode was 'signed off' when a player no longer required any significant medical treatment although there would also be a means to document that a player was participating either partially or fully in training and matches despite ongoing management. It was hoped this would create significant depth in the injury type data.

Due to the necessity to document injury progress regularly, the project relied on the ScribePro® app providing a means to timeously enter data daily for players, both in training and in matches. As mentioned previously, a balance had to be sought between the varied needs and workforce at clubs in different leagues with different resources to capture basic but reliable data. However, as Hagglund *et al* (69) state, this data must also be collected in a consistent fashion. This paper also recommended that one individual at each club should be responsible for completing and sending their forms to the research staff. The STAYFIT-HURT methodology completely departs from this by integrating this function into a rolling medical record which can be created by different people at the same club.

Injury episodes were categorised and classified as discussed previously with clinicians selecting the most relevant option from a menu within the injury episode including injury type, affected anatomy, mechanism, pitch surface, whether match or training and the subsequent availability. Data points such as ambient temperature and the professional status of players would be collated retrospectively as data was matched to clubs and dates of episodes. Fixed data points such as age and player position would be received anonymously as data was extracted from the app database.

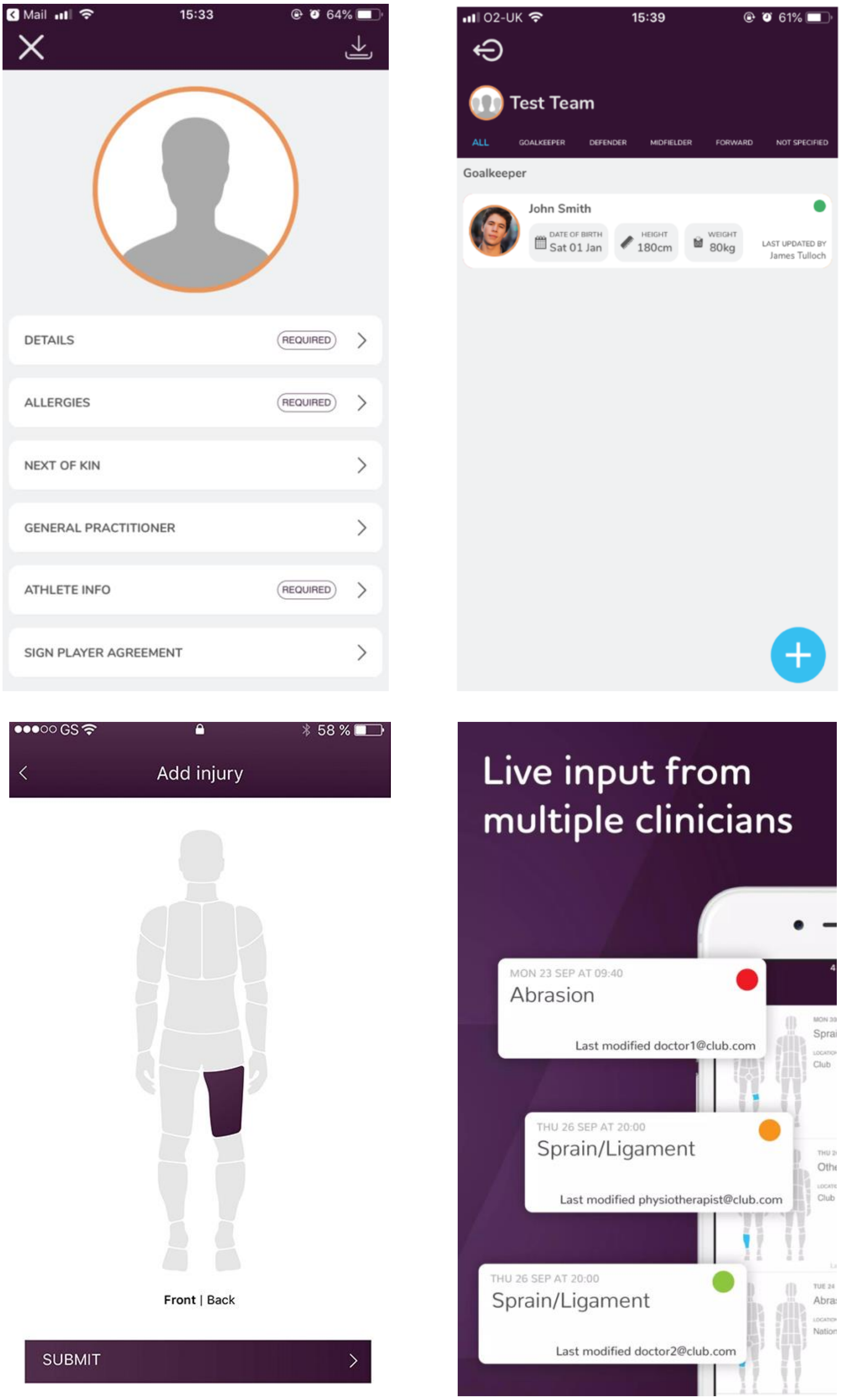
The number of minutes individual players played or trained for could be entered within the app version initially tested however the research team agreed in advance this data entry may be unstable due to a significant burden on clinicians, particularly at semi-professional clubs with only part-time staff. The method to investigate ambient temperature was to retrospectively use an internet-based weather resource (timeanddate.com) to match the date of the injury recorded by a club clinician to either training location or match location of that team, then record the temperature at the time.

After each individual player had provided consent by the means previously described, a player medical record was created. It is important to reiterate that the STAYFIT-HURT project did not have access to data created by several features in the ScribePro® app which improved user function. Examples of this included player contact details, detailed demographics, illness episodes, prescribed drugs, medical investigations, or further details of medical episodes that were entered using a free-text function.

Injury episode entry can best be briefly illustrated with the following app screenshots:

Example Screenshots of ScribePro® app

Figure 2** ScribePro ® **app Screenshots



2.h. Club Recruitment / Engagement Process

The STAYFIT-HURT project revolved around harnessing data from football clubs. This was clearly dependent on the involvement of clinicians providing care at individual football clubs as their practise, clinical skills, diagnoses and management strategies would be the basis of the data. The first contact made with clinicians involved in Scottish football was during the Scottish Sports and Exercise Medicine Symposium at Hampden Park Stadium on 9/5/2018. This meeting was the premier educational forum for Sports Medicine clinicians in Scotland, including those in football, to discuss research, innovations, current issues, and consensus management. This was a brief 5-minute overview presentation delivered by Dr Kaye highlighting the aims of the STAYFIT-HURT project, the potential for a confidential medical records tool and the fact that all clubs would be invited.

In Scottish football there is a very wide variety in terms of number of clinicians, clinical roles, and hours of weekly involvement. The clubs at the top of the SPFL pyramid may have as many as 3 full-time physiotherapists involved in providing first team care as well as a full-time doctor. This does not consider those employed in sport science roles or other allied positions. At the base of this SPFL pyramid it would be common that the entirety of the medical provision is a single part-time sports therapist. Engagement of these clinicians at different levels with a medical records tool that demonstrated sufficient depth of functionality for those more heavily involved with focused roles versus those who required a more basic tool was challenging. It was also necessary that data was entered with some uniformity so these different levels could be compared like for like. The ScribePro® app therefore had several functions that were not directly relevant to the project, nor designated to provide data for the STAYFIT-HURT project. It was necessary however to demonstrate these features of a bespoke medical records tool to maximise engagement.

Following a brief STAYFIT-HURT project presentation mirroring that from the Symposium of May 2018, the first demonstration of the ScribePro® medical records app was undertaken at a Sport PROMOTE® (Practical Resus Of Medical Or Trauma Emergencies) course in March 2019 at the invitation of the course organisers. This course is specifically designed for clinicians working in football and is attended 3 yearly by anyone providing emergency care to players. The consensus response from the attendees at the course was very positive with several expressions of interest to be involved.

To maximise this engagement in the project and show no bias to any club involved, lead researcher Dr Kaye attempted to make direct personal contact with medical personnel at all 42 professional and semi-professional clubs SPFL clubs. This was achieved using an existing contacts database from the Scottish Football Association cardiac screening programme. One of the research team was the existing controller of this data. Consent was sought via email from these contacts to use their email address only as a means of contact by the STAYFIT-HURT project. A specific password protected email address was created to make these contacts and disabled at the end of the project. Although the project was supported by the SFA it was essential that clubs and clinicians were neither coerced into involvement nor given any impression of medical licensing obligation. This was made very clear in the emailed contact.

In June 2019 prior to pre-season training medical representatives, varying between physiotherapists, doctors, and sports therapists, were contacted with information about the study via email. Club administrative staff were also sent information about the project given their potential GDPR responsibility. An early issue identified in this process was the transient nature of many of these staff and rapid turnover in employment. In many cases multiple attempts were made to find a medical representative involved for the new season. Indeed, this issue of staff turnover caused the disengagement of a number of clubs early in the process although the STAYFIT-HURT research team were unaware of the change in medical personnel until months later which gave no opportunity to act and re-engage the club.

The emailed invitation provided details about the STAYFIT-HURT project and free use of the ScribePro® medical records app for the entirety of football season 2019/20. A face-to-face meeting held at the club involved or at a place of the object clinician's choosing was offered and if no response was received a second email was sent a fortnight later. Lead researcher Dr Kaye attended face-to-face meetings with 26 clubs, explained the project and demonstrated the ScribePro® app while providing detailed consent forms to be completed for each player, privacy notices and participant information sheets. No obligation was implied, and the outcome of this process is discussed within the results section. Consent was to be obtained from players by the club doctor/physiotherapist to allow their data to be used for research purposes.

2.i. COVID 19 Pandemic

The COVID-19 pandemic had a seismic impact on global sport and the Scottish league football season was no exception. On 13th of March 2020 the Scottish football season was suspended until further notice by the SPFL (Scottish Professional Football League). All football under the jurisdiction of the Scottish Football Association was suspended. With around a quarter of league fixtures left unfulfilled, it was announced by 18th of May 2020 that the league season 2019/20 would not recommence. During this time football clubs would not train and hence any data collection via the medical records app ceased. Indeed, it was apparent later that data input from participating clubs had tailed off in the weeks before the season was abandoned as focus shifted. Prior to the 13th of March medical care and day-to-day care of players had been transformed with minimised contact and COVID testing dominating. This unique period in sports medicine care would have provided a useful and relevant research angle but there was no provision within the existing ethical framework or research plan, nor time to organise this with the rapidly shifting landscape, to interrogate any data created around this. The ScribePro® team rapidly adapted the app to include a COVID-19 symptom screening tool, however this could not be incorporated into the research in time for the end of the season, nor was it part of the ethical approval or study methodology.

The STAYFIT-HURT study was designed and received ethical approval to collect data throughout the 2019/20 Scottish football season and the curtailment of the football season necessarily ended data collection prematurely. The access to the ScribePro® app data collection system was also based on collection of the above season's data only. Hence the impact on the STAYFIT-HURT research of COVID-19 should be considered as very high.

In anticipation of the above football season suspension the research group convened for a meeting on 10th March 2020. The key points were progress with data collection and development of the project in the shifting landscape of COVID-19. Club engagement and the quantity of data production had been disappointing, discussed in more detail in the results section. The option of further ethical application to continue the data collection phase of the study into season 2020/21 was discussed however the uncertainty of future COVID-19 developments meant planning for this was particularly challenging. The ScribePro® app was also rapidly developing to include a COVID-19 symptom screening tool and concentrating on new features outside the remit of the study. It was felt that the datasets as they existed should form the basis for basic statistical analysis.

It was also acknowledged that the lead researcher and majority of the research team have full-time clinical commitments away from the STAYFIT-HURT project. COVID-19 placed unforeseen and completely unprecedented demand on their time, both within roles in professional football and elsewhere in healthcare.

2i.i. Contingency Plan

When it became apparent that the football season 2019/20 was to be suspended and later abandoned, the decision was taken to focus on practical mitigation activity during the COVID-19 pandemic. This fell into two broad categories: firstly, activity that would provide useful feedback about the research methods employed and the barriers to generating robust research data during the season; and secondly proposed development to a data collection tool, in this case the ScribePro® medical records app, but with relevance to any future system. This needed to strike a balance between improved clinical relevance and traction with different sports clinicians, whilst still generating standardised data. The COVID-19 pandemic represented unique challenges to clinicians in sport. Both the research team and the app developers recognised a potentially crucial role in developing an early reporting screening system for players to report core COVID-19 symptoms to club clinicians trying to manage risk within the team environment.

The key activities undertaken since the COVID-19 pandemic ended the STAYFIT-HURT data collection are itemised below. These were undertaken in tandem with the ScribePro® team.

1. Interviews with key clinicians

    On 16th May 2020 a mixed sample of six clinicians made up of physiotherapists and doctors working at full-time professional football clubs was asked to provide written feedback on their experience of using the ScribePro® app medical records system. This questionnaire was developed specifically for and by the ScribePro® development team, however there was obvious crossover in themes generated. Clinicians were asked about barriers encountered and to outline suggested strategies for improvements.

2. Web-based meeting of key clinicians to feedback to app developers

On 19th May 2020 a remote Zoom® meeting was convened to involve the above clinicians, three members of the ScribePro® app development team and the lead Scottish Football Association Clinician (a member of the STAYFIT-HURT project supervisory group, Dr John MacLean). The above themes were explored in more detail and development of a uniform injury reporting tool with application to COVID-19 symptom screening was discussed.

3. Involvement in app development for use as COVID screening tool

   Both before and after the above meeting Dr Kaye had liaised with the app development team and the company's medical director (Dr Jonny Gordon) about development of the app. This was based on the principle of football club players and staff receiving and completing an emailed screening questionnaire each morning before attending any football club facilities. Completion of their questionnaire would then populate the existing medical record held by the football club; the clinician responsible for monitoring this would be automatically alerted if an individual was at risk or displaying symptoms and the affected person would then have to follow the standardised quarantine protocol. For many clubs this would form a core element of the club's strategy for safe return to work / training.

4. Interviews with key clinicians

   It was agreed within the research group that the most appropriate method by which to provide further robust qualitative data regarding the above process and evaluation of engagement issues would be using recorded interviews with some of the clinicians involved in inputting data.

2i.ii. Evaluation Phase / Chapter 5 Methodology

The results of the evaluation phase of the STAYFIT-HURT project form Chapter 5. This was conceived by the STAYFIT-HURT research group in response to the surfacing themes of poor engagement, discussed in Chapters 4 and 6. It was decided at the end of the 2019/20 SPFL season that some early evaluation was critical to understanding flaws in methodology, exploring options to maximise future research engagement and to evaluate user experience of the ScribePro® app. This was initially discussed between the research team and their own experience of app use, then informal dialogues with clinicians working in Scottish football, particularly some of those who had not engaged in the project. Although the pervasive culture in Scottish football emerged as a theme, it was agreed that a more re-producible format for evaluation was worthwhile. This evaluation was then formalised with the aim of collating personal incident narratives using planned recorded interviews by research lead, Dr. Kaye. These would take place with a variety of clinicians working at clubs who had engaged in the project and provided useful data. To provide balance to opinion and neutralise bias, some club clinicians that had disengaged during the project were considered but, despite attempts, they did not respond to contact attempts. Another clinician and club formally withdrew from the project, as mentioned in the results section, therefore they had removed consent to involvement. It would have been especially useful to clarify why this had happened, but the only reply forthcoming was a reported change in team management. Had any of these clinicians been involved in the evaluation process, it was felt further consent would have been necessarily formalised. Discussions were had regarding the necessity of further ethical approval, but this was not formally sought as the interviews were deemed an evaluation process with clinicians who had already consented to take part in the project. All interviewees gave verbal consent for their interviews to be quoted. A letter to this effect was received retrospectively from the University of Glasgow ethics committee (appendix 10).

Those involved in the interviews were a sports medicine doctor and GP, who had worked at a full-time professional league 1 (third tier) club during season 19/20, and also working with Scotland national squads, but had since moved to a premier league club (***Doctor 1***); an experienced physiotherapist with sport science qualification who had also worked at a full-time professional league 1 club but moved to a Championship club (***Physio 1***); a full-time NHS GP working in match cover at a part-time club in league 1 (***Doctor 2***); a sports medicine doctor and GP working at a full-time Championship club during 2019/20, but previously at a premier league club (***Doctor 3***); and a physiotherapist working at a full-time Championship club (***Physio 2***).

The interviews to evaluate the experience of the ScribePro® app mirrored questions and themes used to provide feedback at a focus meeting with the app developers and hence were known to stimulate important discussion with key learning points, both in app development and research project design. There was also the opportunity to gauge the enthusiasm of relevant clinicians to adopt such a system that may enhance player care, clinician safety, uniformity of practise and future research. The specific questions asked were:

- ‘What advantages and disadvantages do you envisage from having a standardised medical records system in Scottish Football?’
- ‘What system have you previously used?’
- ‘What were the barriers to using the App?’
- ‘What may be the key developments for the App that would improve experience?’
- ‘If you have decided to use an alternative system, please describe what the key reasons for this are.'

The key responses from the evaluation discussions follow in Chapter 5 in the format of important quotations from each question then form the Chapter 5 results and discussion.

2.J. Generation of Team Reports

The previously discussed aim of producing clinically relevant team-specific injury reports for the SPFL season 19/20 was a key objective of the STAYFIT-HURT project. The format of the UEFA Elite Club Injury study formed a useful logical framework (see Appendix 10). As explored in Chapters 4, 5 and 6 limited data quantity limited the range of results, and this meant the project was unable to interrogate planned areas such as exposure and injury burden fully. Nonetheless the focus remained optimising the available results into information for participating clubs.

Therefore, it was decided the team report would be divided into 6 sections with information displayed on squad data provided, number of matches (as a limited measure of team exposure), injuries according to age and playing position, anatomical injury location, injury type and injury context that included match versus training and playing surface.

In the individual team reports demonstrated in Chapter 4 all the participating clubs names appear to aid comparisons, however the other clubs' names would be redacted before being sent to the specific participating club.

2.K. Research Process. Comparisons and Statistics

Data was received in a Microsoft Excel® spreadsheet format from ScribePro® with each injury episode attributed to an anonymised player in a named club's squad. This data was collated into simple comparison tables using Excel®, initially comparing the previously defined variables between squads, and these basic descriptive statistics would evolve to form the basis of the team reports. The comparisons investigated were on each of the data parameters available as listed above in the generation of team reports. The statistical analysis undertaken on the available STAYFIT-HURT project data are based on simple exploratory comparisons with summary descriptive analysis. Exploratory analysis to demonstrate statistically significant outcomes proved inadequate sample sizes and hence most has not been included. Comparisons of means were tested using T-test and ANOVA, and association between variables using a Chi squared test of 2 proportions. Results that have not been included are due to lack of relevance with low numbers of data.

Statistical analysis was further discussed during the planning phase of the project and the possibility of multi-regression analysis of several data variables for an individual player was explored. Unfortunately, this was also limited by the disappointing data quality and quantity. The intention was to use a continuous variable such as age to investigate the other data variables for trend, although it was acknowledged that this could be challenging given re-injury rates and the patterns of one individual being injured multiple times. A further option would be to use multiple layer models or mixed effect models to demonstrate differences between teams (ie. one effect would be team).

Some datapoints provided a worthwhile quantity to test including mean injuries per player for full-time professional versus semi-professional players. These results were so similar that an Independent T test was used to clarify any statistical significance. Mean injuries per player in different playing positions also suggested an important result and this was demonstrated using a box and whisker plot.

The available results were also discussed with a University of Glasgow statistician with a view to optimising output from the available results. It was agreed that using a power calculation to demonstrate an example of the necessary data quantity to reach a future significant conclusion on a key outcome measure would be especially worthwhile. Minitab® was chosen as the processing software. Analysis was performed using a test of 2 proportions and a power curve for 2 proportions accepting 80% power. Theoretical 2 sample Poisson rate tests were also discussed.

Chapter 3 - ScribePro® App Development

a. ScribePro® App Contact
b. Specific Development Meetings
c. Key Issues Encountered
    i. Secure Entry
    ii. Technical Issues / Internet Accessibility
    iii. Saving
    iv. Loss of Match Minutes
    v. Communication
    vi. Worthwhile Continuation
d. Specific Developments Discussed within STAYFIT-HURT
    i. Storage of External Clinical Information
    ii. Links to External Resources
    iii. Format of Clinical Data Entry / SOAP
    iv. COVID-19 Screening
    v. Use on Laptop / Desktop
e. Exploration of Data Scrape

Chapter 3 ScribePro® App Development

3.a. ScribePro® app Contact

The use of the ScribePro® app was a unique opportunity for the STAYFIT-HURT team to engage in a development process of a bespoke tool for medical records in professional football. It was available without charge for one football season in Scotland only. This was a key methodological factor in a research project without funding, with inherently less bias. One of the ScribePro® app development team was a clinician working for the Scottish Football Association but with no ties to the STAYFIT-HURT project. After informal discussion it was realised the two enterprises could work together for mutual benefit. Both by a clinician from the research team using the app at his professional club, and from regular informal feedback from research participating clinicians, the project was able to gain a unique understanding of how such a tool can develop and maintain relevance to different care disciplines. With careful respect to the University ethics policies and legal processes for data sharing, an agreement was reached between the ScribePro® app development team and the STAYFIT-HURT research team / University of Glasgow (Appendix 6).

None of the research group had any direct involvement nor pecuniary interest in the ScribePro® app development, however the clinicians quickly realised the benefit and potential impact for the care of their players. The project provided a beta testing platform for a medical records tool that was in development and the feedback from the research group and clinician app users was the limit to which the project influenced the app evolution. This feedback took the form of face-to-face meetings between the STAYFIT-HURT team and app developers, and emailed questionnaires or on-line focus group meetings (using the Zoom® software) with wider groups of clinicians where development ideas and priorities could be explored. There were also instances of less formalised feedback during telephone conversations between the STAYFIT-HURT team and app developers. The formalised meetings were co-ordinated by the medical director of the ScribePro® team after consent to participate in meetings was facilitated by email invites from one of the STAYFIT-HURT team to the relevant wider group of participating clinicians. No confidential specific player or team information was discussed at these meetings.

One of the challenges of the app evolution and development was that the platform being used for data capture during the study had to remain static, unless concerning or key app faults were identified.

Some of these evolutions affected functionality short term which in turn influenced engagement and ease of use.

From the SPFL season 2021/22 the ScribePro® app became a highly developed commercially available tool being used in a variety of clinical settings in both domestic and international sport. It was not commercially available during the 2019/20 football season and although the ScribePro® team contacted Scottish league football clubs before the 2020/21 season, no link was made between the STAYFIT-HURT project and continuing to use the app. There was no coercion to any club involved in the study for continued app use. Any discussion about development or association with the University of Glasgow STAYFIT-HURT project ceased before the app was marketed or available to purchase and no member of the research team has any ongoing interest in the app beyond its use clinically.

From a research methods perspective the key aspect of the app to discuss is the security of data. This is outlined in more detail in the data protection impact assessment in the appendices, but the central points are that the app storage is encrypted by default and the device itself had standard lock features. The data transfer to and from the server is also encrypted by sending it over HTTPS. On the cloud server there are hack defences and data encryption while individual users are mapped to specific data, meaning that only data authorised to be accessed can be seen. This is also true of the data extracted by the primary data holder (ScribePro®) and sent to the research team in an anonymised format. All case data is stored along with GDPR permissions. This is built into the app with the appropriate defaults. ScribePro® are utilising the Firebase® cloud-based server that is integrated into the Google platform and is GDPR compliant.

3.b. Specific Development Meetings / Presentations

During the planning phase of the STAYFIT-HURT project in 2018 several informal meetings were held between the research lead, Dr. Kaye and key representatives of both the ScribePro® team and the contracted app developers Daysix®. The aims and feasibility of the project were discussed using the example UEFA Elite Club Injury Study Report (Appendix 12) as a framework on which to build an aspirational outcome from injury data. Early in the app design stages, before any University agreement was reached, a planning meeting was arranged between the STAYFIT-HURT lead researcher and the medical director of ScribePro®. It was important that the key data points sought were highlighted to guide certain aspects of app development such as injury terminology. ScribePro® intended to use the Orchard injury classification system (60) which matched the STAYFIT-HURT plan. GDPR considerations were central, and the regulations were published during the planning phase which meant adapting to the methodology to be compliant, as discussed previously. Other commercially available systems that clinicians had previously accessed were also discussed along with strengths and weaknesses of these.

The subsequent phase of the project took the form of literature review of existing evidence, ethical approval proposal and revision, data impact assessment and management planning. These are all examined in the methodology section. The first formal ScribePro® app demonstration took place at one of the Sport PROMOTE® (pitch-side emergency care) courses on 8th March 2019, attended by clinicians working in Scottish football. A brief forum took place at this meeting to gauge interest and answer questions from any clubs interested in involvement. There was very positive discussion and feedback giving a sense from clubs at all levels that there was an appetite for involvement. It was explained how contact would be made and that use of the ScribePro® app would be without charge. Discussions took place about the intended benefit of player records passing between involved clubs at the time of player transfer and the benefit of ensured adherence to the recently implemented GDPR standards. A plan to invite all clubs through direct email contact was devised among the research group and a final meeting between Dr. Kaye and the Medical Director from the ScribePro® app took place on 7th June 2019 to discuss the current version of the app, appropriate features, and how optimise demonstration of the app during June 2019 to prospective clubs.

Meetings during the SPFL 2019/20 season were more focused on specific user experience or development issues. There was regular feedback and discussion by email and telephone discussion with a more structured in-person meeting between Dr. Kaye and the Daysix® app development team at the midpoint of the season on 11th November 2019. At this meeting issues surrounding data points and the developing evidence of limited engagement were discussed and are elaborated on below. In early 2020 the surfacing COVID-19 pandemic shifted focus, as previously discussed, before the season ended prematurely and data collection ceased. As a result, further virtual informal meetings were scheduled after fixtures were suspended among multiple doctors working in professional football in Scotland. Although these meetings were wide-ranging in topic beyond the STAYFIT-HURT project, for example: COVID-19 testing, future vaccination and medical effects on players, project engagement was discussed.

A specific virtual focus group of clinicians was convened, including representatives of the ScribePro® team, by the Daysix® app development team on 19th of May 2020. This meeting was not scheduled or led by the STAYFIT-HURT research team, but a few key themes were discussed that were applicable and helped to stimulate the subsequent evaluation phase of research engagement. The key themes the Daysix® team sought to explore were as follows, clearly with the aim to measure future commercial viability:

- *What are your pinch points as doctors / physios working at a club?*
- *What is the core feature set you feel you need from a player medical record?*
- *What has been good about ScribePro® to date?*
- *What would you like to see improve / be added to make it work great for your club?*
- *How interested do you think your players are in accessing their medical data?*
- *What's more important to you: access via a computer or phone?*
- *If you already use a tool for medical tracking, what makes you want to switch to ScribePro®?*
- *What medical reporting requirements do you have in your club (to management, admin, external to club)?*
- *At a club level, who are the users who would ideally have access to ScribePro® and what would they do?*

The specific outcomes from these questions were documented and taken on by the Daysix® app development team and were not part of the STAYFIT-HURT evaluation process. As a result, the participants were neither consented nor briefed that this discussion could form part of the research project. The content of this meeting is not further explored here but the discussions at the forum triggered the dialogue between the research team in starting an evaluation process and forming a COVID-19 contingency strategy to keep the project outcome relevant. The main eventual outcome of this is the evaluation process in chapter 5.

In the time after the SPFL football season 2019/20 ended and the STAYFIT-HURT team were examining the project data output, lead researcher Dr. Kaye had two further meetings using Zoom® software with a director of the ScribePro® company. This director, Dr. David Lowe, a leader in medical app technology development and honorary professor at the University of Glasgow, provided valuable guidance in future research options including a more detailed evaluation of user experience in the form of personal incident narratives. App experience was further discussed development ideas examined.

3.c. Key Issues Encountered

App users and research participants encountered a variety of issues during the curtailed SPFL season 2019/20, as could be anticipated when using a developing medical records tool. App compatibility had been extensively tested to operate on Apple® / iPhone Operating System® devices and Android but some individual clinicians still encountered compatibility and access problems at the outset, likely influenced by pending device software updates. The Daysix® app development team were very responsive and available to rectify these issues but there was an evident attrition in hindsight that some users did not report these issues and stopped using the app at the beginning of the project.

Secure entry to the app on an individual's device was a key feature that enhanced data protection and was strictly necessary. A password protected device often used a fingerprint or device code to open the device or access the app. Several rapid logins triggered a fail-safe code or email being sent to the individual to enhance safety, but this also caused login delays which in turn inhibited ease of use.

The ScribePro® app and its data were cloud-based, therefore use and login were based on necessary internet access. An unforeseen issue in app engagement was that some clinicians, particularly those at smaller clubs, worked in matchday team environments (changing / medical rooms) with poor or limited internet access, often 3G level or worse. This affected ease of use and app function and inhibited timeous documentation. The Daysix® app development team went on to develop off-line functionality, subsequently found useful for travelling teams such as those on plane journeys, but not available on versions during the project.

The most encountered issue in day-to-day app use was in saving injury episodes. The reason for the save function temporarily not working was unclear but this was frustrating for clinicians. This issue was generally rectified by updating to the latest version of the app where faced bugs had been addressed.

Unfortunately, one of the app features that was sacrificed as other aspects were focused on and developed was the facility to document match and training involvement minutes. It was important to prioritise core functions in medical and injury record taking. This meant that the version of the app being used would not provide data to sufficiently examine player exposure, as detailed in the UEFA Elite Club Study. It is important to state that subsequent version of the app have re-instated this feature.

As mentioned above, communication failures were predominantly between the research participating clinicians and the STAYFIT-HURT team. The research team did not pro-actively follow-up clubs in the early months of the season, assuming from meetings with clubs that the app was being used. There was no appreciation of the limited data entry until data feedback was received a couple of months into the season, at which point acting on this was challenging and would not generate worthwhile data. This is explored later in the discussion but a key feature in app development would be a rapid access help feature and user support structure.

Limited engagement from club clinicians inevitably led to concerns from the Daysix® group about their product and there were discussions during the project about worthwhile continuation with an understanding of future commercial viability. The STAYFIT-HURT team offered opinion based on their clinical user experience but that was the limit to which there was involvement.

3.d. Specific Developments Discussed with STAYFIT-HURT

In addition to the more formalised meetings already outlined, there was a regular informal dialogue, either by telephone call or email conversation that recommended changes or additions to function. The STAYFIT-HURT team had no specific involvement in the practical application of these discussions, but their anecdotal experience merits some exploration. One such exchange explored the idea of a space to add miscellaneous clinical information such as clinical correspondence from specialist clinicians, for example external specialist opinion relating to an injury. This would be part of the stimulus to develop the 'virtual filing cabinet' on the ScribePro® app. It was felt that cardiac screening results and club health screening information could also be stored here although a future specific area for screening information with a link to player availability or eligibility would be beneficial.

Other novel clinical aspects that came up in conversation were: a direct link to a SCAT-5 concussion assessment tool, the trends from which could be monitored; in-app links to drug-checking tools such as Global-Dro® which could ensure safer prescribing according to WADA with associated evidence of appropriate checks to protect players and clinicians; and facility to document specific procedures such as joint injection or wound management techniques.

The ScribePro® app was initially designed with clinical input from doctors and there was an evident slant towards common methods of medical documentation. By engaging physiotherapists in the STAYFIT-HURT study it became apparent that documentation facility in the app may need to evolve to become more universally user-friendly. The ScribePro® team subsequently adopted the SOAP acronym (Subjective, Objective, Assessment, Plan) which could be used for data entry.

Perhaps the most significant development between the SPFL seasons 2019/20 and 20/21 was the introduction of a COVID-19 screening tool which the STAYFIT-HURT team had no direct involvement with but was a key consideration when a COVID-19 contingency plan was being formulated. This involved an emailed symptom screening questionnaire being sent to players, the collective replies being collated and applied to the player profiles, then email alerts being sent to relevant clinicians if any high-risk symptoms were reported. COVID-19 test results could also be amassed here. An extra visible facet of player availability status was also added to each player on the club profile.

In addition to this there was regular informal discussion about use of ScribePro® between clinicians at the same club. This often generated some interesting angles from the individual that merit consideration. An example of this would be one of the participating physiotherapists describing entering data on their phone in an office shared with club coaching staff. They described the stigma of ‘being on your phone’ and having to justify this, whereas using another software which was laptop/desktop computer-based was a more acceptable format in an office environment.

Other aspects of the ScribePro® app that were discussed retrospectively were more focused on optimising future engagement in a similar project. Examples of this include a facility to flag to all users within a specific club’s squad that a new injury or illness has been documented, enhancing inter-clinician communication. A further option to encourage clinicians to keep injury episodes updated was a running link for coaches or managers, with a very limited form of app access, that merely showed whether a player is available or not. It was felt this would underpin some accountability and consequence for sole clinicians often working in isolation.

3.e. Exploration of Data Scrape

A key aspect of the STAYFIT-HURT study was a means to examine exposure. This requires accurate data on individual player training sessions, number of competitive match minutes and number of matches participated in. As discussed above, early versions of the ScribePro® app included a facility to record this information and hence this was included in the planning phase of methodology. The app version used for data capture had dropped this facility to focus on core functionality of injury episode recording. It was felt that, although disappointing, if injury episodes were kept up to date accurately and hence duration could be determined, injury burden would remain the key outcome to be measured.

As the app developed the STAYFIT-HURT team explored other means by which to generate information on exposure. Internet resources are readily available that retain data on player exposure at the upper echelons of professional football although it is difficult to ratify the validity of these. The most reliable of these was felt to be the SPFL archive. News resources such as the BBC Sport website also retains information on player match minutes. The research team investigated the possibility of a ‘data scrape’ for such resources. The immediate methodological and ethical challenge to this is in matching web-based, player-named data on exposure to anonymised data in the STAYFIT-HURT injury database. It was decided that in keeping ethical approval and due to the potentially unvalidated data this was not appropriate. However, the methodology for data scrape was discussed and designed with the DaySix® app developers. A coding method is provided as an example using the SPFL database as a platform and is included as appendix 13.

Chapter 4 – Results of Injury Data

a. Stakeholder Engagement
b. Combined Club Injury Results SPFL Season 2019/20
c. Team Reports

Chapter 4 Results of Injury Data

The results of the STAYFIT-HURT project have been limited by the restricted data obtained during the SPFL season 2019/20. The conclusions drawn from the injury data are therefore limited in depth and statistical significance. The process and available results have however provided a good platform for a descriptive statistical outcome. There are two key reasons for this restricted data capture. Firstly, full club engagement was limited with only 6 of the 42 SPFL clubs supplying enough meaningful data (14%). And secondly, the necessary curtailment of the 2019/20 SPFL season due to the COVID-19 global health crisis. The mitigation plan for COVID-19 is discussed previously and the outcome of the supplementary qualitative evaluation exercise is detailed later. In the Scottish Premier League teams ended the season having played either 29 or 30 games of a planned 44 games (66% or 68%). In the Scottish Championship, the league pyramid's second tier, between 26 and 28 games were completed of a planned 36 (between 72% and 78%). In League 1, the third tier, between 27 and 28 games were completed of a planned 36 (between 75% and 78%); and in League 2, the fourth tier, between 26 and 28 games were completed of a planned 36 (between 72% and 78%).

4.a. Stakeholder Engagement

The research team's contact to initially engage clubs avoided coercion but was successful with face-to-face meetings held with 26 clubs: 6 clubs in the Scottish Premier League, 8 clubs in the Scottish Championship, 5 clubs in League One and 7 clubs in League Two. All of these had expressed an interest in involvement in the research at email contact and, after presentation of the ScribePro® app, 3 clubs in the SPL, 5 clubs in the Championship, 5 clubs in League One and 6 clubs in League Two gave a positive response that they were interested in using the app and participating in the STAYFIT-HURT project. This gave a planned total engagement of 19 clubs, 9 of which were full-time professional, the remainder being semi-professional. This is summarised in the flowchart figure x.

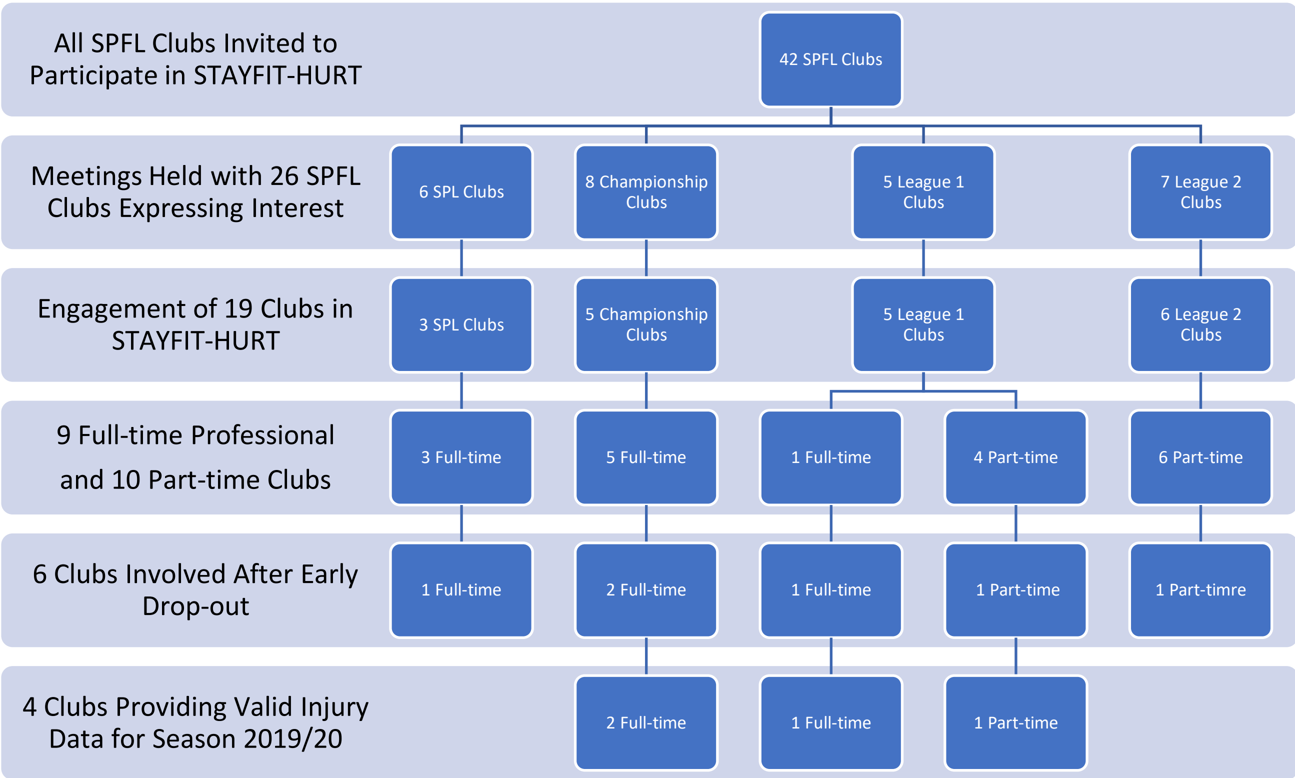
At face-to-face meetings a detailed explanation and presentation of the STAYFIT-HURT project was provided to prospective recruited clinicians and each participating club had a ScribePro® app account created at the time of training. A very open follow-up and support offer was created with the research team by means of email contact if required, but no specific follow-up appointment was arranged, nor early review of app use specified. This would be a key methodology development in the future to limit early drop-out. Most clubs were positive about engagement initially but did not progress to supply data or did not use the app consistently enough to provide any useful data. In the STAYFIT-HURT project, largely due to the use of an intermediary application to collect data, the degree of this disengagement was not apparent to the research team for months. There is a plethora of issues related to professionalism, culture in football, GDPR understanding, attitudes to research, comfort with technology and existing systems that are explored in more detail in the discussion.

Several further reasons that influenced this disengagement have retrospectively been identified which relate to methodology. Limited technological support was initially available as a direct link was not established between ScribePro® and the club clinicians. This meant any IT issues with the app could not be addressed immediately. Another issue was that often only part of the medical team at each club was willing to engage which invariably meant the system was not used consistently, and indeed the resultant data was unstable or incomplete. No data deemed unreliable or unstable was retained for analysis. A key development strategy here would be to ensure signed commitment from all clinicians at a club. The clinicians themselves were often transient and it was recognised that there was a high turnover in staff at football clubs. In only one case were the STAYFIT-HURT team informed of this change early in the season which accounted for one of the clubs that disengaged, the incoming physiotherapist declining to continue use of the app or participation in the study. Other examples of changes in staff were only identified when follow-up contact was made by the research team, and in the case of one Premier League club, this accounted for an unacceptable data loss after an initial promising data return. A methodology development here would be to monitor data return at regular intervals and make more regular contact with the relevant clinicians. Unfortunately, this level of follow up was not possible within the resources of the STAYFIT-HURT research team during SPFL season 2019/20.

These clubs that did not engage were not pursued to avoid coercion as was discussed in ethical approval. One of the key six clubs withdrew from the project during the football season, as stipulated was their right, according to the ethical approval and consent. The reason for this withdrawal was given as a change in club management structure and their wish to withhold injury information. A second of the six clubs had initially provided variable data and engagement and, despite multiple attempts to support data input, disengaged from the study. There was significant worthwhile data and injury episodes documented by both clubs. The first club, from league 2, asked not to be involved further so as consent was withdrawn the data was neither analysed nor further stored by the

STAYFIT-HURT team. The second club's data, from the Premier League, was too inconsistent and incomplete to be analysed. Several attempts were made by the STAYFIT-HURT team to contact the clinicians involved retrospectively to ask that the data injury episodes could be more completely documented but these contacts were refused. Therefore, the project analysis is based on only 4 clubs.

Figure 3. Flowchart of Stakeholder Engagement



Among the key aims of this research was the duration of injury episodes and time to return to play. Within this the research team had hoped to investigate those players who had an injury but had been able to continue training and/or playing. No data received from clubs was reliable or robust enough to investigate this theme with durations unreliably updated. The medical records system offered a key facility to mark players as cleared of any injury episode, receiving treatment for an ongoing injury episode but available to play, or unavailable due to illness and injury. This facility was either ineffective, not deemed relevant to clinicians or simply not used.

As a result of the limited data the subsequent results demonstration and analysis should be qualified by the small numbers. The key outcomes described are therefore descriptive and illustrative of the kind of data a future research project, or indeed participating football club would receive. As discussed in Chapter 2, a key useful statistical outcome would be an estimation of the amount of data necessary to investigate key themes this research initially sought to investigate.

4.b. Combined Club Injury Results SPFL Season 2019/20

At the outset of the project the design was to compare outcomes against the gold standard research available in the field and hence produce team reports that are clinically useful to participating clubs. As a result, after an analysis of the overall combined club results, data is presented in the format of team-specific injury profiles, with resultant repetition. In injury reports issued to clubs the details of other clubs involved in comparison statistics would be anonymised, however for the benefit of interpreting results in the attached reports other clubs have not been anonymised.

A total of 122 significant injury episodes were recorded sufficiently from the participating clubs. There was insufficient data on training or individual match minutes which means the limit to which exposure can be discussed is number of matches played by each club. Although the app featured simple tools to record whether injury episodes were from contact with another player or non-contact or whether an injury was a recurrence, these data points were not usually completed meaning any opportunity to interrogate this was lost. Injury severity data was not stable enough to use based on poor documentation of injury duration or specified return to play.

At the outset of the project the research team proposed investigating themes which are not included in the UEFA study, including playing surface, player age, professional status, and ambient temperature as an indicator of climate conditions. The limited data capture, as already outlined, has resulted in sparse results to present on some of these factors which have been combined for each of the clubs and follow with respect to professional status and ambient temperature.

The statistical analysis undertaken on the available STAYFIT-HURT project data are based on simple exploratory comparisons with summary descriptive analysis. This is fundamentally due to limited data availability. Analysis methods are discussed in section 2.k of Chapter 2. The dataset compiled is too small for assessing most injury patterns for statistical significance, but it does demonstrate that the method can produce worthwhile data. By extrapolating the output from Falkirk FC as an example club where two clinicians were fully engaged in entering injury data, albeit in a curtailed SPFL season, we could assume multiples of the number significant injury episodes that were recorded there. 44

injury episodes were recorded in a season reduced by a quarter. Hence, we could expect 59 injury episodes from a typical club over a full season and so over 1000 injury episodes from 20 clubs.

STAYFIT-HURT

Combined Club Season Report
SPFL 2019/20

Professional .vs. Semi-Professional

Table B
Table of STAYFIT-HURT TOTAL Professional v Semi-Professional Injury Probability

	Professional	Semi-Professional	Total
Number of Players	71	14	85
Number of Injuries	102	20	122
*Injury per Player Season 2019/20 **	1.44 (0.491)	1.43 (0.488)	

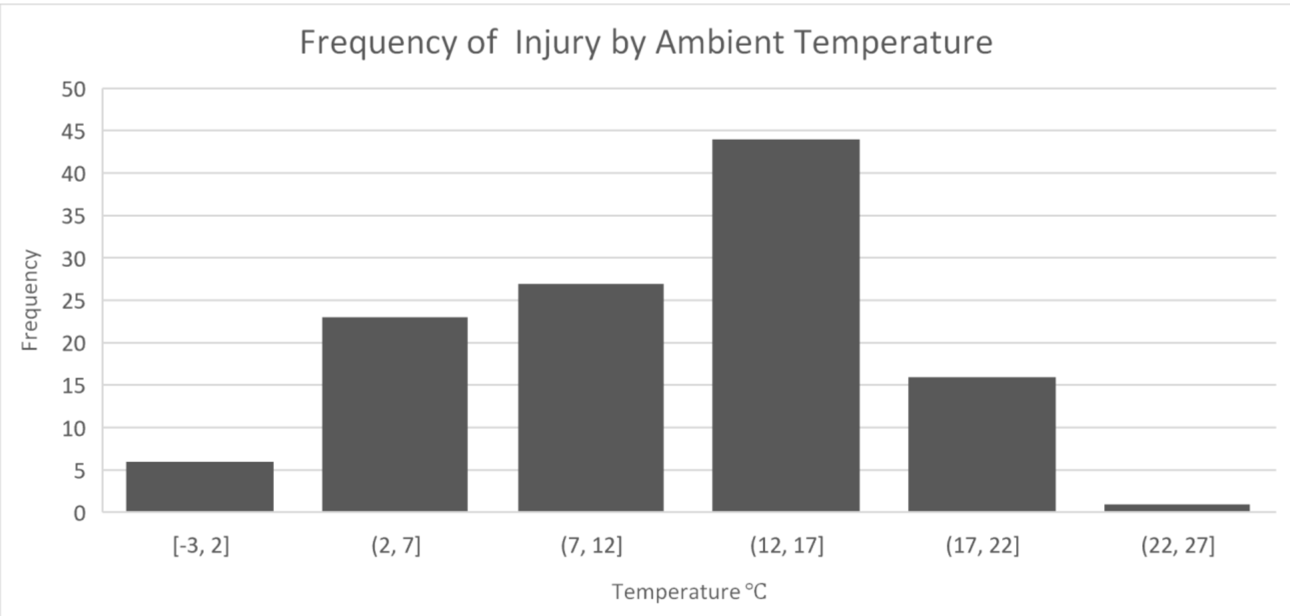
**curtailed football season due to COVID-19 pandemic*

Independent Samples T-test

Difference	-0.010
Standard Error	0.143
95% Confidence Interval	***-0.2953 to 0.2753***
Significance	***P 0.9446***

Injury Frequency by Ambient Temperature

Figure 4
Bar Chart of STAYFIT-HURT TOTAL Injuries by Temperature Range



Age Analysis

Table C

Age	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*	*35*	*36*	*37*
Nos	*3*	*1*	*4*	*8*	*8*	*8*	*5*	*4*	*8*	*6*	*5*	*3*	*4*	*2*	*2*	*3*	*6*	*1*	*2*	*0*	*1*	*1*
Inj Frq	*1*	*3*	*5*	*9*	*7*	*9*	*9*	*8*	*9*	*6*	*13*	*7*	*12*	*9*	*3*	*2*	*9*	*0*	*1*	*0*	*0*	*0*

Figure 5

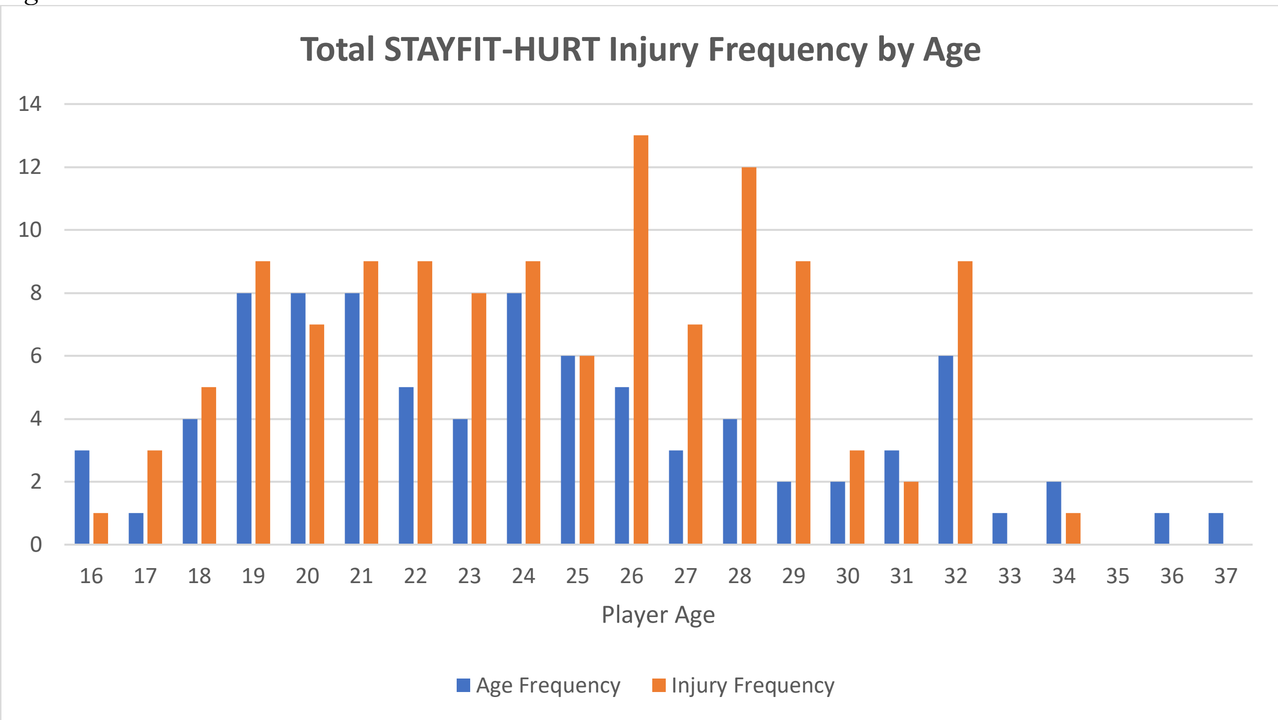
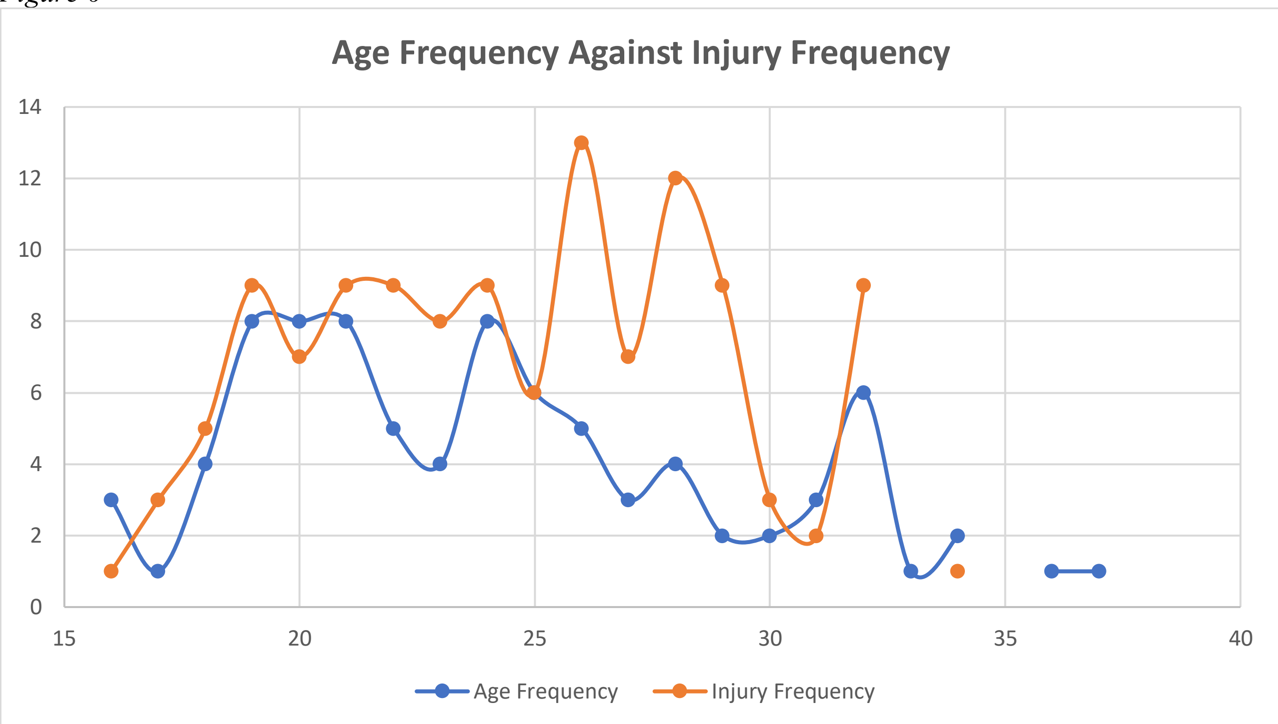


Figure 6



Position Analysis

Table D

Position	*Goalkeeper*	*Defender*	*Midfielder*	*Forward*	*Total*
Number of Injuries	*13*	*40*	*52*	*17*	*122*
Number of Players	*8*	*25*	*35*	*17*	*85*
Mean Injuries per Player	***1.625***	***1.6***	***1.486***	***1***	***1.428***

Analysis of Mean Injuries per Player	
Mean	1.42775
Standard Error	0.14575686
Median	1.543
Standard Deviation	0.29151372
Sample Variance	0.08498025
Skewness	-1.7568281
Range	0.625
Confidence Level(95.0%)	0.46386338

Figure 7

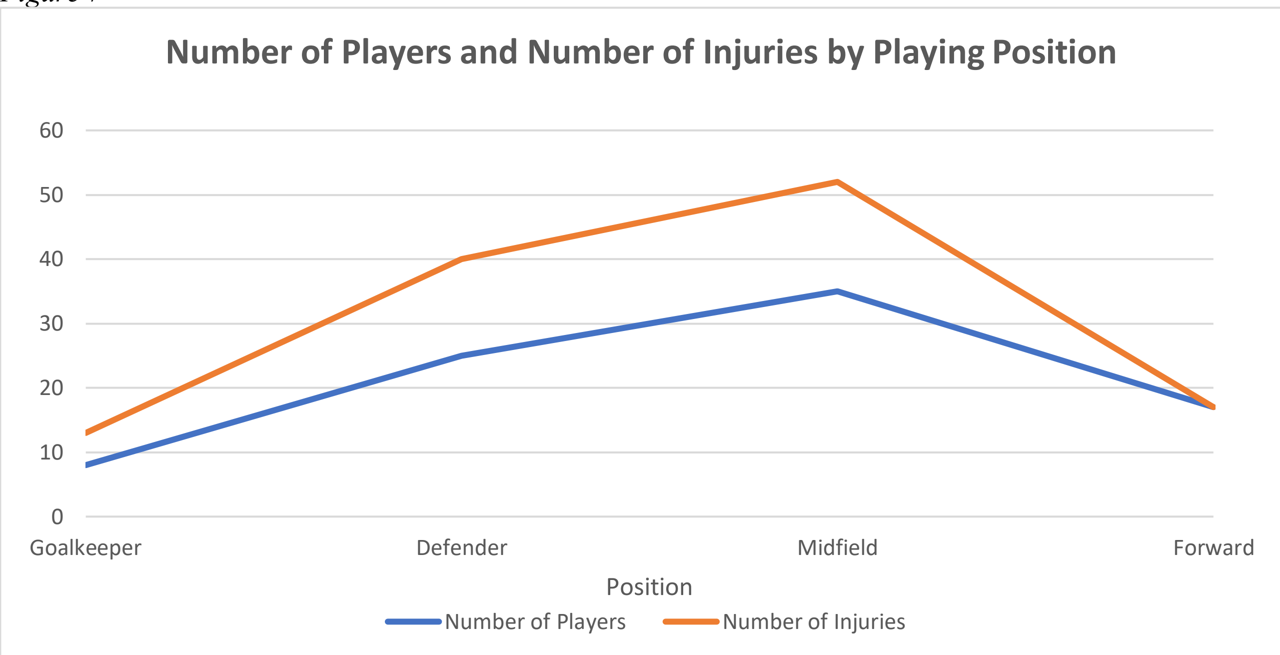


Figure 8

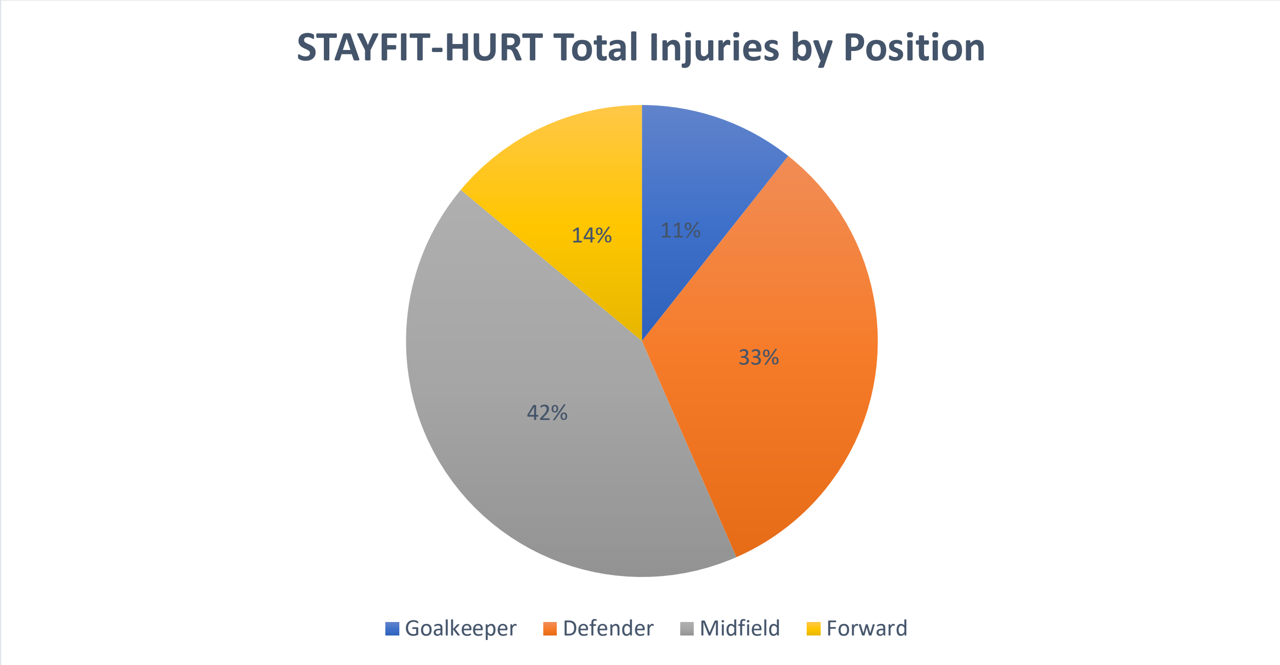
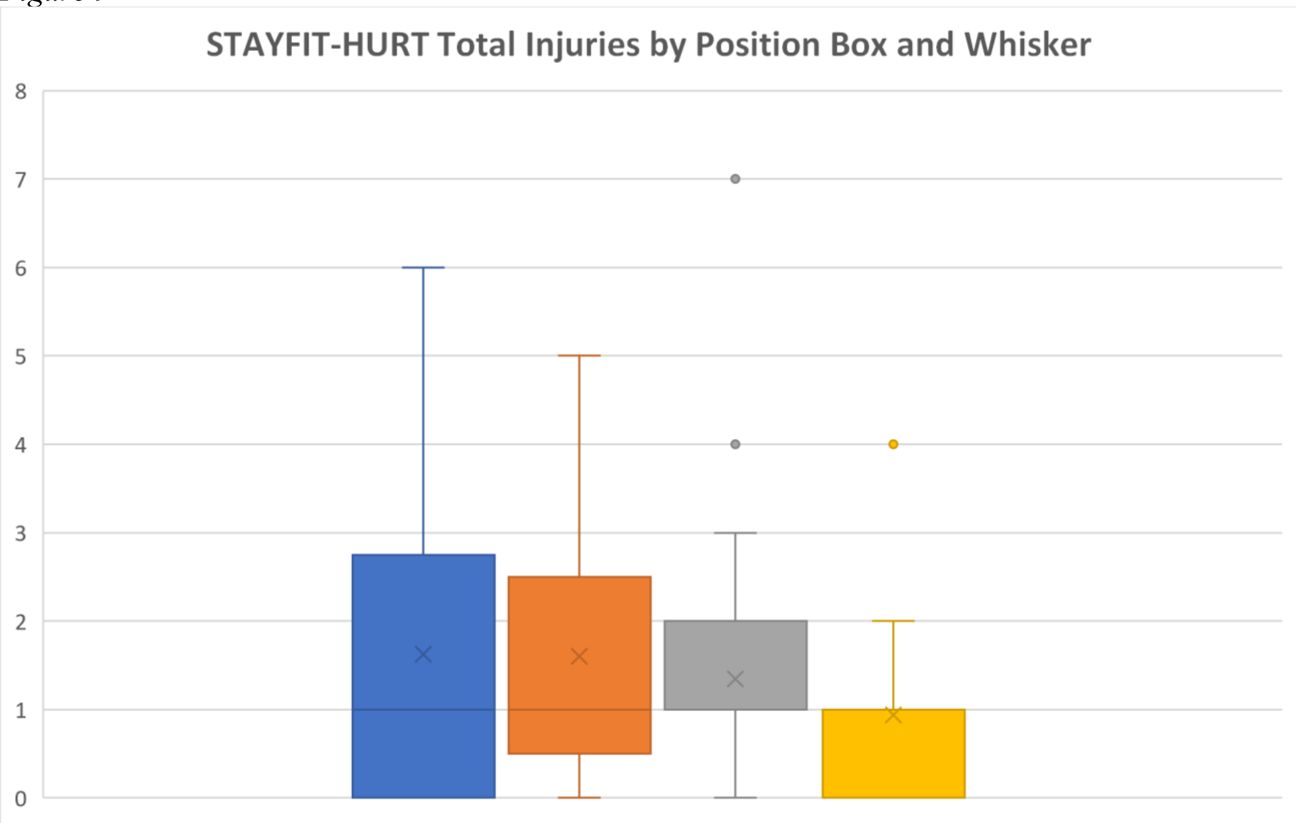


Figure 9



Injury Location Analysis

Table E

Location	*Hip/Groin*	*Thigh*	*Knee*	*Ankle*	*Head*	*Other ***	*Undefined**
Number of Injuries	7	29	17	24	6	33	6
Percentage of Total Injuries	5.738	23.770	13.934	19.672	4.918	27.049	4.918

** 6 Injury episodes from 1 club were undefined in location*

*** Other locations were shoulder, elbow, hand, wrist, abdomen, back, pelvis, calf, foot and toe*

Figure 10

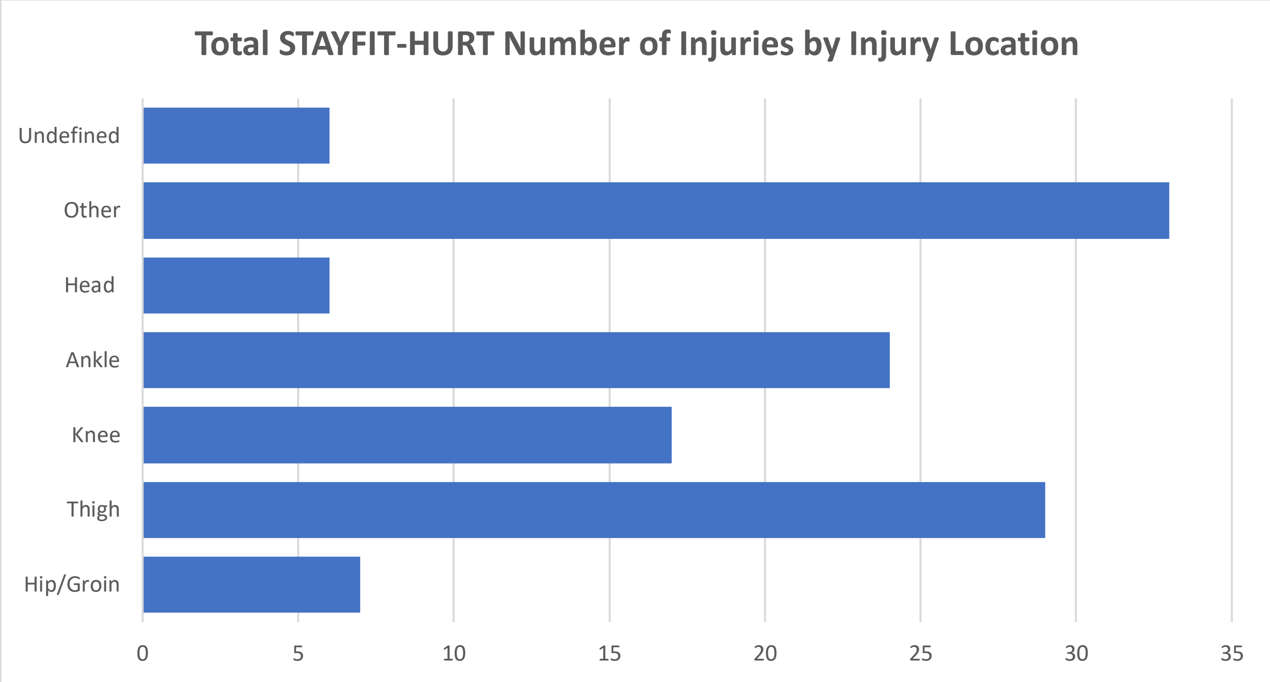
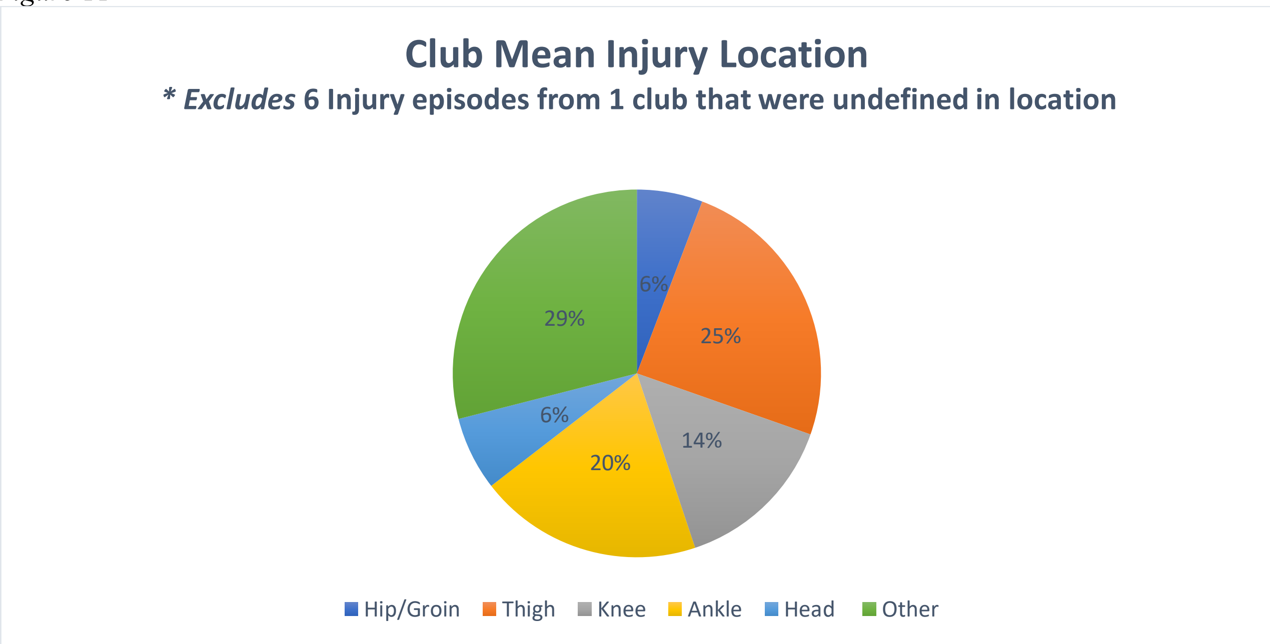


Figure 11



Injury Type Analysis

Table F

Injury Type	*Muscle*	*Ligament*	*Tendon*	*Contusion*	*Other**
Number of Injuries	43	24	9	16	30
Percentage of Total Injuries	35.246	19.672	7.377	13.115	24.590

* *Other types were either defined as 'other' in-app, meniscus, bursitis, fracture, effusion, concussion, laceration, dislocation or nerve*

Figure 12

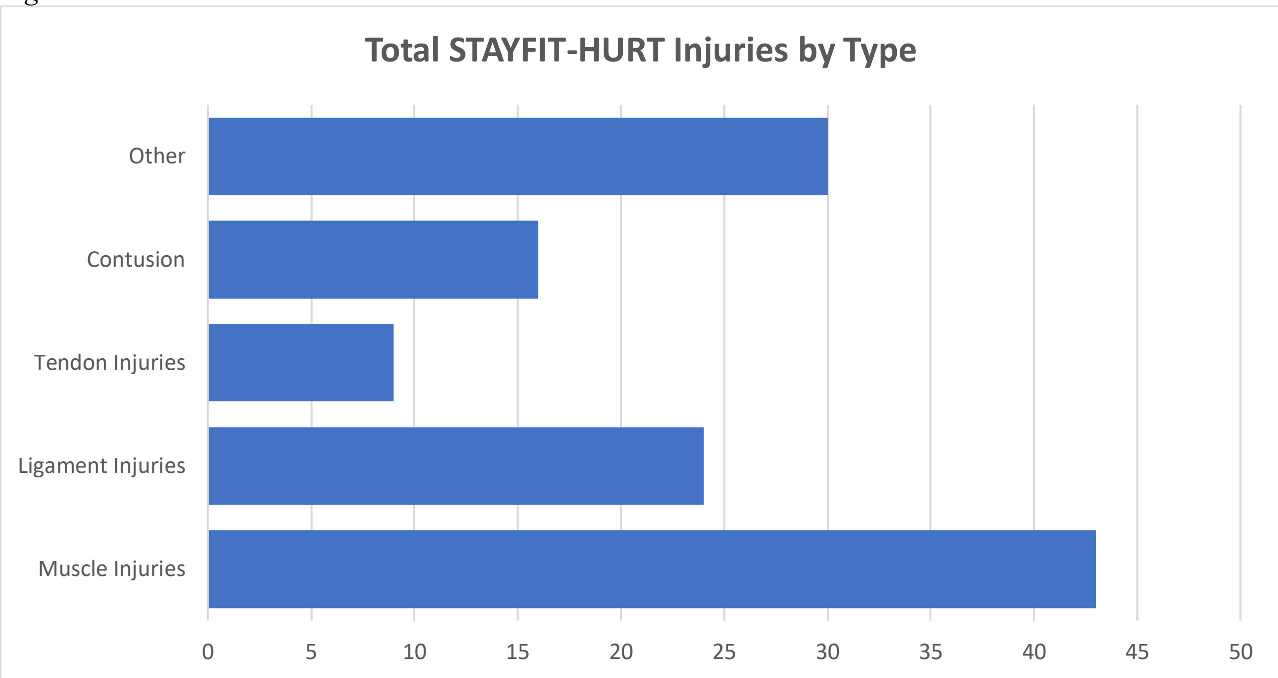
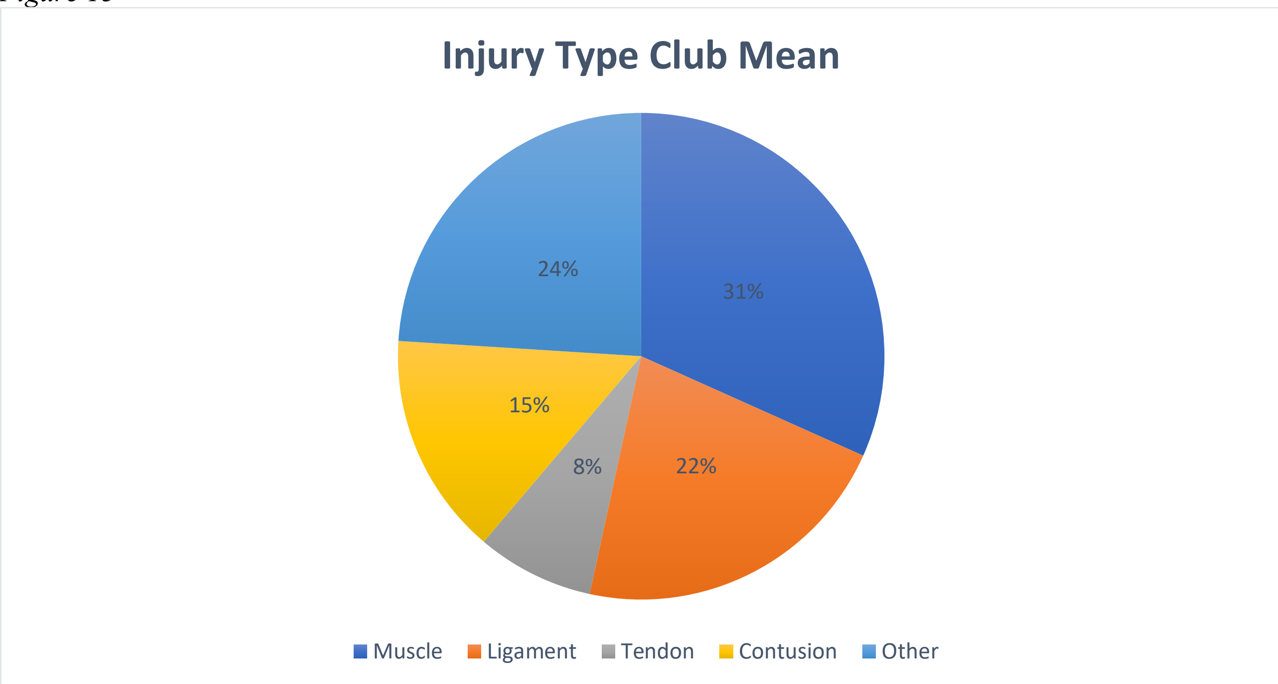


Figure 13



Injury Context Analysis

Table G

Injury Context	*Match*	*Training*	*Overuse / Breakdown*	*Other*
Number of Injuries	*75*	*43*	*3*	*1*

Figure 14

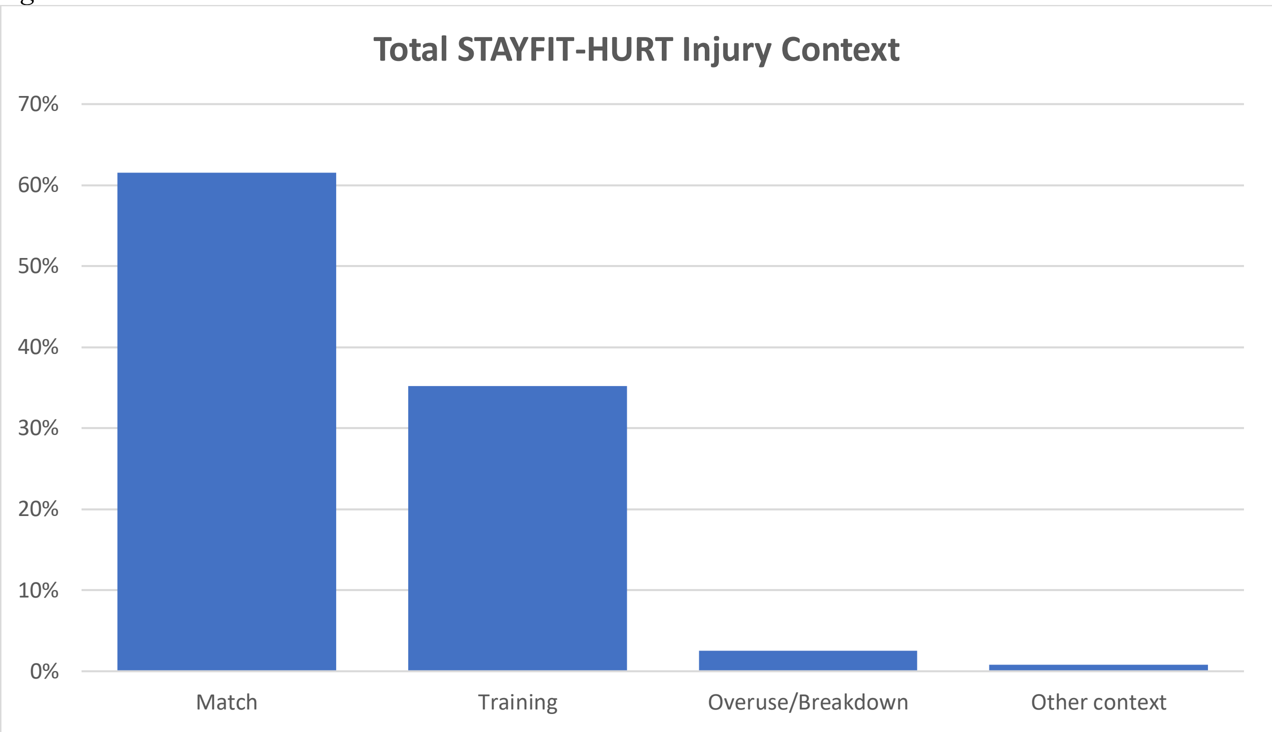


Figure 15

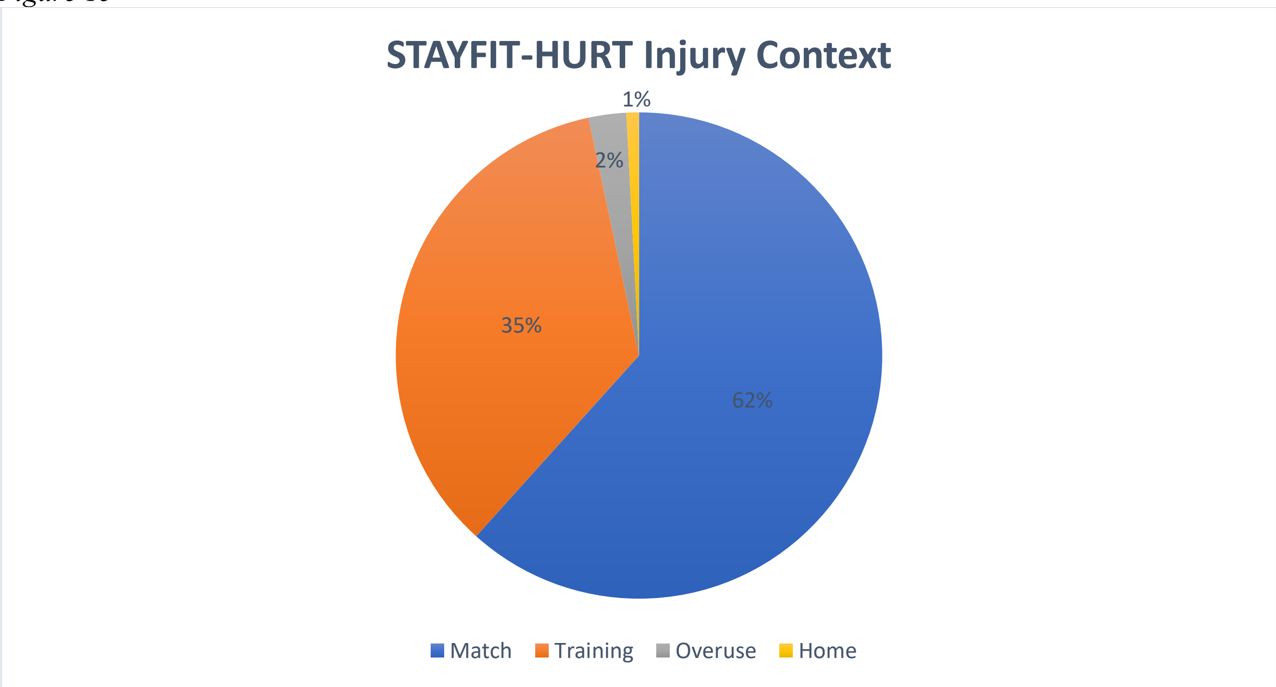
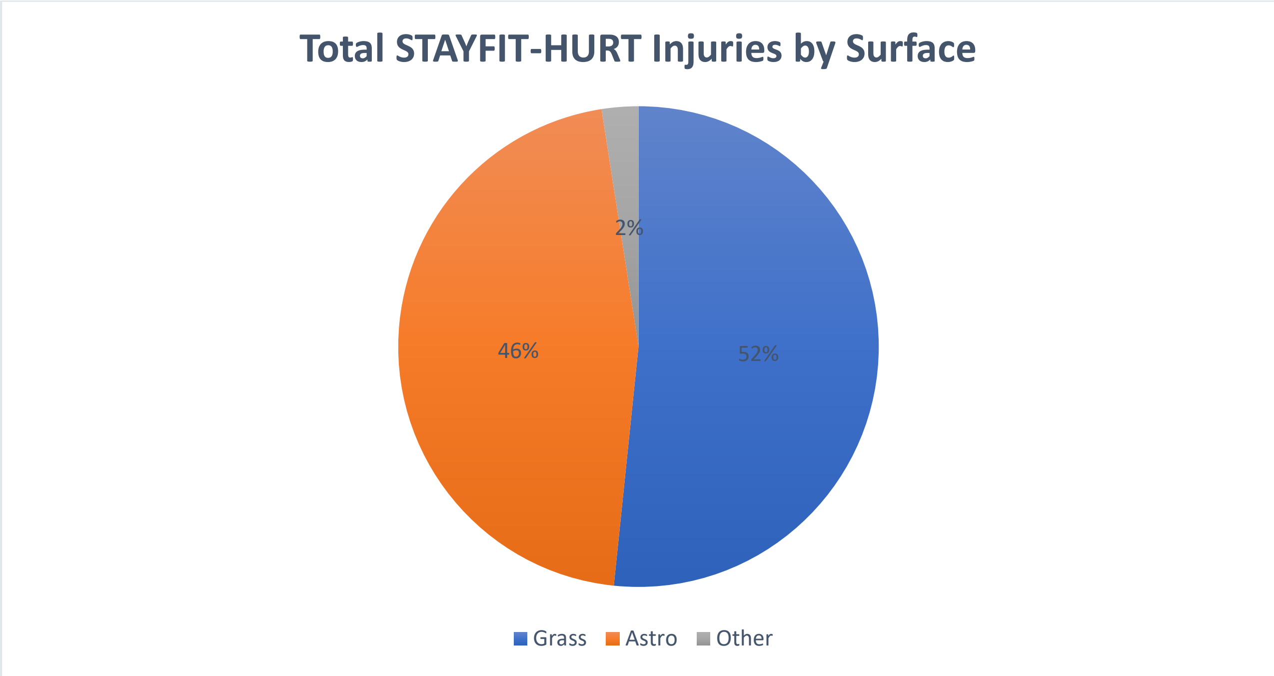


Figure 16



As an outcome measure that optimised the available number of results and demonstrated an indication of the null hypothesis that injuries rates do not differ on natural grass or artificial turf this was tested further using a test of 2 proportions, then extended into power calculations on page 96.

Table H

Injury Context	*Grass*	*Astro*	*Other*
Total Number of Significant Injuries	*63*	*56*	*3*
Total Number of Competitive Matches STAYFIT-HURT Clubs Involved in	*91*	*50*	
Significant Injuries in Matches	*50*	*25*	
Significant Injuries per Match	***0.549***	***0.500***	
Test of 2 Proportions: Difference	***0.0494505***		
95% CI for Difference	***(-0.122763, 0221664)***		
Normal Approximation	***P-value 0.574***		
Fisher's Exact	***P-value 0.600***		
Significant Injuries in Training	*13*	*30*	

Combined Variable Comparisons by Position

Table I

	Goalkeeper	Defender	Midfielder	Forward	Total
Total Number of Injuries	13	40	52	17	122
Number of Players	8	25	35	17	85
(Injury Location)					
Hip and Groin	2	1	4	0	7
Thigh	1	14	12	2	29
Knee	3	4	3	7	17
Ankle	1	9	12	2	24
Head	1	2	3	0	6
Other	5	7	17	4	33
Undefined	0	2	2	2	6
(Injury Type)					
Muscle	2	18	20	3	43
Tendon	1	4	4	0	9
Ligament	3	7	10	4	24
Contusion	0	6	8	2	16
Other	7	5	10	8	30
(Injury Context)					
Match	5	25	36	9	75
Training	8	14	16	5	43
Overuse		1		2	3
Other				1	1
(Injury Surface)					
Grass	1	23	31	8	63
Astro	12	16	21	7	56
Other		1		2	3

Figure 17

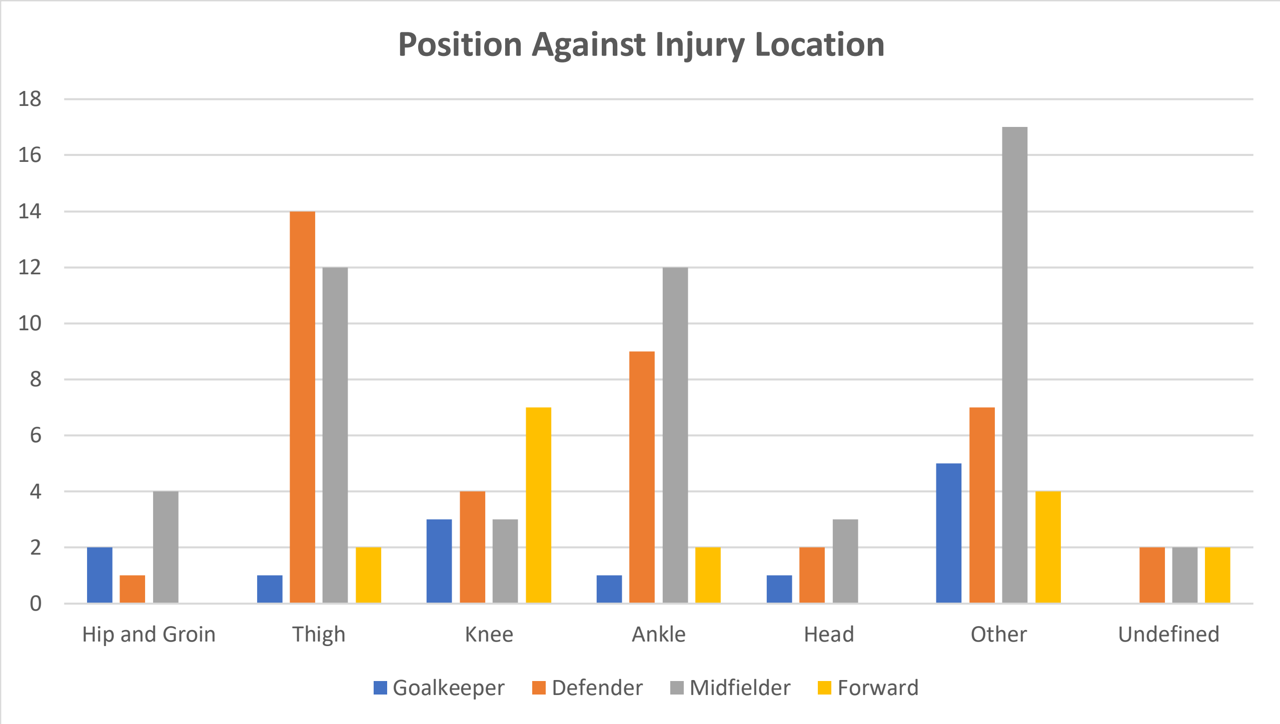
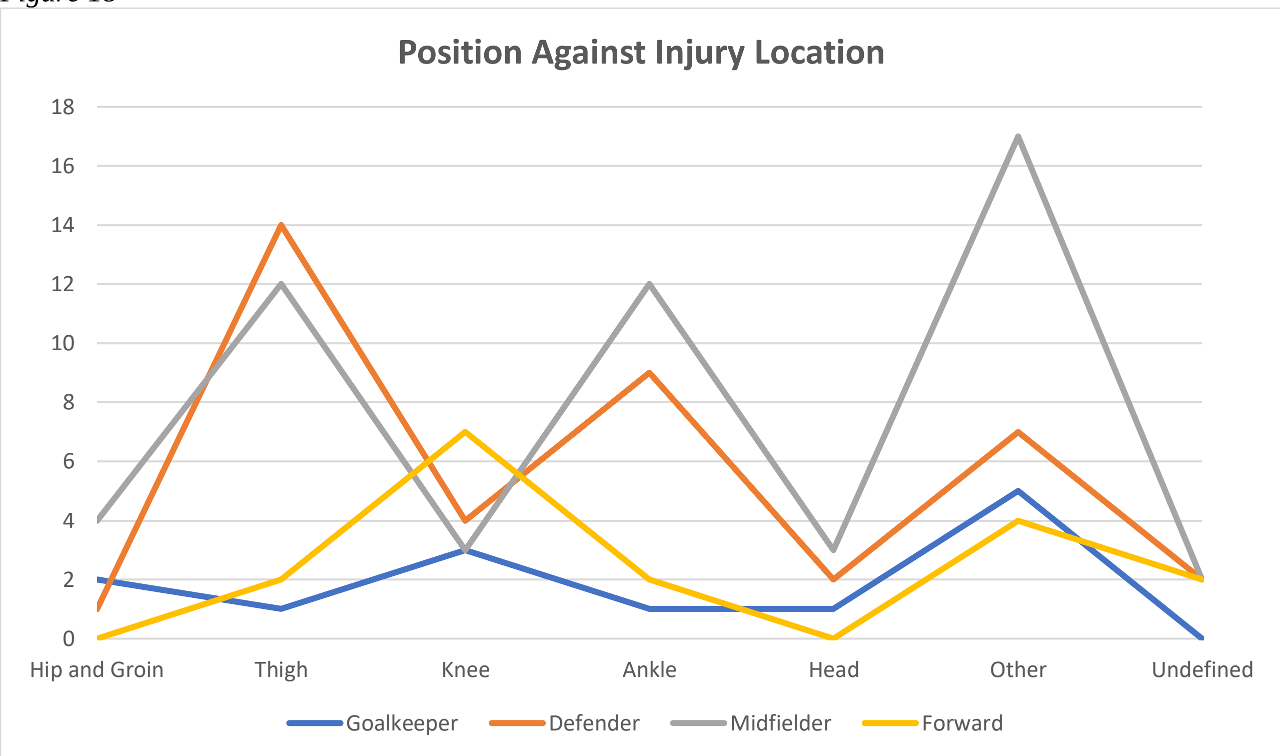


Figure 18



The above tables show the variability in different injury locations against outfield positions with defenders and midfielders following a very similar pattern of peaks in thigh and ankle injuries whereas forwards had proportionally less of these and a suggestion of more knee injuries.

Figure 19

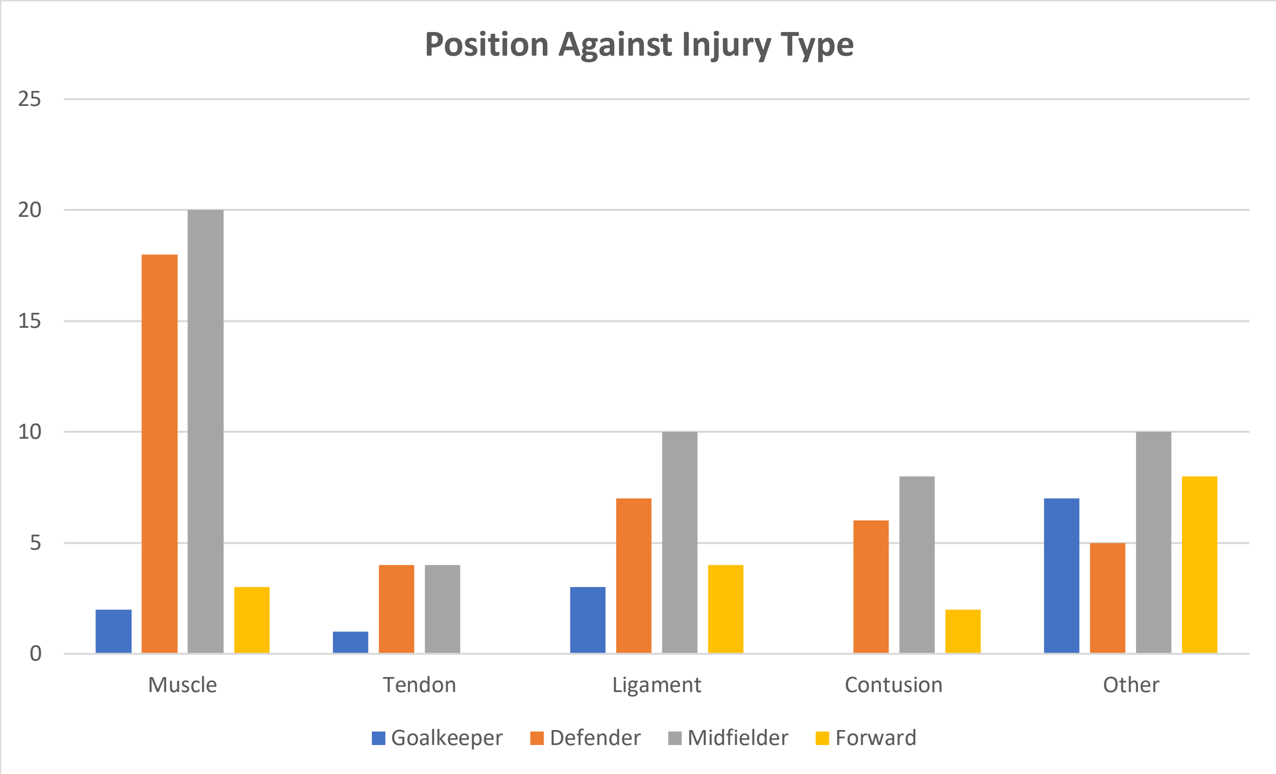
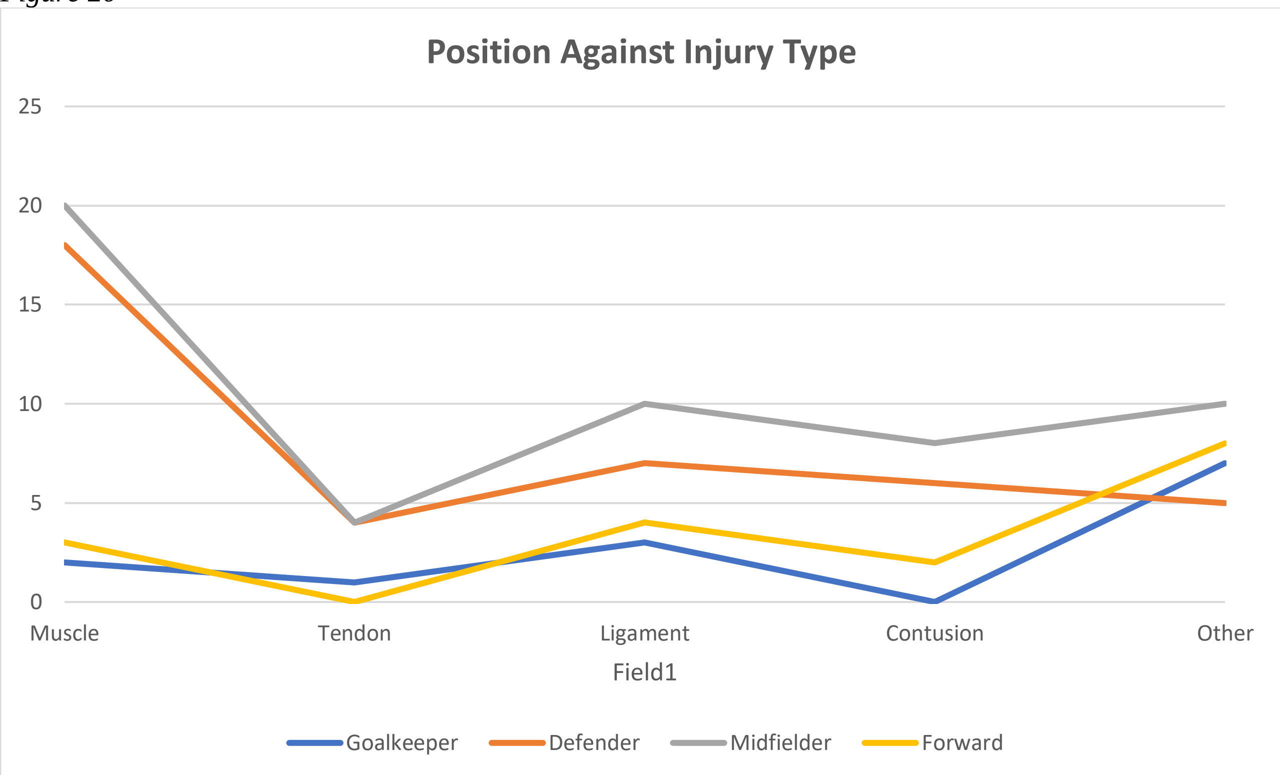


Figure 20



The above tables show the variability in different injury type against positions with a suggestion of defenders and midfielders following a similar pattern of a peak in muscular injuries.

Figure 21

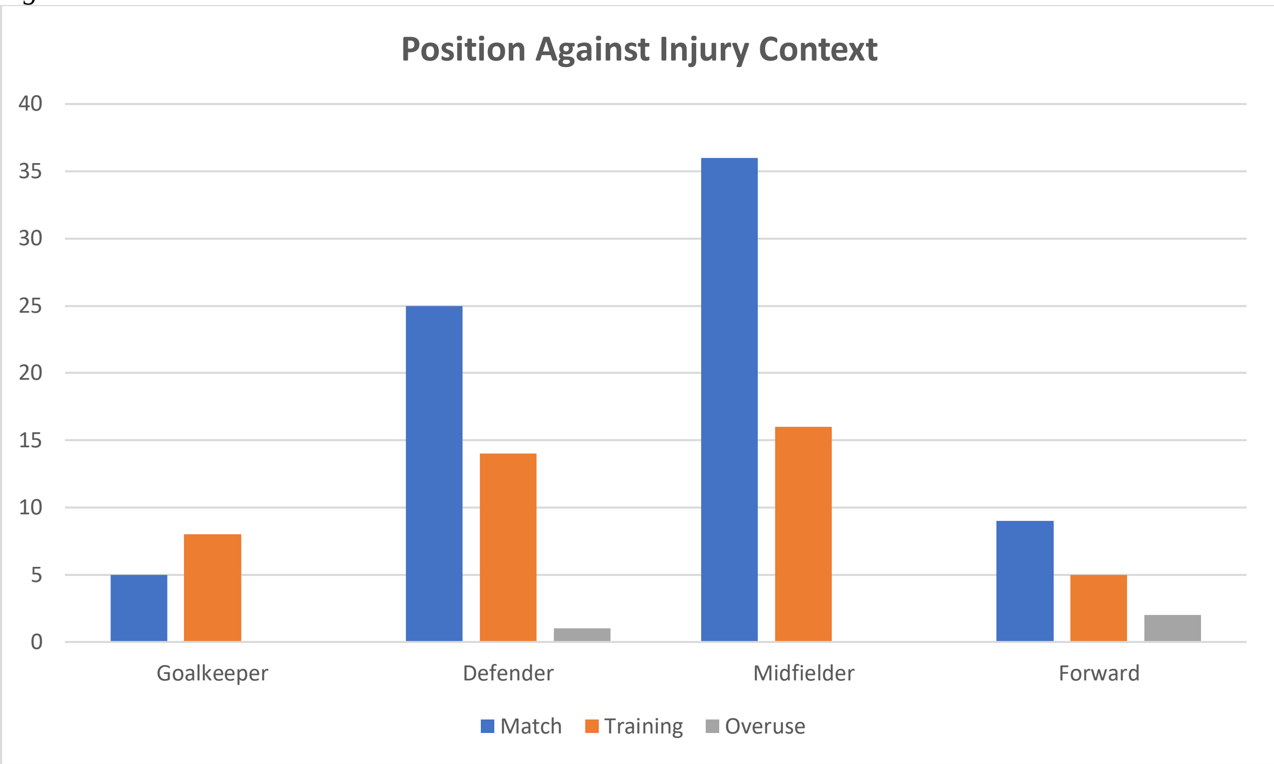
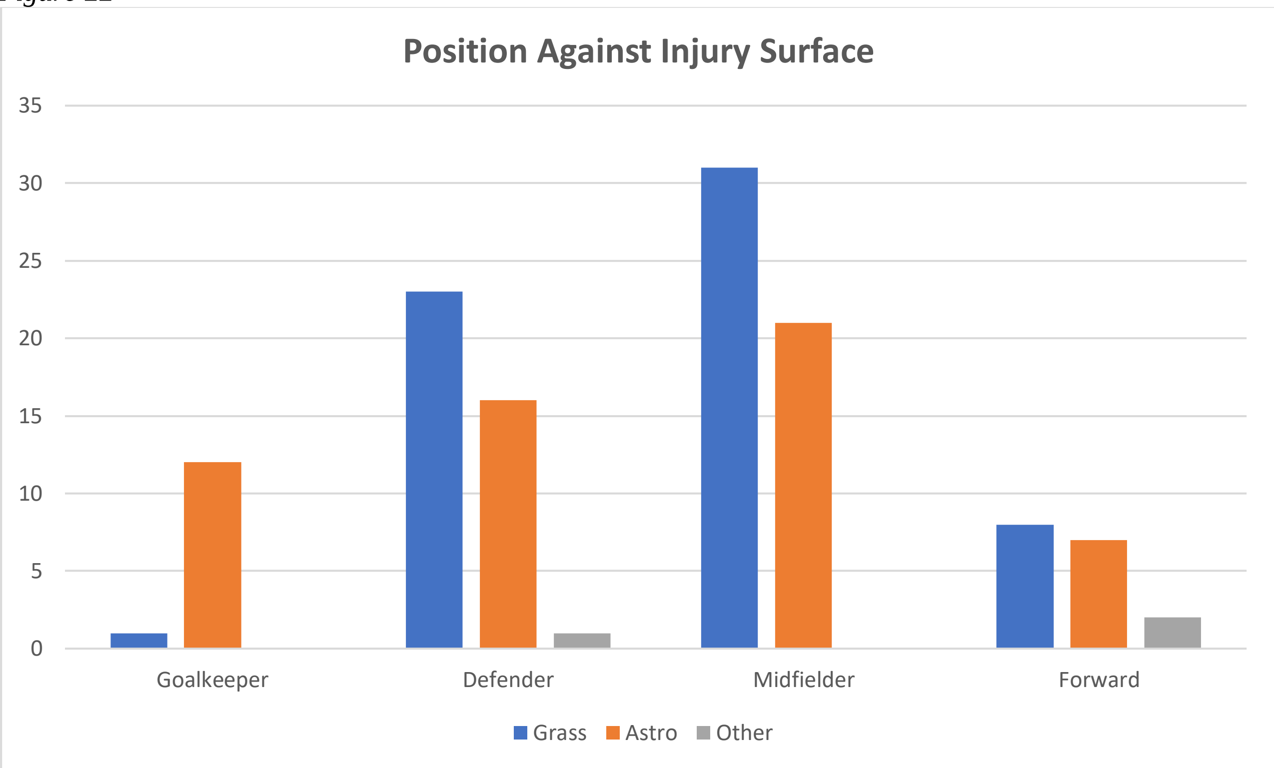


Figure 22



Combined Variable Comparisons by Injury Type

Table J

	Muscle	***Ligament***	***Tendon***	***Contusion***	***Other***	***Total***
Total Number of Injuries	43	24	9	16	30	122
(Surface)						
Grass	26	11	3	9	14	63
Astro	16	13	6	7	14	56
Other	1				2	3
(Context)						
Match	23	19	5	13	15	75
Training	19	5	4	3	12	43
Overuse	1				2	3
****Other***					1	1

*Non-Football context injury not included in below table

Figure 23

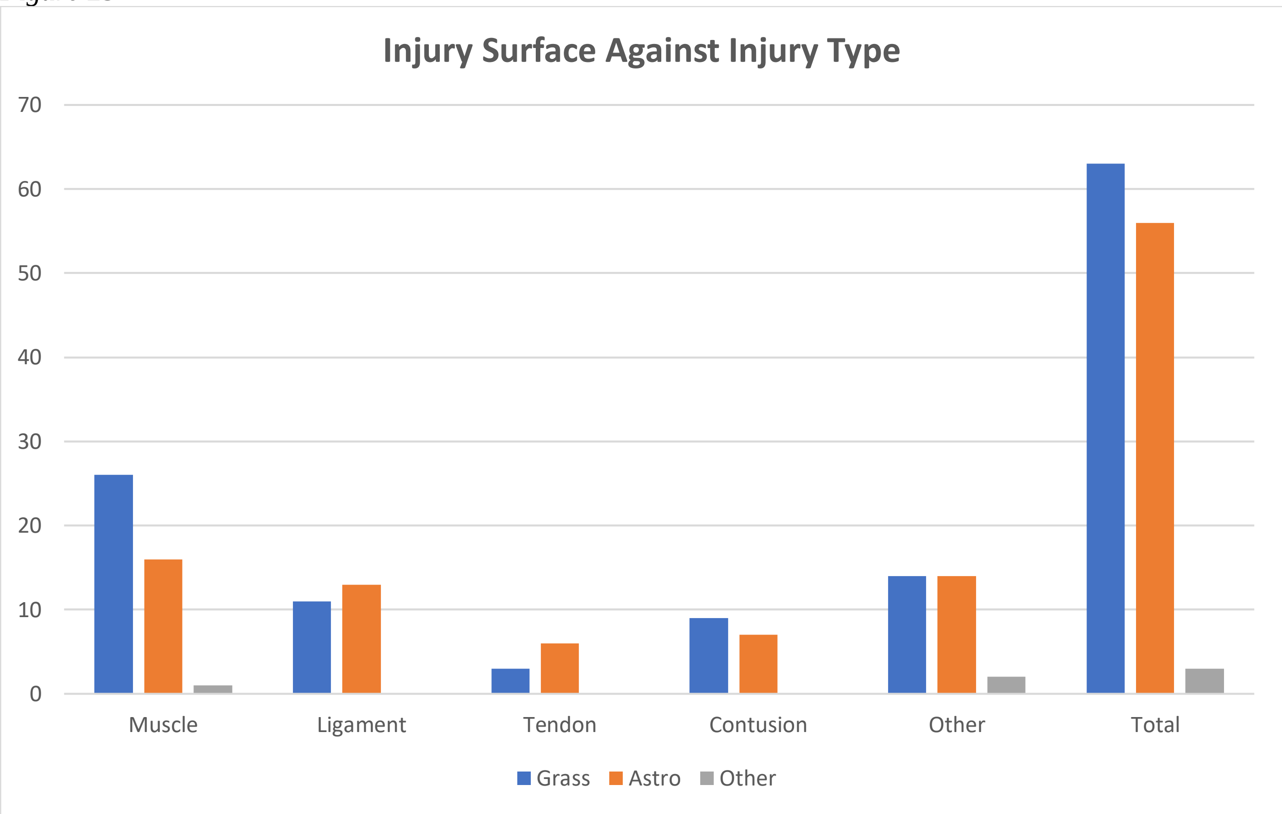
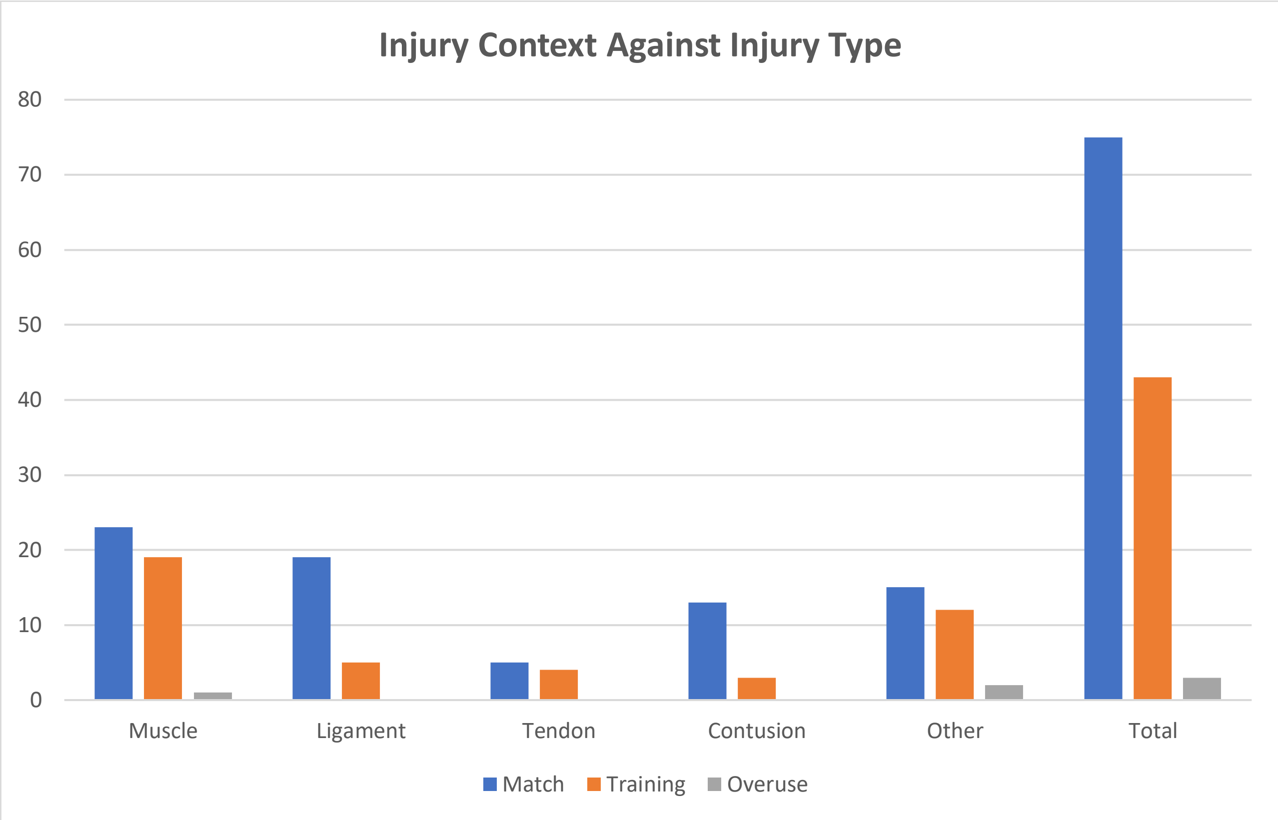


Figure 24


Injury Context Against Injury Type
80
70
60
50
40
30
20
10
0
Muscle
Ligament
Tendon
Contusion
Other
Total
Match
Training
Overuse

Combined Variable Comparisons by Injury Location

Table K

	Hip/Groin	*Thigh*	*Knee*	*Ankle*	*Head*	*Other*	*Undefined**	*Total*
Total of Injuries	*7*	*29*	*17*	*24*	*6*	*33*	*6*	122
(Surface)								
Grass	3	18	8	10	4	15	5	63
Astro	4	10	8	14	2	18		56
Other		1	1				1	3
(Context)								
Match	2	14	10	18	5	24	2	75
Training	5	14	6	6	1	8	3	43
Overuse		1	1			1		3
****Other***							1	1

*Non-Football context injury not included in below table

Figure 25

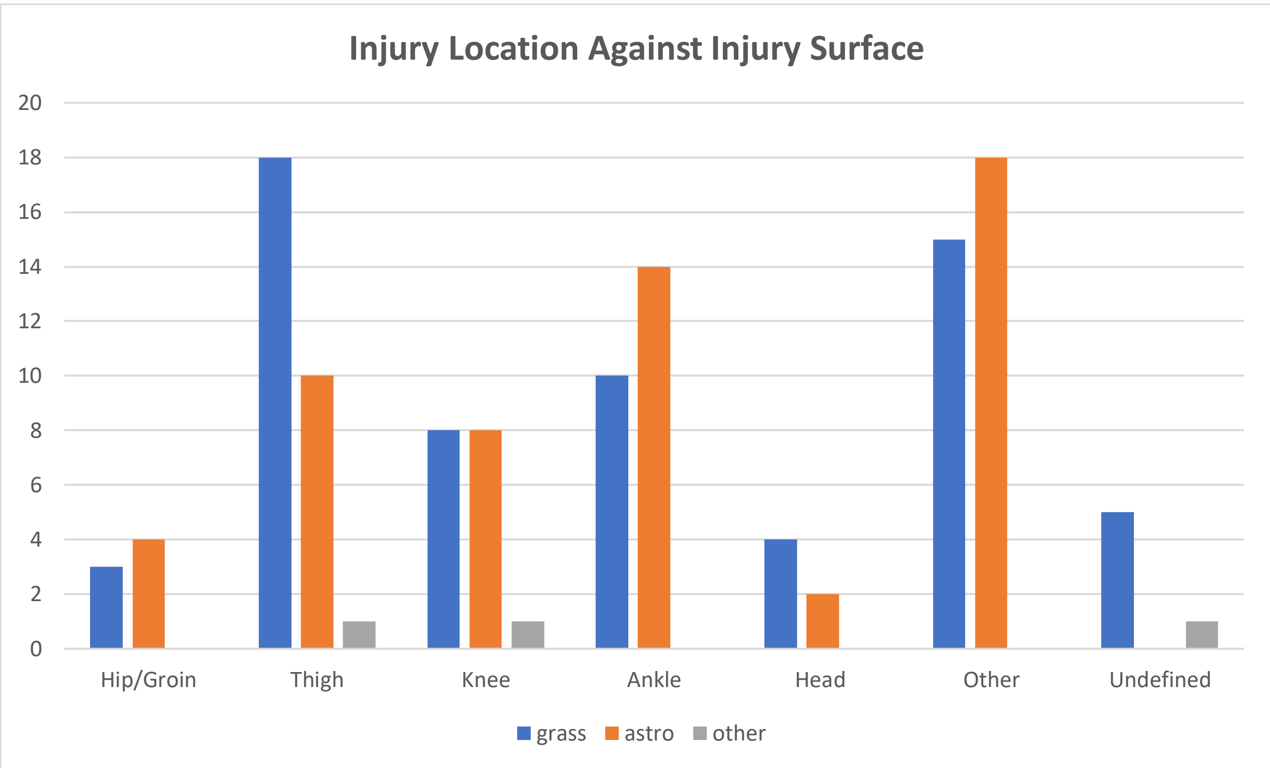
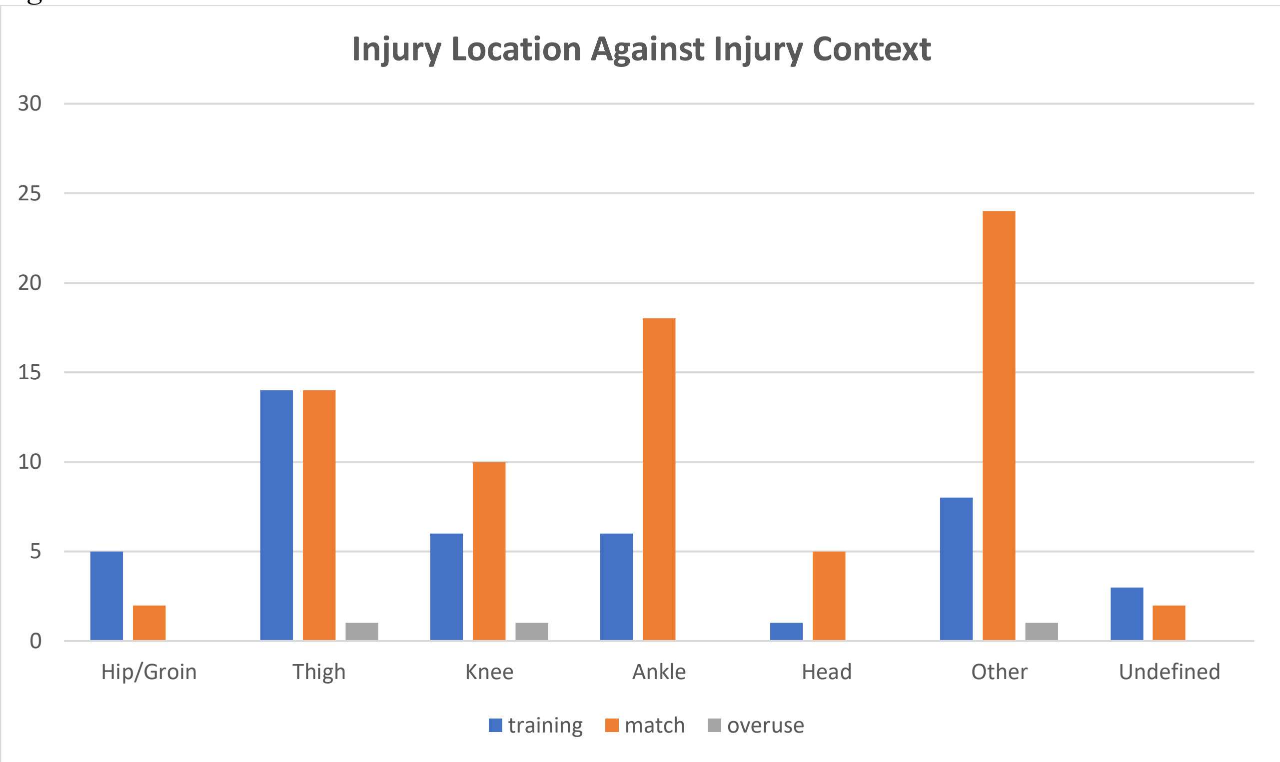


Figure 26


Injury Location Against Injury Context
30
25
20
15
10
5
0
Hip/Groin
Thigh
Knee
Ankle
Head
Other
Undefined
training
match
overuse

Power Calculations

The limited data available means the above data is demonstrated as descriptive statistics which is of limited statistical significance. Assuming the STAYFIT-HURT data is replicated across a wider population of players in Scotland, it is possible to employ power calculations to establish the likely necessary player numbers to sufficiently power a future investigation to have significant results. However, we must acknowledge that data may not be normally distributed.

Using the example of the results of injury rates during matches on different playing surfaces (table L), chosen due to the reasonable number of data points, it is possible to produce a basic power calculation making assumptions. For example, if it is accepted that a 5% difference in overall injury rate between surfaces would be clinically significant; and that the exposure for each player in the sample population would be the same (ie. equal number of games on each surface type), then to reach 80% power would require 376 matches in each group, 752 matches in total. Assuming clubs were chosen that would produce approximately even numbers of matches on grass and artificial surfaces this is likely to require approximately 17 clubs in an SPFL season. As data would be collected from each team in isolation, a match where both teams were being studied could be considered as 2 matches or 'episodes of exposure'.

Test for Two Proportions – Significant Injuries During Matches on Grass vs Artificial Surface

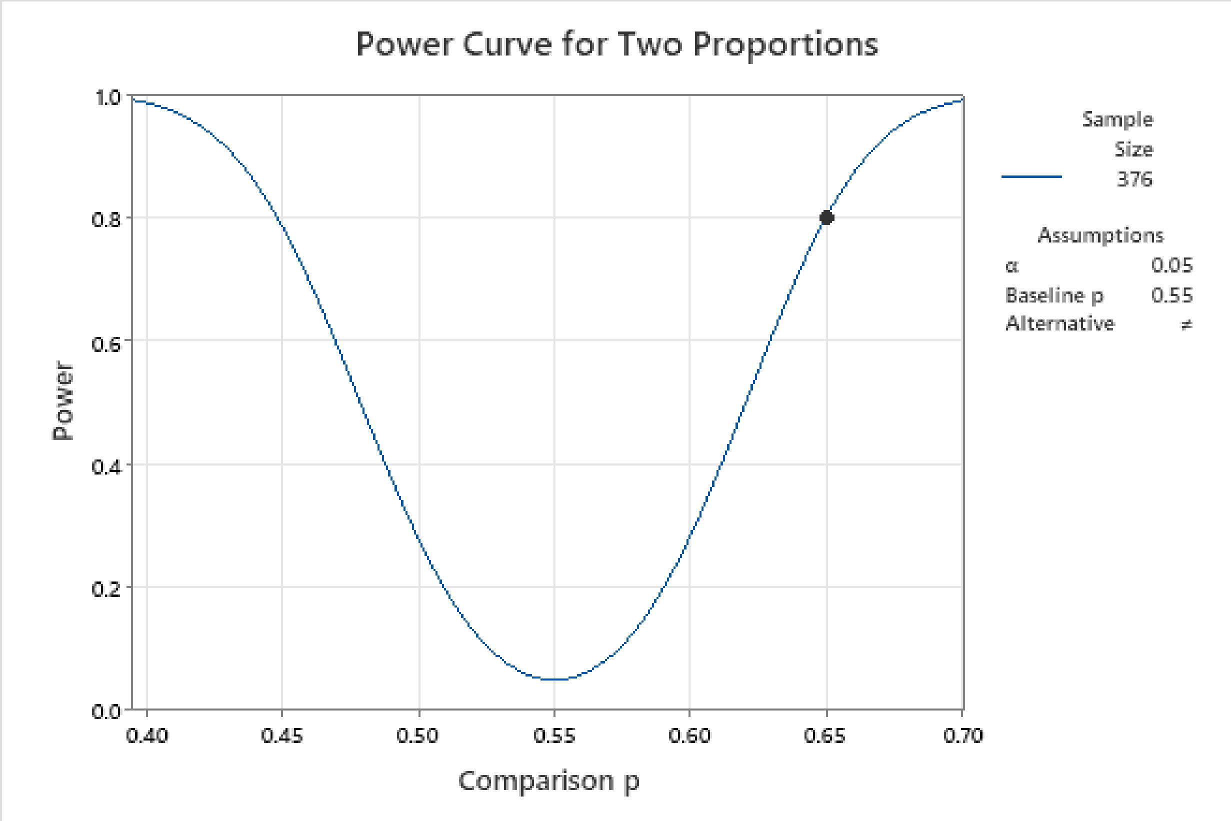
Testing comparison p = baseline p (versus ≠)
Calculating power for baseline p = 0.55
$\alpha = 0.05$

Results

Table L

Comparison p	**Sample Size Each Group**	Target power	Actual Power
0.65	**376**	0.8	0.800456

Figure 27



The necessary sample size to achieve 80% power could also be adjusted if the population was exposed to more matches on grass, as in the STAYFIT-HURT study where there were approximately double the number on grass. This could be achieved by the simple calculation of:

(9 x 752) / 8 = 846 Equating to a sample size of 282 on Artificial and 564 on Grass

To continue to investigate injuries on different surfaces would require an analysis of training injuries. There is insufficient data regarding number, duration and type of training session in the STAYFIT-HURT project to investigate the potentially interesting theme of 13 injuries occurring on grass and 30 on an artificial surface. The heterogenicity of club training patterns means analysis of this is of very limited significance. Rather, simple data based on training circumstances should be sought to investigate this.

However, considering that 2 of the investigated clubs trained predominantly on grass and 2 on artificial grass, and not taking account of the part-time club who would be training proportionally less, it would be possible to take an estimated average of club training sessions per week then estimate the number of injuries per player per session (or per season). For illustrative purposes, a calculation could be performed making the assumptions that clubs are training for the same number of hours per week and that there are the same number of players in each squad. Using a 2 Sample Poisson Rate test, the rate of injuries 'per player season' and 'per team season' could be demonstrated. This has not been undertaken as the above assumptions are clearly not applicable to the STAYFIT-HURT dataset. Similarly, it would be possible to perform a 2 Sample Poisson Rate test to evaluate specific mean injuries per player defined by, for example, anatomy, hence demonstrating the number of players and number of clubs that would be required to sufficiently power a future study on any single injury domain.

4.c. Team Reports

The STAYFIT-HURT project has elected to present the project data in the format of team reports, as would be supplied to participating SPFL clubs.

Figure 28

Map of STAYFIT-HURT Club Locations.

Summary Squad Data

The following team reports include a first section on simple squad data. The number of players in each squad's reported data was felt to be low so internet resources were used to compare reported squad numbers. Transfermarkt.co.uk and Wikipedia were used as freely available resources to compare reported squad members during the 2019/20 SPFL season although it is acknowledged that the accuracy of these reported numbers may be variable.

The data received for the Dundee FC squad included injury records of 20 players. The internet resources suggest a full squad size of up to 32 players but at least 11 of these appear to be youth squad players with very limited first team involvement. The data received for Ayr United FC included records of 26 players whereas the online resources suggest a full squad size of up to 28 players, some of whom appear to have departed the club early in the season. The reported squad size of 26 players for Falkirk FC appeared accurate. The data received for the Dumbarton FC squad included injury records of 13 players. Internet resources suggested a full squad size of up to 24 players, however this includes at least 6 players who made less than 4 appearances. There is further discussion of squad data entry in Chapter 6.

The average age of the 85 players about whom data was received in the STAYFIT-HURT study was 24 years and 89 days. 8 players were defined as goalkeepers, 25 as defenders, 35 as midfielders and 17 as forwards.

STAYFIT-HURT

Team Reports
SPFL 2019/20

STAYFIT-HURT

<u>TEAM REPORT 2019</u>

Study of A Year of Football Injuries and Trauma and evaluation of a Handheld Uniform Recording Tool (STAYFIT-HURT)

Team Report Dundee FC SPFL 2019/20

Dundee FC played in the Scottish Championship, the second tier of the SPFL during season 2019/20. They are a fully professional club that play their home matches on natural grass and were training predominantly on natural grass. Data was provided by both part-time club doctor and full-time physiotherapist.

The STAYFIT-HURT Project was conducted during the 2019/20 SPFL season between June 2019 and March 2020 at which time professional football ceased as a result of the COVID-19 pandemic. This report compares the injury data for Dundee FC against that of 3 other SPFL clubs that provided a significant quantity of injury data.

The report is divided into 6 sections with information displayed on squad data provided, number of matches, injuries according to age and playing position, anatomical injury location, injury type and injury context that includes match versus training and playing surface.

Due to the limited amount of data collected in a single season, injury rate should be evaluated with caution given the few actual injury episodes. Unfortunately, there was insufficient data to provide information on the duration of injury episodes, player availability and hence injury burden. When considering the impact on the club, club clinicians should consider prioritising the duration of injury episodes and player availability for training and matches in any future data capture.

1. Squad Data

The data analysed for the Dundee FC squad included injury records of 20 players. Internet resources suggest a full squad size of up to 32 players but at least 11 of these appear to be youth squad players with very limited first team involvement. The average age of the players about whom data was received was 22.35. 2 players were defined as Goalkeepers, 7 as defenders, 9 as midfielders and 2 as forwards. In total 38 significant injury episodes were recorded.

2. Number of Competitive Matches

Figure 29

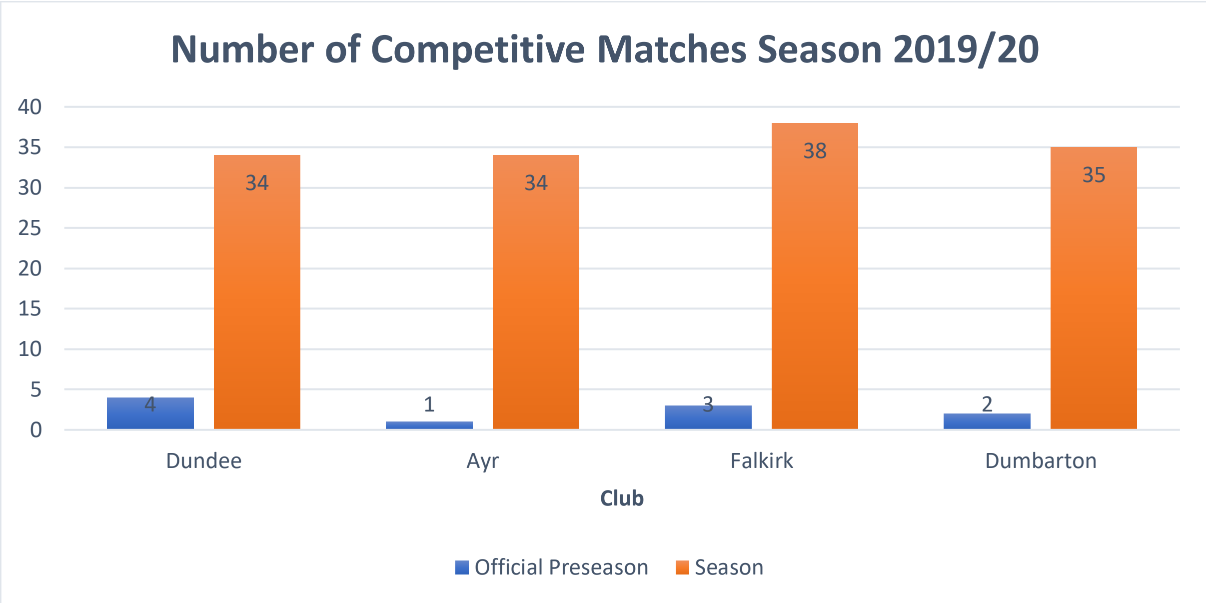
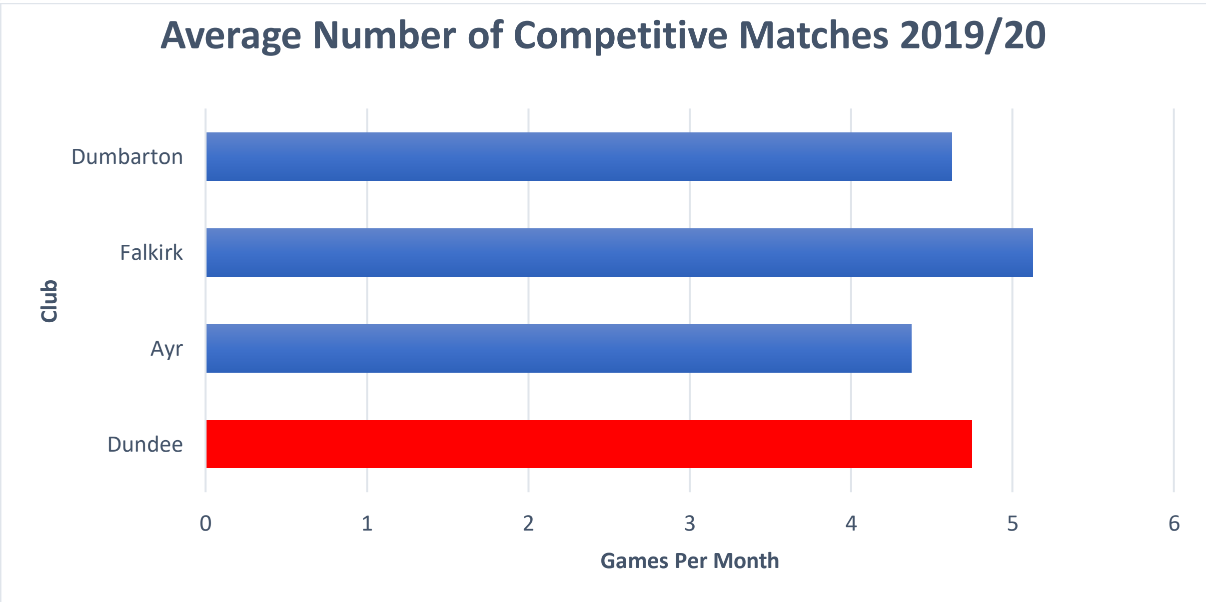
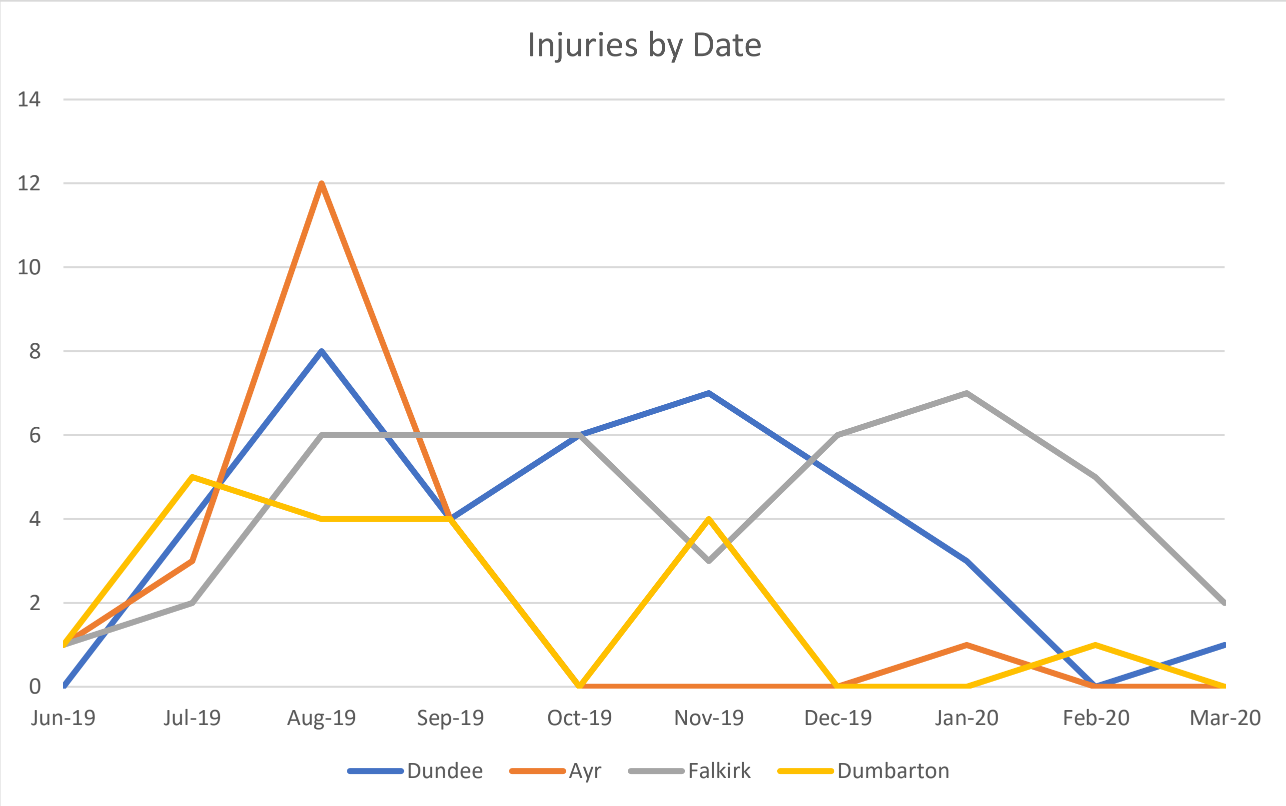


Figure 30



STAYFIT-HURT Total Injuries by Date

Figure 31



3a. Injuries According to Age

Figure 32i

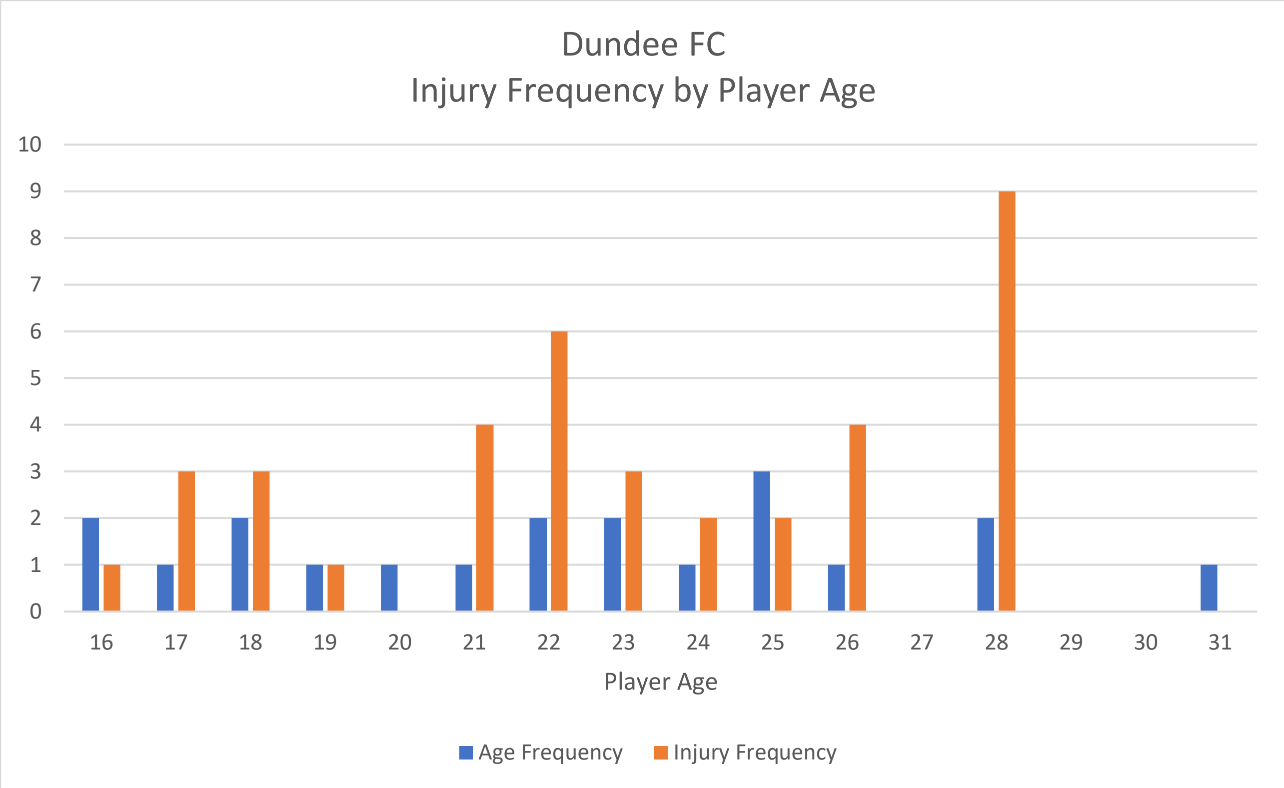
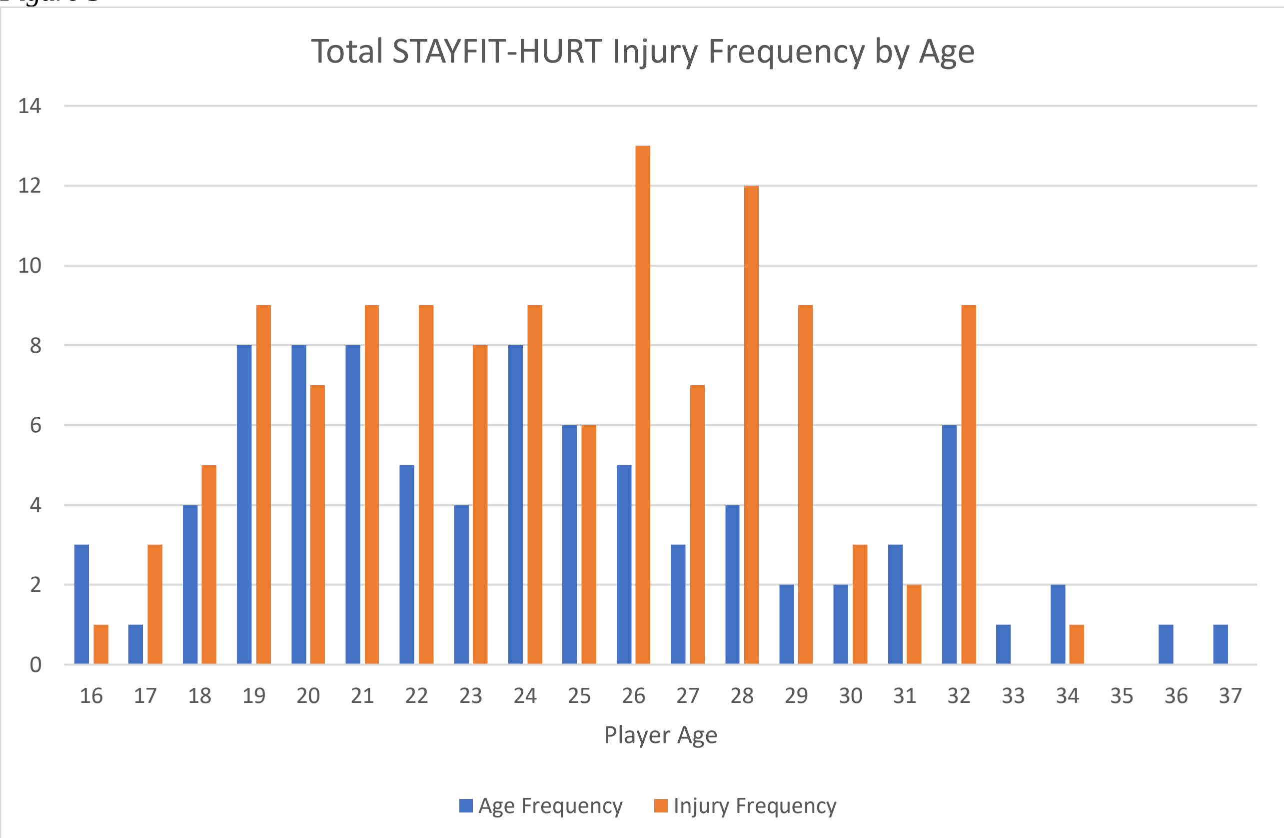


Figure 5



3b. Injuries According to Playing Position

Table Bi

Playing Position	*Number of Significant Injuries*
Goalkeeper	0
Defender	17
Midfield	15
Forward	6

Figure 33i

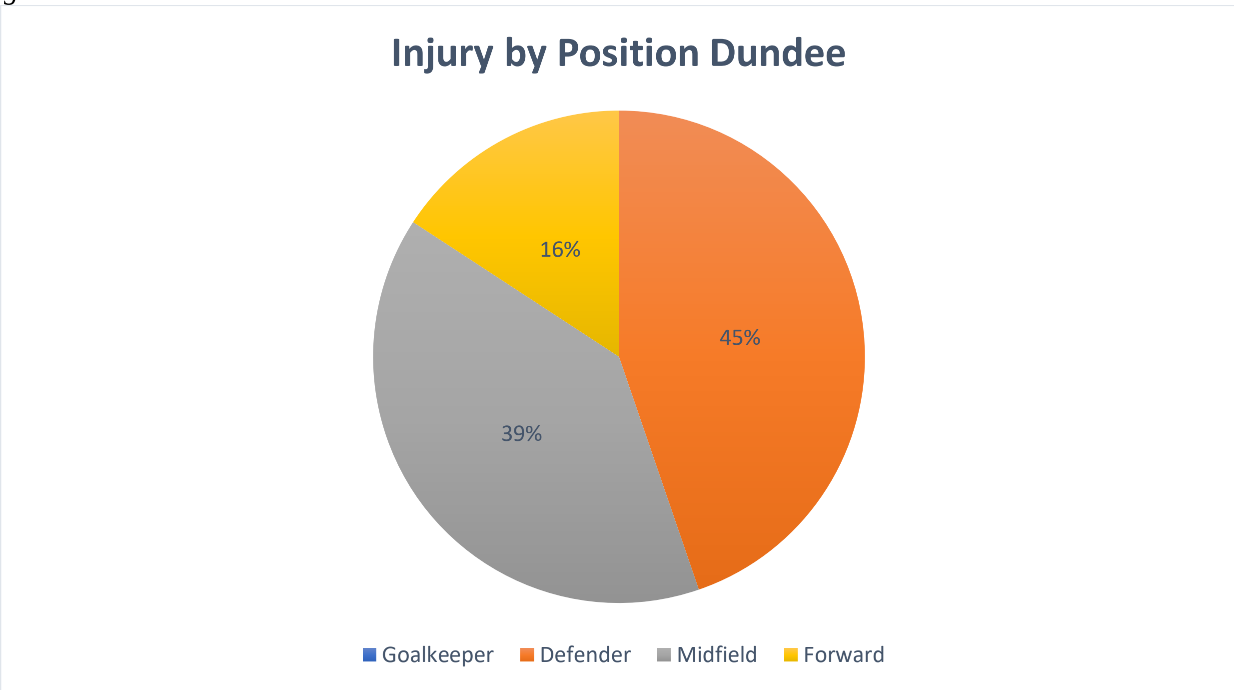
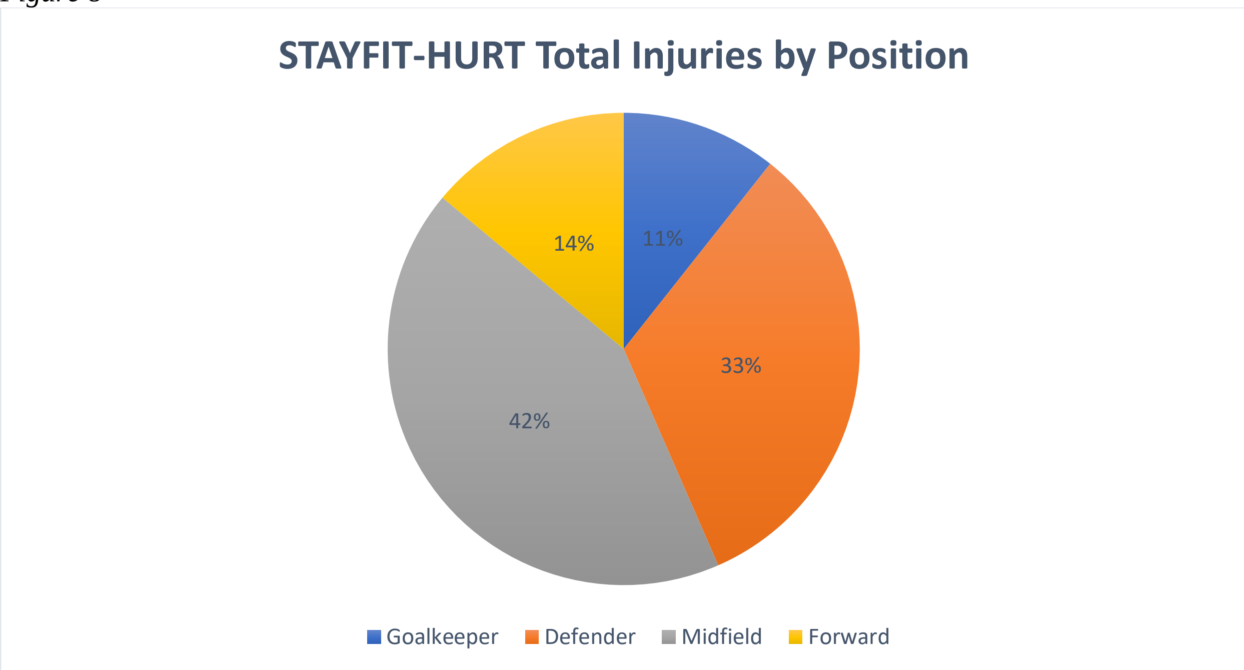


Figure 8



4. Injury Location

Table Ci

Location	*Number of Significant Injuries*
Hip/Groin	2
Thigh	13
Knee	4
Ankle	6
Head	1
Other	6
Undefined	6

Figure 34i

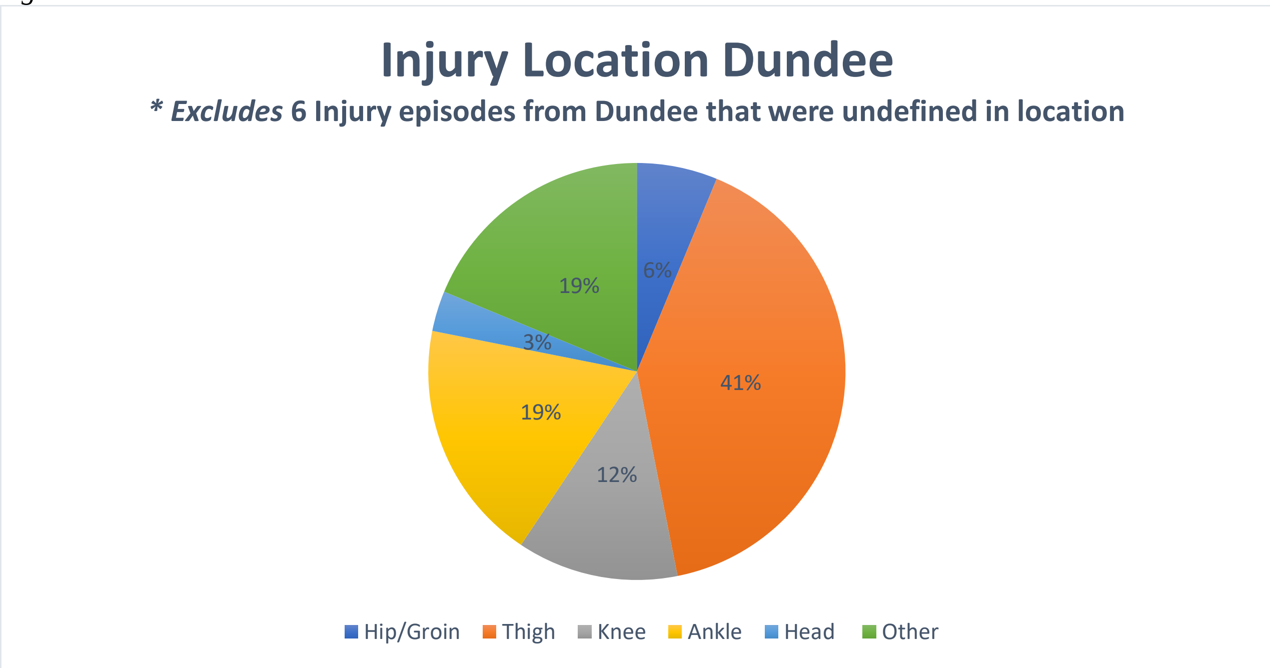
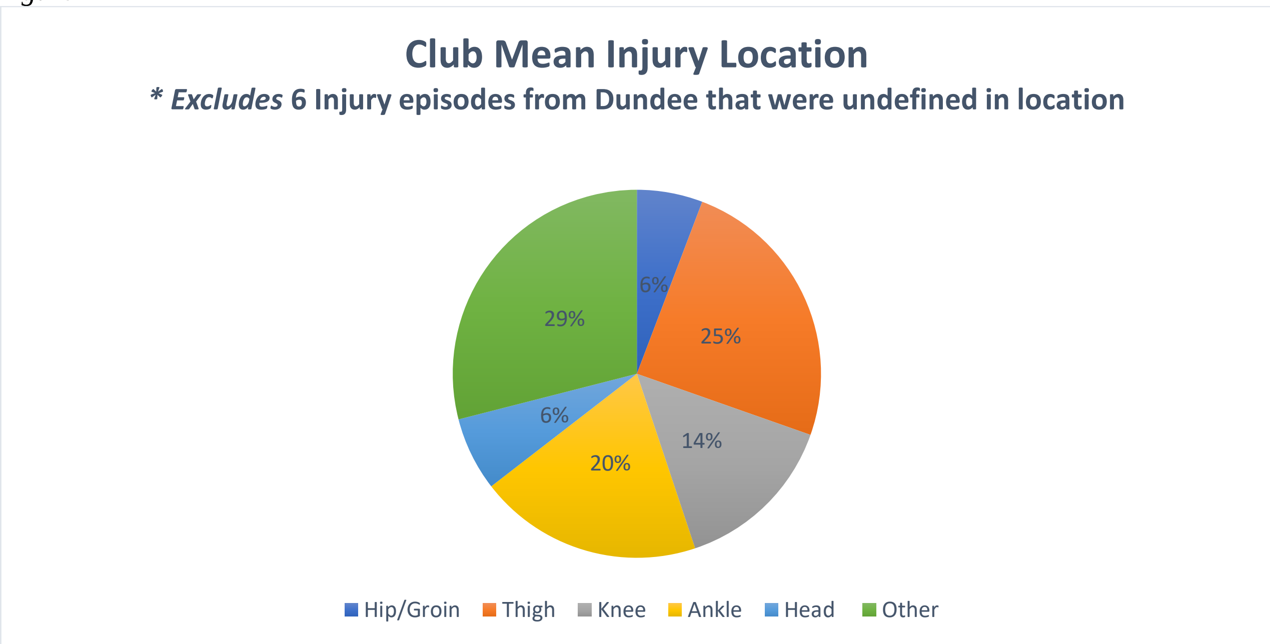


Figure 11



5a. Injury Type

Table Di

Injury Type	*Number of Significant Injuries*
Muscle Injuries	20
Ligament Injuries	7
Tendon Injuries	1
Contusion	1
Other	9

Figure 35i

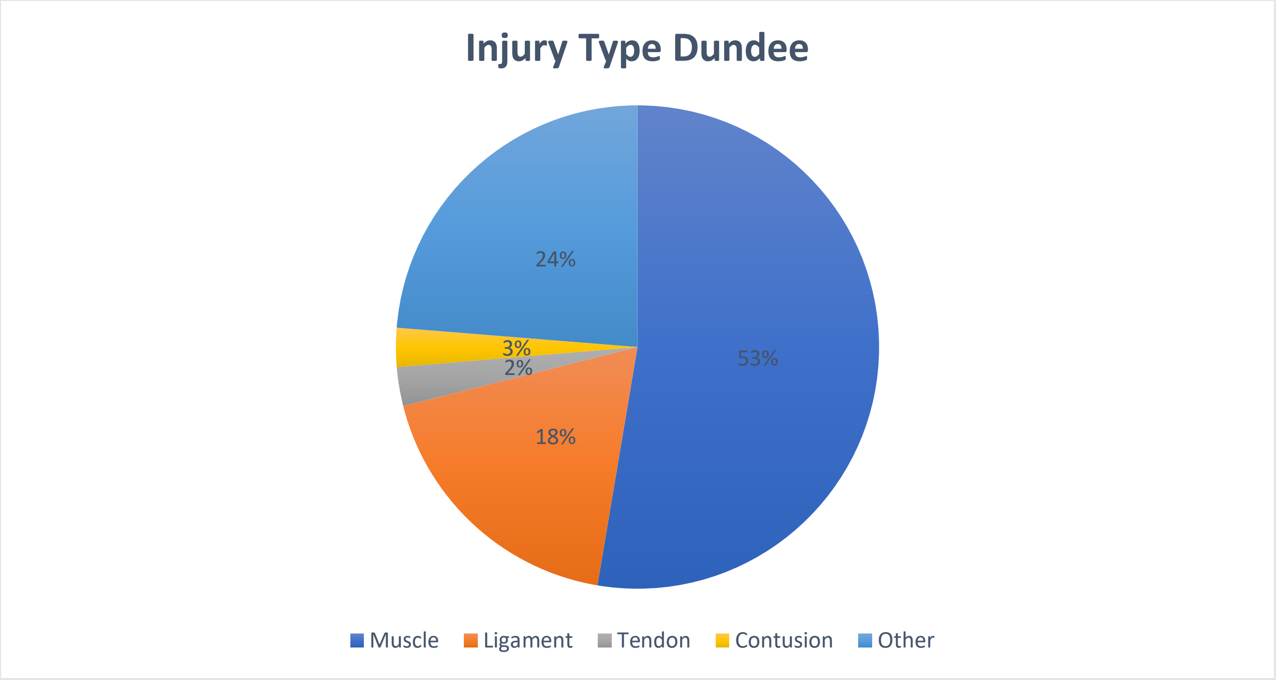
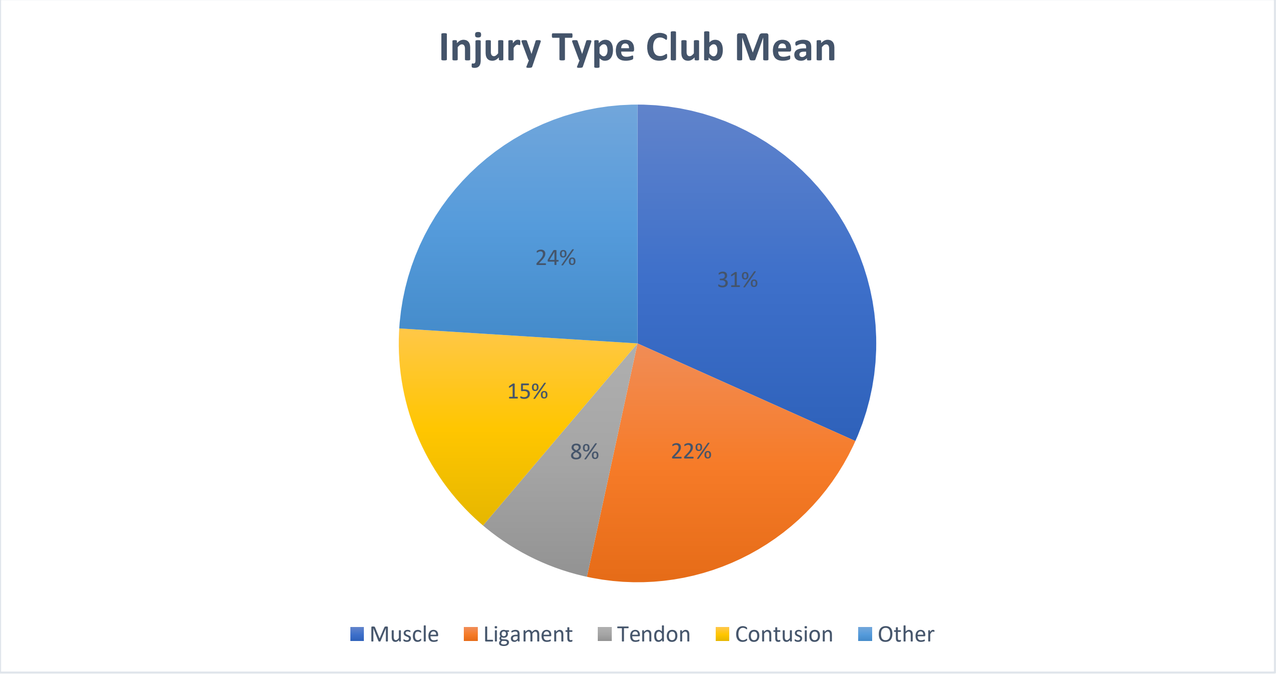


Figure 13



5b. STAYFIT-HURT Total Distribution of Muscle Injuries

Figure 36

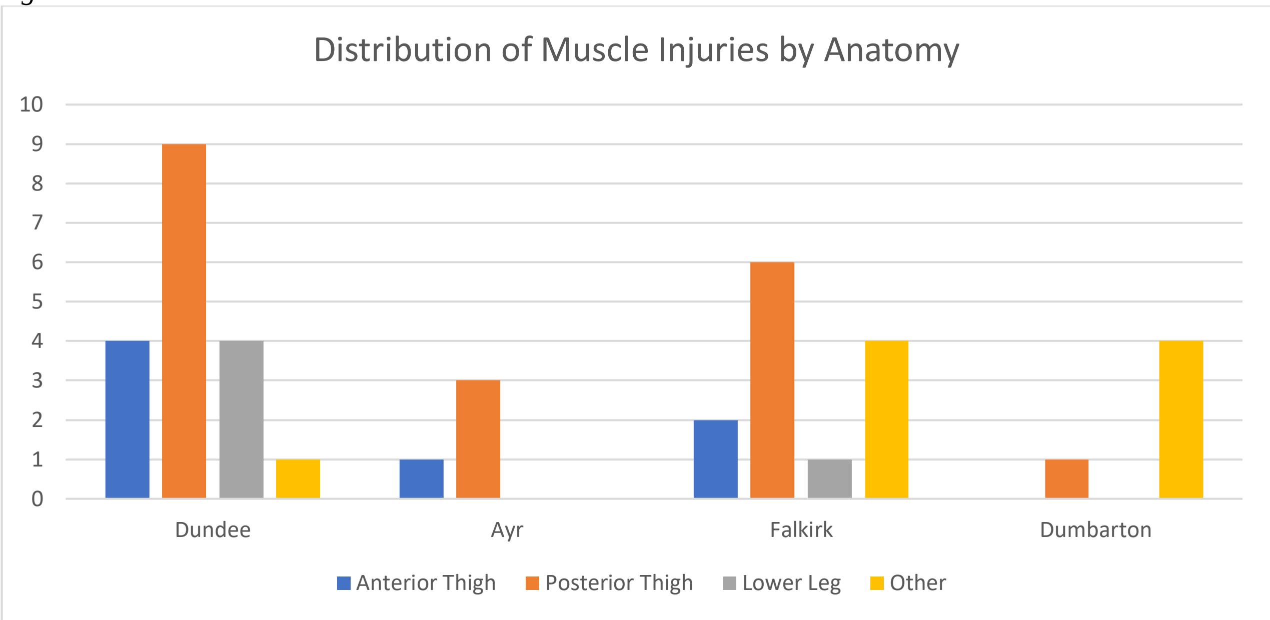
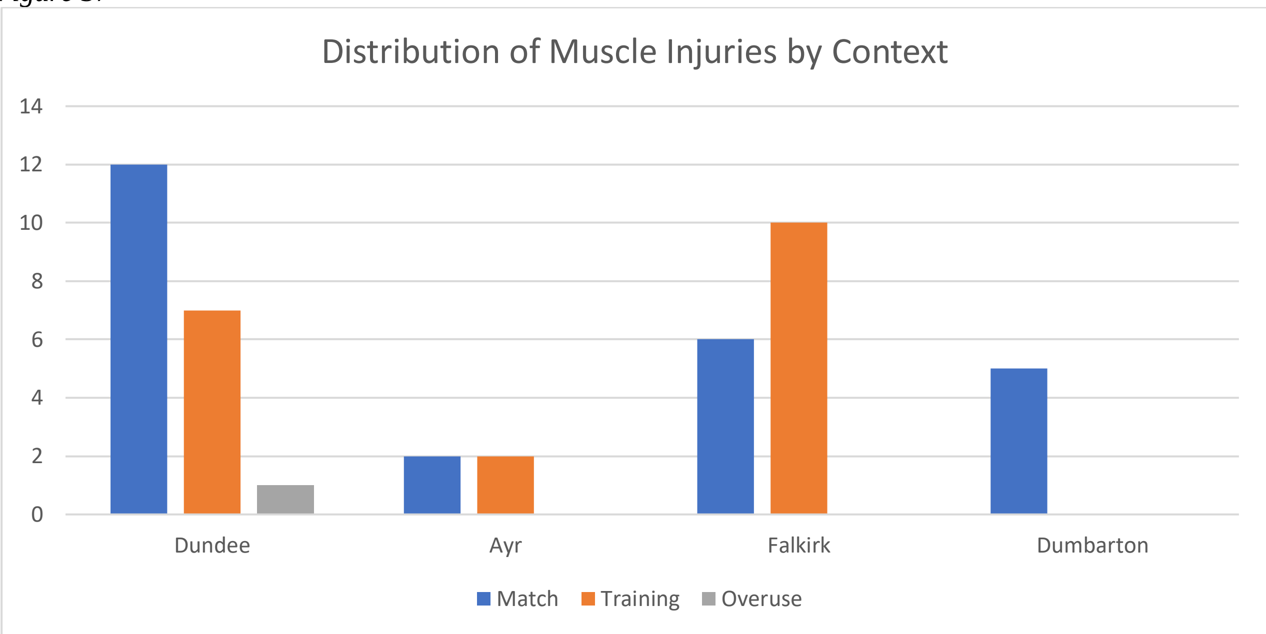


Figure 37



STAYFIT-HURT Total Distribution Ligament Injuries

Figure 38

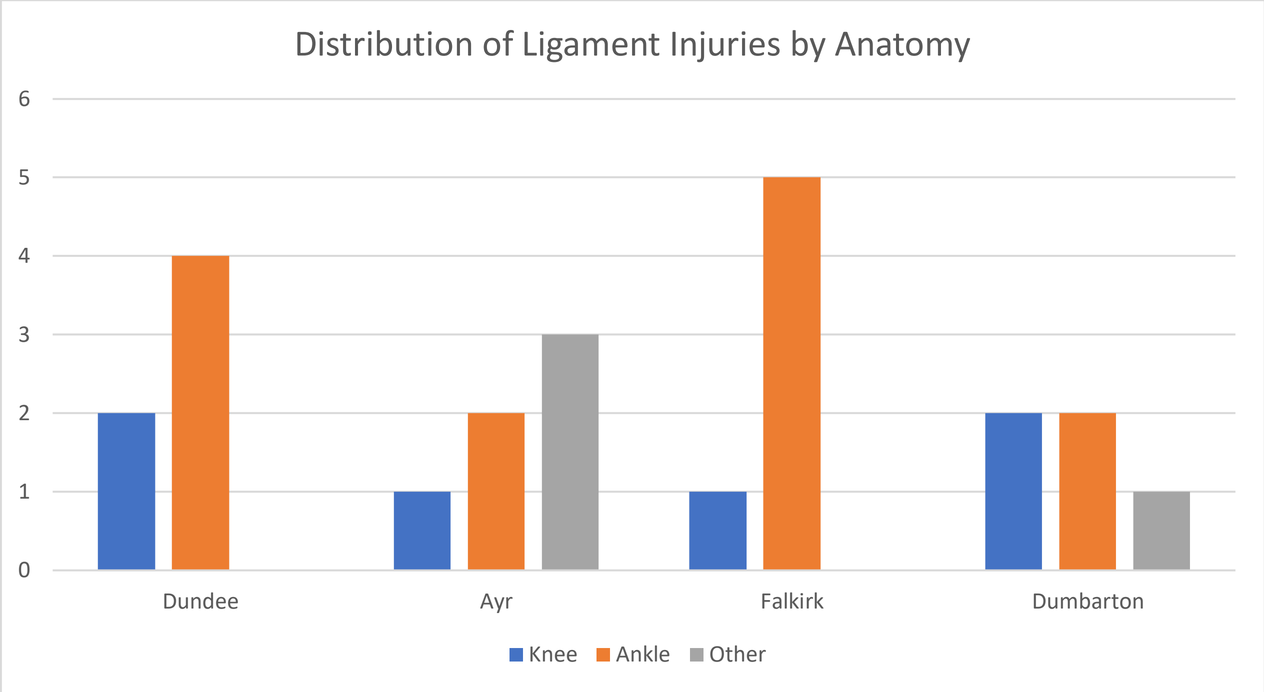
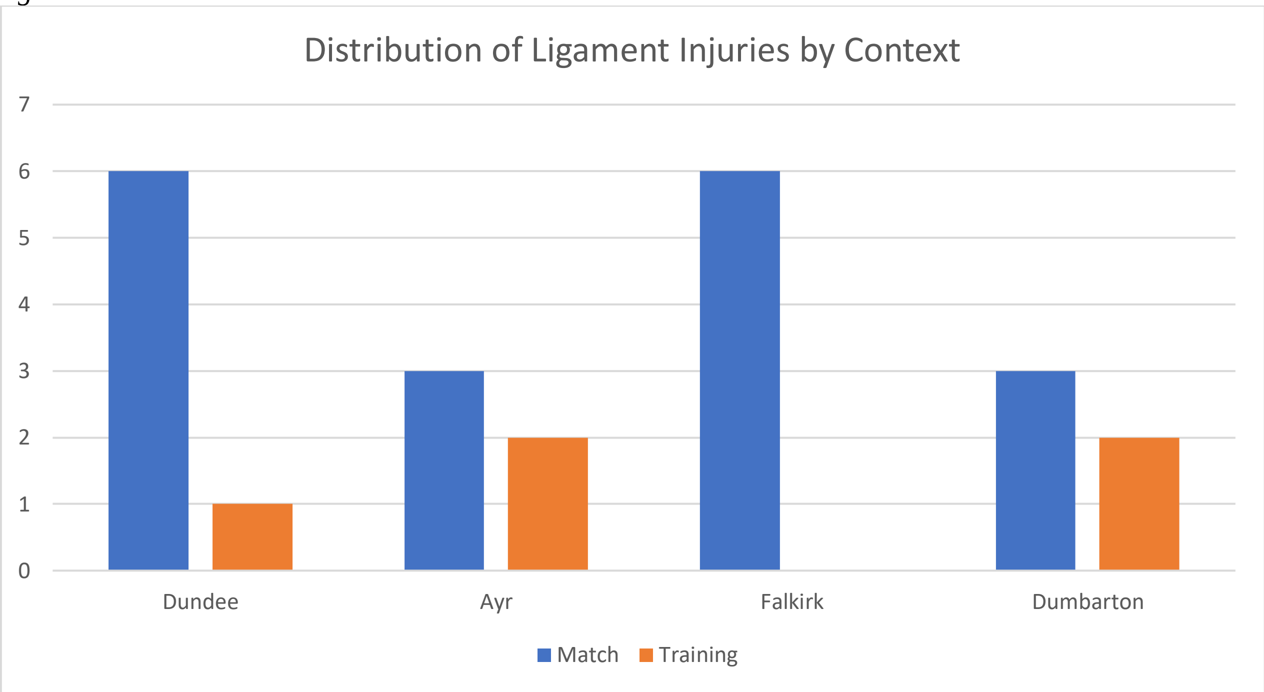
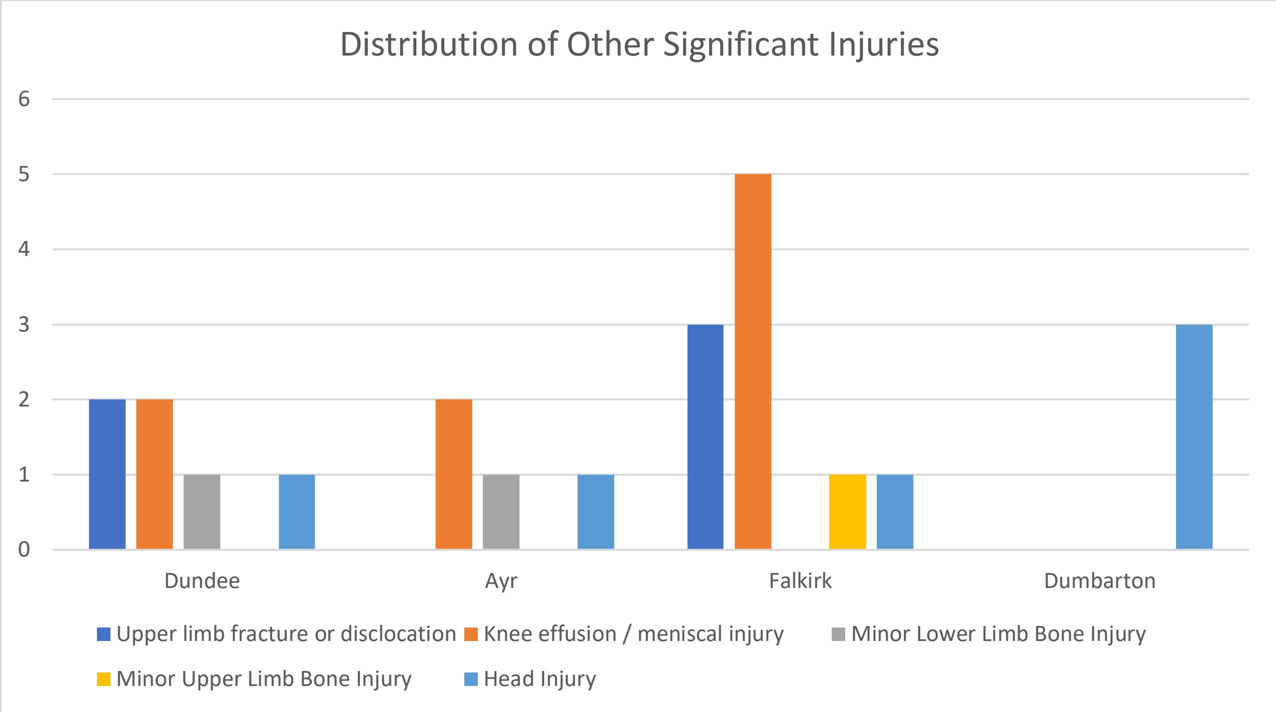


Figure 39



STAYFIT-HURT Total Distribution of Other Significant Injuries

Figure 40



6a. Injury Context – Match vs Training

Table Ei

Context	*Number of Significant injuries*
Match	27
Training	9
Overuse/Breakdown	1
Other Context	1

Figure 41i

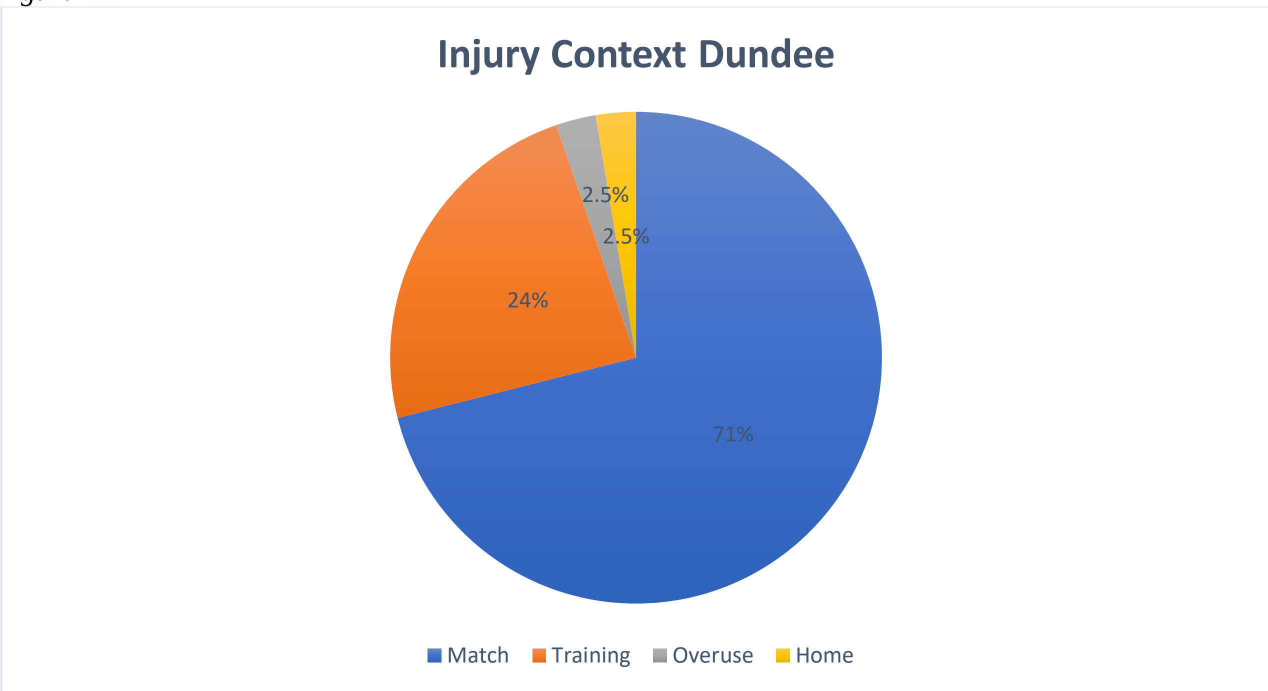
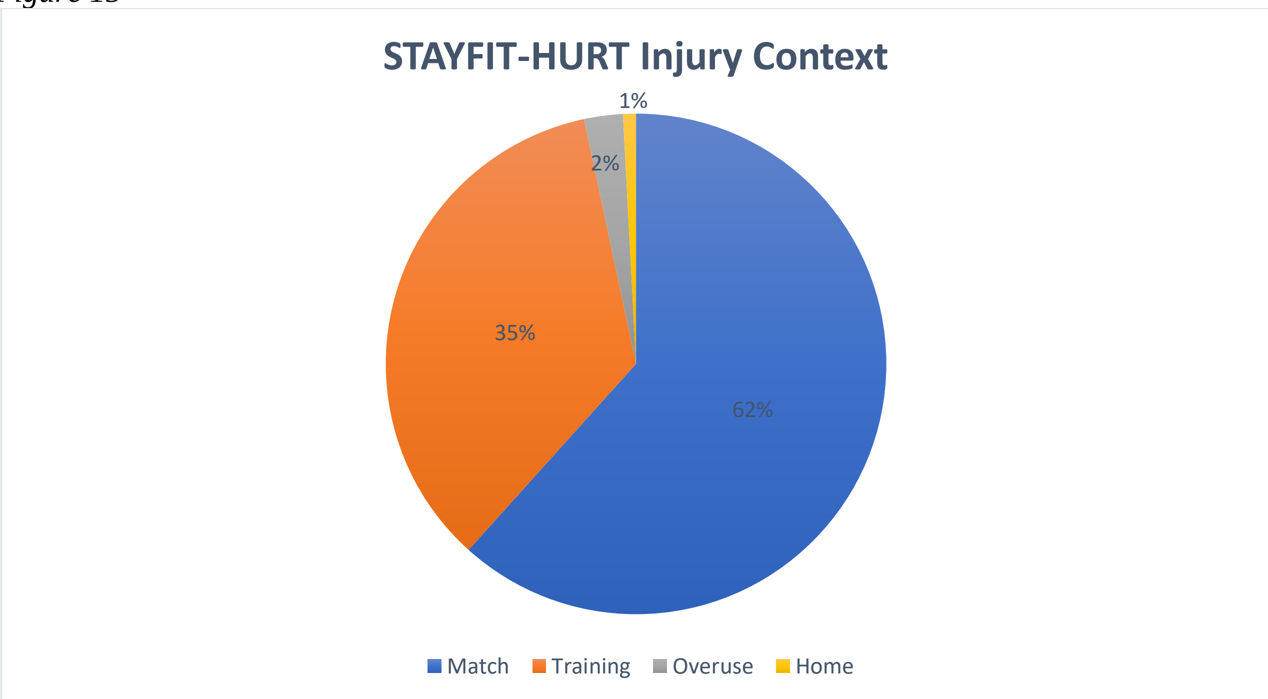


Figure 15



(alternative) Injuries in Training vs During Match

Figure 42i

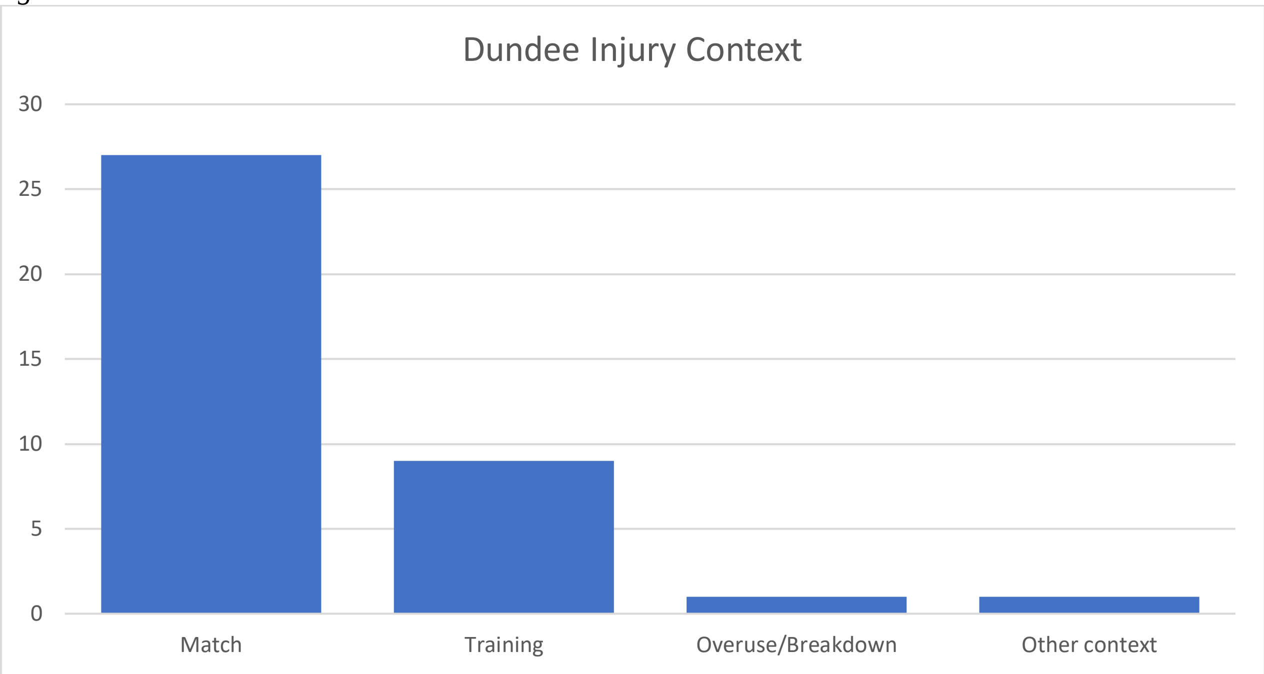
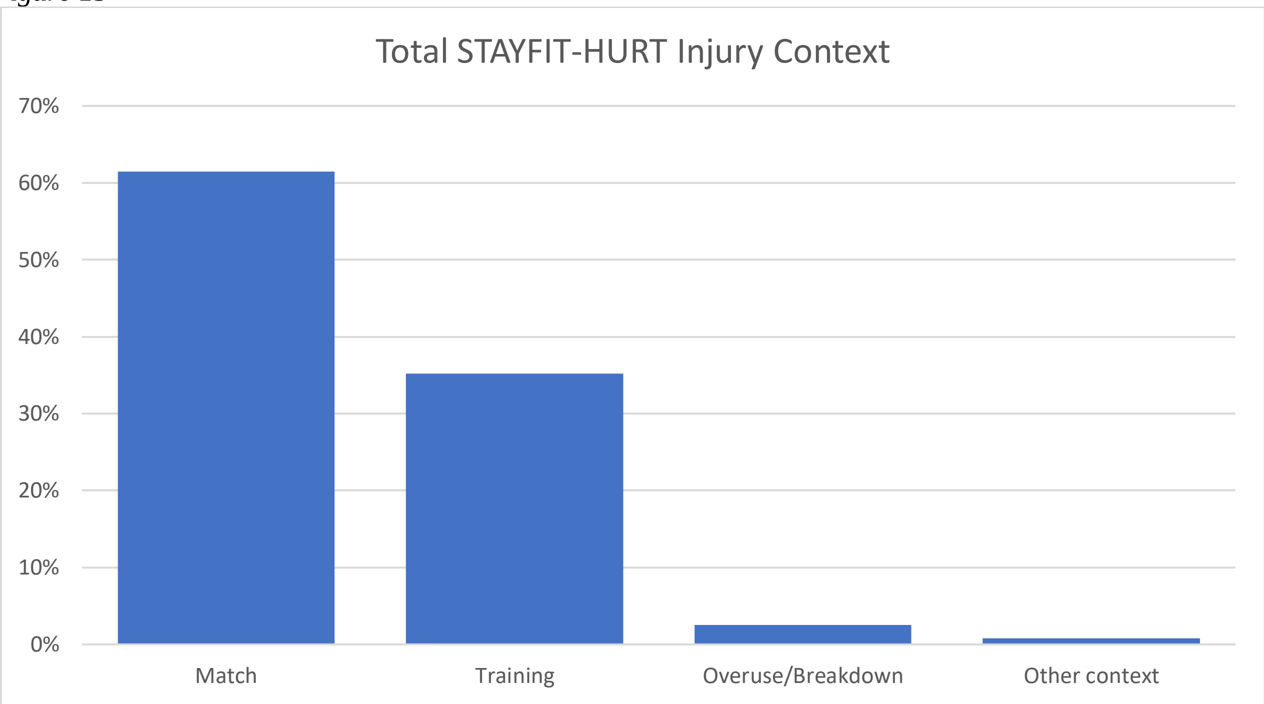


Figure 13



6b. Injury Context – Playing Surface

Table Fi

Playing Surface	*Number of Significant Injuries*	*Number of Competitive Matches*
Grass	34	29
Astroturf	2	5
Other	2	

Figure 43i

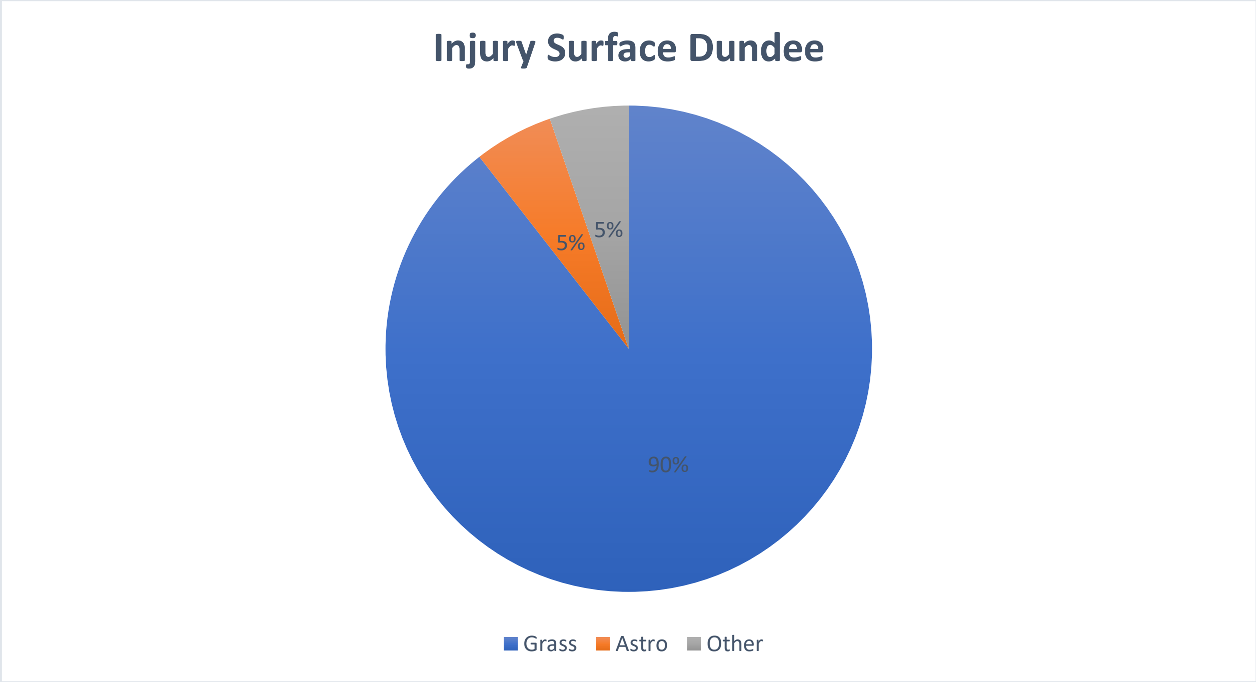
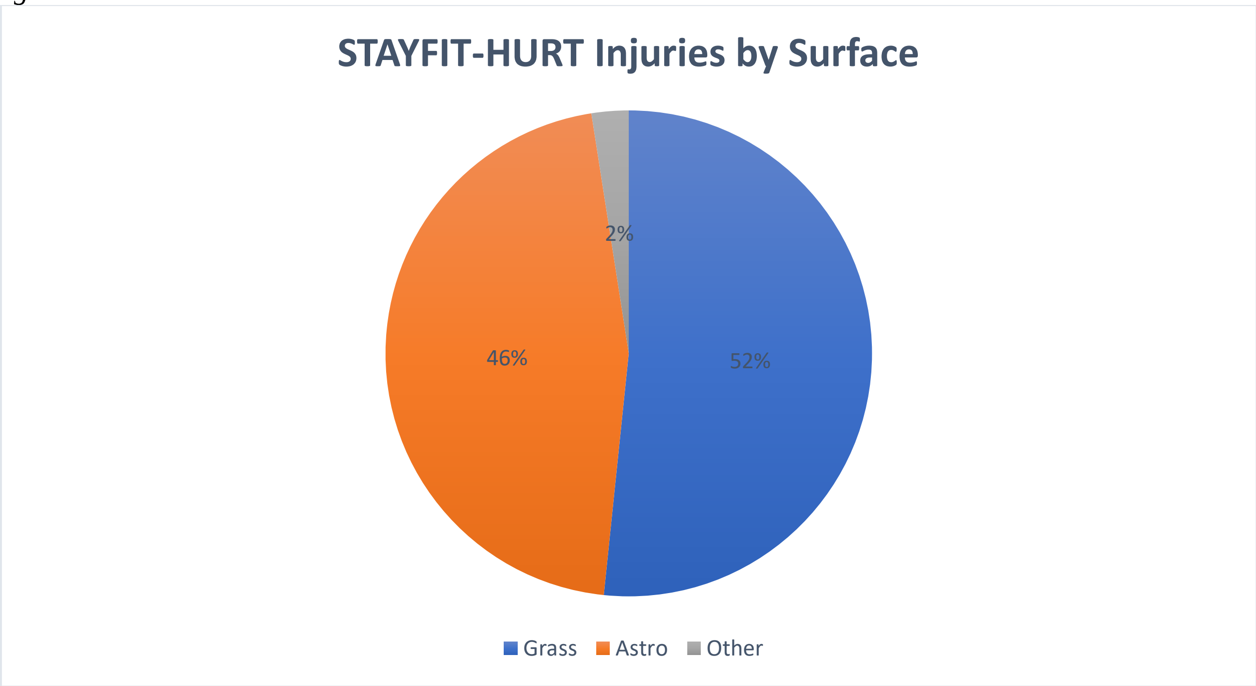


Figure 16



STAYFIT-HURT

TEAM REPORT 2019/20

Study of A Year of Football Injuries and Trauma and evaluation of a Handheld Uniform Recording Tool (STAYFIT-HURT)

Team Report Ayr United FC SPFL 2019/20

Ayr United FC played in the Scottish Championship, the second tier of the SPFL during season 2019/20. They are a professional club, with one player listed on a semi-professional contract during 2019/20. They play their home matches on natural grass and were training predominantly on artificial grass. Data was provided by the full-time physiotherapist.

The STAYFIT-HURT Project was conducted during the 2019/20 SPFL season between June 2019 and March 2020 when professional football ceased as a result of the COVID-19 pandemic. This report compares the injury data for Ayr United FC against that of 3 other SPFL clubs that provided a significant quantity of injury data.

The report is divided into 6 sections with information displayed on squad data provided, number of matches, injuries according to age and playing position, anatomical injury location, injury type and injury context that includes match versus training and playing surface.

Due to the limited amount of data collected in a single season, injury rate should be evaluated with caution given the few actual injury episodes. Unfortunately, there was insufficient data to provide information on the duration of injury episodes, player availability and hence injury burden. When considering the impact on the club, club clinicians should consider prioritising the duration of injury episodes and player availability for training and matches in any future data capture.

1. Squad Data

The data analysed for the Ayr United FC squad included injury records of 26 players. Internet resources suggest a full squad size of up to 28 players, some of whom appear to have departed the club early in the season. The average age of the players about whom data was received was 23.73. 3 players were defined as Goalkeepers, 8 as defenders, 10 as midfielders and 5 as forwards. In total 21 significant injury episodes were recorded.

2. Number of Competitive Matches

Figure 29

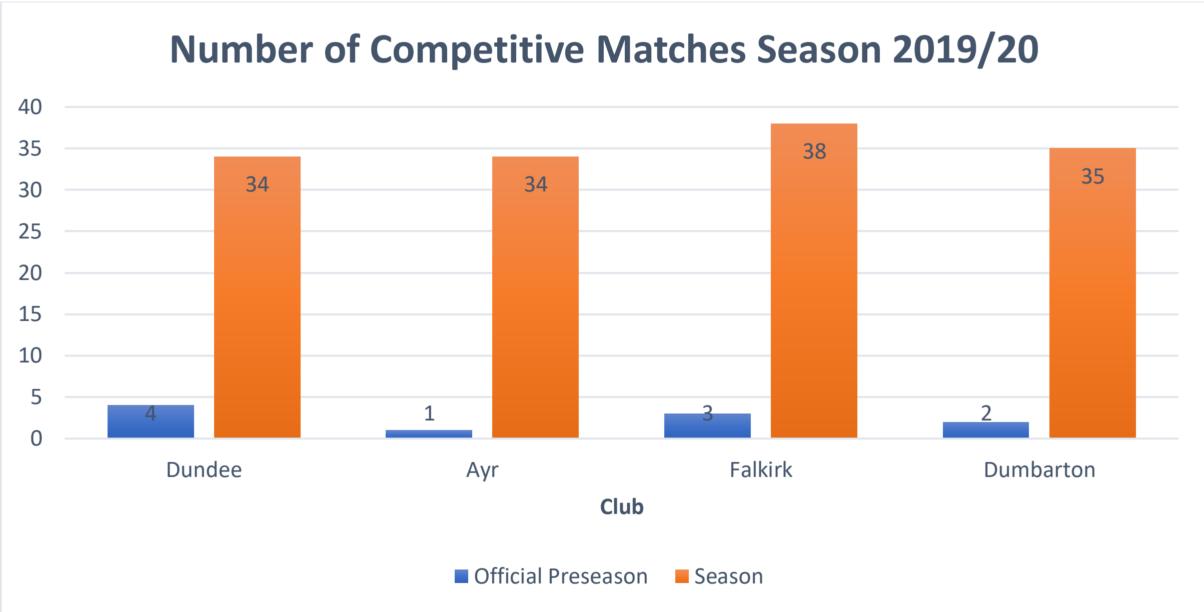
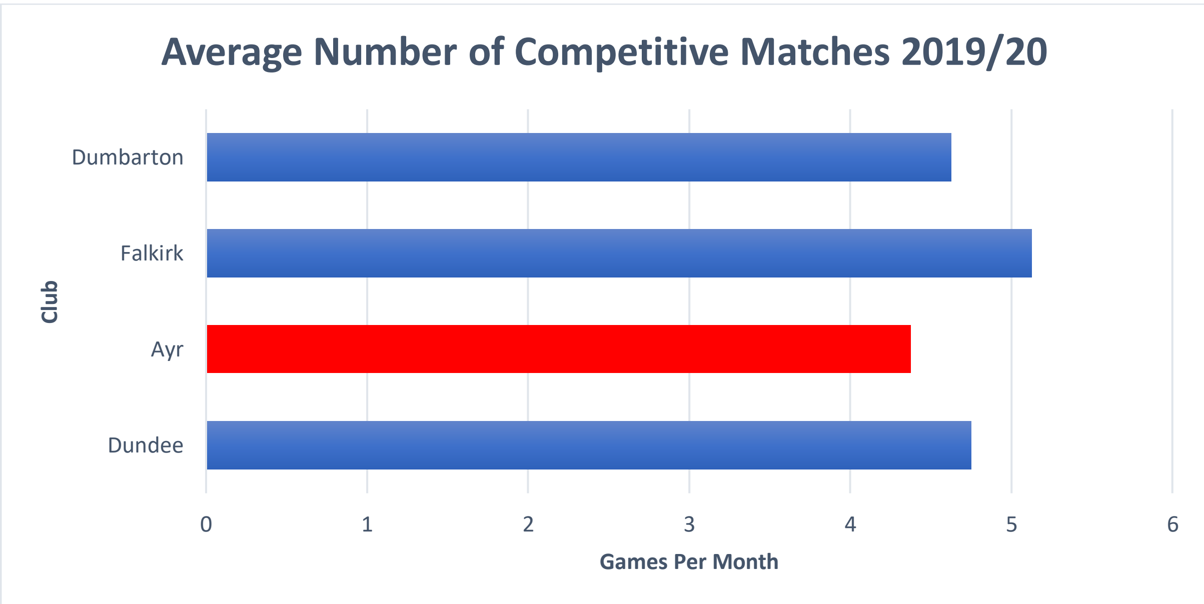
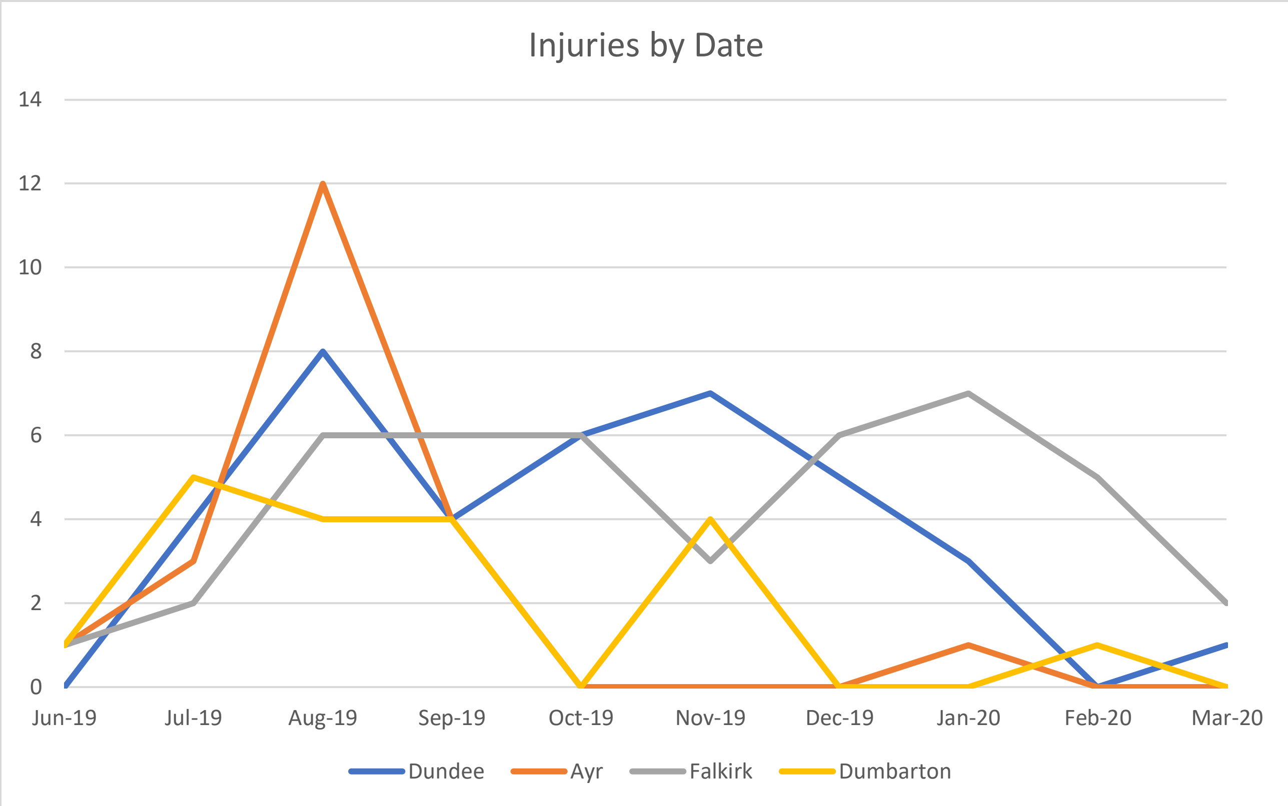


Figure 30



STAYFIT-HURT Total Injuries by Date

Figure 31



3a. Injuries According to Age

Figure 32ii

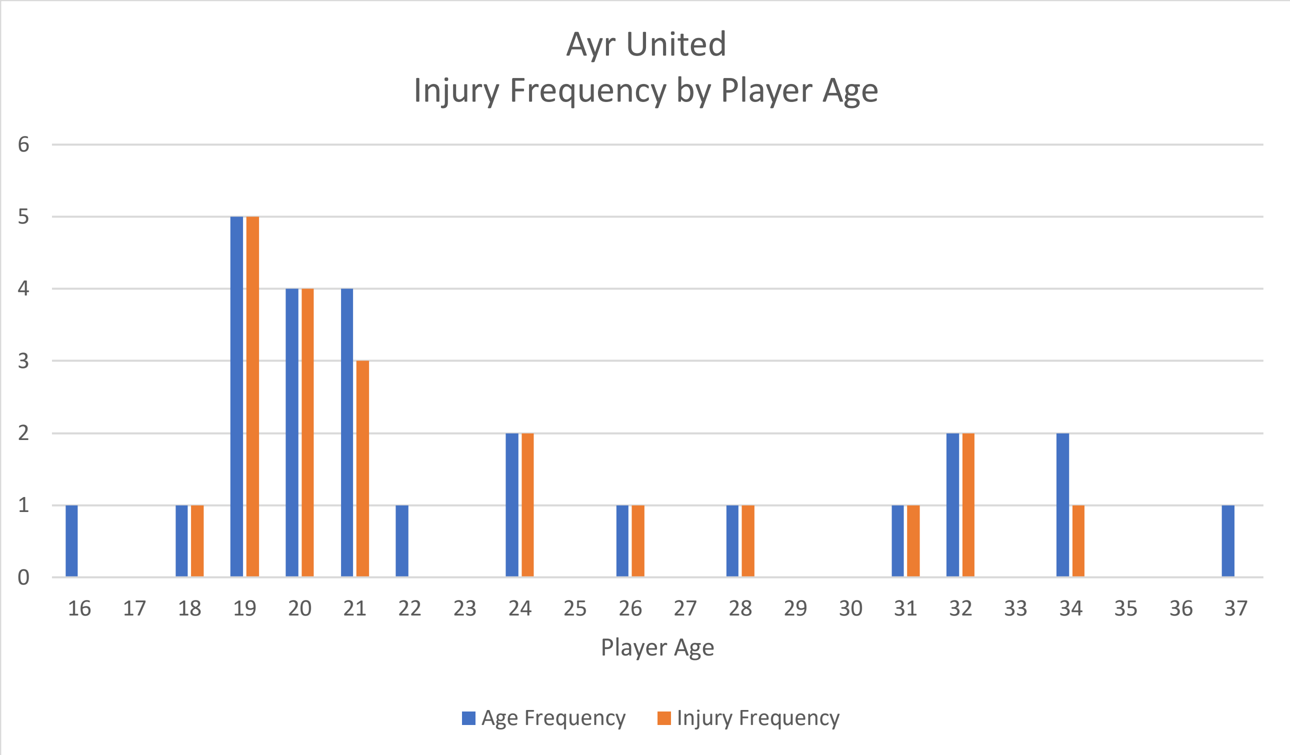
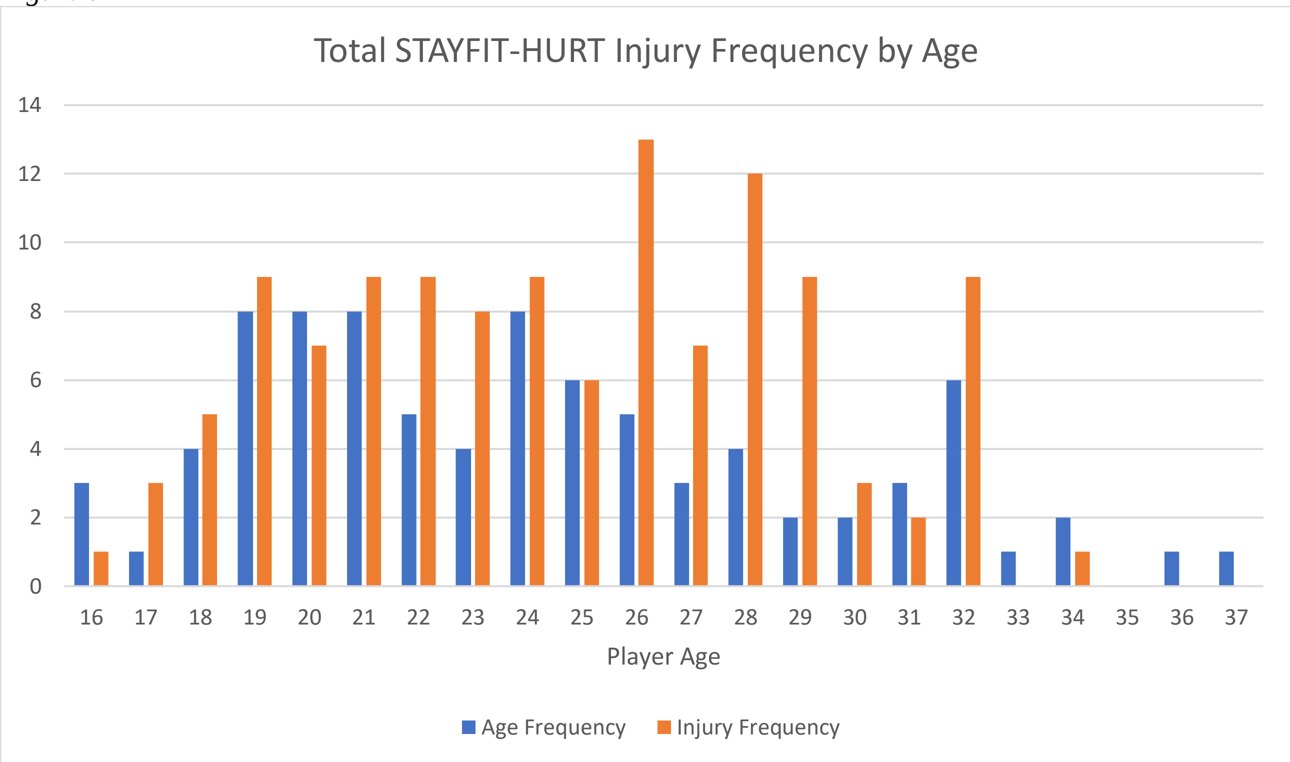


Figure 5



3b. Injuries According to Playing Position

Table Bii

Playing Position	*Number of Significant Injuries*
Goalkeeper	5
Defender	4
Midfield	9
Forward	3

Figure 33ii

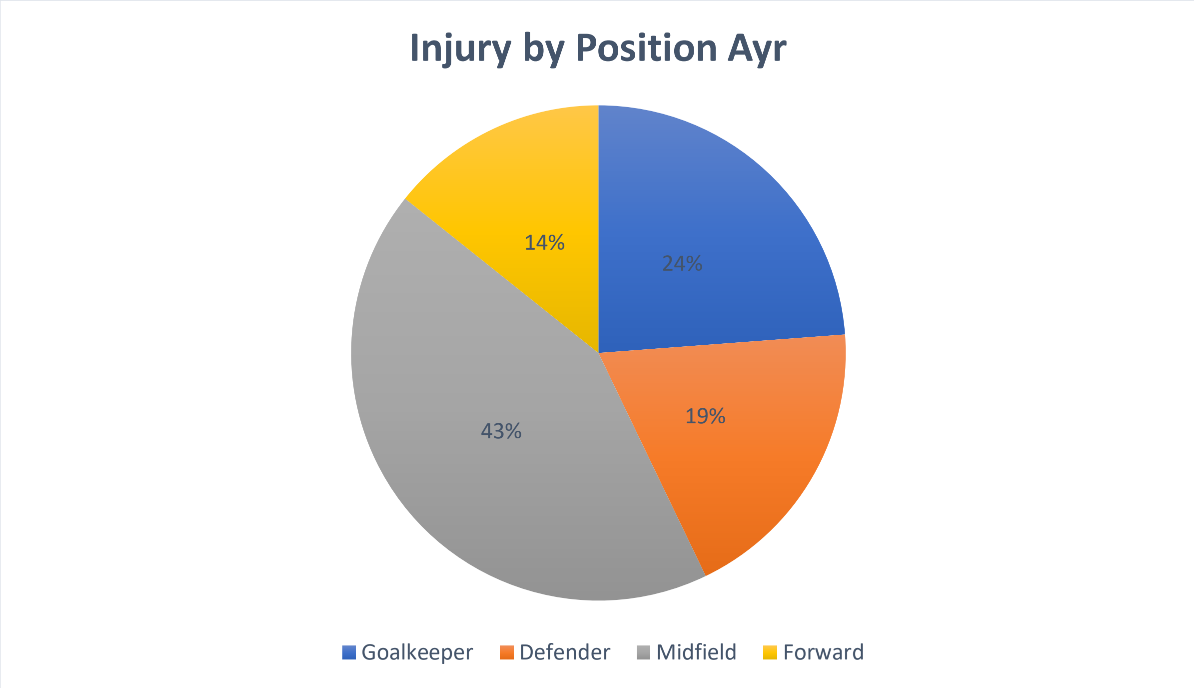
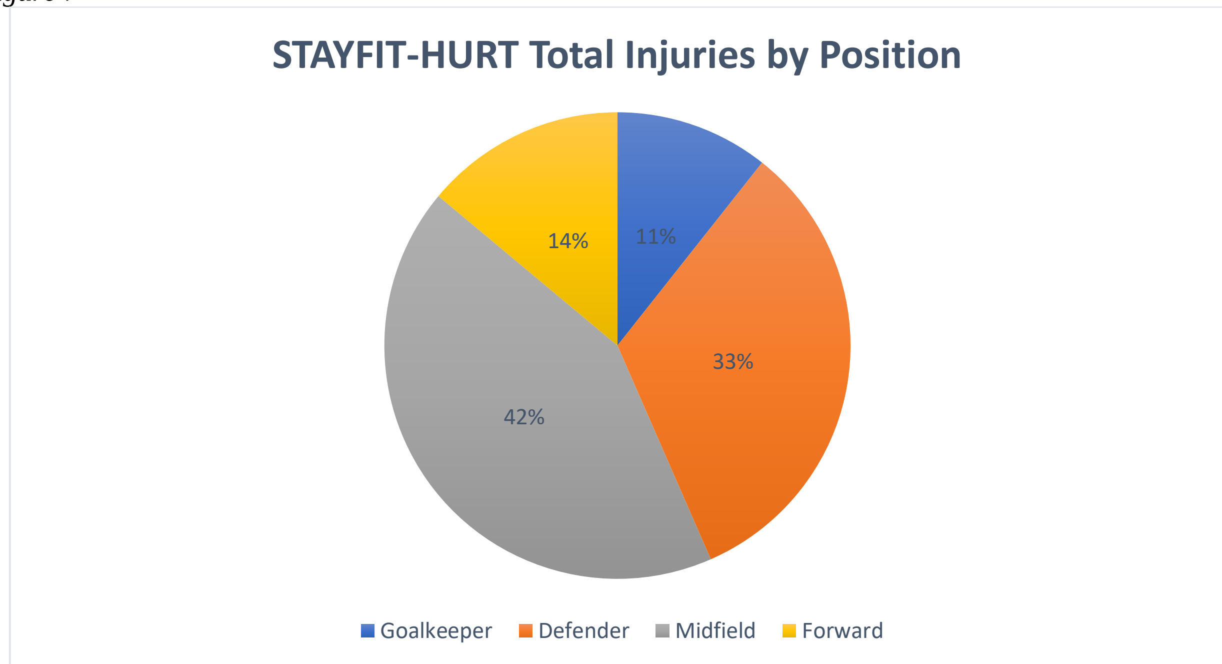


Figure 7



4. Injury Location

Table Cii

Location	*Number of Significant Injuries*
Hip/Groin	1
Thigh	5
Knee	4
Ankle	4
Head	1
Other	6

Figure 34ii

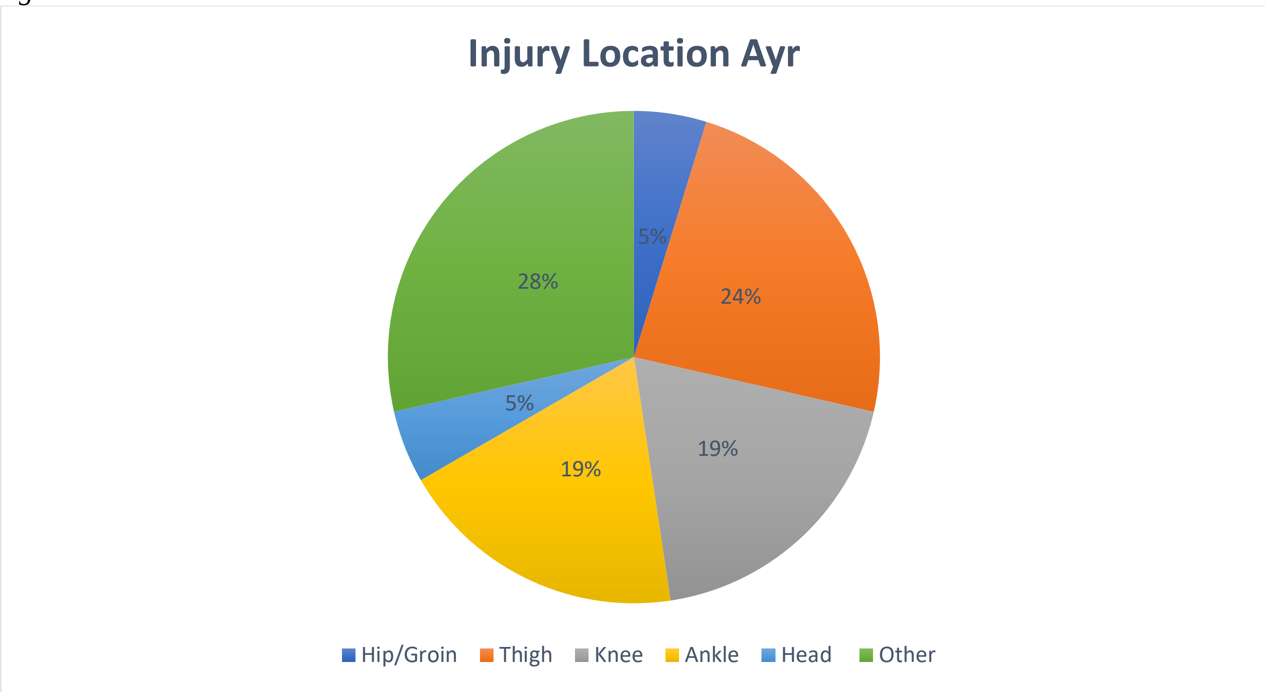
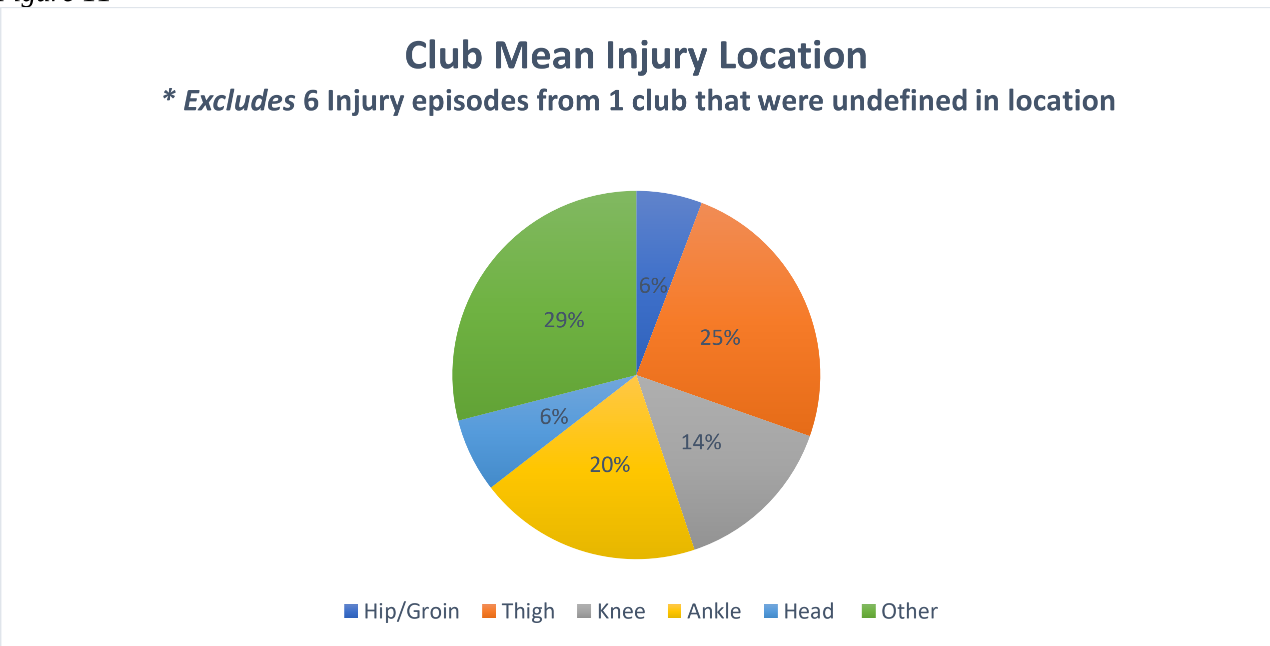


Figure 11



5a. Injury Type

Table Dii

Injury Type	*Number of Significant Injuries*
Muscle Injuries	4
Ligament Injuries	6
Tendon Injuries	3
Contusion	3
Other	5

Figure 35ii

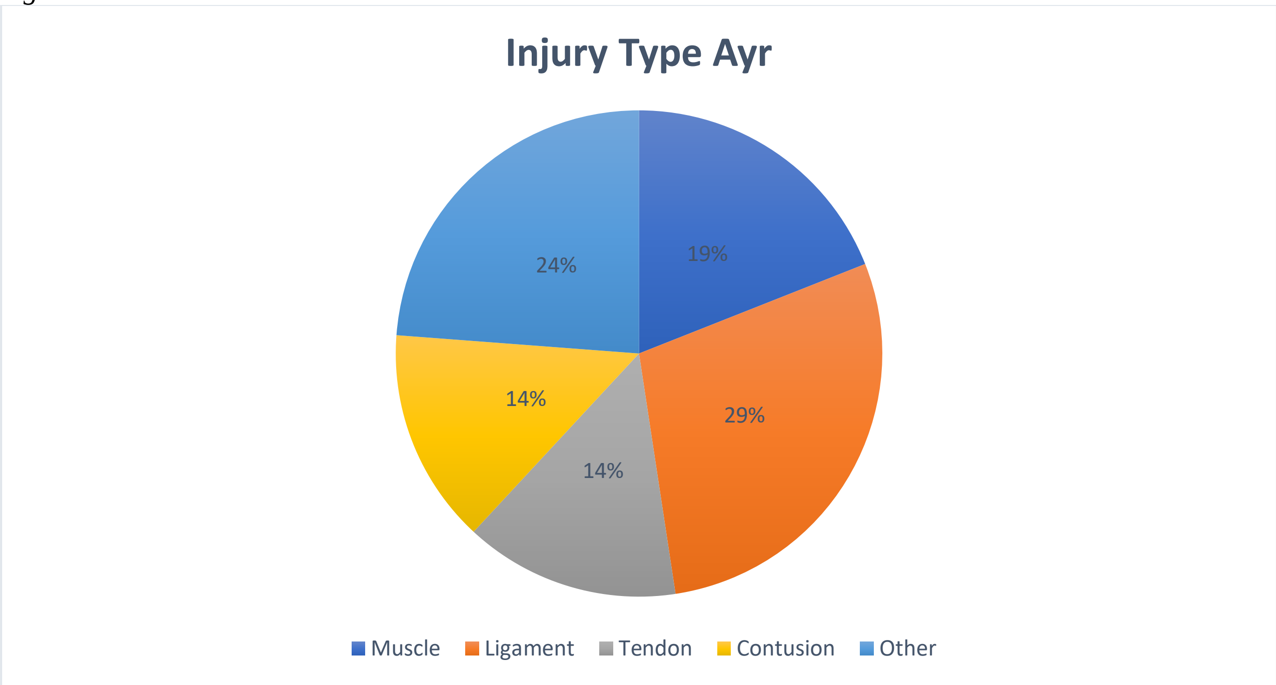
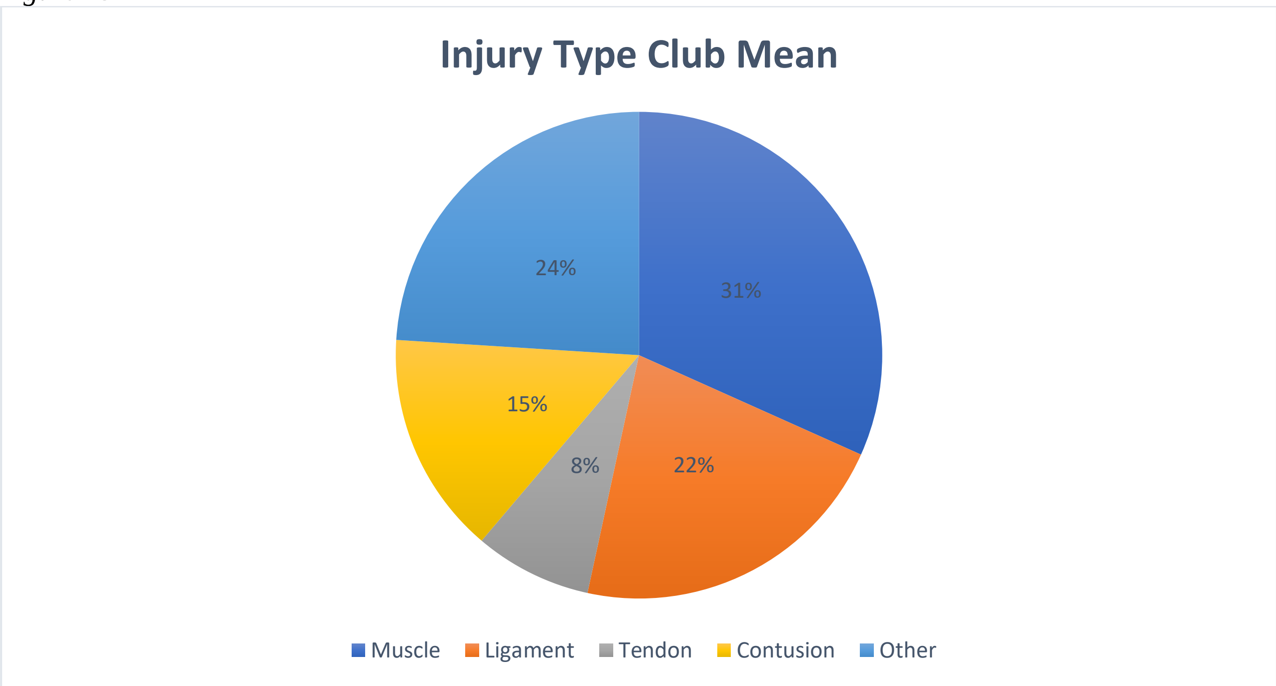


Figure 13



5b. STAYFIT-HURT Total Distribution of Muscle Injuries

Figure 36

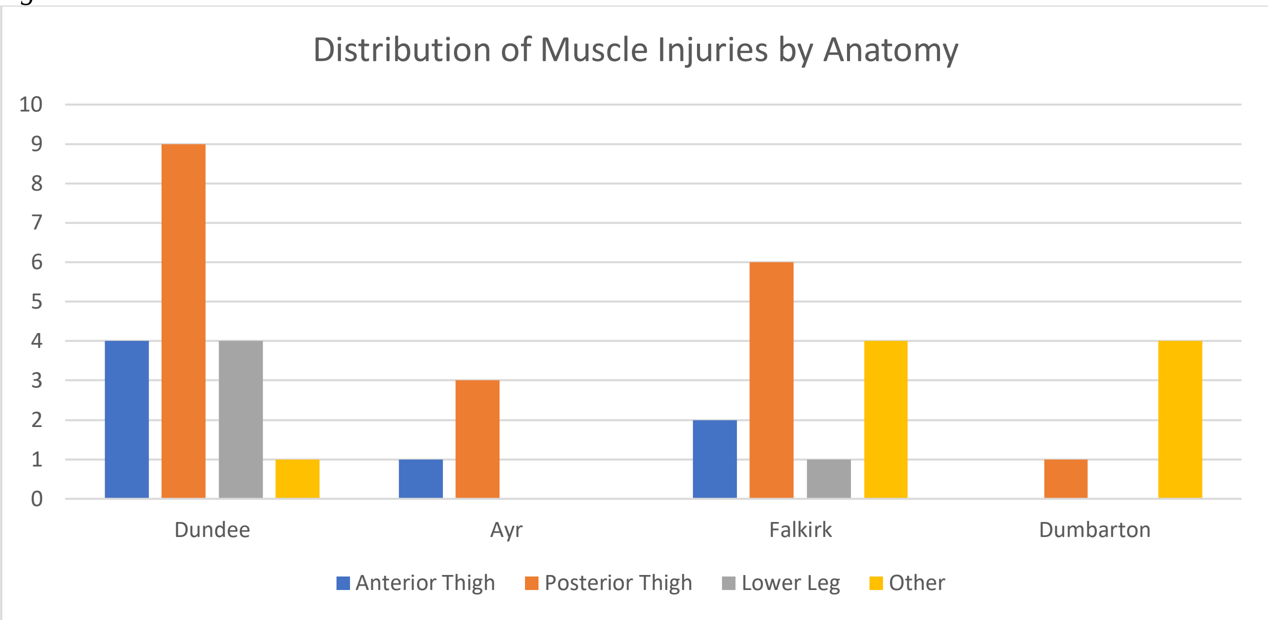
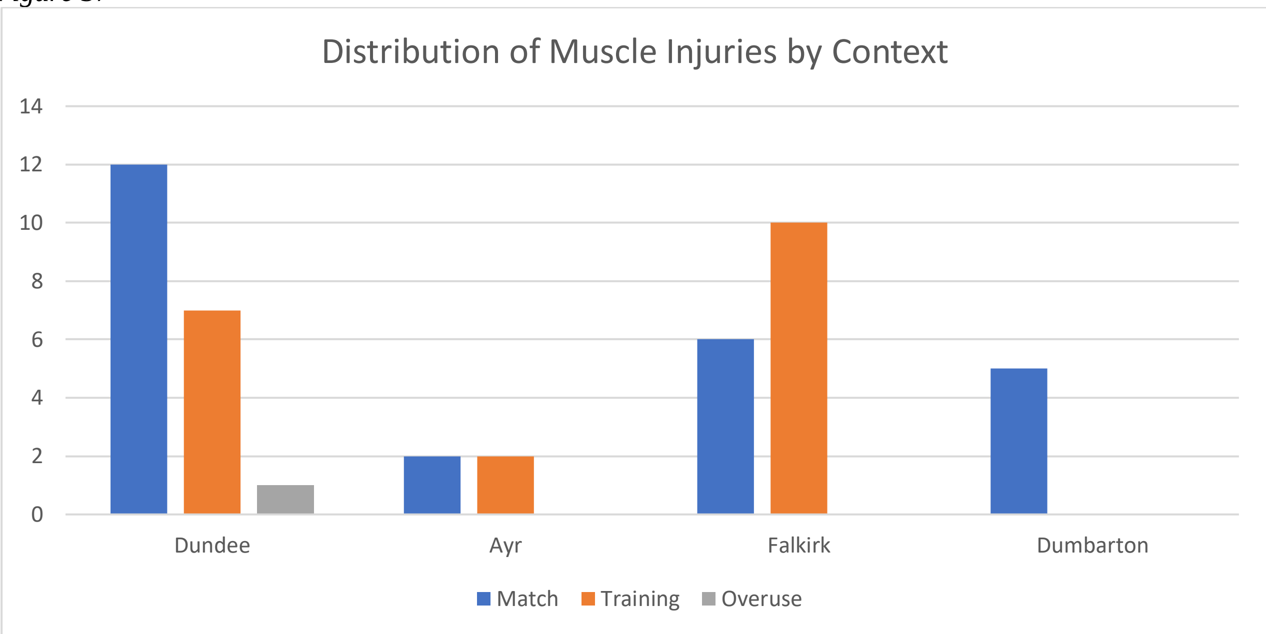


Figure 37



STAYFIT-HURT Total Distribution Ligament Injuries

Figure 38

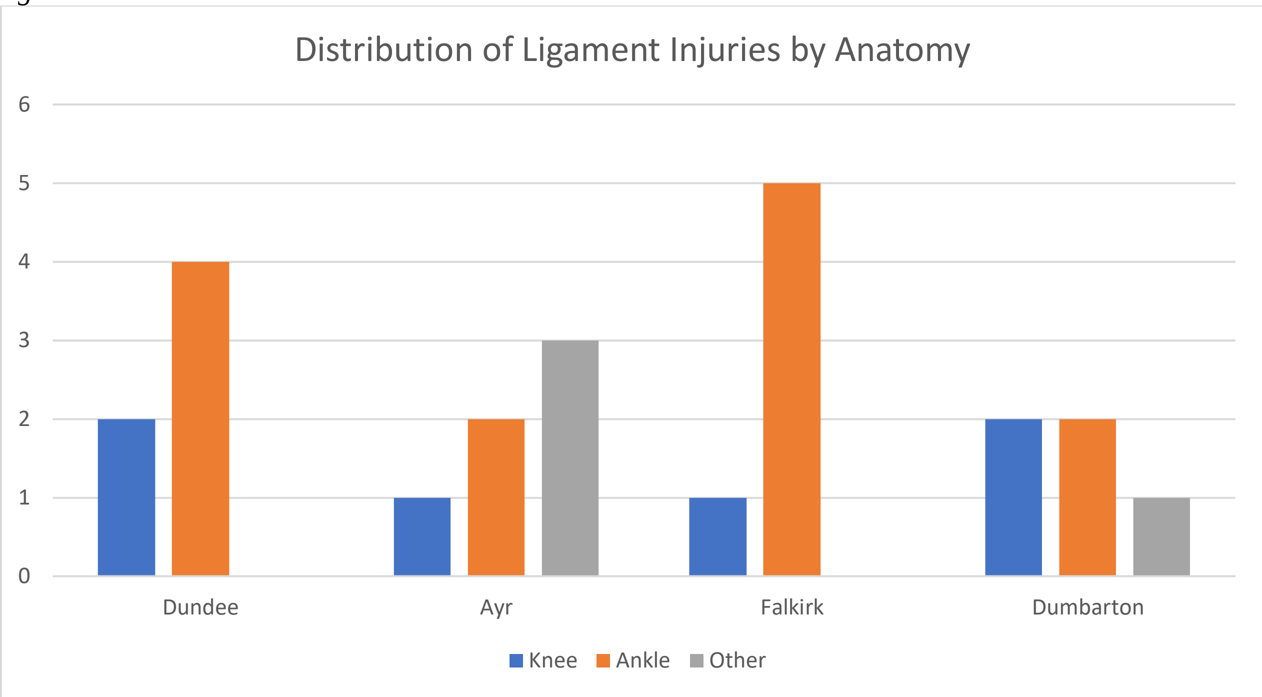
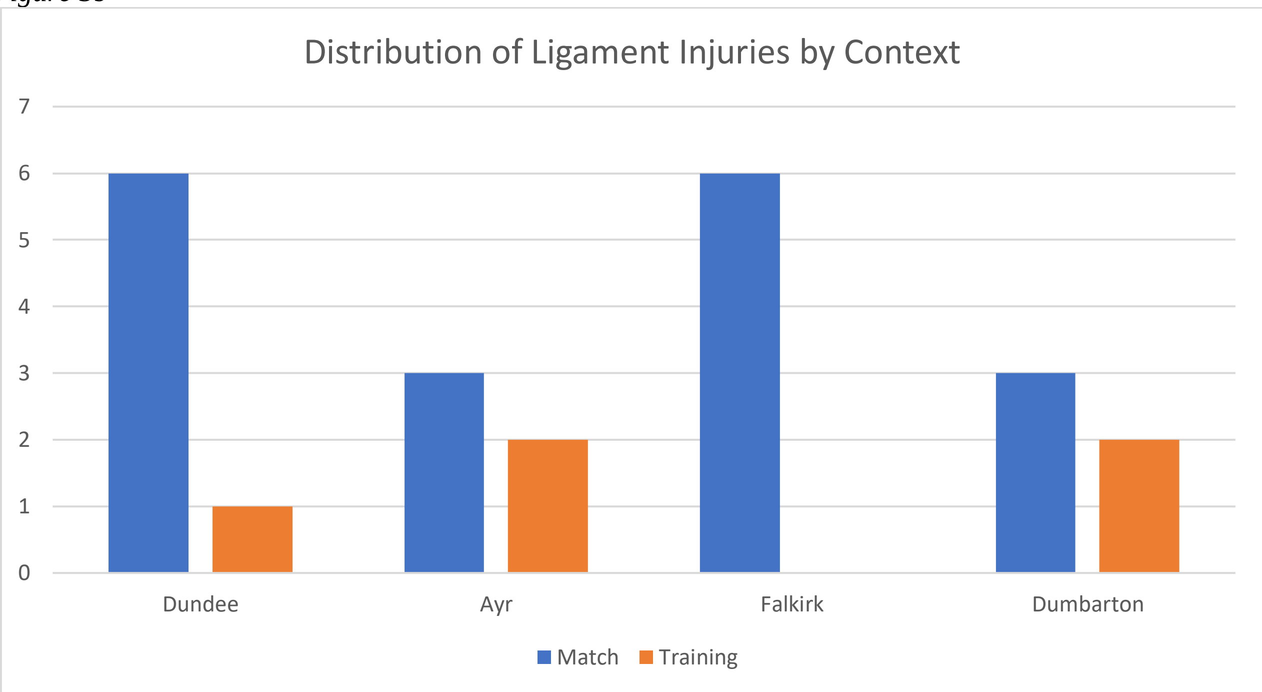
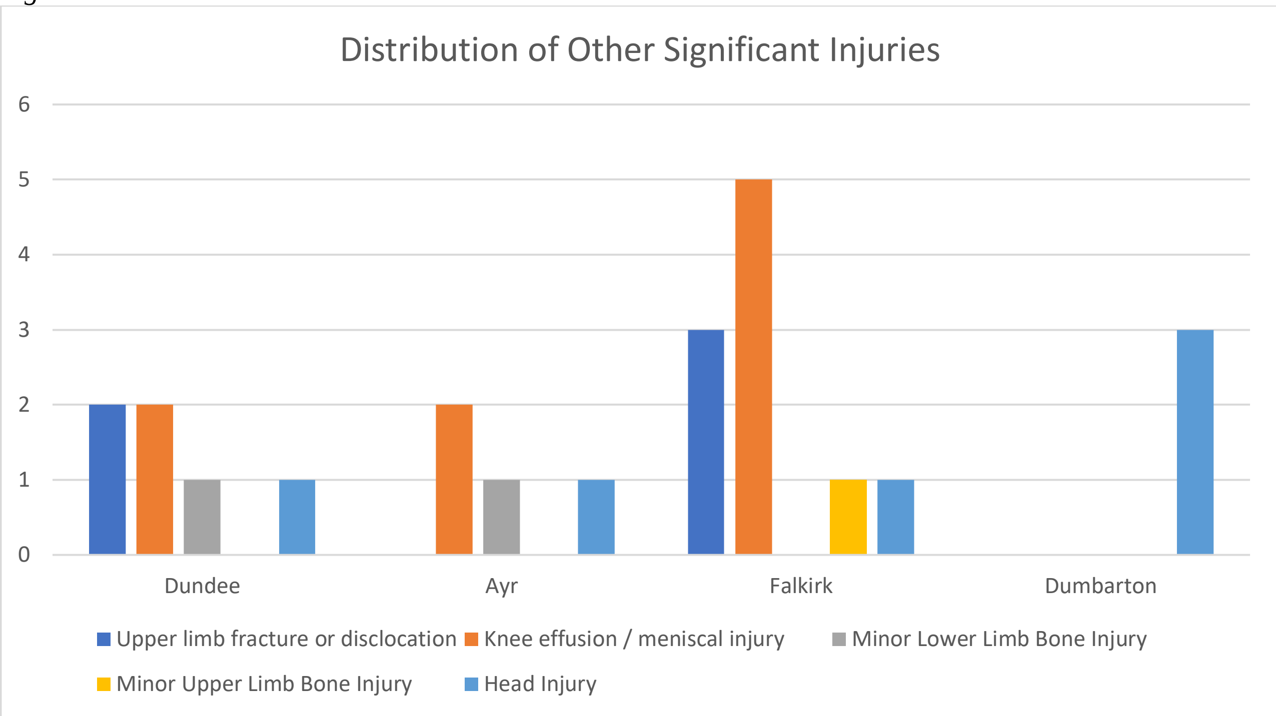


Figure 39



STAYFIT-HURT Total Distribution of Other Significant Injuries

Figure 40



6a. Injury Context – Match vs Training

Table Eii

Context	*Number of Significant injuries*
Match	11
Training	8
Overuse/Breakdown	2
Other Context	0

Figure 41ii

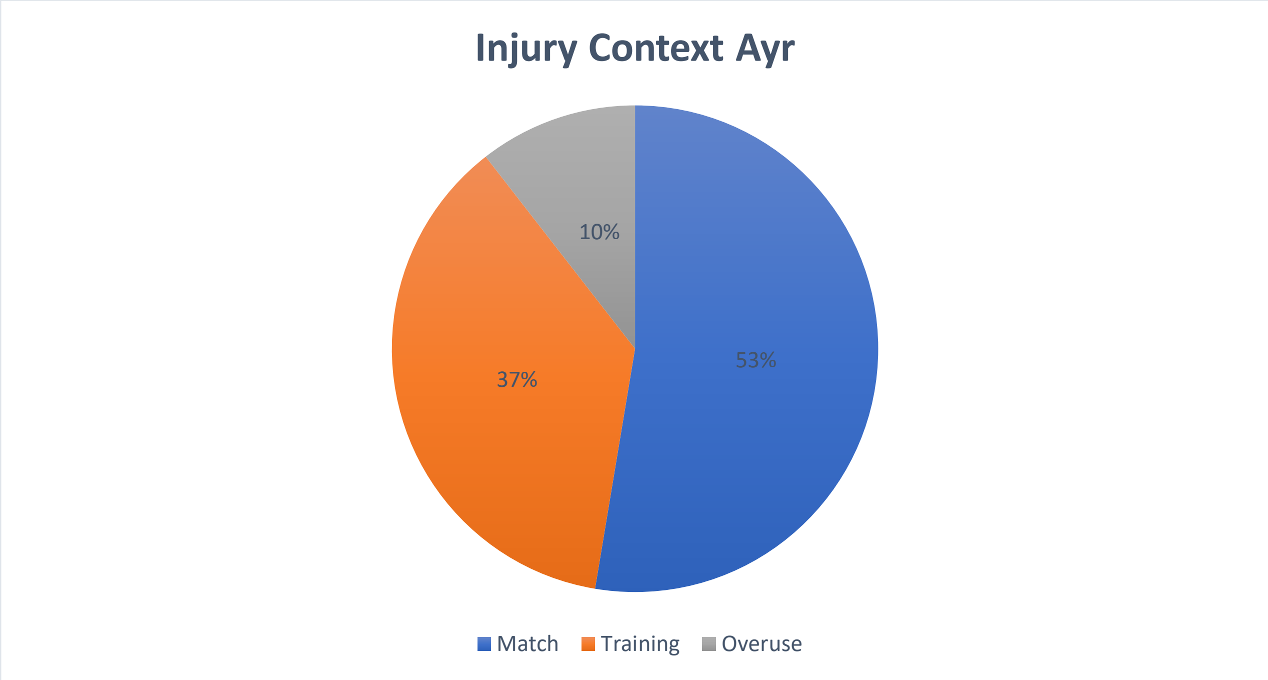
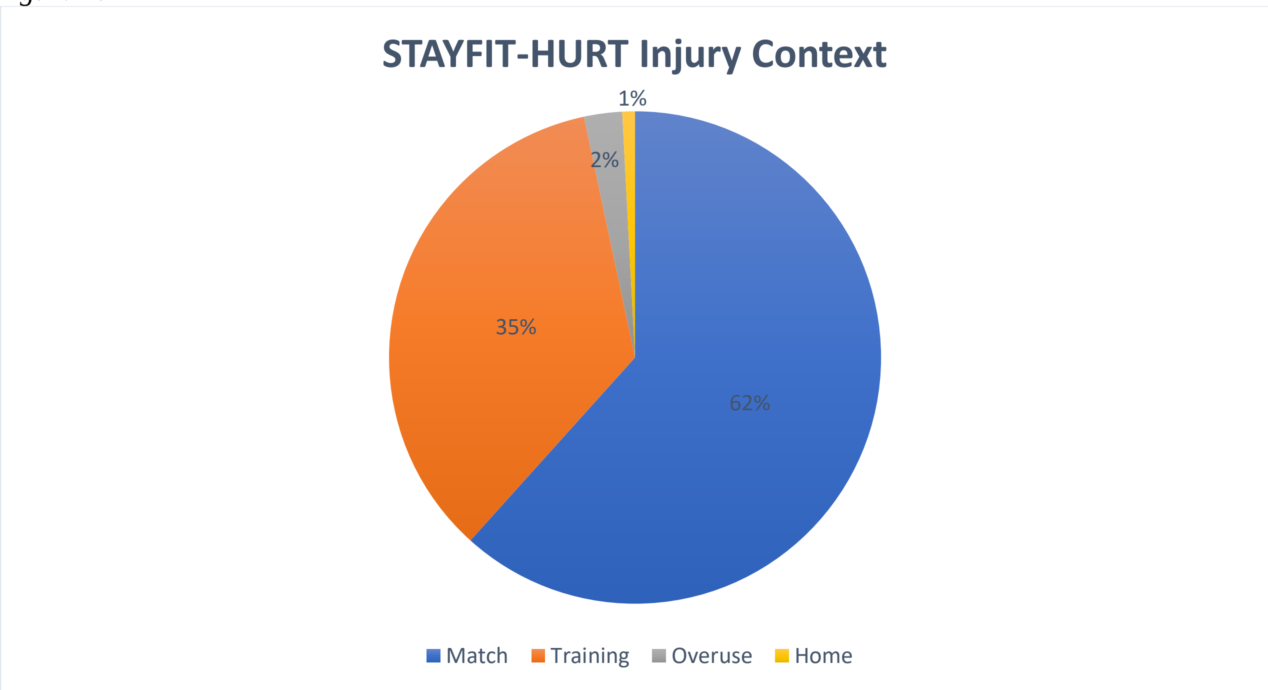


Figure 15



(alternative) Injuries in Training vs During Match

Figure 42ii

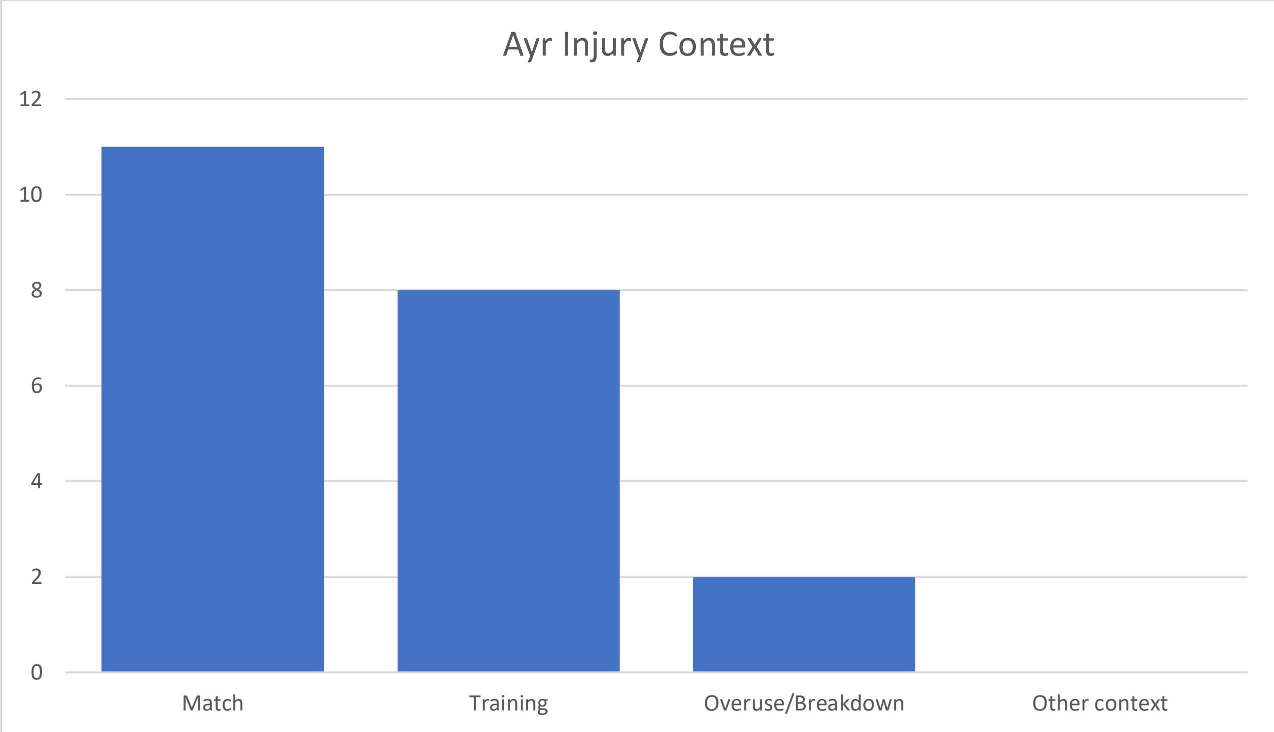
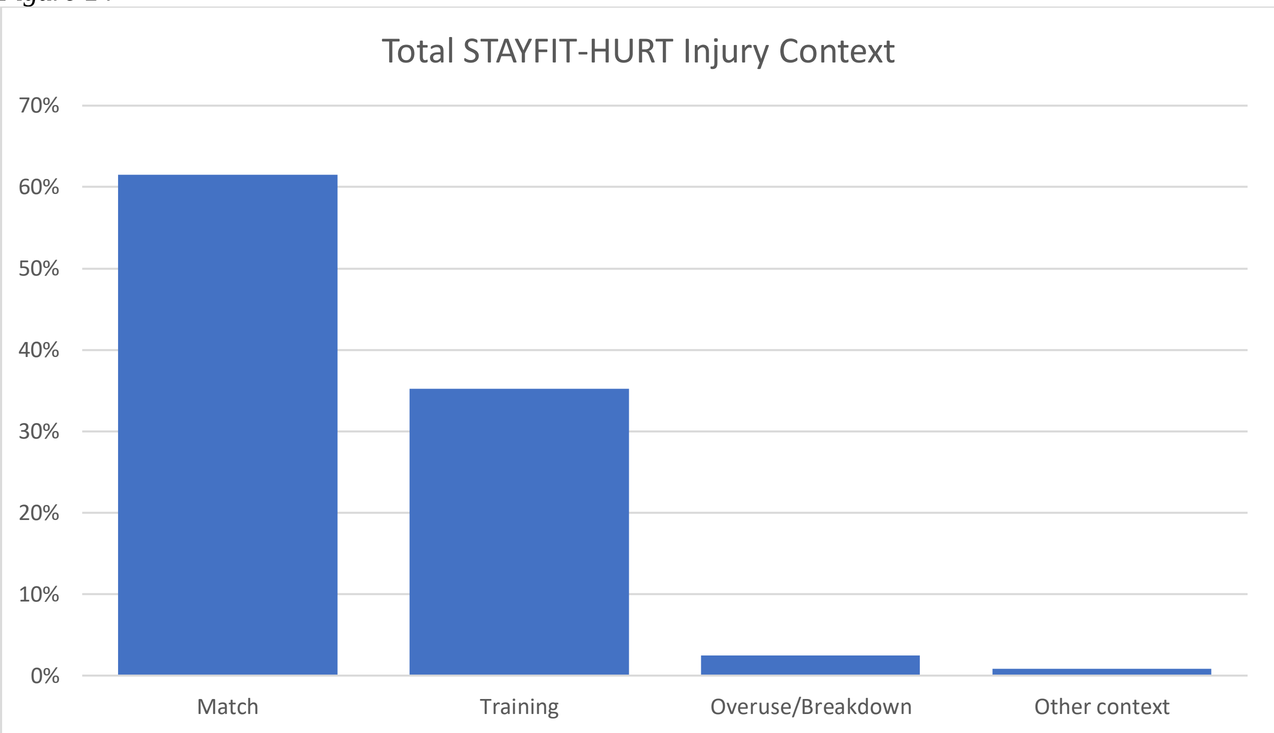


Figure 14



6b. Injury Context – Playing Surface

Table Fii

Playing Surface	*Number of Significant Injuries*	*Number of Competitive Matches*
Grass	6	30
Astroturf	14	4
Other	1	

Figure 43ii

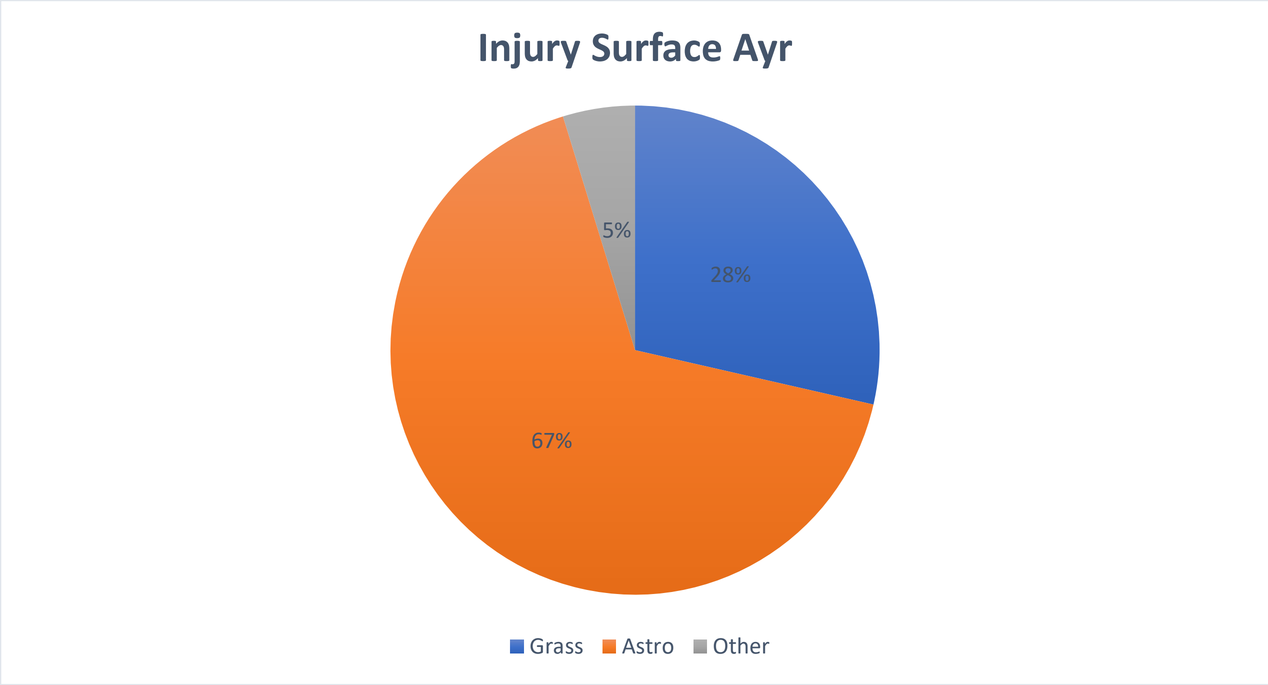
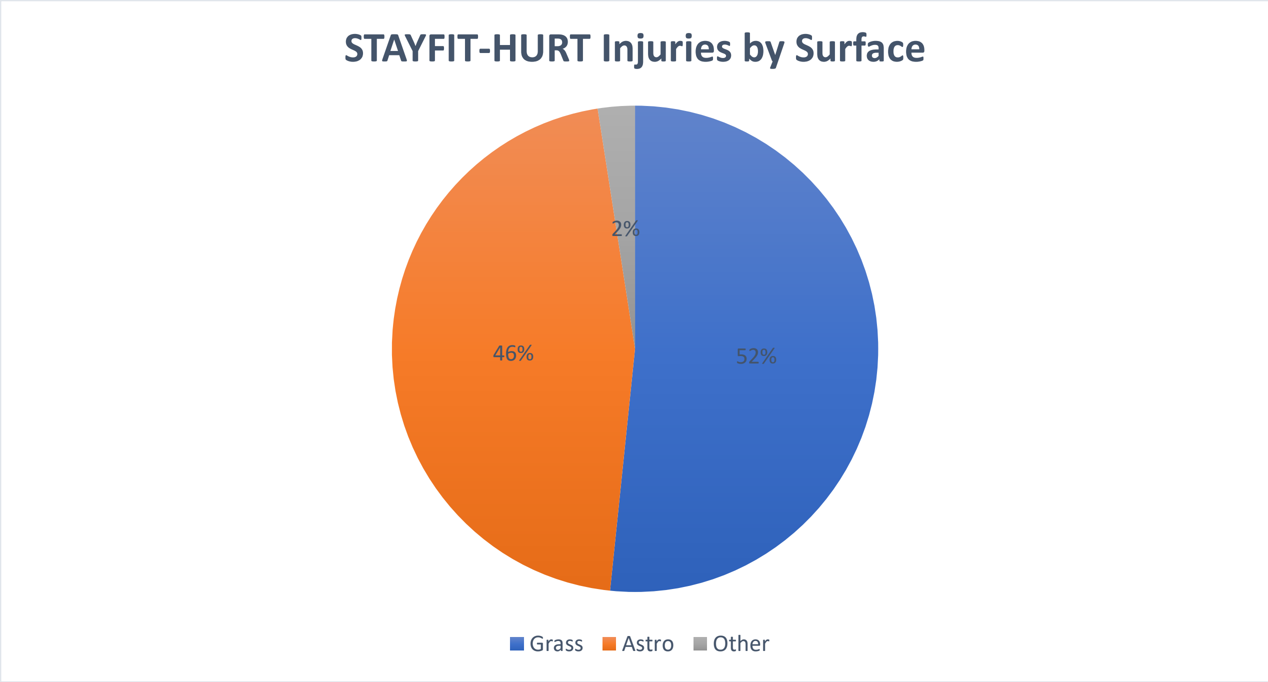


Figure 16



STAYFIT-HURT

TEAM REPORT 2019/20

Study of A Year of Football Injuries and Trauma and evaluation of a Handheld Uniform Recording Tool (STAYFIT-HURT)

Team Report Falkirk FC SPFL 2019/20

Falkirk FC played in Scottish League One, the third tier of the SPFL during season 2019/20. They are a fully professional club that play their home matches on artificial grass and were training on artificial grass. Data was provided by the full-time physiotherapist and part-time club doctor.

The STAYFIT-HURT Project was conducted during the 2019/20 SPFL season between June 2019 and March 2020 when professional football ceased as a result of the COVID-19 pandemic. This report compares the injury data for Falkirk FC against that of 3 other SPFL clubs that provided a significant quantity of injury data.

The report is divided into 6 sections with information displayed on squad data provided, number of matches, injuries according to age and playing position, anatomical injury location, injury type and injury context that includes match versus training and playing surface.

Due to the limited amount of data collected in a single season injury rate should be evaluated with caution given the few actual injury episodes. Unfortunately, there was insufficient data to provide information on the duration of injury episodes, player availability and hence injury burden. When considering the impact on the club, club clinicians should consider prioritising the duration of injury episodes and player availability for training and matches in any future data capture.

1. Squad Data

The data analysed for the Falkirk FC squad included injury records of 26 players. The size of squad appears accurate based on internet search. The average age of the players about whom data was received was 26.62. 2 players were defined as Goalkeepers, 7 as defenders, 10 as midfielders and 7 as forwards. In total 44 significant injury episodes were recorded.

2. Number of Competitive Matches

Figure 29

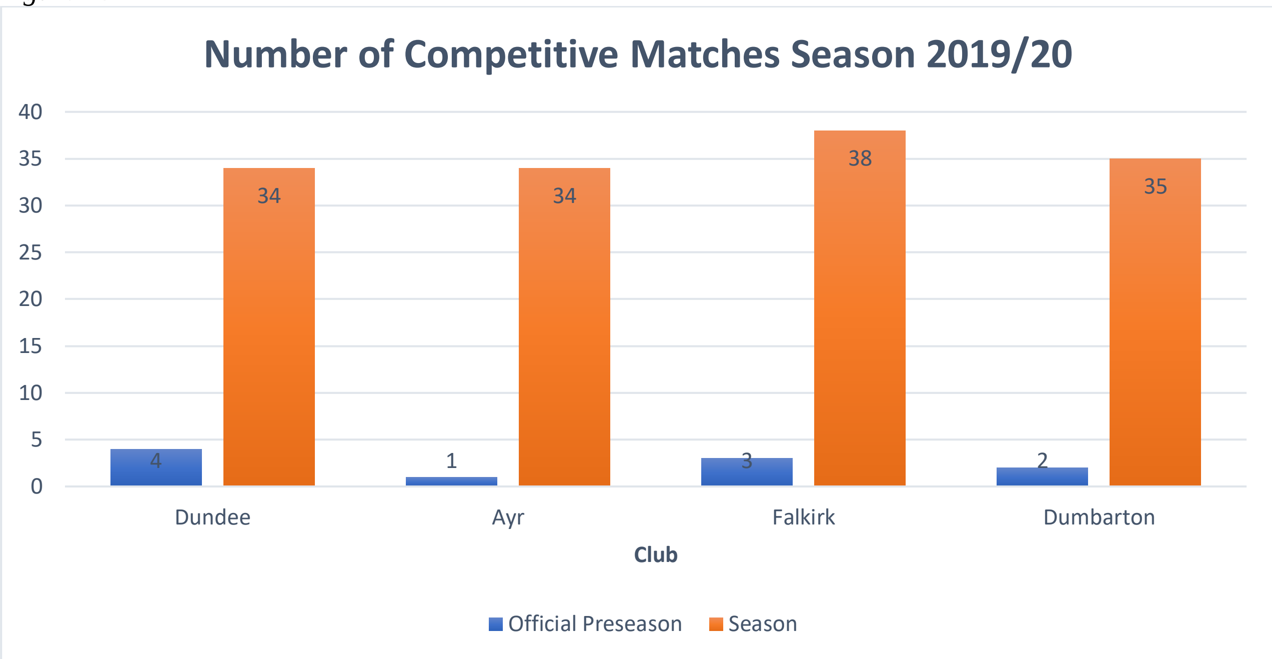
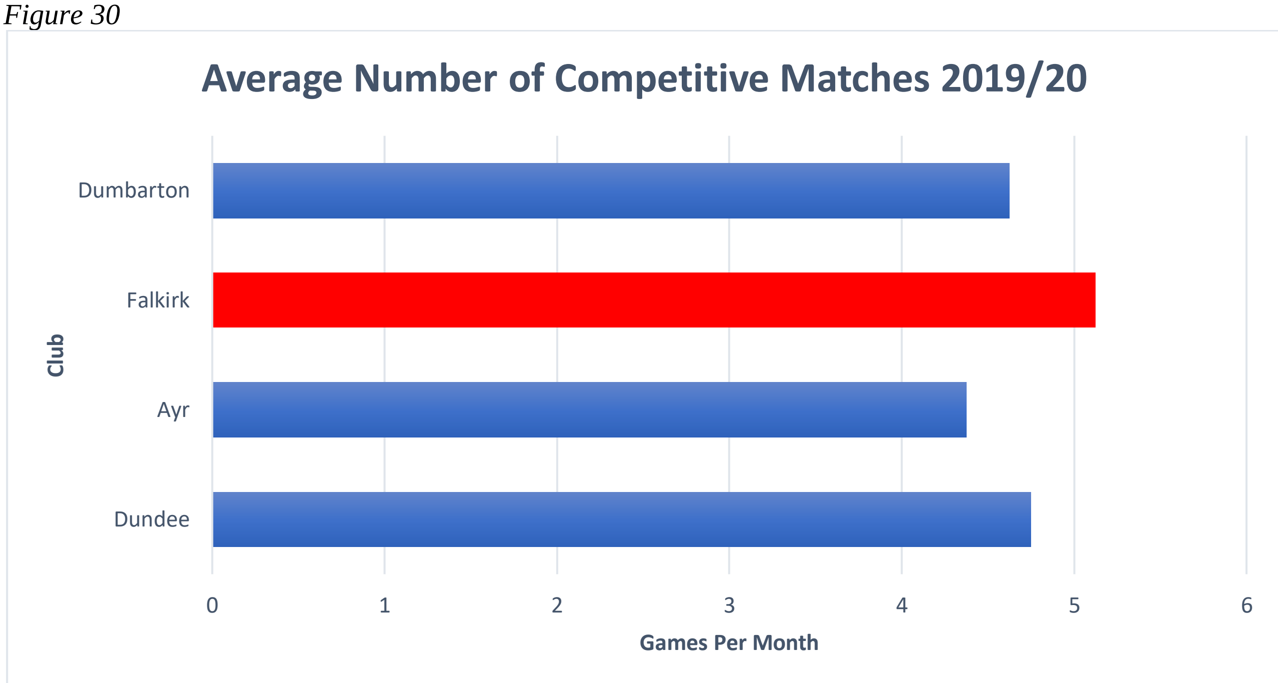
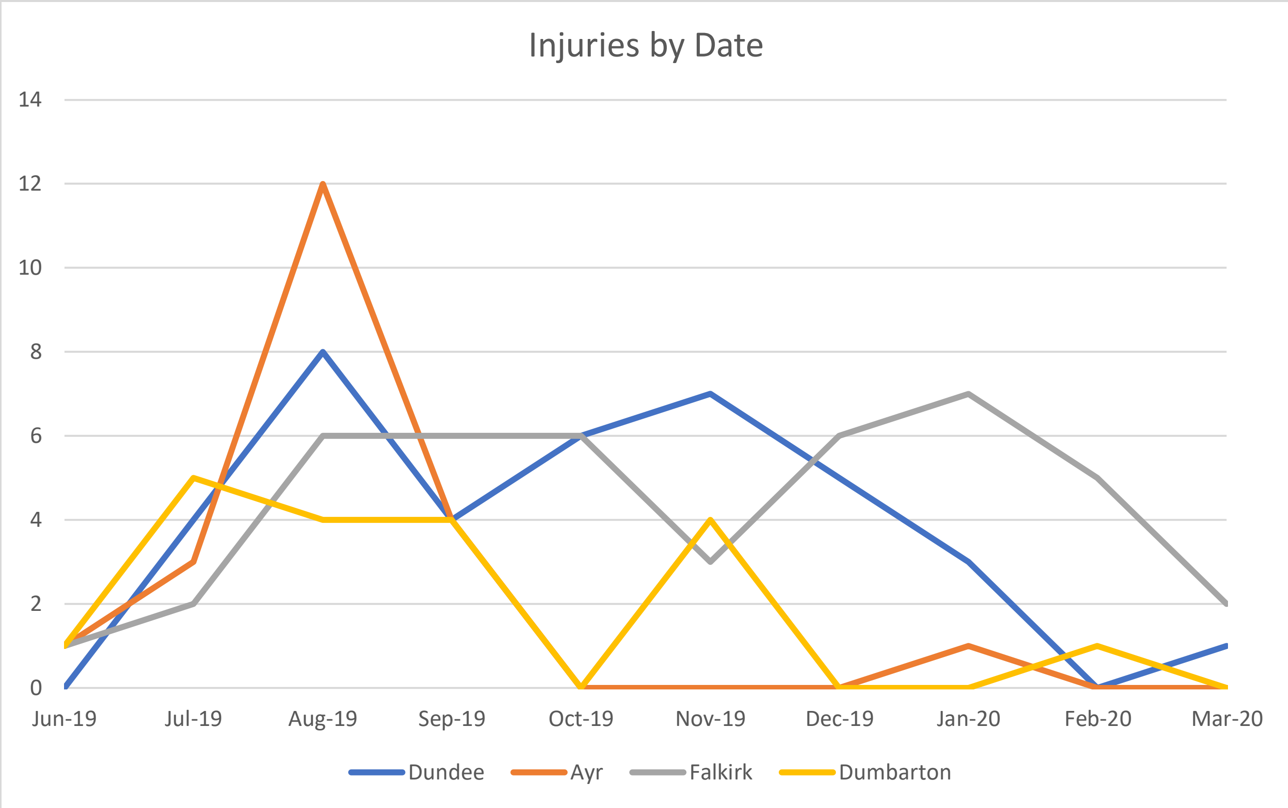


Figure 30



STAYFIT-HURT Total Injuries by Date

Figure 31



3a. Injuries According to Age

Figure 32iii

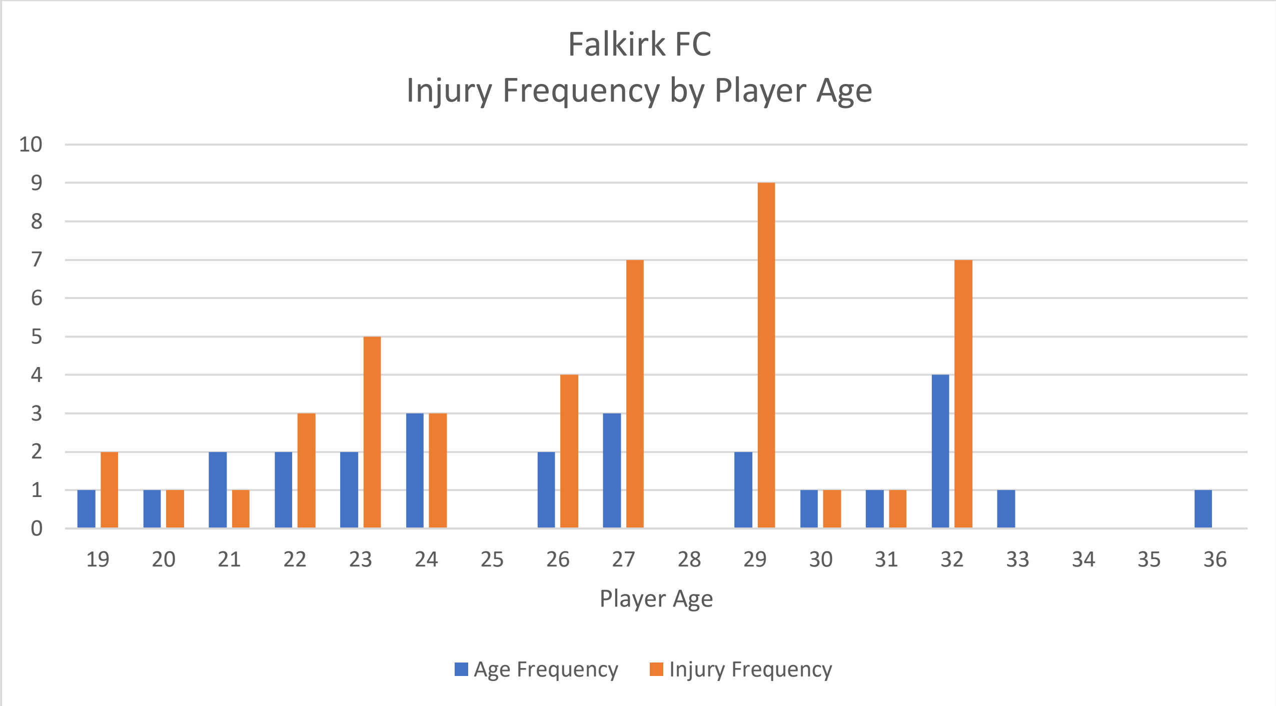
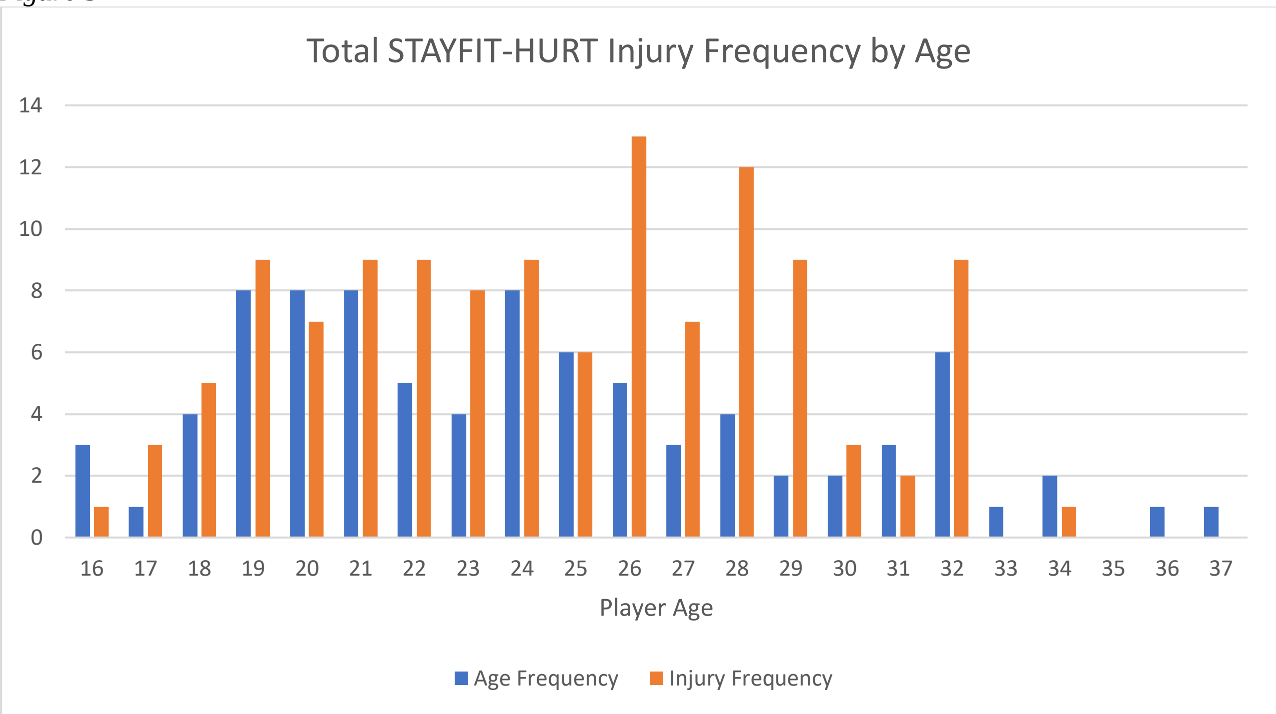


Figure 5



3b. Injuries According to Playing Position

Table Biii

Playing Position	*Number of Significant Injuries*
Goalkeeper	7
Defender	15
Midfield	17
Forward	5

Figure 33iii

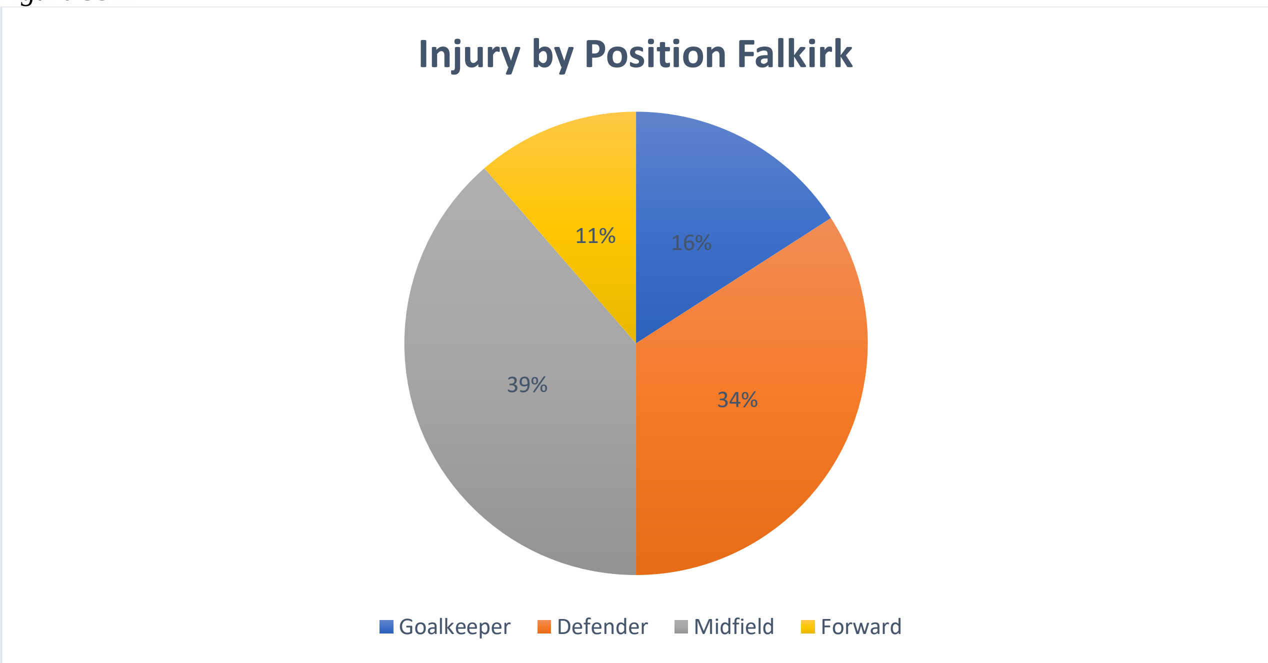
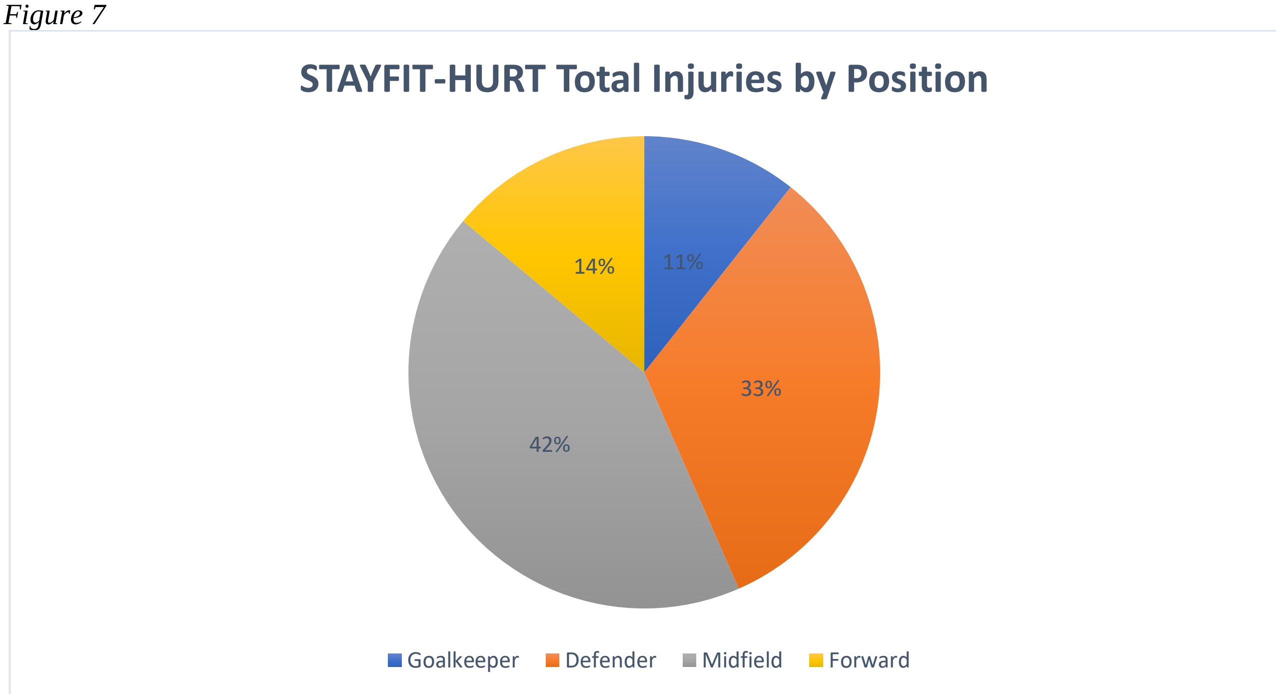


Figure 7



4. Injury Location

Table Ciii

Location	*Number of Significant Injuries*
Hip/Groin	3
Thigh	8
Knee	7
Ankle	11
Head	1
Other	14

Figure 34iii

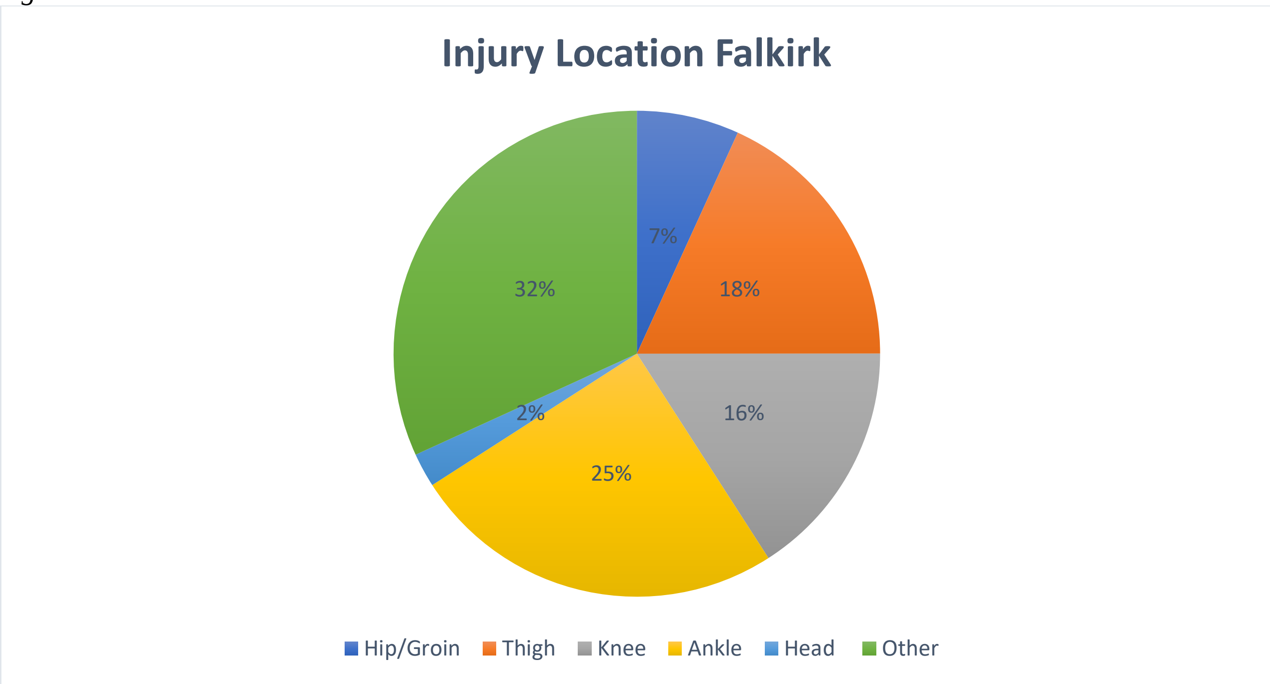
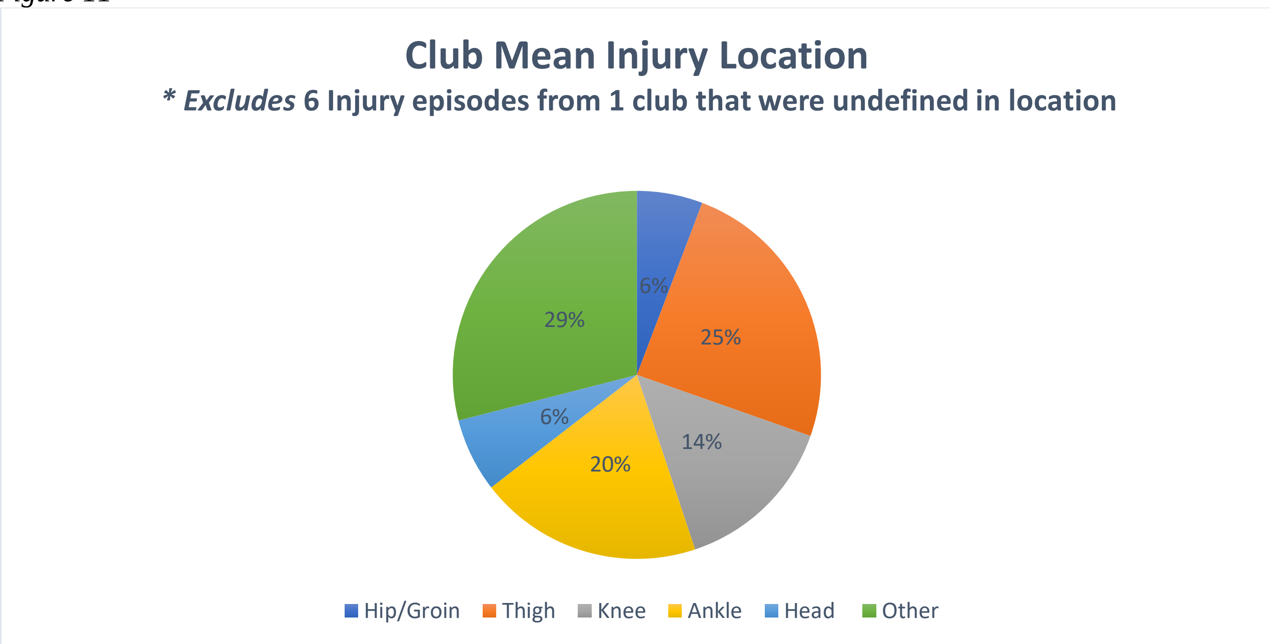


Figure 11



5a. Injury Type

Table Diii

Injury Type	*Number of Significant Injuries*
Muscle Injuries	15
Ligament Injuries	6
Tendon Injuries	4
Contusion	7
Other	12

Figure 35iii

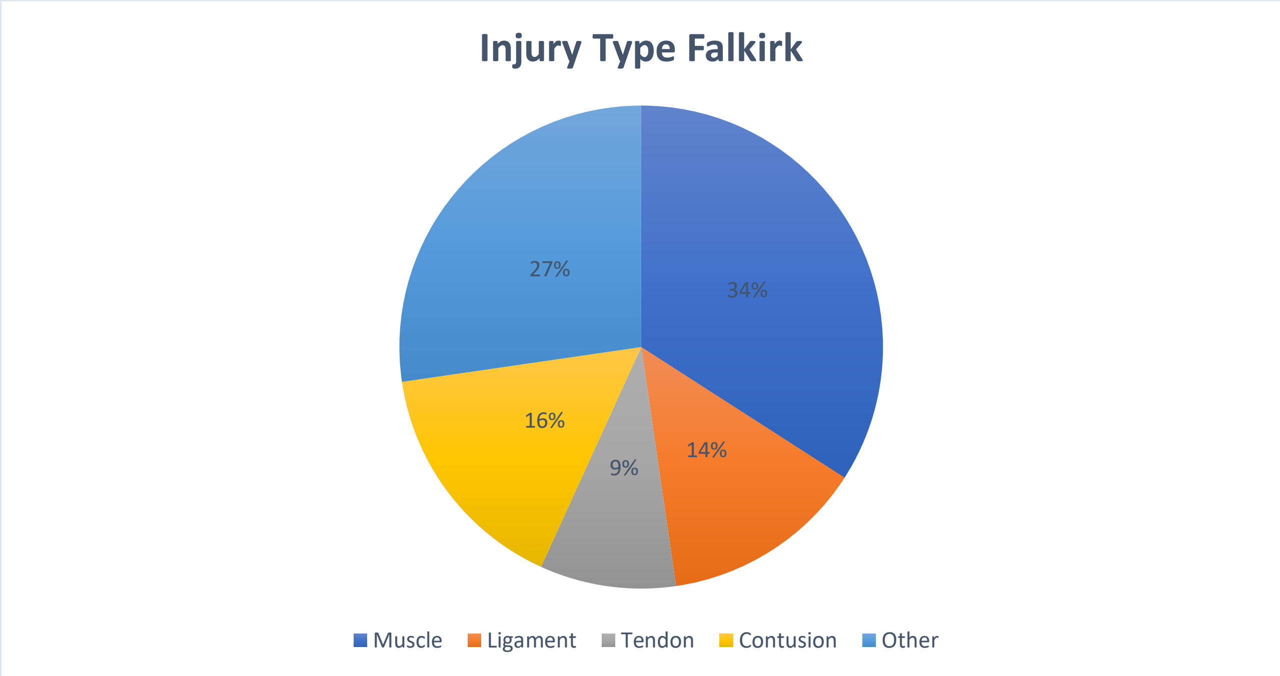
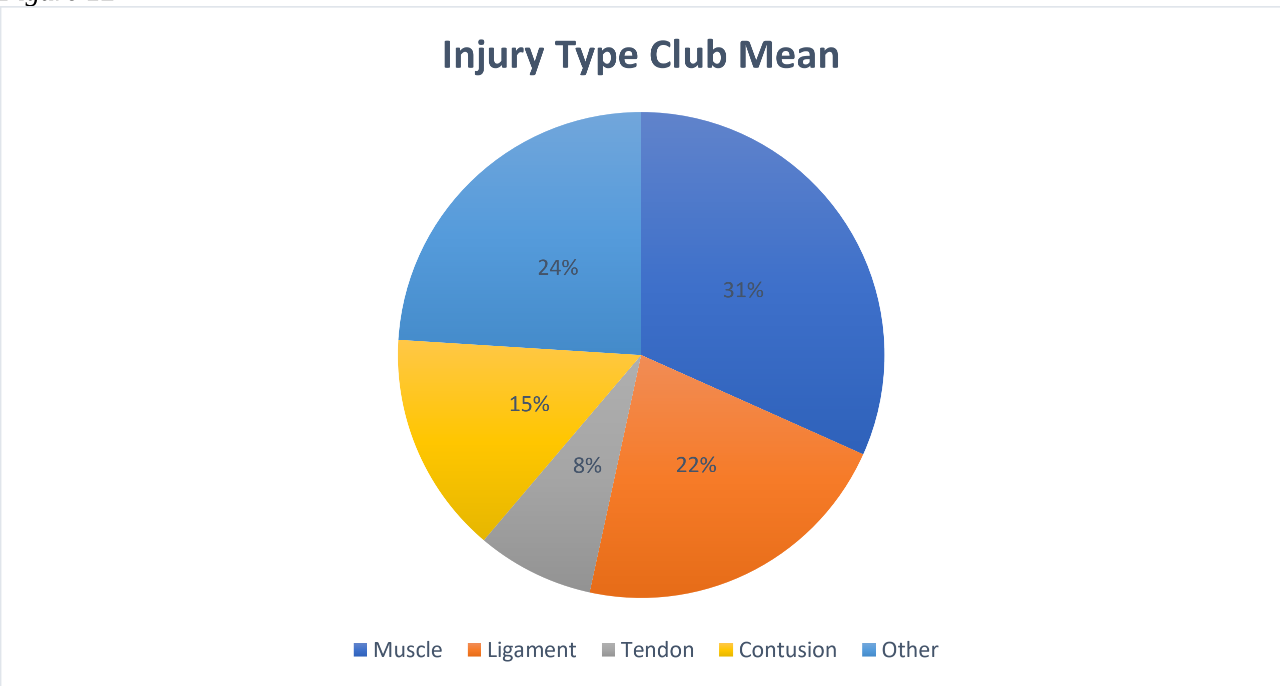


Figure 12



5b. STAYFIT-HURT Total Distribution of Muscle Injuries

Figure 36

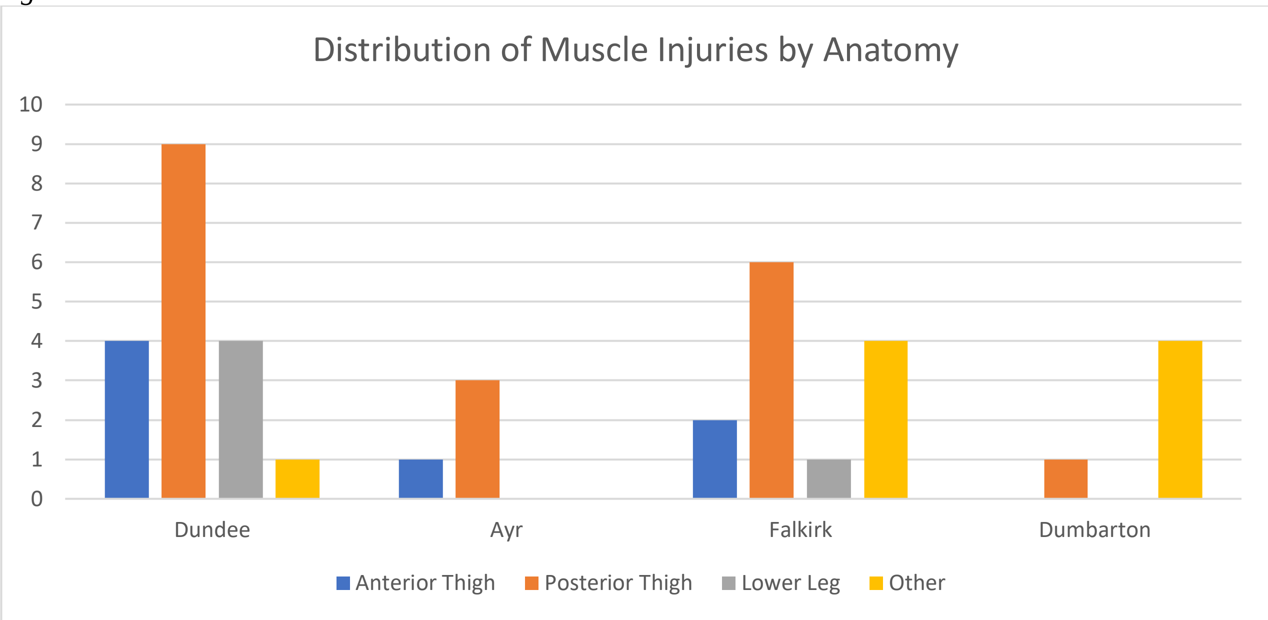
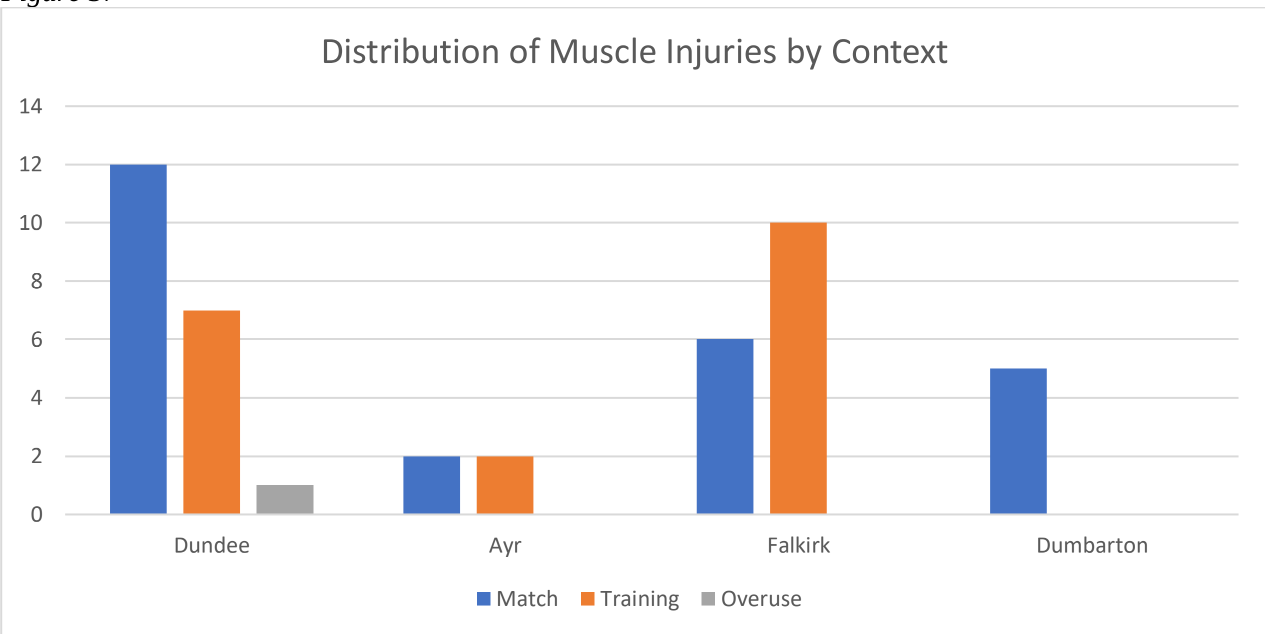


Figure 37



<u>STAYFIT-HURT Total Distribution Ligament Injuries</u>

Figure 38

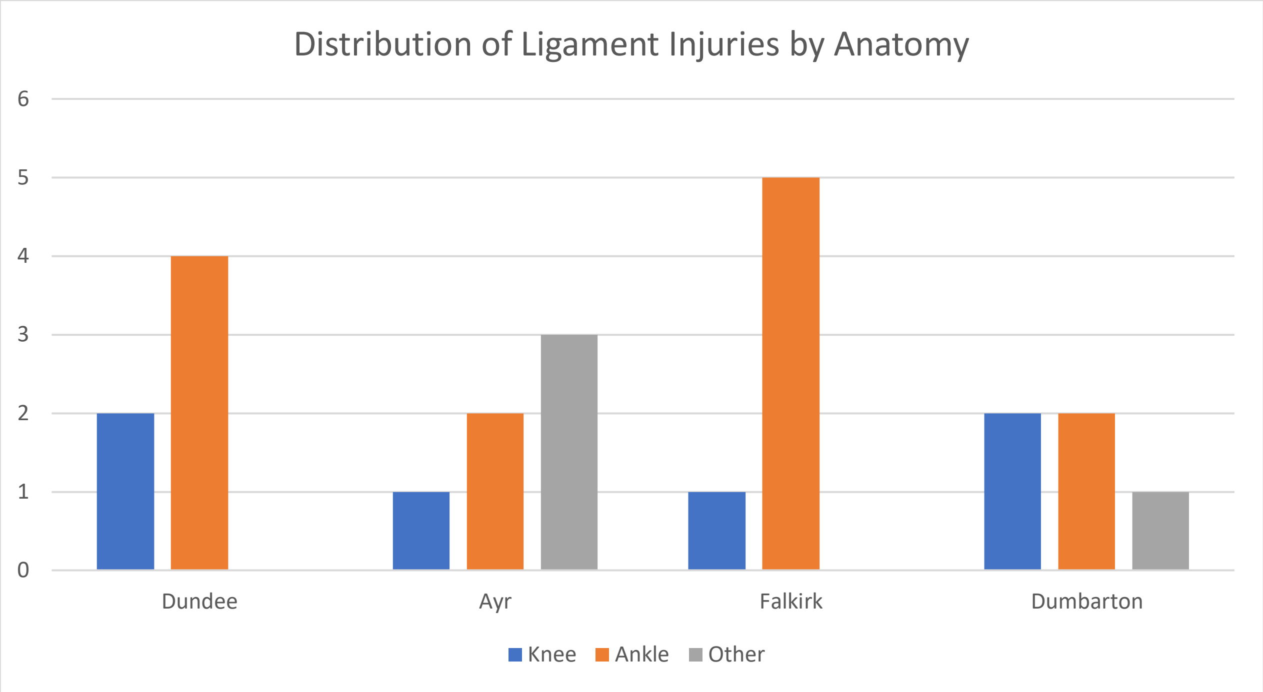
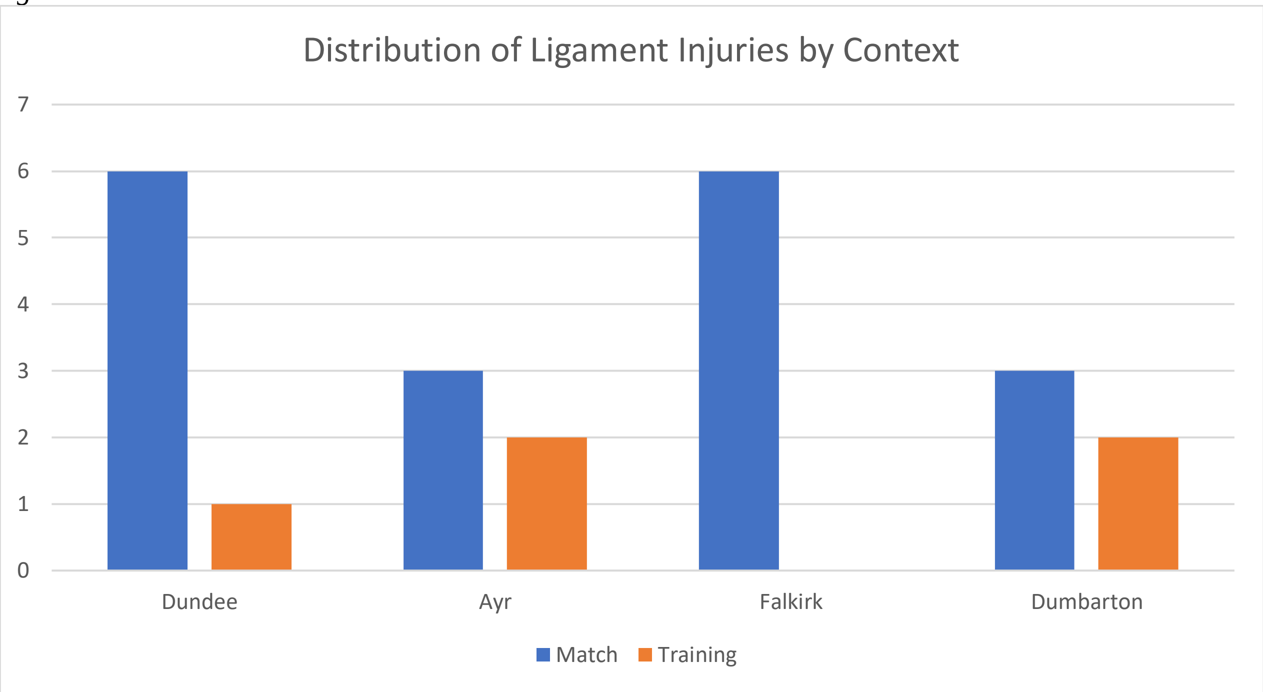
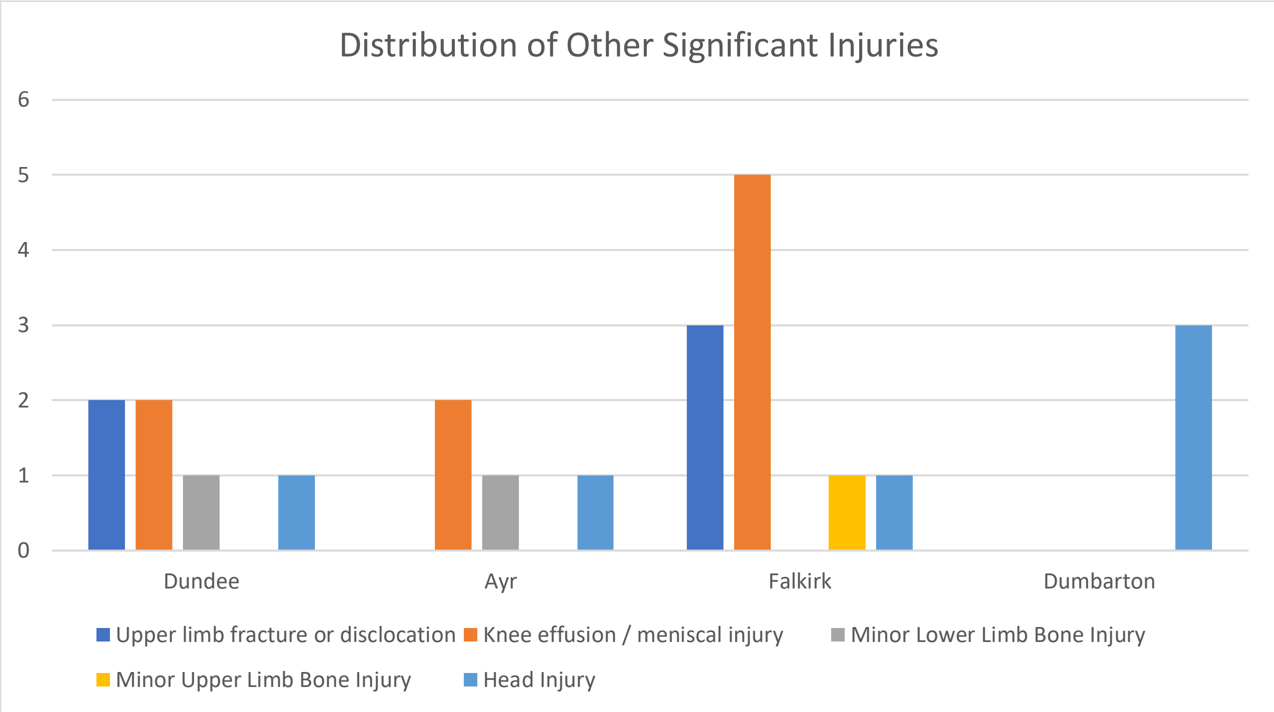


Figure 39



STAYFIT-HURT Total Distribution of Other Significant Injuries

Figure 40



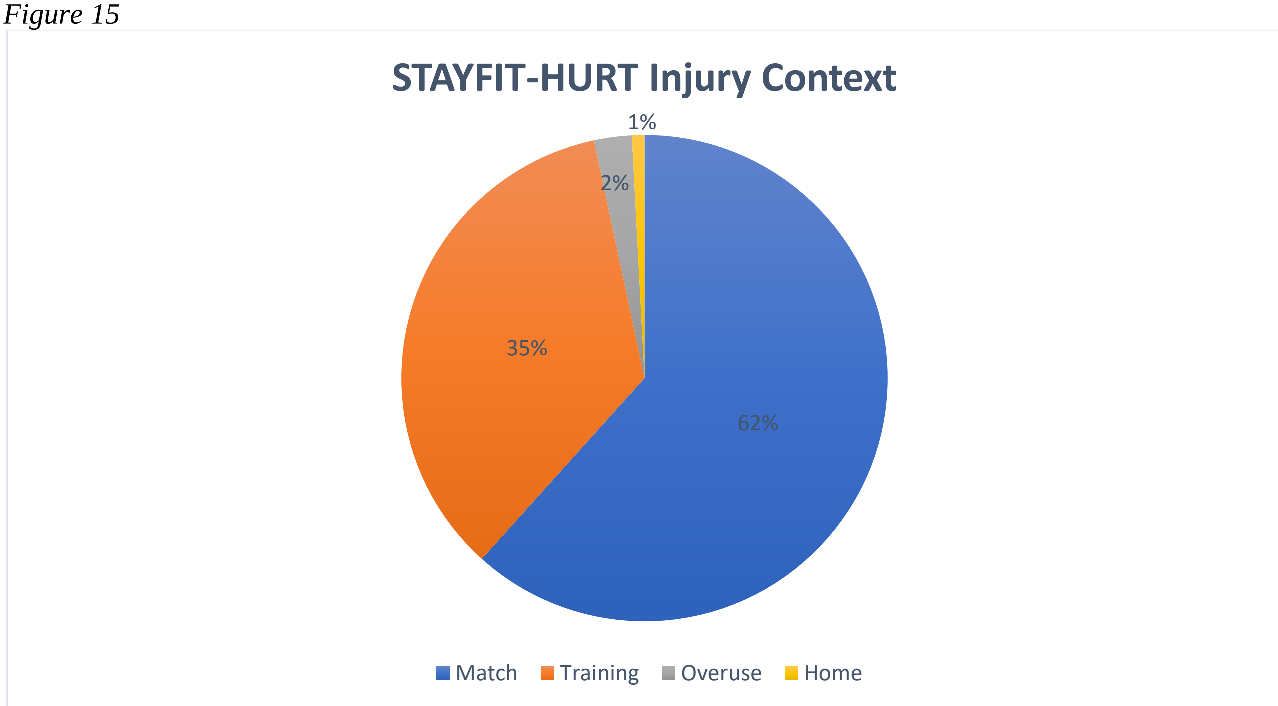
6a. Injury Context – Match vs Training

Table Eiii

Context	*Number of Significant injuries*
Match	22
Training	22
Overuse/Breakdown	0
Other Context	0

Figure 41iii

Figure 15



(alternative) Injuries in Training vs During Match

Figure 42iii

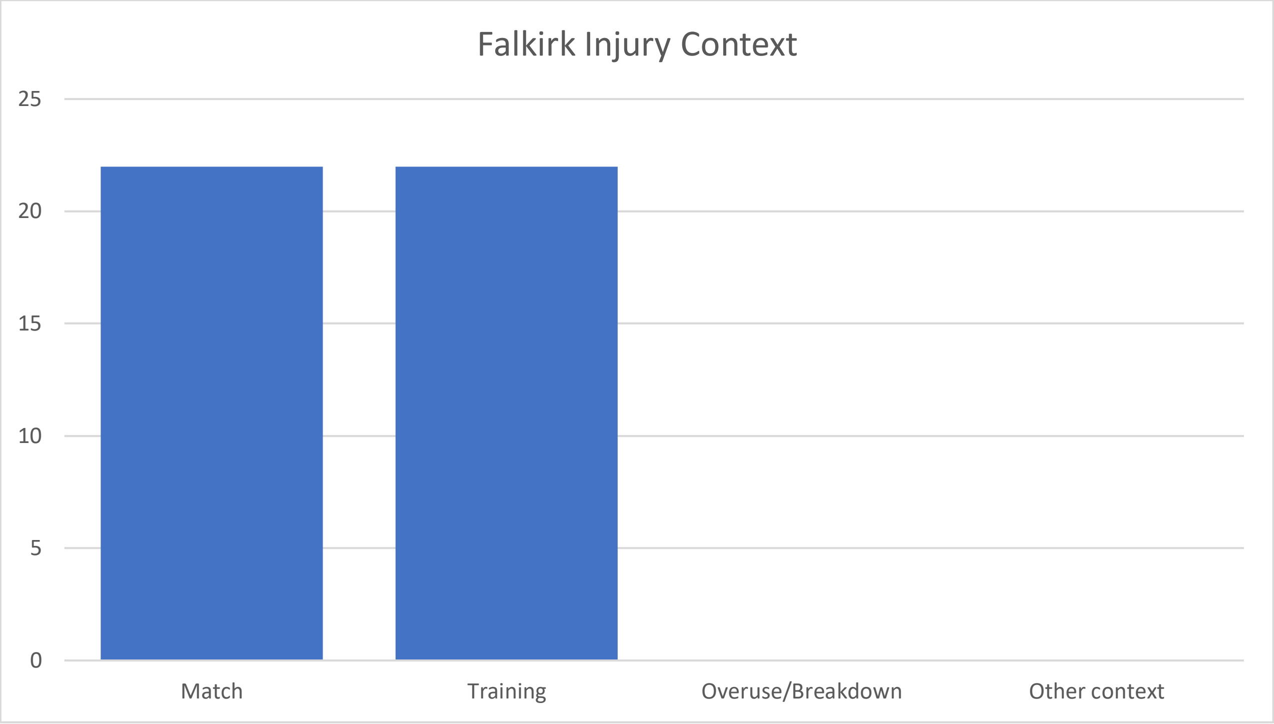
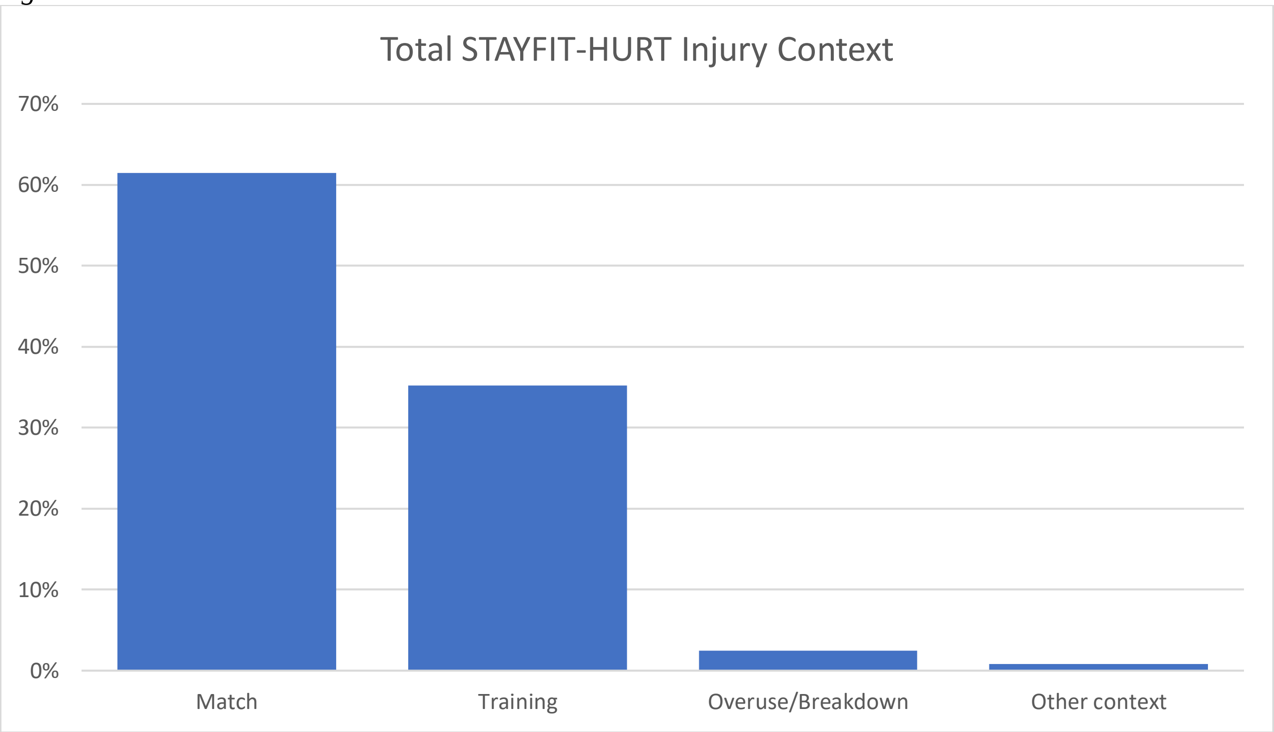


Figure 14



6b. Injury Context – Playing Surface

Table Fiii

Playing Surface	*Number of Significant Injuries*	*Number of Competitive Matches*
Grass	4	29
Astroturf	40	9
Other	0	

Figure 43iii

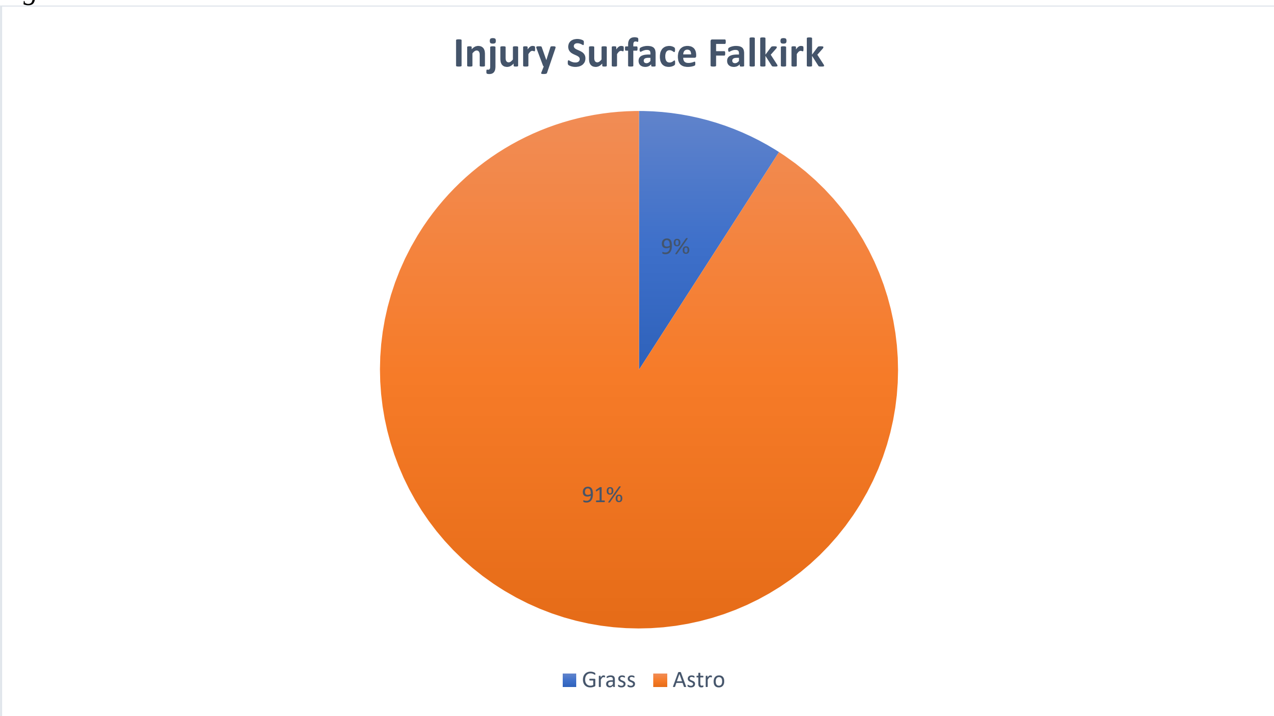
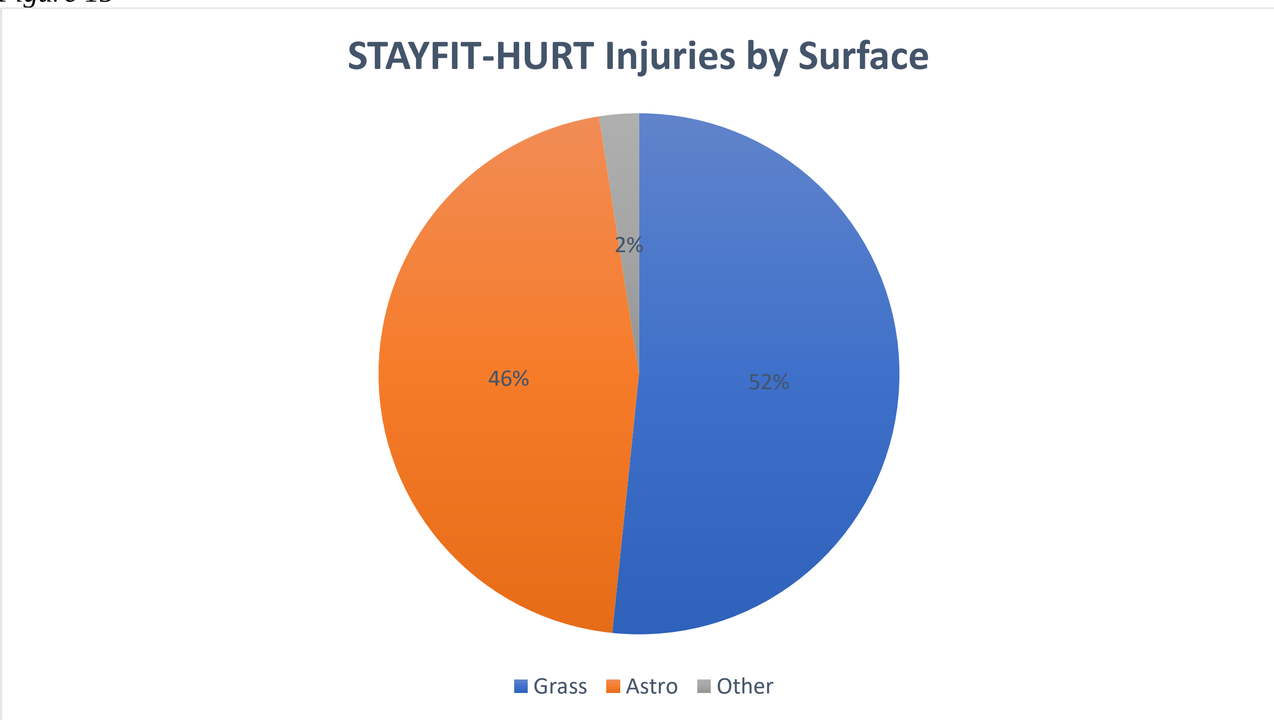


Figure 15



STAYFIT-HURT

TEAM REPORT 2019/20

Study of A Year of Football Injuries and Trauma and evaluation of a Handheld Uniform Recording Tool (STAYFIT-HURT)

Team Report Dumbarton FC SPFL 2019/20

Dumbarton FC played in Scottish League One, the third tier of the SPFL during season 2019/20. They are a semi-professional club that play their home matches on natural grass and were training on natural grass. Data was provided by the part-time club doctor.

The STAYFIT-HURT Project was conducted during the 2019/20 SPFL season between June 2019 and March 2020 when professional football ceased as a result of the COVID-19 pandemic. This report compares the injury data for Dumbarton FC against that of 3 other SPFL clubs that provided a significant quantity of injury data.

The report is divided into 6 sections with information displayed on squad data provided, number of matches, injuries according to age and playing position, anatomical injury location, injury type and injury context that includes match versus training and playing surface.

Due to the limited amount of data collected in a single season injury rate should be evaluated with caution given the few actual injury episodes. Unfortunately, there was insufficient data to provide information on the duration of injury episodes, player availability and hence injury burden. When considering the impact on the club, club clinicians should consider prioritising the duration of injury episodes and player availability for training and matches in any future data capture.
matches / exposure tables

1. Squad Data

The data analysed for the Dumbarton FC squad included injury records of 13 players. Internet resources suggest a full squad size of up to 24 players, however this includes at least 6 players who made less than 4 appearances. The average age of the players about whom data was received was 23.46. 1 player was defined as a Goalkeeper, 3 as defenders, 6 as midfielders and 3 as forwards. In total 19 significant injury episodes were recorded.

2. Number of Competitive Matches

Figure 29

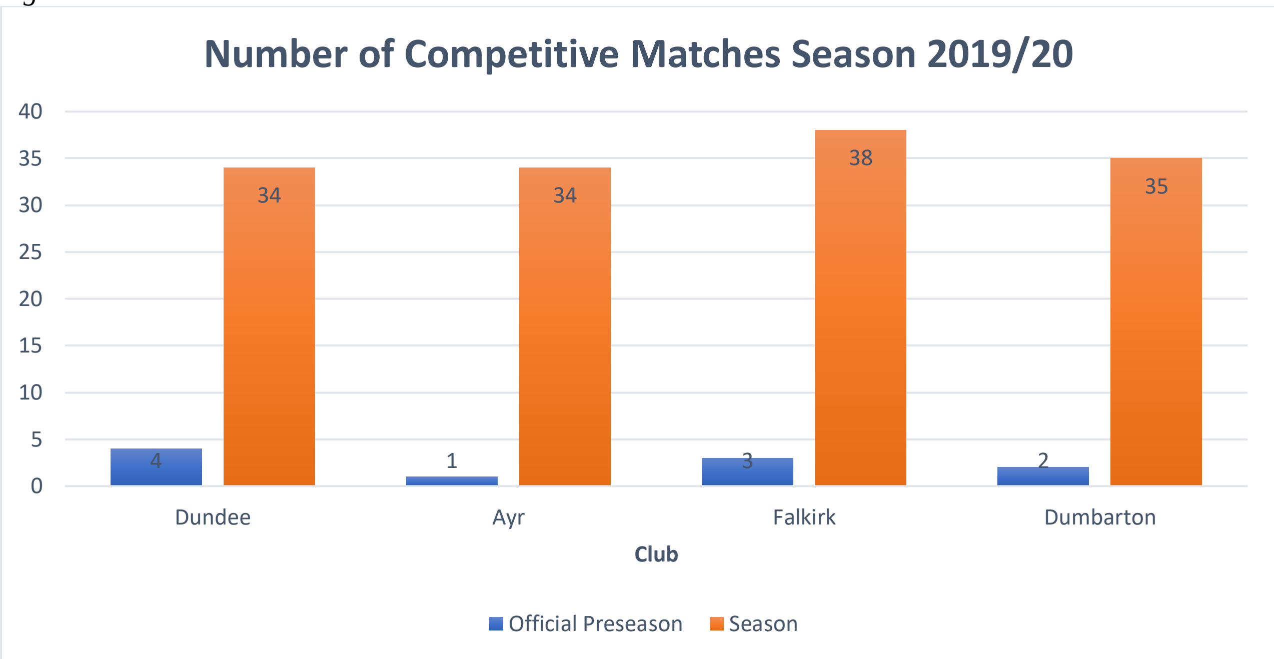
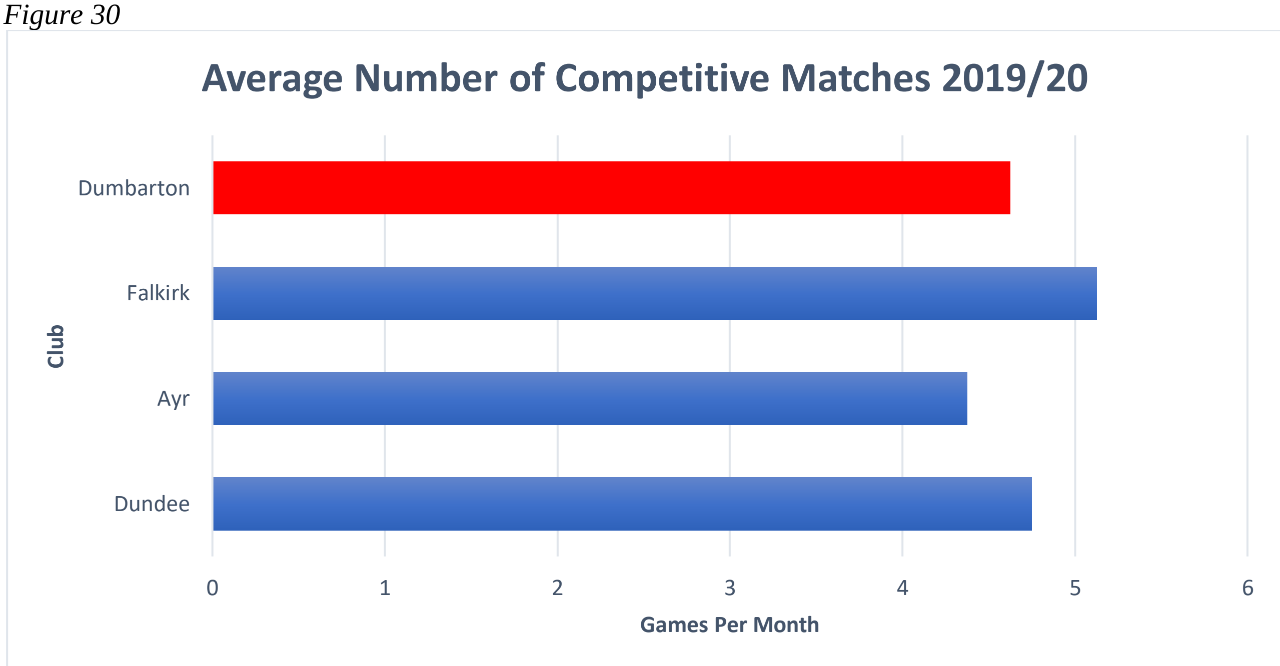
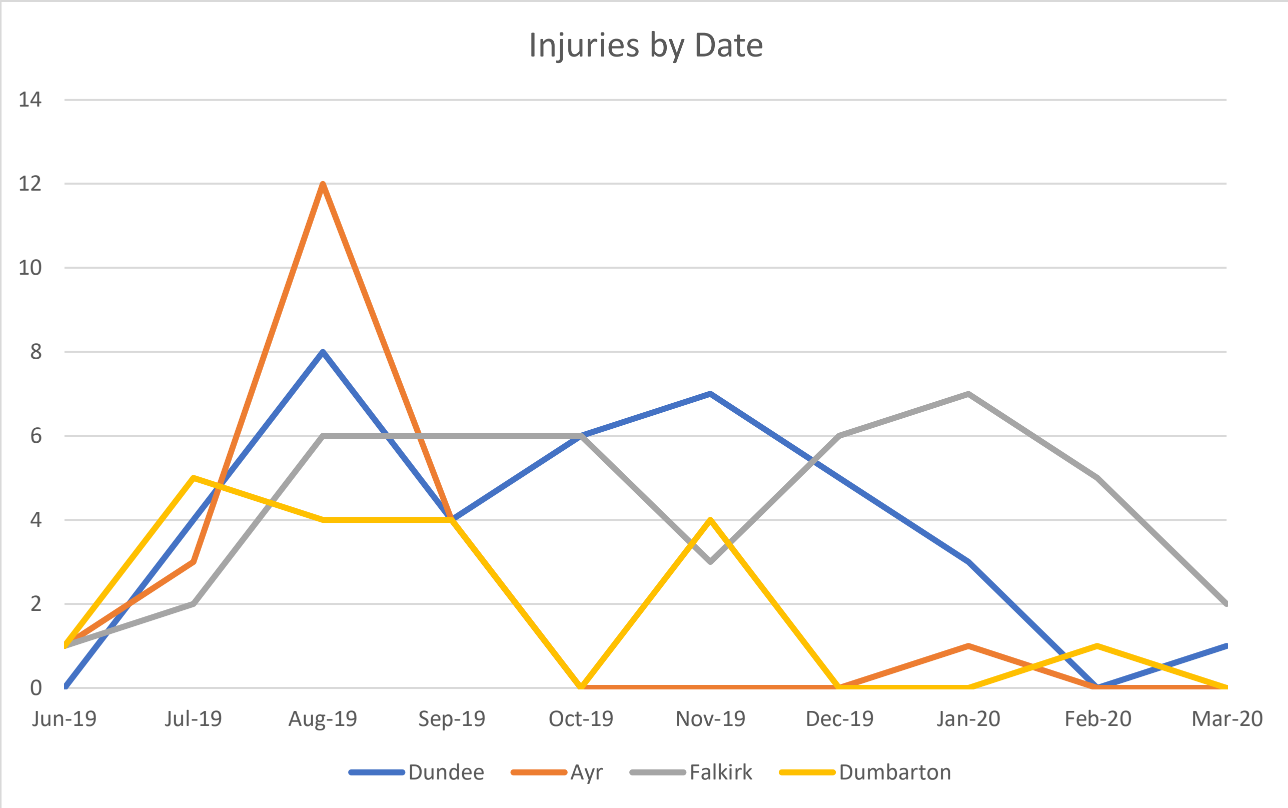


Figure 30



STAYFIT-HURT Total Injuries by Date

Figure 31



3a. Injuries According to Age

Figure 32iv

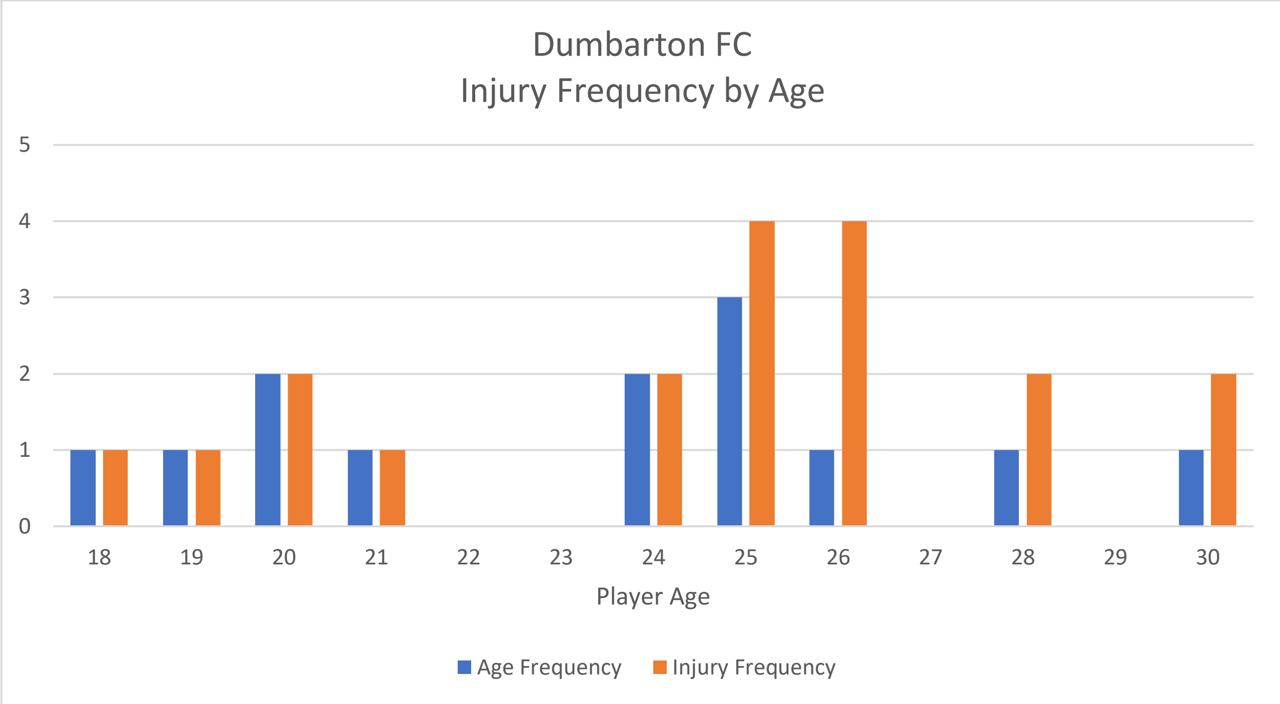
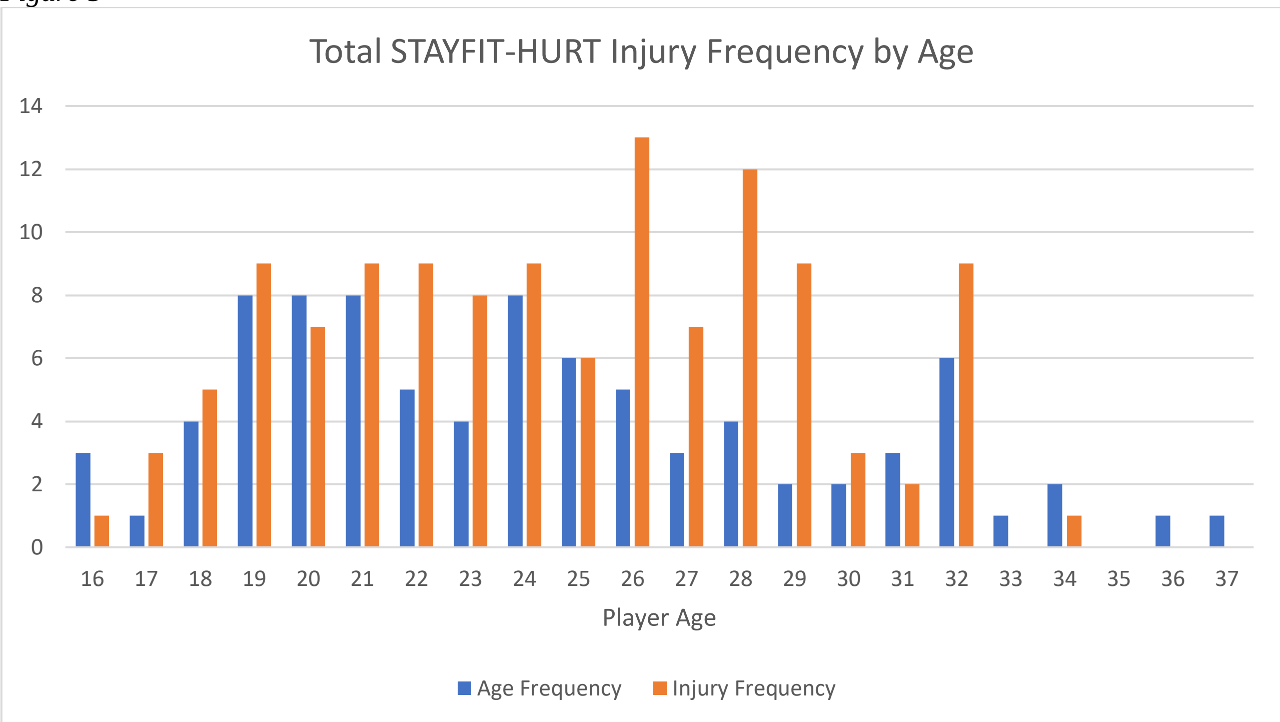


Figure 5



3b. Injuries According to Playing Position

Table Biv

Playing Position	*Number of Significant Injuries*
Goalkeeper	1
Defender	4
Midfield	11
Forward	3

Figure 33iv

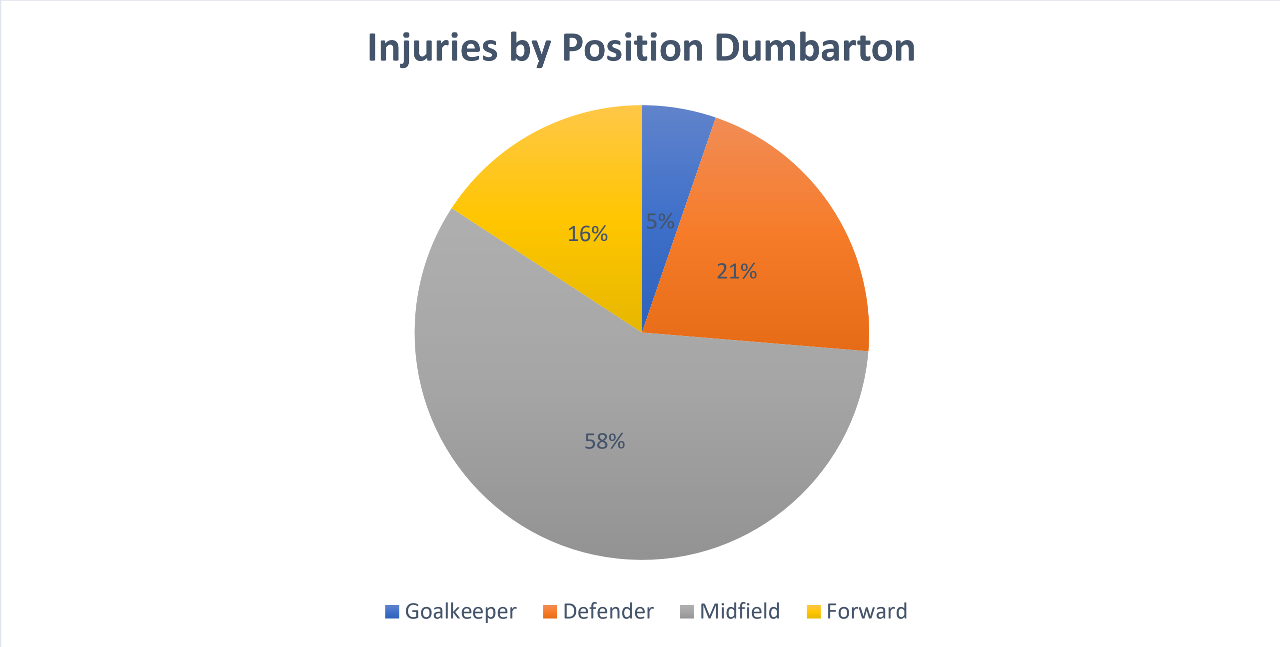
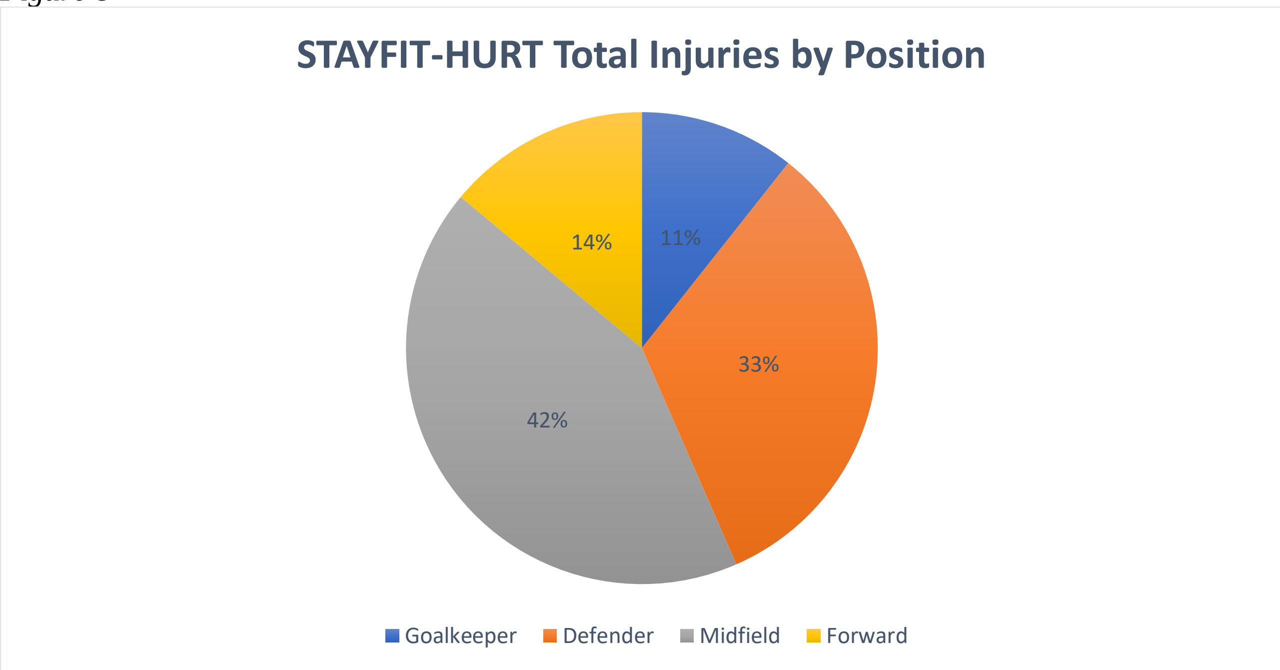


Figure 8



4. Injury Location

Table Civ

Location	*Number of Significant Injuries*
Hip/Groin	1
Thigh	3
Knee	2
Ankle	3
Head	3
Other	7

Figure 34iv

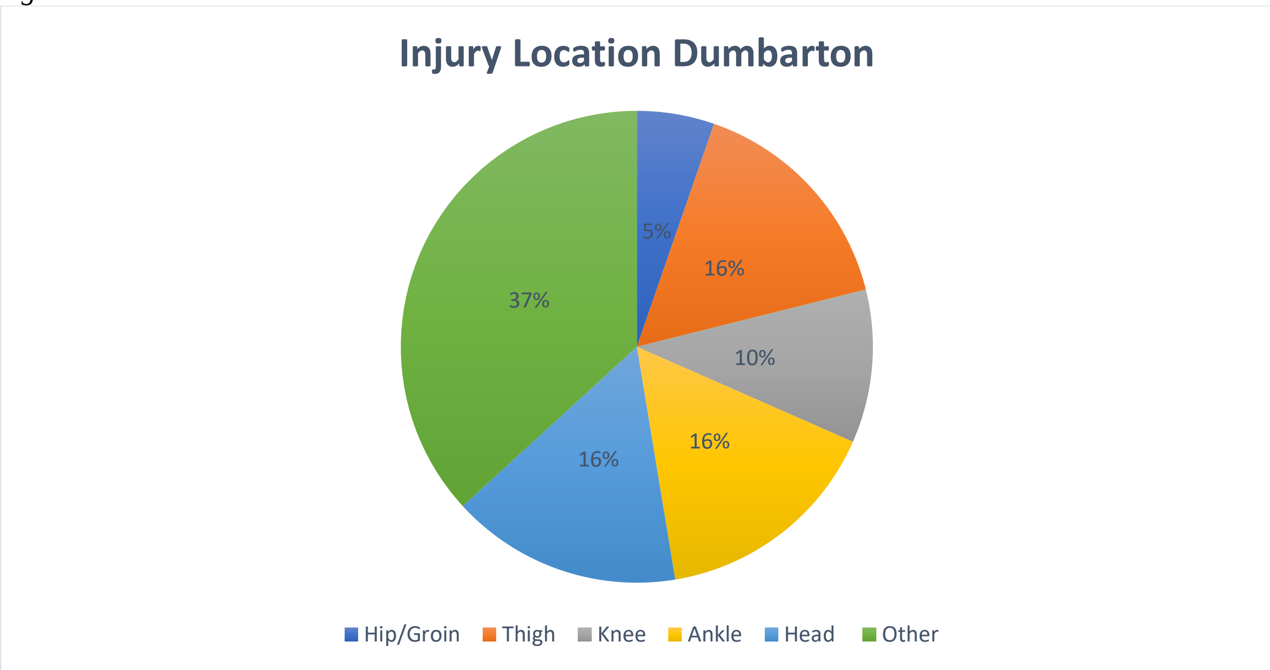
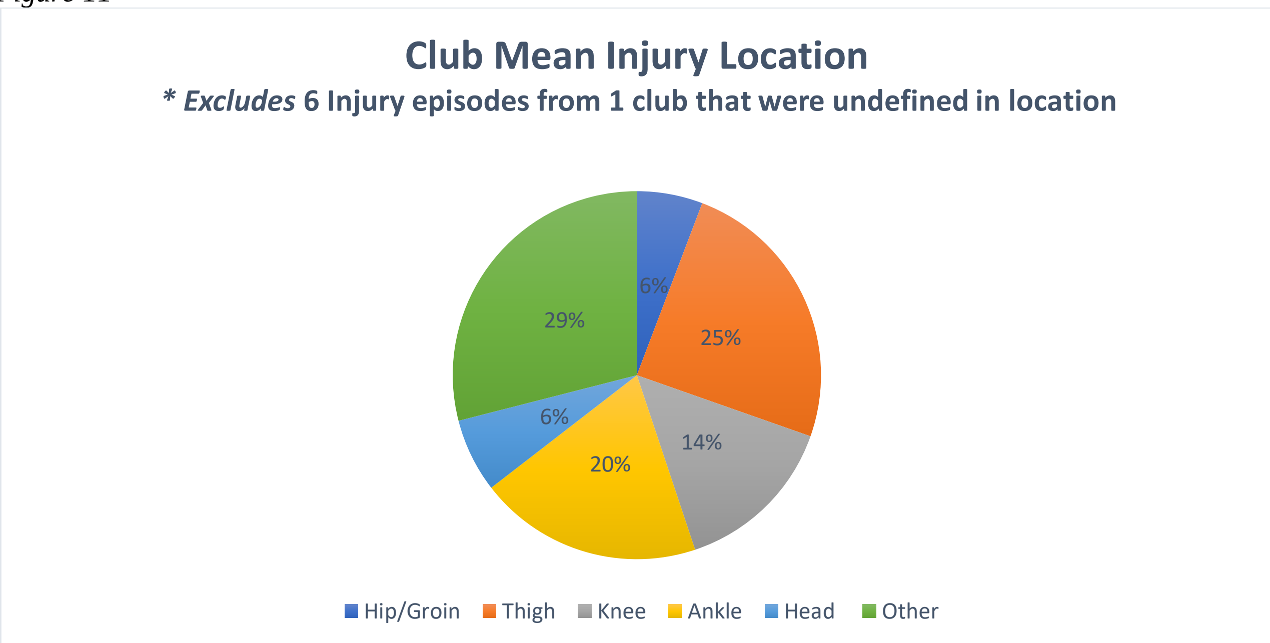


Figure 11



5a. Injury Type

Table Div

Injury Type	*Number of Significant Injuries*
Muscle Injuries	4
Ligament Injuries	5
Tendon Injuries	1
Contusion	5
Other	4

Figure 35iv

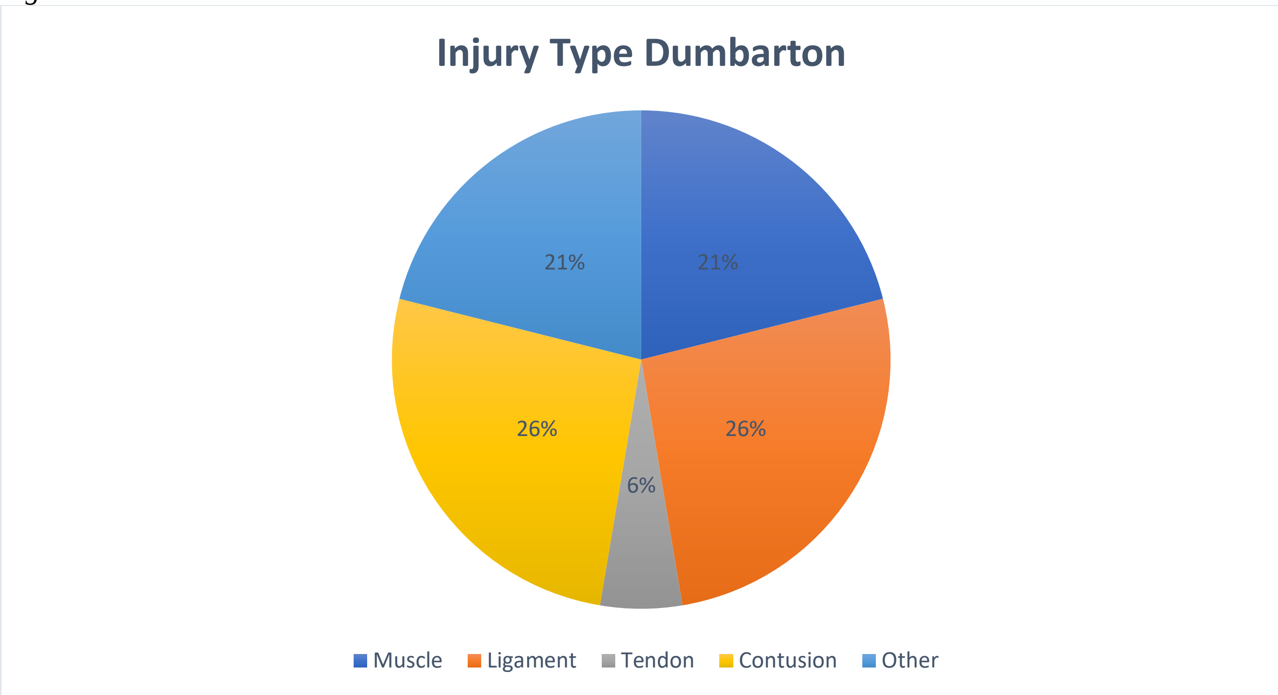
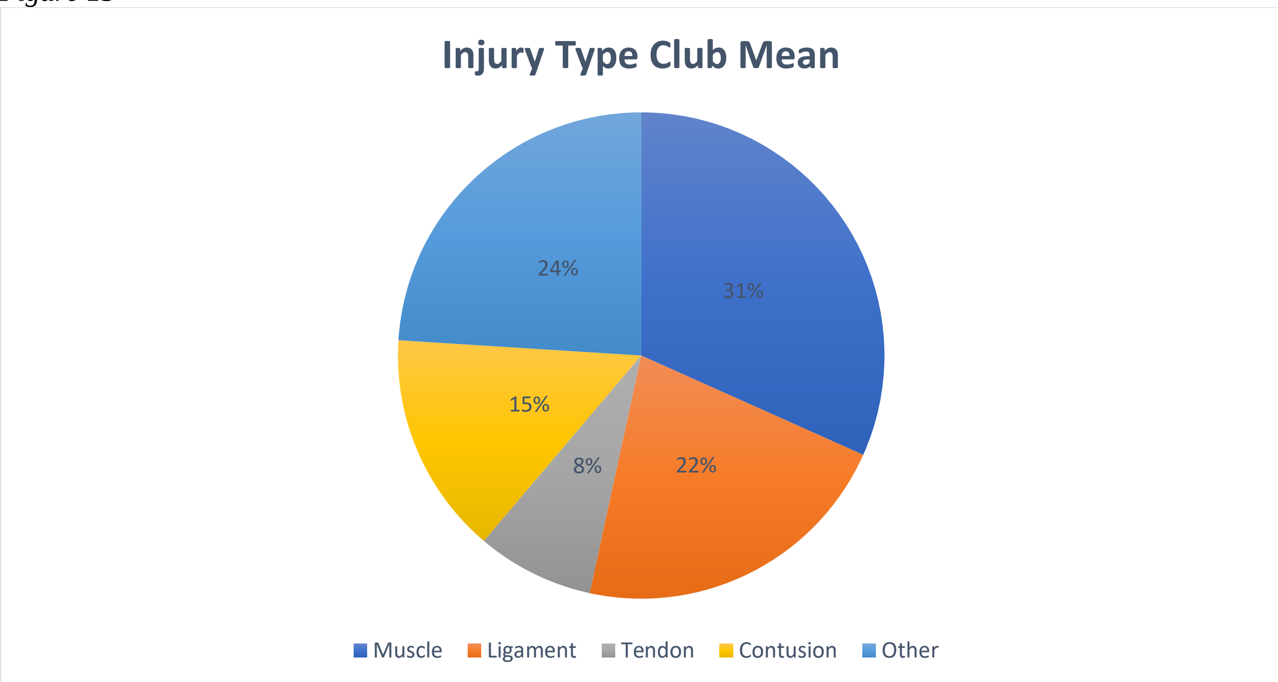


Figure 13



5b. STAYFIT-HURT Total Distribution of Muscle Injuries

Figure 36

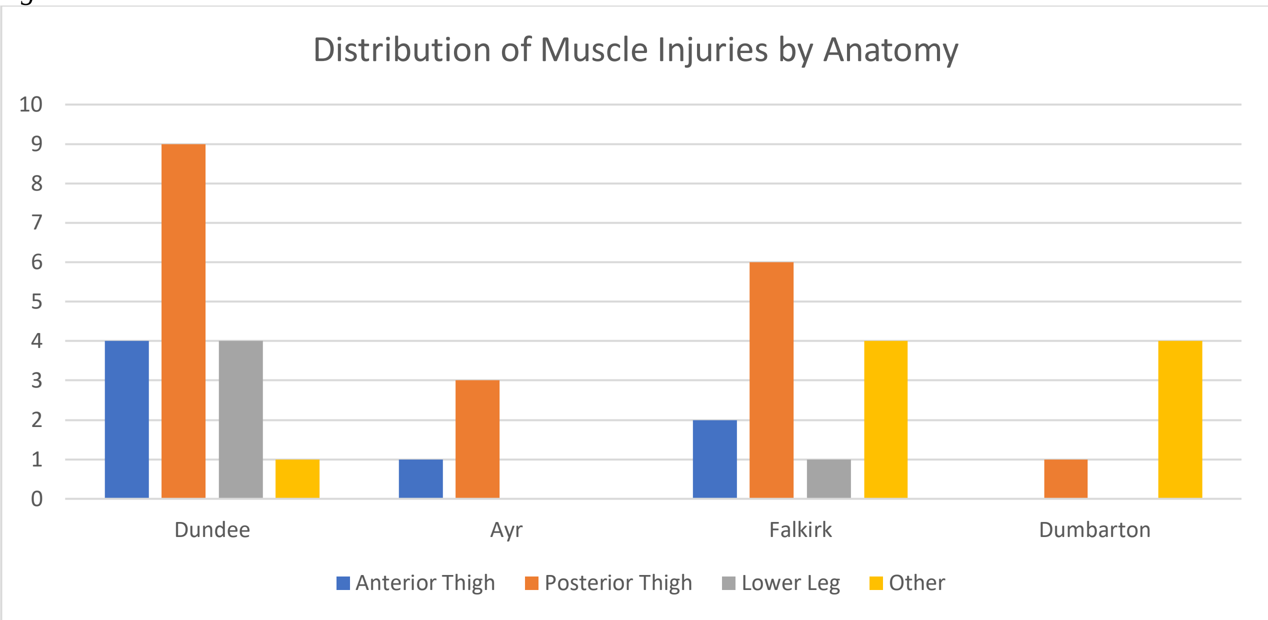
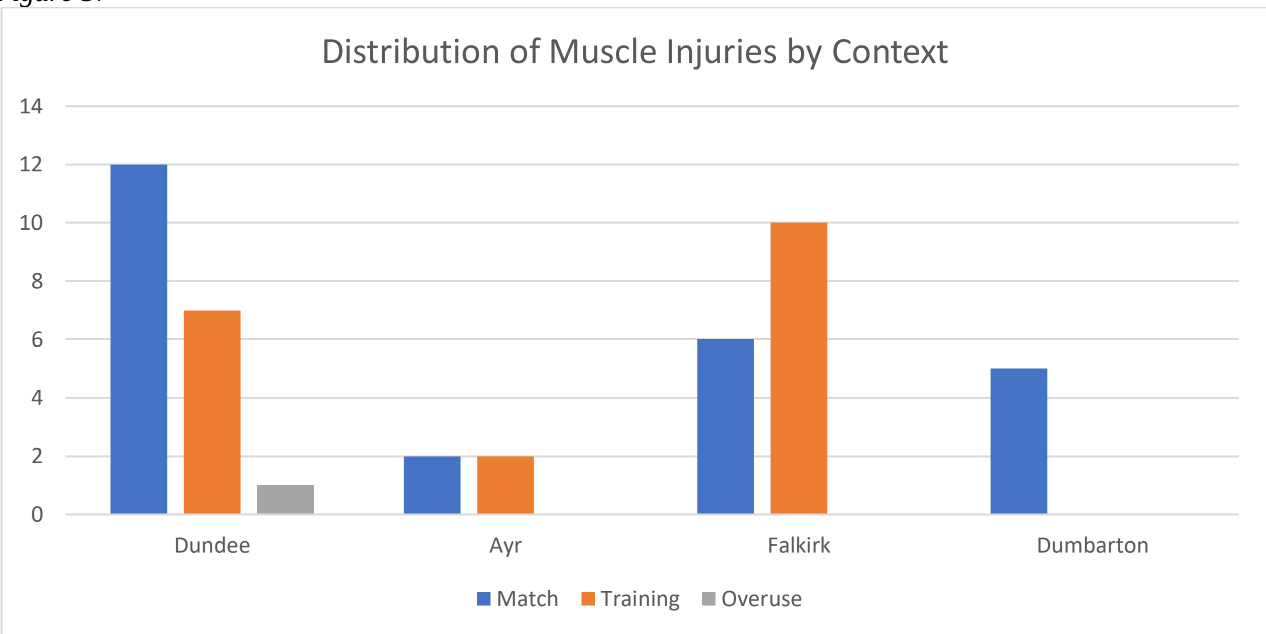


Figure 37



STAYFIT-HURT Total Distribution Ligament Injuries

Figure 38

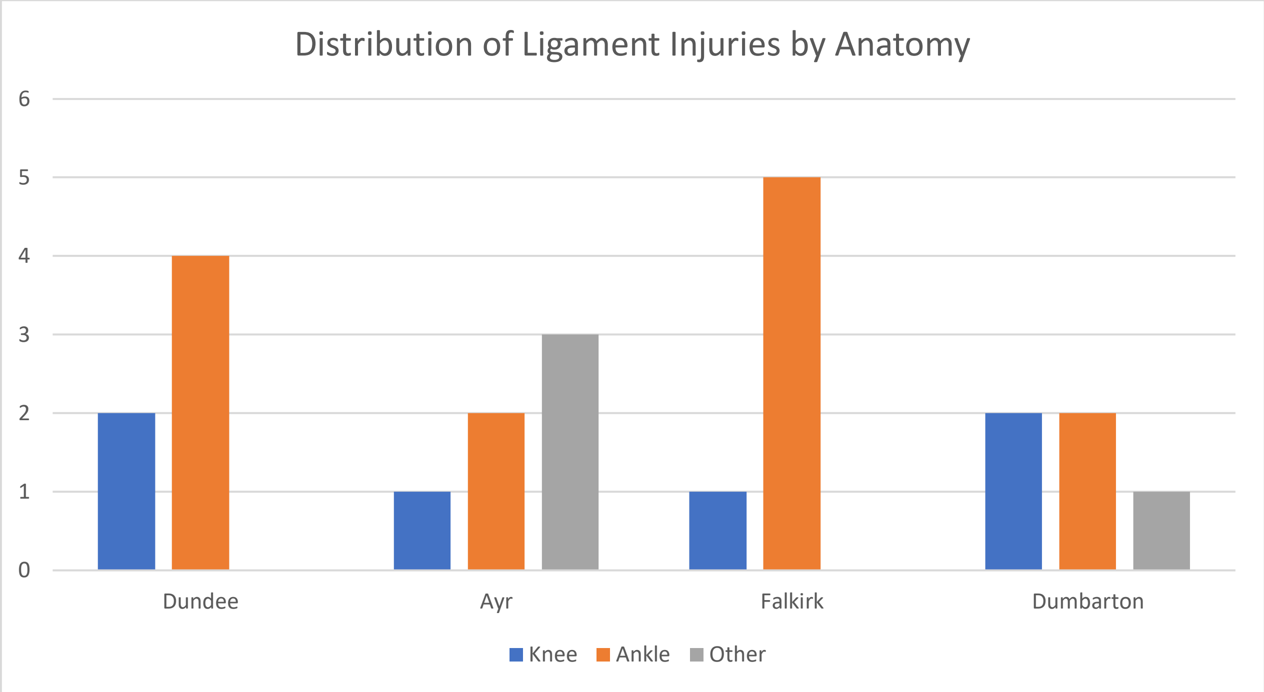
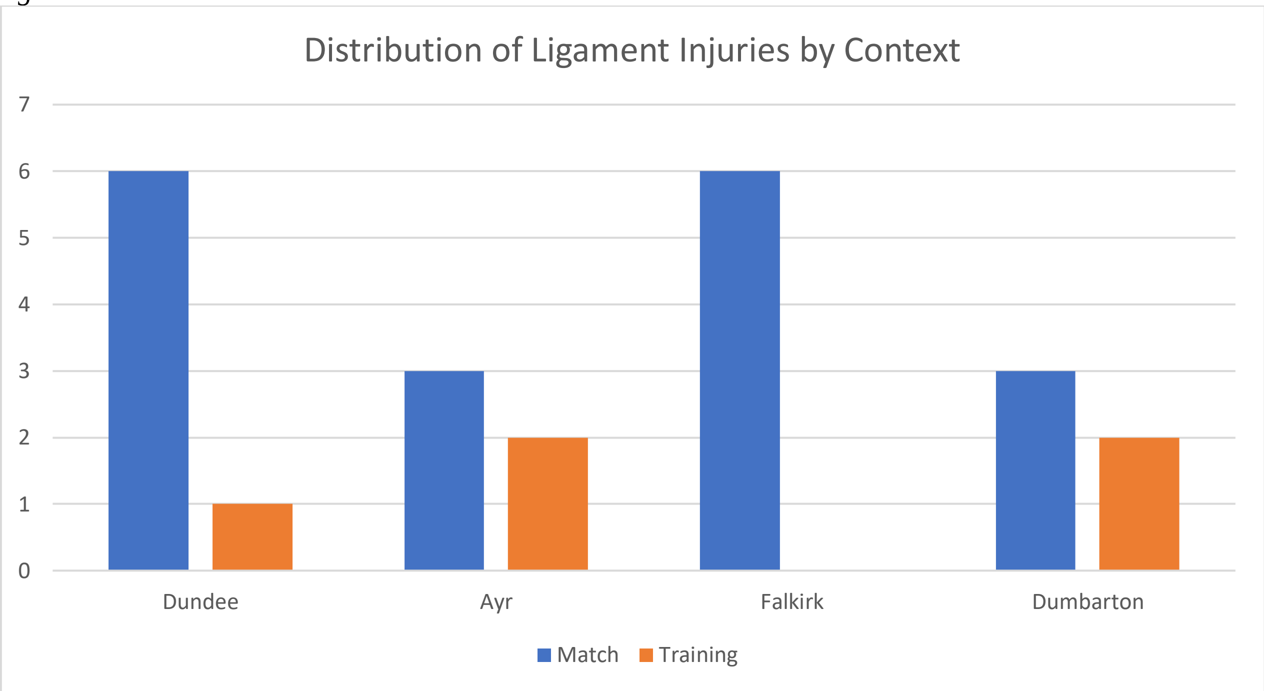
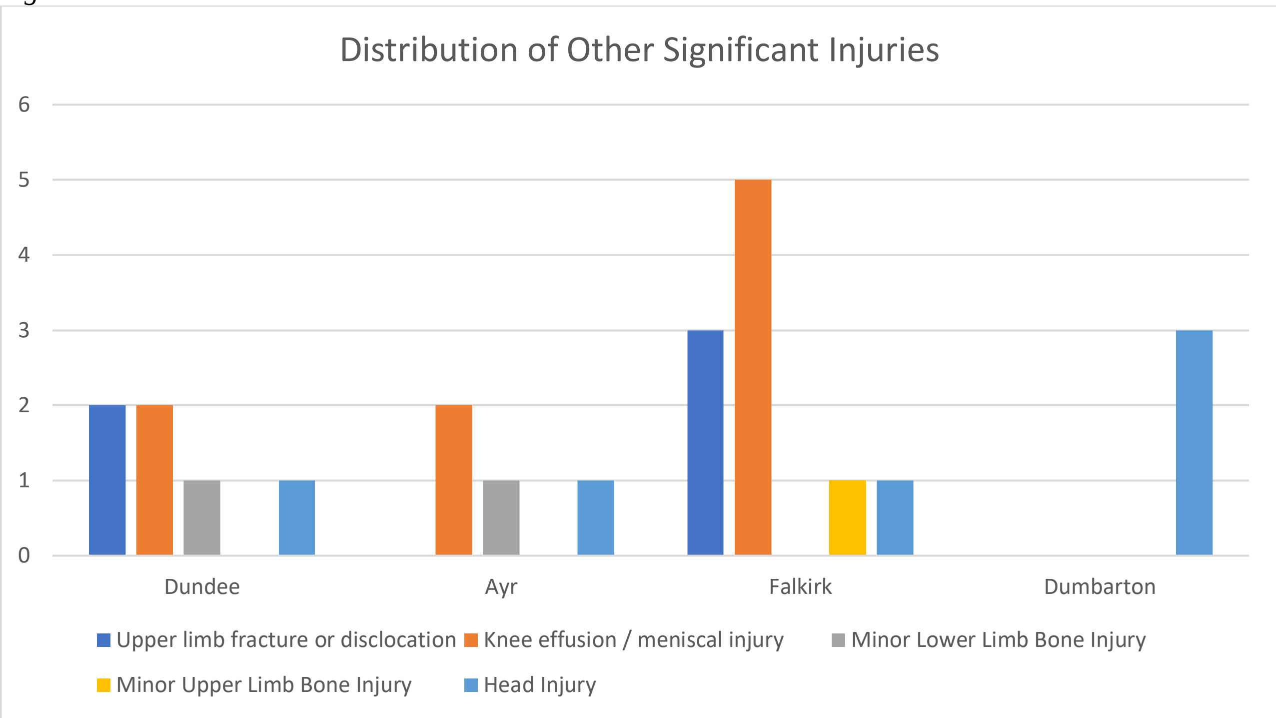


Figure 39



<ins>**STAYFIT-HURT Total Distribution of Other Significant Injuries**</ins>

Figure 40



6a. Injury Context – Match vs Training

Table Eiv

Context	*Number of Significant injuries*
Match	15
Training	4
Overuse/Breakdown	0
Other Context	0

Figure 41iv

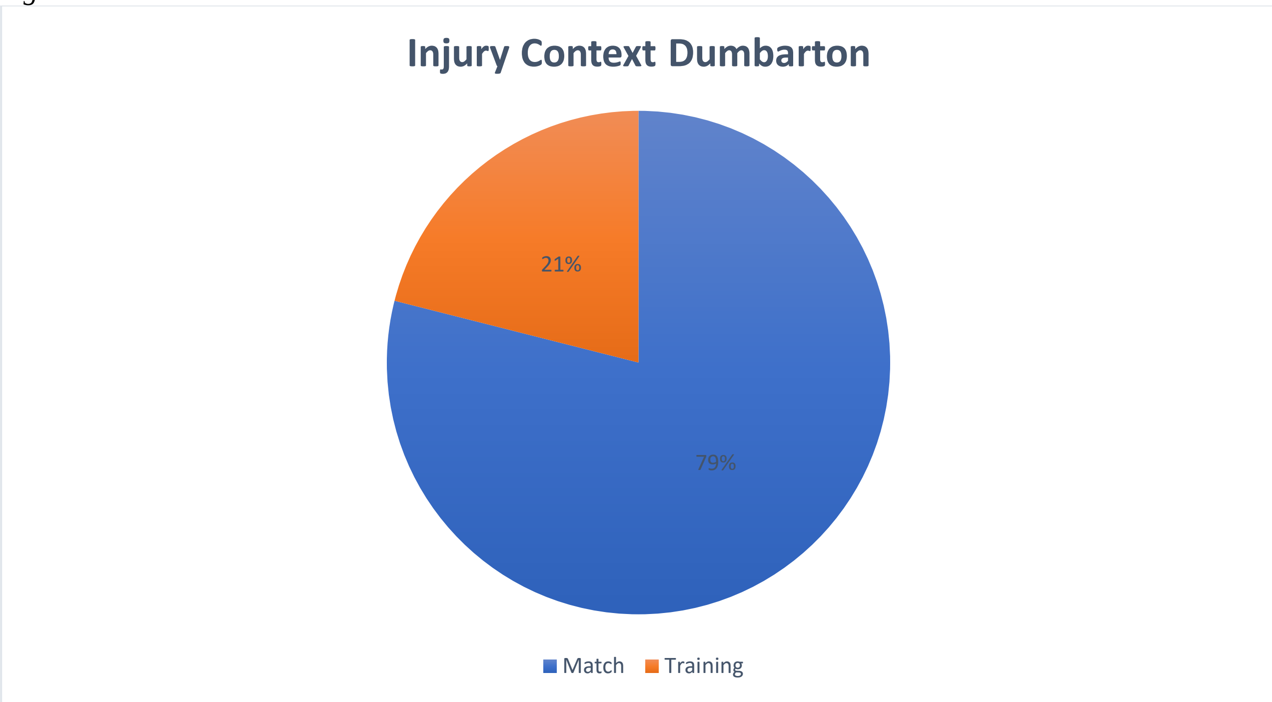
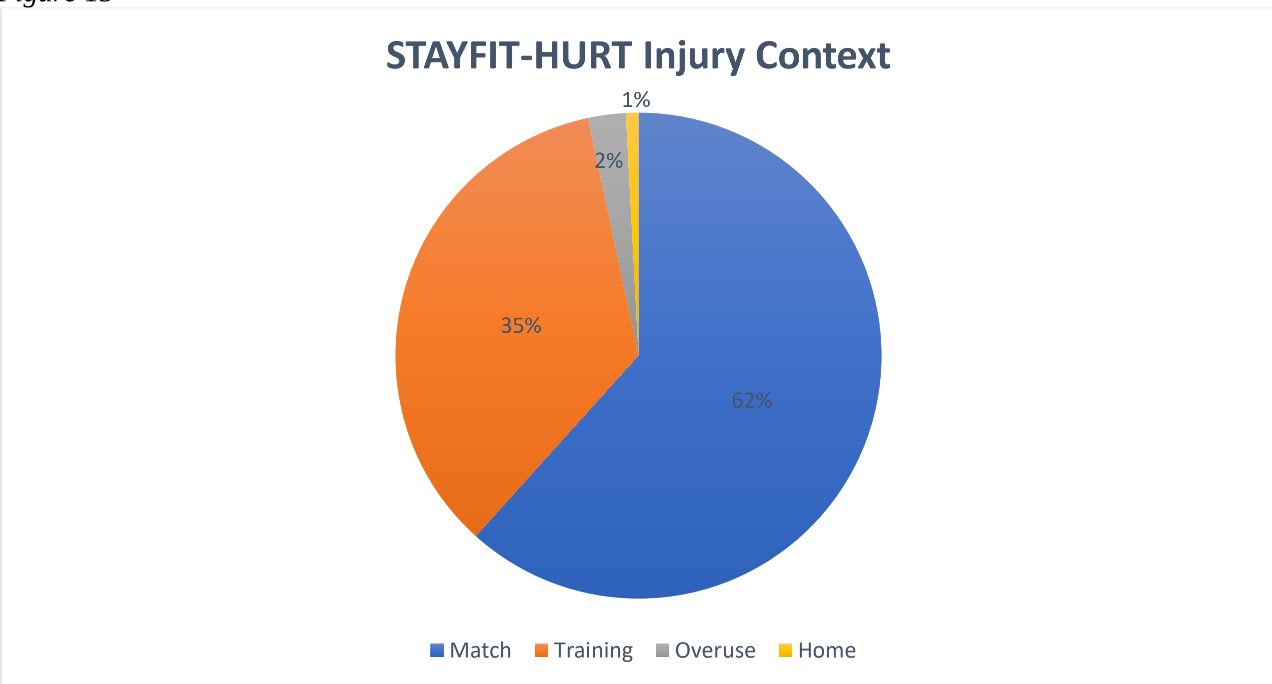


Figure 15



(alternative) Injuries in Training vs During Match

Figure 42iv

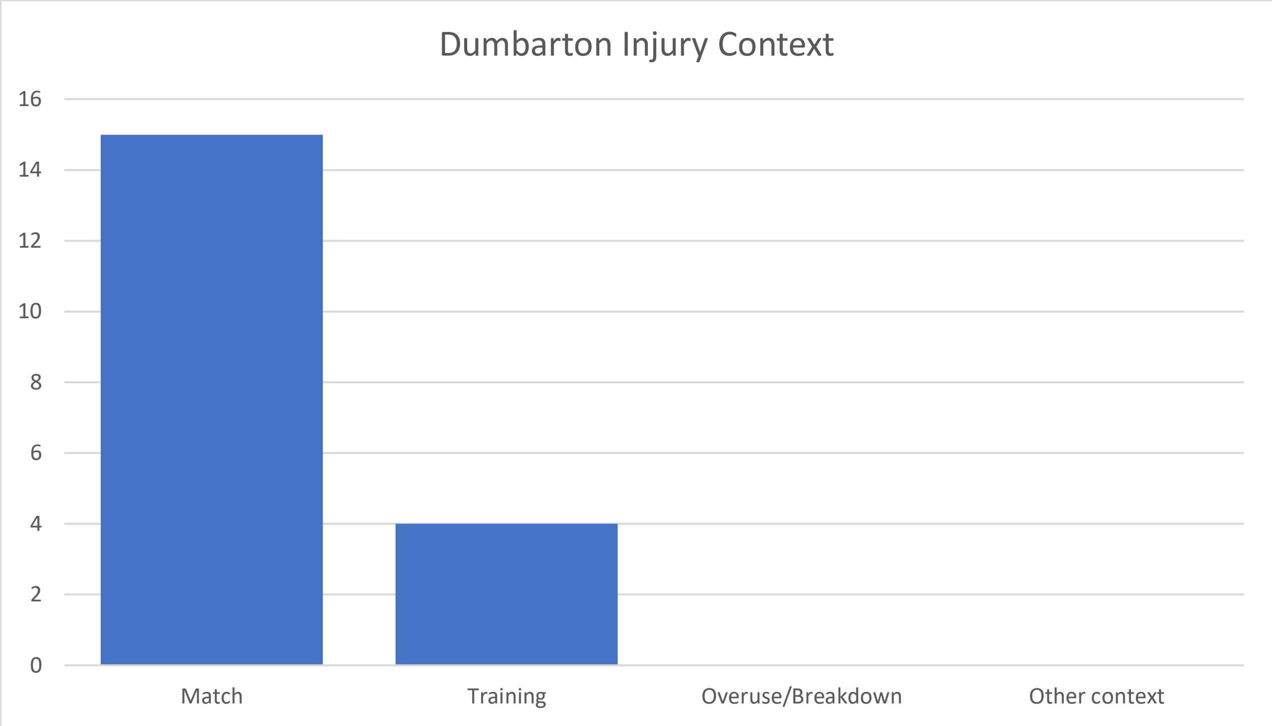
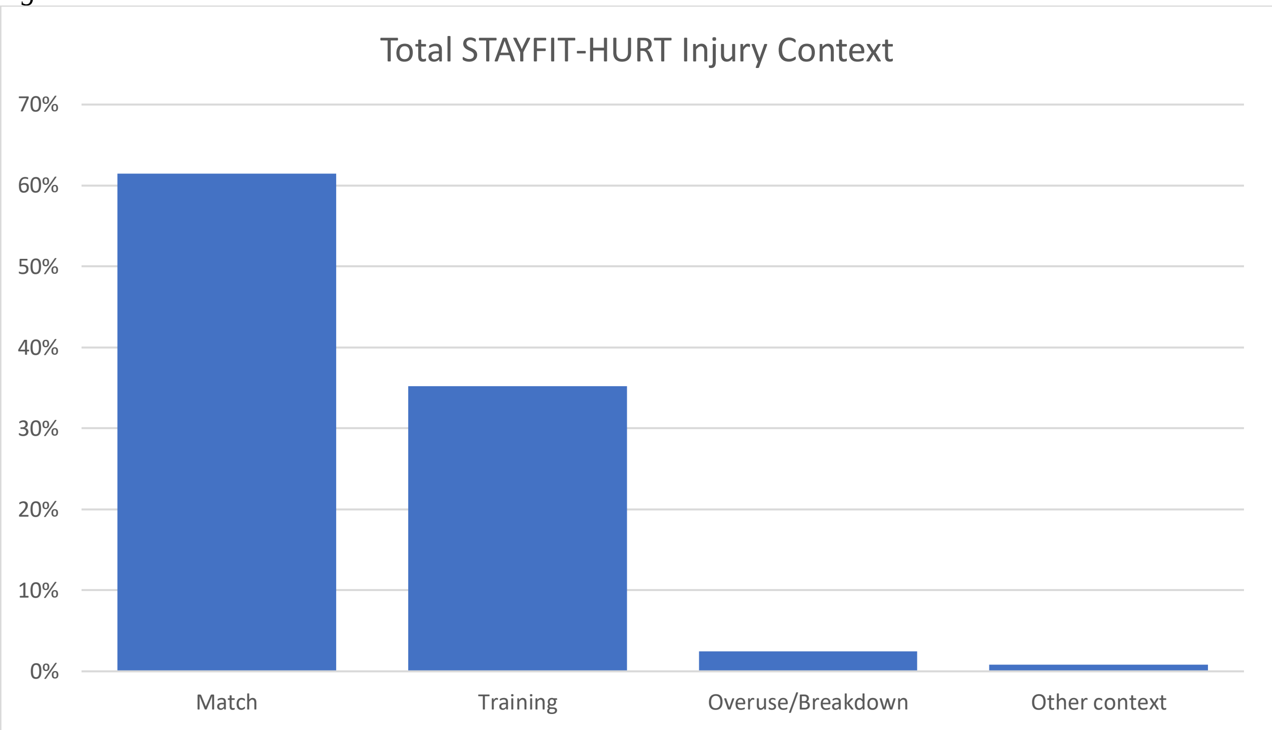


Figure 14



6b. Injury Context – Playing Surface

Table Fiv

Playing Surface	*Number of Significant Injuries*	*Number of Competitive Matches*
Grass	19	23
Astroturf	0	12
Other	0	

Figure 43iv

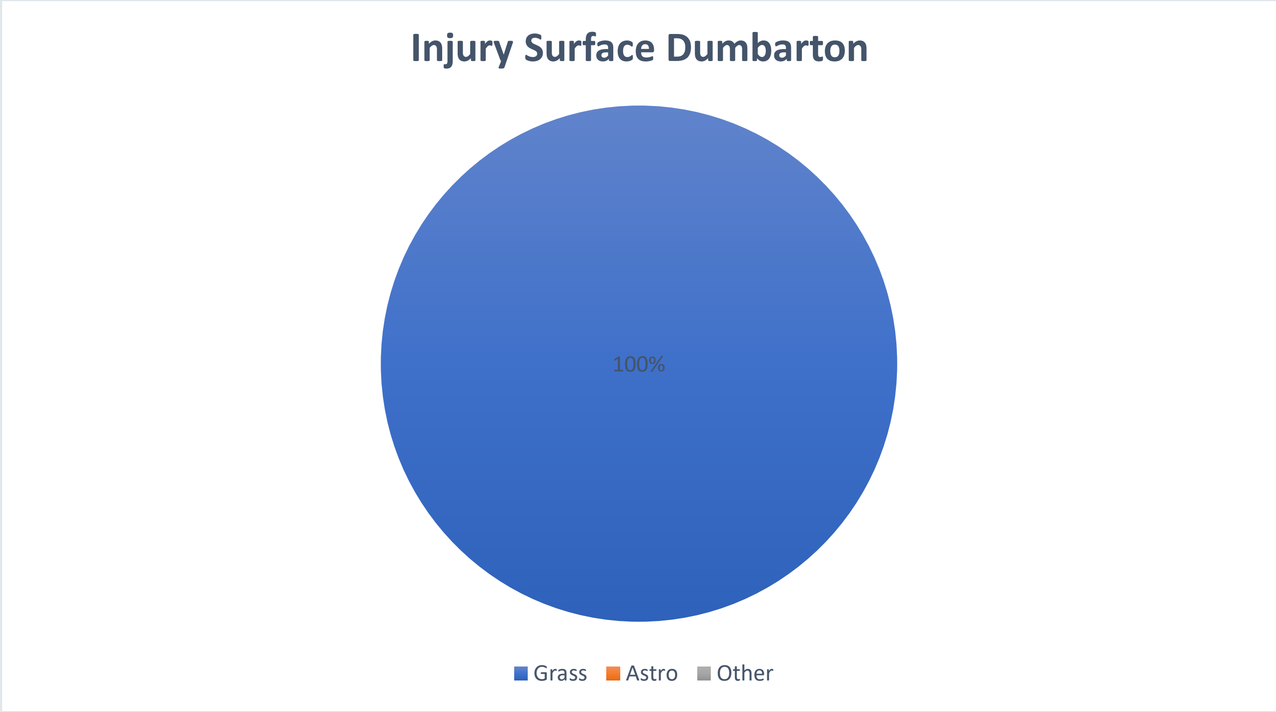
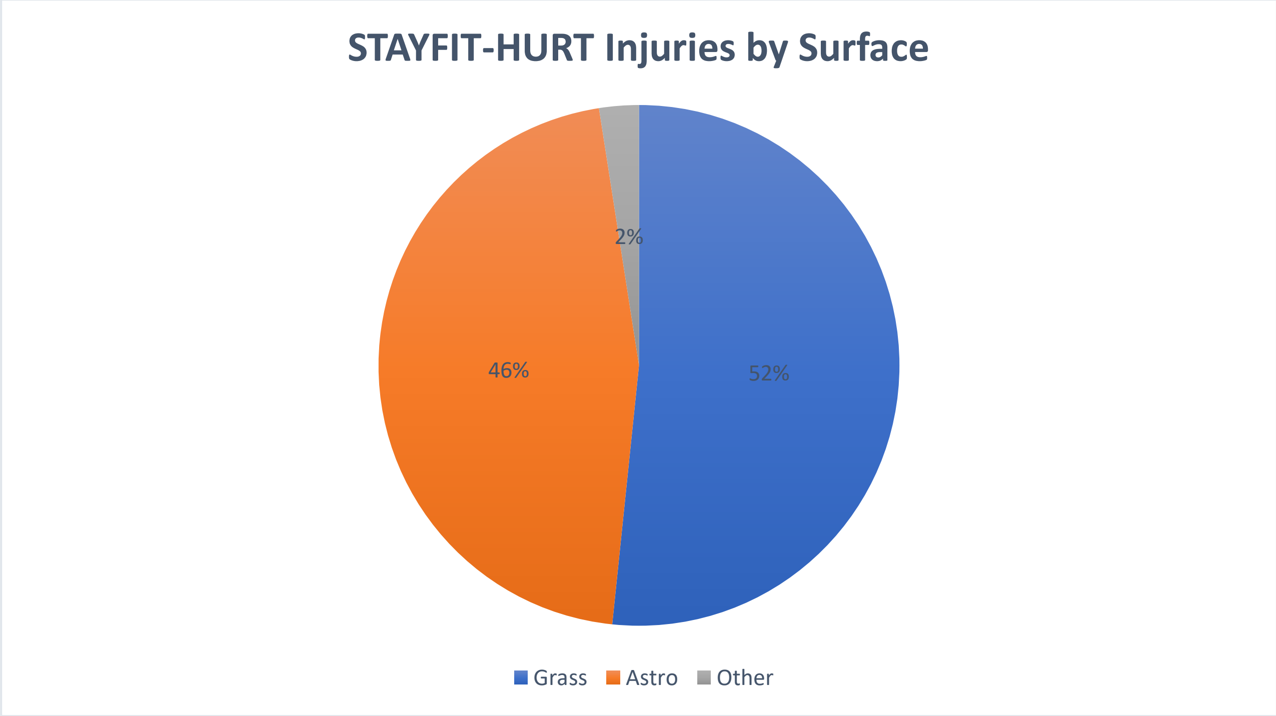


Figure 16



Chapter 5– Evaluation of STAYFIT-HURT Engagement

a. Evaluation Process

b. Interview Transcripts

c. Key Themes from Data Collection Evaluation

Chapter 5 Evaluation of STAYFIT-HURT Engagement / Data Collection

5.a. Evaluation Process

As part of the COVID-19 pandemic contingency plan conceived by the STAYFIT-HURT research group and in response to the surfacing themes of poor engagement, it was decided at the end of the 2019/20 SPFL season that some evaluation of method and the ScribePro® app was a key development to support planning in a future similar study or surveillance project. The method employed for this is explained in section 2.i.b. As described in Chapter 2 the specific questions asked were:

- 'What advantages and disadvantages do you envisage from having a standardised medical records system in Scottish Football?'
- 'What system have you previously used?'
- 'What were the barriers to using the App?'
- 'What may be the key developments for the App that would improve experience?'
- 'If you have decided to use an alternative system, please describe what the key reasons for this are'

The key responses from the evaluation discussions follow in the format of important quotations from each question by each interviewee. The key themes are then explored:

5.b. Interview Transcripts

<u>*1. What advantages and disadvantages do you envisage from having a standardised medical records system in Scottish Football?*</u>

Doctor 1 –

(Advantages)

'Easy accessibility to player records especially if we are away from home or traveling around the country'

'The standardised format or using an app that's similar in the different clubs makes things far easier in term of what it stores, how to find information and how to input information'

'I've certainly had experience of linking up between both club and international teams and there's no doubt that the crossover and knowing how the app works is very beneficial'

'In terms of looking at data, obviously projects and research and clinicians from different clubs being able to record in similar fashion'

'Biggest positive for me in terms of access is obviously accessibility and having access to various bits of information and various records around the country'

(Disadvantages)

'Human factors, in terms of relying on people actually inputting the data'.

'Inputting data on a phone - I quite like to have a slightly bigger keyboard so I can be documenting something a bit more efficiently although an app on a phone sometimes convenient'

'Accessibility and safety is imperative – there may be risks of people accessing that if someone leaves a phone lying around'

Physio 1 –

(Advantages)

'I think it makes everything so much simpler, more transparent player moves between clubs.'

'It makes it easier to access or transfer their documents in standardised format and means less need for paper copies of notes which can go missing.'

'It keeps everything in one place within a club and I think it makes it easier that everyone has access.'

'Even part time staff, who aren't on the premises, can stay up to date or doctors aren't on the premises every day can add to or stay up to date with player progress'

(Disadvantages)

None

Doctor 2 –

(Advantages)

'I think it works well, I think if it can be transferrable as well'

'I think it's nice to have all the data in your hand on a phone.'

'It's nice to have a standardised set of questions and a set of input data areas that you can then put the injuries, the medication and the treatments they've had'

'All doctors or physios across Scotland would we'd be entering the data in a standard form, which hopefully could be transferable with the player as they move from club to club.'

'I think it's it helps to integrate and share data if it's all standardised.'

(Disadvantages)

None

Doctor 3 –

(Advantages)

'The advantages are clear when the players move between clubs, because at the moment we don't have any and sort of follow up or follow on from that. And I suppose that's mainly to our advantage as the medical team.'

'Continuity of care and making sure that we are all well aware of previous a history, then that's a great advantage.'

'Having all of the physios and doctors used to looking at sharing would be quite useful, particularly on match days. We could discuss cases with each other and everyone's used to the same format as well.'

'So I think it would help a just general usage when we're when we're dealing with our colleagues across Scottish football.'

'One of the problems we've had in recent years is the doctor and the physio being quite separate, not having them easily accessible when they were all paper-based, (advantageous) to have them joined in the same file.'

(Disadvantages)

‘It may not necessarily be to the player's advantage. They may not want to disclose previous injuries or certain things.’

Physio 2 -

‘I think it's great that we can fit in each other's notes.’

‘(the doctor) could look at my notes, see when I'm on a mobile device and we don't have to be at the club or in the office to do that.’

‘It was great just to stay up to date with all the data’

‘Great advantage to be portable on a mobile device’

(Disadvantages)

None

2. What have you previously used?

Doctor 1

Paper notes

Physio 1

Paper notes

Doctor 2

'Microsoft word template that I would populate after the game, I would take contemporaneous notes, and then when I when I got home, I would transcribe those on to a word template, which was then secured electronically and that kind of database which was encrypted. So fairly safe but inefficient.'

Doctor 3

'Paper notes and filing cabinets, because we still have that here so we can then file documents and we still sometimes use that for certain entries.'
'We have tried various things, including physio spreadsheets, and Dropbox.'

Physio 2

'I just used a Word system developed for the company that supplies (the club). I basically used templates and ideas from some other colleagues.'

3. What were the barriers to using the App?

Doctor 1 –

‘I think the clubs, and especially if it's something that they're looking to link in various formats’

‘To get information that you want in terms of linking in with other systems that clubs will use, for example it doesn't have that tie-in to some of the screening or the sports science data.’

‘At the moment it certainly would be more doctor / physiotherapists-orientated but some clubs would probably want there to be standardised and in the same format’

Physio 1 –

‘From a physiotherapy point of view, the way that we recorded the information wasn't as straightforward as it could have been.’

‘As the development of the app went on, all the new updates made things a lot more streamlined and easier to input information.’

‘Initial barriers were just ease of use and technology problems such as phone access on my device’

Doctor 2 –

‘One of the things was getting the players to actually input all the demographic data, for example, didn’t know who their GP practice was’

‘I think everything else seemed to work quite well within the app, getting them sometimes just to sign that the bit where they had to sign their signature, which was sometimes difficult.’

‘It would be nice, I suppose, if you could just say verbal consent and you could just take it.’

‘Sometimes it was difficult to fill in all the (mandatory) fields.’

Doctor 3 –

‘I suppose it is quite specific, a lot of the things that needed to be filled in. We often need a bit of space for free text’

‘I suppose different consultations can go in all sorts of different directions, much like general practice, particularly in mental health’

‘Sometimes when I am even doing injections for people, just knowing where to record all of that’

‘A lot of it was very good and very organised in lay-out, but having a little bit more freedom to put in just what we would normally put in medical notes would be good.’

Physio 2 –

(no significant barriers)

‘I just feel like everything was there.’

‘It's just really, really adaptable and really easy go on and understand.’

(when entering data) ‘It’s easy for somebody else to follow this.’

4. What may be the key developments for the App that would improve experience?

Doctor 1 –

‘It would be that ability to input on another kind of platform whether it was online or on your laptop, just in terms of the feeling like I'm writing notes or read a bit more clearly.’

‘I suppose storing some of the other information such as paper copies of results somewhere. I just think makes it a little bit clearer and easier to see.’

Physio 1 –

‘I would have quite liked a desktop access. It was great having a portable, you know, an iPhone or tablet, just easy to sit on a bus, you can have a look at things and can input things. But sometimes you have to use a screen and a keyboard.’

‘In addition, I think there's a couple of things that I mentioned before about the way that we would improve physiotherapy entries such as having to re-enter a few new episodes for the re-occurrence of injuries and things. That started to streamline as well with development.’

Doctor 2 –

‘I think making it a bit simpler’

‘I think it was nice to kind of capture the data it made you think about when did this actually happen? So you had to record the time, you know, the mechanism of the injury. It was nice the way it was structured. But actually, in a busy dressing room where there's about three or four different players waiting to be seen, maybe just simplifying the data collection part of it.’

‘Some kind of head injury assessment I felt for me would have been nice, for example, to have the questions that we ask after a concussion, or maybe take a picture of the (assessment) form and upload it to the app.’

‘The players would ask about certain drugs and for drugs that have been taken for other things, and they wanted to make sure that it was safe. It would be nice to have those drugs on your phone, which potentially could be updated regularly as more and more drugs come on and off.’

‘The GPs probably don't have any insights on what's going on, so having some system which unifies all of that and feeds back into the GPs records’

Doctor 3 –

'An area for results of Echos or scans. I'm doing ultrasound here as well, so maybe having a bit that I could put in my own scans, a bit separate from the official reports. This would be useful for injection therapies as well, and even vaccinations. It might be nice to have that in a separate zone if possible.'

Physio 2 –

'I think images of mechanics such as range of movement would help me as well, because I can't really view them. I'm having to store them on another device like a laptop for the guys' rehab programs.'

'I suppose then put scouting reports in the app.'

5. If you have decided to use an alternative system, please describe what the key reasons for this are

Doctor 1 –

'My recent experience is of Sports Office. I think it's that all the data can be kept in the same place. It's accessible from a medical physiotherapy side but also scheduling can be put in, sports science can use it as well with analytics and results. So I think it is the bringing together of the multiple different parts of the team is why clubs use other formats at the moment.'

Physio 1 –

'Kitman. It's very easy to use, very straightforward. That's quite customizable as well. So you're not limited to what's already there, you can add in variables. You can update the types of injuries and you can just type as if you're writing on a paper, which I find very handy to do. And it also links with other data systems like GPS systems and things as well, which just brings everything together.'

Doctor 2 –

It's always been making notes and transcribing them. I'm not aware of any other system, to be honest. I haven't used any. This was the first all-in-one system that I've used for making notes.

Doctor 3 -.

(Still using ScribePro)

'Also I'm using Skype and I'm just putting them in the filing cabinet as we used to do.'

Physio 2 –

(Still using ScribePro)

5.c. Key Themes from Data Collection Evaluation

This evaluation exercise has demonstrated several themes that dovetail with those identified by the STAYFIT research team at the outset of the project. The key question is the feasibility of a uniform user-friendly medical records system that can be adaptable enough to support different medical disciplines, such as physiotherapy and medicine, while being systematised enough to produce consistent and robust injury data.

Question 1 evaluated the attitudes to the idea of having a standardised medical records system in Scottish professional football. The prevailing attitudes encountered were very positive with clinicians, unprompted, identifying the same benefits that the STAYFIT research team envisaged. A key advantage that clinicians had experienced in using an app-based system was that of accessibility on a mobile device. Having portable medical records available when travelling, at away fixtures and pitch-side, ensured maximum ability to document and reference care timeously. Indeed, the standard of documentation itself was recognised as a key benefit where uniformity and structure aids clarity and third party understanding. This standardisation was introduced as a means by which high-quality practice could be driven. Both improved documentation and standardisation were seen as beneficial for doctors and physiotherapists and furthermore information sharing between disciplines was identified as having improved. It was not predicted that the data collection phase would provide a means for clinicians within a club to communicate but this was mentioned as a benefit, with part-time staff and full-time staff at the same club having more regular contact about their player management.

Information sharing within a club was not the only benefit identified. Clinicians also described the potential for improved integration between clubs, particularly at the point of player transfer, providing safety for player and clinician while maximising continuity of care. Clinicians bemoaned the lack of transparency at the time of player transfer for a number of reasons and felt a system that made these medical records available from previous club to new would be tremendously beneficial, although not necessarily to the player. A further nuance in information sharing that had not been anticipated was that of cross-over into international football. Most clinicians working with Scottish international teams will also have a club role and this was raised a key benefit for one clinician interviewed who used the app in both settings. A further key discussion point raised was that of a research benefit and an understanding of clinicians of the need to drive standards with robust research.

There were a few aspects that were identified as both positive and negative, and in keeping with a core of the project, these surround data access and security. It was identified that in many instances a large stable base of encrypted data stored on a protected mobile device would be much more safe and secure compared to historical paper notes or written computer files. Although the opposite view offered was that if this data was accessed illegally on that device, the potential data breach would be much larger. Similarly, access to this data by those supposed to be creating and using it would be much improved; but the potential nefarious data access would much larger.

Other potential disadvantages that were identified included issues surrounding data input variability and attitudes, discussed as human factors. Although not explored in depth, this ties in with attitudes in player care in Scottish football, recognised as problematic by the research participant. Certainly, this inconsistency in data entry was a key problem for the research project and would be mirrored in any future standardised medical records system. Another disadvantage mentioned was player resistance, particularly at the point of transfer to a new club or contract renewal, when it may not be in the individual's interests for all their previous records to be available to an assessing clinician employed by a prospective new club. This player viewpoint merits further exploration in the discussion section.

Question 2 evaluated the previous systems used and baseline practice before the STAYFIT project. There was no uniformity to this, and most clinicians were still reliant on creating paper records, whether later transcribed to electronic documents or not. In NHS work or private clinics paper records are consigned to archive and seen as neither appropriate nor safe for most medical care, particularly since GDPR legislation. Some participants also discussed using their own created spreadsheets or electronic templates as a means to standardise a record of what they were doing. It was volunteered that this was inefficient and not ideal but showed a recognition that records needed to move on from 'paper notes and filing cabinets.' The clinicians interviewed were not yet working at the wealthiest few clubs in the country during the 2019-20 season, although interestingly by the time of this evaluation some were. These clubs had not engaged in the project at the outset, forming a further discussion point later, therefore it was unsurprising that none of these clinicians had been previously using costly existing bespoke sports medical records systems.

Question 3 evaluated the perceived problems and barriers experienced during the STAYFIT study and the participants referenced the future issues beyond the study. One of those barriers was in the clubs themselves with one respondent suggesting clubs may have prioritised systems that link to other disciplines such as sport science, this tie-in with sport science emerging as a key oversight that future research would need to recognise. Clinicians clearly felt that access on devices such laptop computers was a further barrier, this being a mainstay of other systems. One physiotherapist gave an insightful response regarding the different ways that physiotherapists and doctors tend to document findings, and this was a prioritised development early in the ScribePro® app evolution. Technological issues early in the season were also acknowledged, particularly early in the season when login procedures were being improved.

GDPR and consent issues meant the ScribePro® app was developed with a detailed electronic consent procedure and privacy notice for players about whom personal and special categories data would be stored. This was an absolute requirement, and a further feature was built into each injury episode that sought a player and clinician signature at the time of return to play. This was described as a barrier for one clinician who described having to tie players down to provide demographic data and signing each resolved injury episode was challenging.

A doctor working at a part time club commented that he would like more freedom to document findings in his usual medical way, again highlighting the issue of different users or job roles having different requirements of a uniform system. This duality of purpose in the app is a critical future development, with free text entries being less useful for stable data extraction but important for useability. A very valid example to illustrate this provided by this clinician was in managing player mental health.

To follow the discussion regarding perceived barriers, question 4 evaluated the key developments that would improve the engagement. Some themes continued around access on other devices or different options for different professional roles, but there was some discrepancy observed with clinicians working at a higher level seeking more features and those at a lower level seeking simplicity. This again illustrates challenges in achieving uniformity of practise.

The suggested developments were wide-ranging, and some are already recognised as potential app developments. Two doctors discussed the need for a unified system to have an area for storing reports from third parties such as screening echocardiograms or scan results, traditionally kept as paper copies. Furthermore, one participant discussed doing their own ultrasound scans and injection therapies so an area to store these images would be useful. One of the physiotherapists described a further distinction to this being the ability to store clinical photos or videos which were relevant to monitoring players during their rehabilitation programmes. This physio also mentioned scouting reports for players, and although not elaborated, this was taken to mean aspects of their play that could influence their medical care.

Another physiotherapist generated an interesting discussion point when they discussed having to re-enter recurring injury episodes as new injuries. This is a key point of information to develop as different clinicians will describe an injury as a flare of a continuous problem versus those that might describe it as a new injury recurrence. This would be an important area in future methodology consideration.

Another of the doctors again highlighted a potential difference in desired app function for those working at a lower level of part-time football where player contact is more sporadic and likely to be more shared with an NHS GP. This doctor highlighted an option to communicate or share information with NHS primary care. He also described the useful adaptation to incorporate a standardised head injury assessment (eg. SCAT 5) in the app. He further suggested a link to other information resources such as WADA (World Anti-Doping Agency) banned substance lists. It is likely these other resources may be more available in full-time professional sport settings but incorporating them in one place would seem natural.

At the end of the evaluation discussions, question 5 sought to understand why clinicians and clubs had decided to use an alternative system to an app. Two clinicians had continued using the ScribePro® app beyond the STAYFIT-HURT study, their clubs purchasing the continued use. One of the doctors had been using simple transcribed written electronic records. One physiotherapist and one doctor had moved to football clubs at the top of the SPFL pyramid since the STAYFIT-HURT project involvement. Their insight was useful in that they were now using bespoke sports medicine records systems with some in-built analytics facility but no further specific research association. Both clinicians described the benefit of having everything in one place with a sport science tie-in with data such as GPS. The physiotherapist also described the flexibility and benefit of being customisable.

This evaluation phase was useful in developing insight and themes to discuss and support a future similar project, explored further in the following discussion.

Chapter 6 – Discussion

a. Injury Data
    i. Data Quality Review
    ii. Professional Status
    iii. Ambient Temperature
    iv. STAYFIT-HURT Team Reports and Combined Results Analysis
    iv. Matches vs Training and Playing Surface
    v. Power Calculations
b. Methodology Review and COVID-19
c. Stakeholder Engagement
d. Evaluation Phase discussion
e. The Future
    i. IOC Consensus Statement: Methods for Recording and Reporting of Epidemiological Data Professional Status
    ii. Artificial Intelligence
    iii. Further Research

Chapter 6 Discussion

The STAYFIT-HURT project was an ambitious study that was conceived and designed to investigate the feasibility of a novel medical records system providing robust data to investigate the hitherto sparsely researched area of football injuries in Scotland. As with all areas of clinical medicine, governance, clinical audit and scrutiny drive standards and must underpin any standardised guidance to practise. This kind of research base could inform player training standards, coaching practices and even the fundamental rules of the game in an emerging culture of improved player welfare considerations. This process begins with the generation of robust and significant data, and therefore so far, in Scotland at least, we have not jumped the first hurdle. The STAYFIT-HURT research team included three clinicians working with professional footballers in Scotland who recognised this need and sought to move the area forward.

6.a. Injury Data

Despite the obstacles in data collection, **the STAYFIT-HURT project demonstrated the proof of concept that an app can collect high quality injury data in professional football**, with over 120 significant injuries being reported in a population of 85 players at 4 clubs. The results section demonstrates largely descriptive data but there are some important elements to draw-out nonetheless. The data is reported to show 'significant injury episodes' but the STAYFIT-HURT project recognises that minor injuries that do not necessarily affect immediate player availability may remain underreported. Another central theme of suspected under-reporting is in training injuries, especially at lower-level clubs where clinicians may not be as available to assess and document injury episodes.

6.a.i. Data Quality Review

An overview of data quality is important before a more detailed discussion of results. The squads themselves may represent unstable data as there is a suspicion that some clinicians were only creating a player profile at the time of their first injury episode. This may make some of the demographic data unreliable and hence the team reports comment on available SPFL data on number of registered players. This could not be accurately retrospectively investigated without compromising the stipulated anonymity of injury records. However, in players who had a profile created, all had age and playing position clearly ascribed.

In the 4 clubs that produced worthwhile data for analysis, some aspects were of good quality and robust. These were injury type, anatomy involved, whether the injury was sustained during training or match and which surface was involved. This likely reflects aspects of excellent app functionality. From only 1 club was there any data regarding the duration of an injury episode and even for this club less than half of episodes had this information included. Unfortunately, the opportunity to develop information on exposure based on number of minutes playing matches and training was lost as this app function was removed by the ScribePro® team at a time when core app functionality was being prioritised, as discussed in chapter 3. It is also important in reviewing data quality to repeat that other clubs that supplied some data were excluded from analysis. In the case of one club, they asked during the season not to participate further or have data analysed, and another club's data was too incomplete and sparse to be included after they seemed to stop entering data early in the season. Reasons for this are discussed in section 4a.

The clinicians in the research group also retrospectively identified a further risk of under-reporting of injury which may in turn explain why some players are not included in created squads: the medical care of a significant injury episode occurring in a loaned player will generally be undertaken back at the parent club, especially if the club where the player is being loaned is part-time / semi-professional. It is likely that most significant injuries in these players will not be reported fully, if at all. This too is impossible to retrospectively investigate without compromising player anonymity. From another viewpoint this is an excellent advert for a transportable shared medical record for a player who could be cared for simultaneously by two separate medical teams.

One of the key planned outcomes of the study was an assessment of injury burden which is recognised as a useful marker of player availability that can be measured in hours or missed games, and hence be more easily extrapolated to financial cost by a club depending on variables such as player salary. Unfortunately, as discussed elsewhere, this is dependent on accurate documentation and data on duration of an injury episode and return to fitness to participate in training and matches. The reasons that clubs involved in the STAYFIT-HURT study did not complete this aspect of data collection will be discussed further. Similarly, exposure to risk is a key facet of injury analysis but the limit to which this could be reliably interrogated was the number of matches played by clubs. In fact, detailed freely available data exists on various websites that gives information on the number of minutes played by individual players but, again, this project stipulated player anonymity so this route for analysis was not available.

Other data points that were poorly completed by clinicians using the ScribePro® app *included contact with another player or non-contact or whether an injury was a recurrence. Injury severity data were not stable enough to use based on poor documentation of injury duration or specified return to play. The IOC Consensus Statement (71) recommends a means to judge injury severity based on specified duration so this would be a key outcome step of a future similar study.*

Another simple data observation that had been a planned focus for later analysis was the very low number of reported head injuries. The STAYFIT-HURT clinicians felt this was likely to represent under-reporting of incidents that often result in brief pitch-side assessments but no specific documentation or follow-up. Mandatory concussion assessments, clinician education and concussion substitutes are all areas of significant change that have been developed since the 2019/20 SPFL season and a future study is likely to demonstrate more of these injury episodes although there is no impression that true incidence will have changed.

6.a.ii. Professional Status

There does appear to be a basic difference in data quality and quantity received based on a brief comparison between the full-time professional clubs and the part-time semi-professional club involved in the study, although this is neither unexpected nor unreasonable. It is also evident that the type of clinician involved that is documenting data may have a bearing. Dumbarton FC, a semi-professional club with 2 or 3 evening training sessions most weeks, in addition to their match fixtures, have a much lower incidence of reported injuries. This may be due to a difference in what constitutes an injury in part-time football or could be influenced by less clinician contact and hence fewer injuries being identified. It is also very important to point out that the data from Dumbarton FC was largely compiled by the club doctor who would normally only be present on matchdays. Ayr United's data was almost exclusively from the club physiotherapist who was working full-time. Dundee FC and Falkirk FC produced data from club physiotherapists and doctors. It is evident that the number of injuries reported, the quality, and quantity of these two clubs' data is higher. Any direct comparison between club injury rates must bear this confounding factor in mind. Despite these considerations, the difference in reported injury rates at the part-time / semi-professional level does raise interesting questions including the possibility that training less and having more rest may result in fewer injuries. The results are presented with initial results to cover the population of studied players, divided into professional and semi-professional (future projects may wish to adapt this to IOC recommended nomenclature).

The simple analysis of STAYFIT-HURT professional status suggests there is no difference in injury rates across the study. This is clearly limited by there being only 14 semi-professional players registered in the project but the injury per player per season in the two groups is almost identical at 1.44 vs 1.43. An independent samples T-test comparing means produces a p-value of 0.9446 but the confidence interval includes 0 which limits any significance. Nevertheless, this outcome suggestion is in keeping with the findings of Hawkins *et al* (39). However, this English study is perhaps not directly applicable as all levels of football studied there could be considered elite. The finding is at odds with the suggestion from other studies reviewed (40,41,42) from Denmark, Sweden and the Czech Republic respectively, that suggest the level of football can be an important factor in injury rate.

6.a.iii. Ambient Temperature

A question is therefore raised about the geographical location of research subjects and the STAYFIT-HURT project sought to interrogate this more by comparing the average temperature at which injuries occurred. For example, it would be interesting to hypothesise whether more injuries occurred when playing surfaces were very hard, either in warm summer or cold winter, and hence could bring geographical weather conditions under consideration. Clearly, there are multiple confounding parameters which could have a parallel influence such as time of season, density of playing time (exposure) or quality of playing surface, but there was very little previous research that looked at ambient temperature as a factor.

The frequency of injury by temperature is demonstrated in *figure 3* bar chart in temperature ranges. The results show the highest frequency of injury in a temperature range between 12°C and 17°C with relatively few injuries at the extremes of temperature. Clearly to interrogate this further would be to compare this to the frequency of matches or training being conducted in the various temperature ranges but there is too little injury data to make this valid. However, it is worth noting that there were relatively few matches or training sessions undertaken in the lowest temperature bracket, between -3°C and 2°C. 6 recorded injury episodes in this temperature bracket, 4.92% of the total 122 injuries, would appear disproportionately high. The most valid aspect of these results is simply to demonstrate that it can be done in a future similar study and may be an important variable to investigate in injury patterns with a potentially significant impact on optimising player welfare.

The impact of the results in professional status and ambient temperature is limited by the amount of data received; the research team having anticipated a much larger sample size to work from. The SPFL season 2019/20 included neither especially high summer matchday temperatures, nor especially cold winter matchday temperatures by Scotland averages; and the season was terminated in March, cutting out a potential late season temperature peak. In a future project it would be very important to consider that in the UK men's professional football, pre-season and late season are undertaken in summer when temperatures are higher, but also injury rates at the start and finish of a season could be influenced by lack of conditioning or cumulative exposure throughout a season. It is also interesting that there is often significant fixture congestion in mid-winter in the English Professional Football Leagues whereas the Scottish Premier League (top league in Scotland) has introduced a 2-week winter break. It would be an interesting, and arguably necessary, future project for governing bodies to assess whether this break has a scientifically significant impact on injury rates or player welfare.

A further study focusing on ambient temperature or climate as a factor in player injury would need more accurate and detailed information about weather. Precipitation, ground temperature, humidity, altitude and wind-chill factor are only a few of the climate variables that may have a significant bearing on the effective ambient temperature a player is exposed to. The STAYFIT-HURT team became aware at the time of data collection that available retrospective internet data resources on weather in Scotland are generalised from weather stations that often refer to a large geographical area of the country, hence the most accurate method in the future would be to document comprehensive local weather details contemporaneously on-site for any researched match or training session. It would also be important to point out that the clubs involved in the STAYFIT-HURT study were either in or close to Scotland's 'Central Belt', as demonstrated in *figure 4*. This does not optimise the SPFL potential for looking at geographical (and climate) variance where there exists over 200 miles in latitude difference between furthest north and furthest south member clubs.

6.a.iv. STAYFIT-HURT Team Reports and Combined Results Analysis

The injury results are further presented in the format of team reports. These are included in the document to demonstrate the information that would be fed back to individual clubs, a key project aim. The framework is loosely based on that of the UEFA Elite Club Injury Study as these are the gold standard team reports currently being produced in professional football (dummy report for comparison in Appendix 12). With a lack of information available on issues such as injury burden, sections were created to optimise use of the available data. The clinical relevance to participants of these sections was partly based on the research team's own knowledge and experience of working in football. There was also verbal feedback from clubs at meetings for app demonstration that a that UEFA-style feedback report would be useful. The key to this impact was in transparent comparisons with peer clubs, hence the repeated illustration of an individual club's results against those of other teams, or the study as a whole. At the forefront of the process in producing team reports was an aspiration to demonstrate data in clear and simple way to optimise impact across different club personnel, including those without a science background.

It was felt to be vital that the project could exhibit clinical relevance to participants, with the stated aim of building towards a framework on which improved clinical care can be built. It is also essential to demonstrate how even apparently limited data can produce worthwhile injury analysis for a club to act on. There are numerous factors that limit direct comparisons between clubs and their reports, some unavoidable. Among these, the type of clinician involved, the frequency and quality of data input, pre-existing squad injury profiles and differing clinical practises are key. However, there are important aspects of the data to discuss.

The team reports are ordered in league status at the end of the 2019/20 season. All the clubs played a similar number of matches although Falkirk FC, with the highest number of competitive matches over the same time period, 38 vs an average of 34.3 from the other teams, also reported the most injuries, see figure 29. This is further demonstrated in average games per month, the only available measure of exposure reliably reported in the study, see figure 30.

There is a calendar pattern throughout the season in two clubs, Dundee FC and Ayr United. They both reported injuries patterns that seemed to increase in the first two months of the season to a peak in August 2019, then reduce for the remainder of the season, see Figure 31 line graph. In no club is there a peak of injury in pre-season when conditioning may be anticipated to be at its poorest. Falkirk FC's pattern was steadier throughout the season, but all clubs reported fewer injuries in the last month or so of the season before it was terminated in March 2020. There may be multiple reasons for this, but the research team postulated that as the COVID-19 pandemic gathered pace in Scotland, players had less contact with clinicians and the clinicians' priorities may have understandably shifted away from injury management. An overview of club fixture lists does also suggest less fixture congestion in the last 2 months of the played season.

Any association between injury rate and player age is negligible for individual clubs as it may simply be skewed by a single individual of any age in these small numbers. In the overall study there does seem to be a trend towards increasing numbers of injury episodes in players in late twenties and early thirties, see grouped bar chart figure 5 and line graph figure 6. There is not enough data to allow direct comparison to the previously discussed evidence base suggesting older players may be more susceptible to hamstring (43) or calf (45) injuries. There is no suggestion in the project's data that the few players involved above the age of 32 had any higher rate of injury as the project may have anticipated.

Position comparison is complicated for several reasons. Firstly, it was the clinicians creating player profiles that defined player positions, but a player's position can alter during a season. Indeed, how that player is used tactically in different footballing systems or the team's style of play can confound this considerably. Most previous research suggests there is little difference between playing positions (39,45), with the exception of goalkeepers demonstrating fewer muscle injuries (45). As football positions become more fluid in modern football this aspect may need to be redefined as 'player role'. In the STAYFIT-HURT study, numbers or players in any position for an individual club is small. Figure 8 shows the total STAYFIT-HURT injury percentage by position. Based on these there is a suggestion that forwards were less likely to be injured with goalkeepers making up 9.4% of the study population and 11% of the injuries; defenders making up 29.4% of the study population and 33% of the injuries; midfielders making 41.2% of the study population and 42% of the injuries; and forwards making up 20% of the study population but only 14 % of the injuries. Table D demonstrates this as injuries per player with goalkeepers sustaining a mean 1.625 injuries per player, defenders 1.6, midfielders 1.486 and forwards 1.0. The total study average of 1.428 injuries per player is demonstrated with a 95% confidence interval of 0.463, suggesting more data is needed to enhance significance. Placing this against the conflicting reported evidence elsewhere is challenging, the only other study identified in Scotland describing more midfielders being injured (11), whereas an Iranian study suggested defenders are more frequently injured (48). And yet a systematic literature review described strikers sustaining more injuries during matches (47).

An analysis of injury location demonstrates an obvious and expected majority of lower limb injuries and, although 29% of the total injuries were classified as ‘other’, this included a number of foot and toe injuries. Thigh, knee and ankle injuries made up 59% of total injuries with 25%, 14% and 20% of the total number respectively. See figures 10 and 11. Dundee FC had a conspicuously higher proportion of thigh injuries with 41%, whereas the other clubs’ breakdown varied less from the study mean. In an illustration of how these small numbers can be skewed, a single player for Dundee FC had 4 recorded thigh injuries. Although documentation is insufficient to say whether these are recurrences, 1 episode was documented as left and 3 right. But if this individual player were excluded then there would be no higher prevalence of thigh injuries at Dundee FC compared to the other clubs. 6 injury episodes at Dundee were undefined in location which makes further comparison with other clubs less valid.

In the study as a whole muscle and ligament injuries made up 53 % of the overall injury type with the largest proportion of the remaining injury types being defined as ‘other’ making up 24% (see figures 12 and 13), the main individual club deviation from this pattern again being Dundee FC where 53% of injuries were defined as muscular (see figure 35i). This again may be skewed by the preponderance of reported thigh muscular issues, a single player having 4 of these documented during the season.

Figure 36 shows the distribution of muscle injuries by anatomy, demonstrated in grouped bar charts for each participating club. Muscle injuries of the thigh are the most common for each club except Dumbarton FC and posterior thigh (‘hamstring’) is more common for every club compared to anterior thigh. This finding is in keeping with the previously discussed evidence base, including Ekstrand et al (58). Falkirk FC reported a significant number of ‘other’ muscle injury locations and review of this data shows these are described as groin or posterior pelvis in their dataset. Dumbarton FC also report a high number of ‘other’ locations of muscle injury, 2 of these being defined as affecting players’ backs, the others being non-specifically defined as upper body or ‘other’. The STAYFIT-HURT team speculates that some of the low-grade thigh muscular injuries may go unreported in part-time / semi-professional football, as at Dumbarton FC, because players at this level could be more used to managing these themselves without clinician input which is less immediately available. Figure 37 shows in grouped bar chart form whether muscular injuries were more likely to occur during competitive matches or training for each club. As is a theme later in overall injury analysis, Falkirk FC is the only club to report higher rates of muscle injury during training.

Figure 38 repeats the same method for representing ligament injury by anatomy, grouped in bar charts for each participating club. The most common sites for ligament injury are knee and ankle. Ankle ligament injury is more common for each club than knee, except for Dumbarton FC. Ayr United report 3 other ligament injuries. Review of this dataset shows all 3 concern an individual goalkeeper with 2 shoulder ligament injuries and 1 described as affecting his hip. Figure 39 shows that ligament injuries were reported more commonly for every club as a result of match participation rather than training. Although numbers are low and statistical significance of this very limited, this would appear to represent a uniform finding. Figure 40 shows the variety of anatomical distribution of other significant injuries. It is interesting to note the comparatively high numbers of head injuries reported at Dumbarton. The research team proposes this could be due to the data input coming from a club doctor rather than physiotherapist, likely to be more involved in head injury assessment and management. It is also worthwhile noting that Falkirk FC report 5 episodes of knee effusion or meniscal injury and, although these episodes concern only 2 players, different areas of different knees are described so these are unlikely to be recurrences. Rather it suggests these 2 players had some susceptibility to knee issues which could be due to a multitude of factors such as age, previous injury, biomechanics, playing style or anatomy. It is also possible that some of these factors combined with constant use of an artificial playing surface at this club to result in injury.

STAYFIT-HURT Totals Analysis

A review of the total STAYFIT-HURT results of documented injuries by context reveals that 75 of the 122 injuries occurred during matches (62%) and 43 during training (35%). Only 3 injuries (2%) were documented as overuse / breakdown. See figures 14 and 15. The research team speculates that only when a player became unavailable to play were overuse / breakdown injuries being properly recorded, and the function in the app to document ongoing injuries that did not prevent participation in training or matches was not being used. It is also highly likely that some overuse / breakdown injuries were interpreted as an acute episode at the time when the player actually ‘broke down’. A future similar study would need to design a method to eliminate this anomaly. A development strategy here may be to make player availability or ongoing treatment a ‘read-only’ app facet available to coaches / management. This is likely to ensure a degree of accountability for clinicians being required to update player fitness.

6.a.v. Matches vs Training and Playing Surface

The pattern of injuries in matches versus training for Dundee FC and Ayr United was close to the study mean (see figures 41i and 41ii). Both clubs played home games on natural grass, but Ayr trained predominantly on artificial turf. Falkirk FC had as many training as match injuries (see figure 41iii) playing home games and training exclusively on artificial turf. Dumbarton, playing and training on natural grass had proportionally fewer training injuries (see figure 41iv). This may be more a reflection of part-time / semi-professional status and less training time, with the associated reduction in contact with club clinicians. Further interrogation of injury context by surface shows a total of 91 competitive fixtures that STAYFIT-HURT clubs were involved in on grass and 50 matches on artificial turf. There were 50 injuries on grass and 25 on artificial turf producing an average of 0.549 significant injuries per match for a team involved on grass and 0.5 significant injuries per match for a team on artificial turf. There is little difference in these injury rates, in keeping with previous research that has failed to consistently demonstrate that pitch surface is a significant causative factor in player injury, despite player opinion to the contrary (27). A test of 2 proportions produces a p-value of 0.574 and a confidence interval of (*-0.122763, 0221664), both measures suggesting significantly more data is required to reach significance.* However, despite the suggestion of no difference between the match injury rate on different surfaces, the STAYFIT-HURT team speculates that the under-reporting of overuse or breakdown injuries may be crucial here. It is highly likely such an injury may actually present clinically during the training week when player motivation, competition and endogenous cortisol levels are lower, but could have been present on a matchday. It is an interesting observation therefore to see the high rates of injury during training at Falkirk FC. Unfortunately, there is insufficient information to accurately interrogate exposure during training as the exact number and length of training sessions is unknown for each club. Despite this, 30 significant injuries during training on artificial turf versus 13 on grass would appear disproportionately high (see table H). Surface and injury rates are explored further with power calculations, discussed below.

The results section then reports combined variables of injury location, type, context, and surface by position. Small numbers make the significance of these findings limited but the method to show these patterns would be easily reproducible for much larger dataset. Figures 17 and 18 suggest that the highest incidence of thigh, ankle and other injuries occur in defenders and midfielders. The small numbers of injuries in forwards was also demonstrated well with the exception of knee injuries. Figures 19 and 20 show the higher numbers of muscle injuries in comparison to other injury types with these injuries also proportionally over-represented in midfielders and defenders. If this pattern were repeated in a future study further interrogation of precise team role and playing style matched with running distance from GPS data could shed light on this finding. It would also be important to demonstrate whether injuries occurred during contact with another player, another available app feature that was underused.

Comparison of injury context against position in figure 21 suggests goalkeepers are the only group with more injuries during training. This is perhaps explained by the fact that a goalkeeper may be more active during training than a match when the reverse is nearly always true for outfield players. There is also a potential theme of more goalkeeper injuries in absolute numbers on artificial turf than natural grass in figure 22, the reverse being shown for all other positions. If this pattern were repeated in a future larger dataset there may be strong grounds to investigate how a goalkeeper's body interacts with an artificial surface and even question whether goalkeepers should avoid training on these surfaces.

A simple combined variable analysis of injury type against surface and context in figures 23 and 24 respectively suggests some patterns, lacking in significance due to small numbers. There is a suggestion of more muscle injuries on grass versus artificial turf (62.5% increase). Equally there are twice as many tendon injuries on artificial turf versus grass, but only 9 in total. Of 24 total ligament injuries only 5 occurred during training which suggests these may be more likely in match circumstances, perhaps due to contact with other players or under more extreme strain. Unsurprisingly contusion-type injuries are also more common in competitive match situations.

Figure 25 is a grouped bar chart of injury location against surface, the most striking finding being that thigh injuries appear more likely to occur on natural grass compared to artificial turf, 18 vs 10 injury episodes. Ankle injuries appear slightly more frequent on artificial turf which is also in keeping with previous research into artificial turf injury patterns in football. Figure 26 shows that in this project knee, ankle, head and other injuries occurred more often during competitive matches than in training.

6.a.vi. Power Calculations

The STAYFIT-HURT team elected to pursue power calculations to demonstrate a framework for future research to ensure sufficient power and significant results. Extrapolating the existing dataset relies on significant assumption and the example of pitch surface is used to show this. Other data points such as individual types of injury were felt to depend on too many assumptions to be clinically applicable as discussed in the results section. The power calculation employed to investigate playing surface suggests that to achieve 80% power a future study would require 376 matches played on grass and artificial grass each. Each SPFL club will usually play between 40 and 50 games a season which includes cup competitions. The number of games on a particular surface varies between clubs and leagues but could be predicted at the start of a season. Hence approximately 17 clubs would need to be recruited to a future study assuming there were even numbers of games on each surface. It is possible to adjust the proportion of required games on each surface to reach 80% power, as demonstrated in the results section.

6.b. Methodology Review and COVID-19

The methodology of the project rested on the use of the ScribePro® app, a mobile bespoke medical records system still in a development stage at the time of data collection. The project provided a beta testing platform to the company and hence a mutual benefit to both developers and research team. It was assumed there would also be a significant benefit to participating football clubs. Two key problems were encountered during the attempted generation of this data. Firstly, limited stakeholder engagement, to be further explored, and secondly the COVID-19 pandemic that cut short the intended study period.

The COVID-19 pandemic certainly had a negative impact on available injury data that could be collected during the 2019/20 SPFL season, owing largely to the early cessation of the season. There were also a few weeks leading up to the suspension of fixtures with reduced focus on other medical issues and injuries, demonstrable in the minimal received data during this time. The ScribePro® app was not initially designed to incorporate COVID-19 illness or screening and although this became a key feature in later versions of the app, it was not functionally ready to be used during the researched season. This probably gave rise to a degree of disengagement from participating clinicians who needed to document their care related to this issue elsewhere. Moreover COVID-19 illness or screening was not included in either planning or ethics for the STAYFIT-HURT project so these developing app features could not be provided to participating clubs even if they had been ready. It would also be fair to say that the impact on the clinicians involved in the STAYFIT-HURT project was very significant in that their clinical roles away from the study were necessarily prioritised. It was only after the cessation of the season that the impact and significant curtailment of data was truly realised.

The impact of the COVID-19 pandemic was not entirely negative. In terms of research method and innovation in medical records systems, this was a further opportunity for novel ideas and modernisation. The pandemic shone a bright light on medical services in professional football, with overdue recognition of their pivotal role and an increased importance placed on their opinion about player health. This is well demonstrated in the rapid production of return to play guidance after COVID-19 infection or the regular communication and interface with the new Scottish Football Association Joint Response Group (JRG) dealing with COVID-19 in professional football. The circumstances of the pandemic encouraged a degree of uniformity in approach and determination between clinicians at different clubs with an unprecedented degree of inter-communication, facilitated by web-based chatrooms and on-line video conference, or direct discussion and communication with the JRG. This suggested a willingness and attitude among these clinicians to optimise player care which should be capitalised upon in future.

6.c. Stakeholder Engagement

The issues surrounding engagement are multi-factorial however it was felt the dominant issue the STAYFIT-HURT study encountered was the culture in football, pervasive in but not unique to Scottish football. One central attitude is a general apathy for critique and development. It has been said that the culture in Scottish football among clubs and their supporters means there is a battle to address the male-dominated tribal status quo. Indeed, there are numerous high-profile issues that seem to necessitate media attention before change is affected. Examples of this would include the aforementioned Glasgow-based FIELD study that is investigating head injuries in football, a topic that players and the public felt was overdue to be interrogated. A further current example would be concerns regarding child safeguarding in professional football club youth development structure. There is neither evidence nor suspicion that any such attitudes exist on an individual personal level among football clinicians in Scotland but as employees of these clubs, there is a sense that this culture permeates and influences the role. This generalised resistance to change and outdated thinking is often summarised by the oft heard phrase around teams, ‘That’s football’. Perhaps it is the acceptance of this by those motivated to see evolution and improvement that must be addressed.

There is no doubt that another pivotal issue is the limited finance in the country’s football leagues. Most clubs in Scotland do not apportion sufficient funding from their already comparatively meagre resources to their medical departments, and hence medical staff at clubs are usually few and stretched thin. Progression and innovation in this climate are challenging and high-standard medical care falls far behind player availability and match results in a club’s priority list, with little recognition of the obvious symbiosis. This is certainly a factor in the very high rates of medical staff turnover with limited job satisfaction among clinicians who, in contrast to their employers, are primarily driven by player health and welfare. Recruitment of medical staff to work in Scottish professional football is also challenging with increasing clinician recognition of high-risk practice, limited remuneration and difficulties in costly indemnification. This project was designed with these issues at the forefront of the research team’s thoughts and the provision of the app was without cost to any club or clinician for the entire researched season. Moreover, it was envisaged that this would offer a safe and easy means of maintaining medical records, almost certainly for many teams, to a higher standard than previously existed. Indeed, it was hoped that the ScribePro® app would make the job of the clinicians taking part easier with the app’s simple interface and mobile nature. One key to the lack of engagement may have been the failure of those clinicians approached to recognise these benefits, or the failure of the research team to advertise them sufficiently. Although some technological issues were encountered, as discussed in the app development section, there was no significant issue around comfort with technology among clinicians when the app was demonstrated or used.

Fundamentally in the planning and research design phase, the STAYFIT-HURT project underestimated many of the challenges and attitudes encountered throughout the season. The offer of a bespoke free medical records system and end of season team-feedback was not sufficient in appeal to ensure participation, in contrast to the expectation of the STAYFIT-HURT team. The team has reflected that during the planning phase of the project the culture in Scottish football, the aforementioned apathy for development, levels of professionalism and degree of clinical staff turnover were misjudged. The assumption that an end of season feedback report and an enhancement of existing medical records to help drive progress and clinical standards would ensure engagement was inaccurate. Issues around whether the information produced by the project was attractive to clubs is discussed later. The team has also speculated that a dominance of initial engagement from lower league clubs may magnify these issues, as discussed below. As the research team's clinical experience was largely at full-time clubs or international sides, a key development for a future project would be involvement of a clinician at a lower league club in the planning phase.

For participating clubs, crucially, data collection was live, time-critical and ‘once-off’. So, if club engagement or data input fell off, there was no opportunity to address this timeously during the season, while trying to keep the collected data valid. Indeed, the project had neither the resource in manpower nor infrastructure in receiving data, to monitor club activity and hence intervene when data input fell off. A future similar enterprise would require a change in methodology and further ethical consideration if data inputting was to be monitored, for example by seeking guaranteed regular feedback on every player even if uninjured. To monitor this may be to compare against known injuries, already evident in the public domain, but there would be obvious concerns regarding player anonymity and blurring of GDPR.

In general terms, the themes of the attitudes the STAYFIT-HURT project encountered throughout the season depended on the level of club competition and existing resources. At the bigger clubs with larger financial resource, most already used a costly purchased digital medical records system and hence there was an understandable reluctance to duplicate work. It was also felt there was an inherent suspicion about any project that sought to interrogate data about their players, perhaps due to more media and financial scrutiny in the top leagues. It is certainly possible that due to the timing of the project starting in 2019, clinicians had increased awareness of data protection in the wake of the new 2018 GDPR parameters. Despite assurances about anonymisation of player and club data, the issues around many injuries occurring in the public eye and hence true anonymisation being limited was also discussed with clubs. Another key to this reluctant stance may lie in the very nature of competition in professional sport where ‘the common good’ is rarely the priority, but the benefit of a similar model should be clearly demonstrable from the UEFA Elite Club Injury Study. It is worth repeating that participation in the UEFA study is mandatory for clubs competing in the lucrative UEFA Champions League. At meetings with clubs to explain the STAYFIT-HURT project and demonstrate the app, the possible outcomes and team report feedback clubs may receive was demonstrated using a dummy document produced by the UEFA team (Appendix 12). The benefit of this when compared to other similar clubs would provide more potential gain for larger clubs with larger squads and more resource to act on identified issues than for smaller clubs.

The research team also reflected on the provision of the ScribePro® app without cost to participating clubs and have hypothesised that providing a tool that has cost nothing may in fact undermine its value and inherently make a user less inclined to use it given that they are literally less invested.

It is also recognised that in Scotland most clinicians working in the National Health Service have significant job security despite active clinical governance, appraisal, and regular performance analysis. In contrast in football there seems to be a natural resistance to scrutiny of a clubs' own performance in player injury rates and management, which could also be linked to an inherent sense of job insecurity among various employees. At some stage in the analysis of injuries and outcomes at individual club level the performance of the clinicians may well be questioned. If such clinicians felt uncertain in their role, then the 'Turkeys won't vote for Christmas'. In summary of this, the STAYFIT-HURT project was designed with a key benefit being to demonstrate results for each club with analysis of their own injuries compared to other anonymised clubs in their league. It was not considered that the club or its employees may not want this information.

It is worth considering the reasons for a club not wanting this injury information. There are certainly financial arguments, usually at the centre of decisions made in professional football. It is inevitable that issues raised in governance and investigation will lead to a need to invest in medical care at clubs. Furthermore, club infrastructure and facilities could be challenged and potentially costly issues around training areas and playing surface may be exposed. As issues emerge there may also be media attention, both helpful and unhelpful, and it is even possible that new player signings could be discouraged from joining a club with a poor injury record. There is no doubt that players may be particularly interested in outcomes of such a study and player unrest could be an unintended consequence. Another consideration is that the level of football may alter what constitutes a reportable injury or the likelihood of an individual player to report it. At a clinical level there is also the potential for exposing poor practice although the study was not intended to produce any punitive results, rather offering a platform to focus development. A future project would need to understand these concerns and incorporate them fully in study design and recruitment plans.

Perhaps unsurprisingly, in general, as clubs were engaged lower down the leagues, more outdated practice and attitudes were encountered. Often it was felt by the relevant clinicians that they just wouldn't have time to use a new system despite the demonstrable time efficiency. Given the apparent time efficiency the app would offer, one possible explanation for this perceived lack of time was that existing medical records at lower levels may be sparse in detail if present at all, and hence the app would have represented an increase in work. Although there is guidance on standards expected from professional regulators, there is no specific guidance for medical records in Scottish Football, as exists in England. As mentioned in the introduction section the Football Association in England states,

'Each Club shall keep medical records in respect of its Contract Players and Students in accordance with the requirements of the Medical Committee of The Football Association and shall, from time to time, make these available for inspection by Doctors appointed by The Football Association, for the purpose of monitoring.'

It is also worth noting that the most recent UEFA Medical Regulations of 2022 suggest that they may request to review medical records including screening documentation. This may be a key outcome step from the project in Scotland. National policies in this area would force clubs to modernise their practise and approach. It is likely the Scottish Football Association would be well placed to begin the process and include medical record keeping as part of club licensing although policing this would also be costly. Whether using the ScribePro® app or another electronic tool, this may standardise and improve records, protect clinicians and players alike, and facilitate the kind of clinical governance that drives the development of patient care. Cost to clubs would be central to this and a tiered system of pricing for different leagues, whether sponsored by organisations such as the SFA or PFA (Professional Footballer's Association) or not, could help to enable this. Moreover, a uniform standardised system would allow seamless transfer of medical / injury data between clubs as a player moves during his or her career which would certainly improve player safety and welfare, but also a clinician's and club's safety. This could also extend to data sharing with parallel services such as NHS General Practice, either during a player's career or at its end. As already exists between NHS Primary and Secondary care, there could even be a brief 'Emergency Care Summary' which would contain only very brief data such as medication, allergies and organ donation status; the kind of critical concise information that can help an emergency clinician save a life. Scottish football could quickly become a leading light, an example for all other professional sports (and other professional organisations) to follow, creating a bedrock on which to build a Sports and Exercise Medicine evidence base that is currently limited in so many areas.

In terms of central funding of such a project, an interesting comparison in Scottish football would be the considerable investment made in establishing Video Assisted Refereeing ('VAR') in recent seasons. The *Sports Business Journal* reported in April 2022 that the cost for this is £1.2 million per season in the Scottish Premier League, participating clubs dividing this cost based on their finishing league position. VAR is related to the game itself, and arguably the marketed viewing product, rather than protecting player welfare or safety. Governing bodies may wish to consider their priorities, given the relative costs. The clubs involved in the STAYFIT-HURT study could expect to pay £900.00 plus VAT for use of the ScribePro® app per season. It is important to acknowledge that ideally a future study could extract data from clubs who already use an alternative system too rather than unintentionally creating a market monopoly for one system.

In considering the engagement and use of the ScribePro® app, one of the central challenges was in creating a system that was equally user-friendly for doctors, physiotherapists or sports therapists. The STAYFIT-HURT team were not actively involved in the specific technical developments beyond the feedback from the clinicians encountered during the project, but this feedback was equally useful for the app developers and research team. Commonly used methods and patterns of documentation differ between clinical disciplines but also the inherent tendency to make a firm diagnosis may differ. There are myriad ways to describe medical issues, injuries, diagnoses and treatments. Clinicians with different approaches, novel ideas, alternate perspective, and their own theories provide a strength and colour to medical care that should not be suppressed. However, this must be balanced by an onus to justify management strategies, not least in recognition of an increasingly litigious society. A system that uses a standardised coding system may also encourage clinicians to make clear diagnoses and hence justify their care plans to a greater degree. In effect it could 'pin down' clinicians to a diagnosis that they don't otherwise have to make, and if a facility exists to change this diagnosis or clinical impression with evolving information, the practise is likely to protect them from retrospective criticism.

The sports medicine community in Scotland is small, further constricting when considering those working in football alone to just one or two individuals. When considering doctors, there are a very small number of specifically sports medicine-trained clinicians involved at various levels, but inevitably these people are involved at the upper echelons of the game. To widen this pool in specialist knowledge and training is very challenging, indeed it is not possible for a doctor to acquire specific NHS specialist clinical Sports Medicine training in Scotland at all, the previous training posts having been removed. At present in Scotland a doctor interested in Sports Medicine qualification requires to engage in an extra science degree in Sports and Exercise Medicine such as those offered in the University of Glasgow. These are high quality courses but not clinical qualifications. Although far beyond the remit of this project, it would seem that if Sports Medicine training was available in NHS Scotland and indeed an NHS Sports Medicine service was widely available, as is the case in most of England, a scaffolding would be created to build clinical standards, a culture for training and high-quality research. In the meantime, non-specialist clinicians involved in football need support, structure, and guidance; and medical records are a fundamental foundation to this.

In Scottish professional football, there are few posts with any significant funding and most clubs' doctors will be interested enthusiasts, often with extensive experience but little specific training, happy to be involved for renumeration below their normal pro-rata salary. Many physiotherapists and Sports therapists will similarly be accepting salaries beneath that which they could achieve in other disciplines. In a major step forward in recent years, licensing in Scotland mandates that all clinicians are trained in pitch side emergency care (Sport PROMOTE® qualification or equivalent) and have appropriate indemnification. However, otherwise there is no pyramid structure to promote development and training across all these disciplines. A key part of this training would be education about injury patterns and appropriate documentation with reference to individuals' licensing. Without this leadership and unity of purpose in Scottish football, it is unlikely there will be substantive change. Hence it is the view of the STAYFIT-HURT research group that standards of documentation, whether producing data for research or not, is a key outcome target for the future highlighted by this project. When considering this the SFA may need to consider the involvement of executive members at the top of club hierarchy to strengthen the unity of purpose. The STAYFIT-HURT project in its design had very limited contact with such people and this could be considered an oversight.

6.d. Evaluation Phase Discussion

The evaluation phase of the project which was composed of a series of interviews with key clinicians revealed some very positive attitudes towards the project aims and future aspirations of medical records in Scotland. There is clearly an inherent bias that must be acknowledged in that those interviewed were self-motivated to be involved in the project, and it is not clear to what extent their opinion extends across other clinicians in Scottish football. Two clinicians from separate clubs that had withdrawn from the study during the season despite providing initially useful data could not be included in the evaluation process; the first formally withdrew from the study and did not wish their club involved in the evaluation or injury analysis, the second could not be contacted despite multiple attempts although they moved between clubs during the studied season, and the reasons for this move may have influenced the subsequent communication failure.

This evaluation process raised several important themes, both those identified at the outset of the project and more novel ideas. The experience of clinicians using the ScribePro® app, once part of the STAYFIT-HURT project, was generally very positive despite the app being relatively early in its testing phase. It was not felt that the app or any technological issues significantly influenced engagement but rather the team encountered a common apathy to changing medical records, as discussed previously.

One key theme recognised and emphasised by those interviewed was the importance of standardisation of practise between professionals and there was a clear understanding that this could create reproducible robust data that could move the field of clinical research in football forward. Moreover, there was an essential welcoming of clinical governance. There was also a demonstrable appetite within this focus group to work together and create transferrable data that could move with players throughout their career whichever club was employing them. Benefits that were mentioned mirrored the aspirations of the research group that could follow improved player records: improved safety for players; improved safety, security, and accountability for clinicians; and continuity in player care that these professionals are used to in other areas of work. There was a sense that in respect of welfare, professional footballers should be no different to their other patients.

Another unforeseen benefit was raised by an interview that echoes the ethos behind the STAYFIT-HURT project. This doctor was working with both Scotland international and club teams. They explained the benefit of information sharing and collaboration between international and club doctors who may be sharing care of the same player. Simple data entry that can be downloaded and sent to the employing club, or even direct data transfer if the club is also using the same system as part of the same medical record, could be a seamless means of high-quality clinical communication. The same concept would apply to a player loaned between clubs and may have different clinicians at different sites managing the same clinical issue. Indeed, this is an aspiration not yet achieved in NHS communication systems between primary and secondary care. The same ambition therefore could be to enhance information sharing from clubs with players also being cared for by an NHS GP, as raised by another interviewee who works as both team doctor and NHS GP. These aspects would merit very close data security scrutiny with respect to GDPR, but player safety and welfare must remain paramount. It was the feeling of the interviewees that the existing medical records status quo compromises this.

The feedback received specific to the project methodology raised some key issues surrounding useability and engagement. A prominent theme was seeking a multi-platform format. The project methodology rested heavily on creating a simple, mobile, and convenient means to generate a secure medical record on a clinician's mobile device, usually their phone. Although this was discussed as a strength of the project, it was also highlighted that ideally this could be transferrable to a desktop or laptop personal computer, particularly for the entry of more complex injury episodes and rehabilitation. This was certainly discussed with app developers as a central development theme and has since been actioned with a laptop/desktop 'dashboard'.

It is worth considering why a mobile records system is so beneficial in the field of football medicine when few clinician-patient contacts occur in a consulting room setting. A means to create contemporaneous documentation is not only a professional standard, but it can also actually aid clinical decision-making by allowing a clinician to further process and reflect on the information received. Delayed documentation often results in lost or forgotten information, distorted recall, and often a degree of observer bias. Timeous documentation also tends towards uniformity and structure which enhances reproducibility.

A standardised medical records system across any population of clinicians will inevitably encounter user variability, both between different clinical disciplines and with different preferred documentation styles. From an audit or research perspective, when extracting dynamic data is pivotal, this variation is likely to undermine output. A system that allows for these individualised approaches but with specific ‘headlines’ attached to a coding structure for each clinical contact would be an ideal hybrid. This wish to create more flexibility and space to document more freely is recognised as a key objective from the feedback. The ScribePro® app has developed to recognise this dichotomy and has features to account for both coding and free text entry. A future project seeking to generate a wider scope of injury data may wish to consider the need for more formal training of clinician participants. Within the STAYFIT-HURT project it was felt that a face-to-face summary and introduction to the app function was sufficient when meeting clubs that expressed an interest in engaging. The team have reflected that more training in use of the app may have been beneficial for some clinicians. If a national football association wished to enforce mandatory electronic medical records as a baseline standard, they may wish to involve some degree of training in creation and maintenance of player records.

The functionality of an app or records system is a parallel theme that can enhance engagement and clinician experience. This can dovetail with research priorities, for example in the context of an embedded head injury assessment protocol; or can be more a simple clinical aid, such as a link or warning system when considering drug administration of potentially banned substances. With respect to head injuries in football, there is significant interest, investment, and research in retrospective analysis of historical trauma and brain function. It is the view of the STAYFIT-HURT team that a key future area for research is the current management and audit of head injuries which would rely heavily on a standardised reporting system, ideally one that allowed an ‘in-game’ instant clinical decision aid. The most evidence-based example of this would be a SCAT-5, an electronic version of which embedded in a records system would be very powerful.

A topic that arose from the evaluation process was the challenge of creating a medical records system that not only meets the needs of clinicians of different disciplines such as doctors, physiotherapists, sports therapists and even sport scientists, but also clinicians working at different levels of football. A part-time doctor covering only matches in a semi-professional club may benefit most from a simple format due to limited resource, time, and access to more complex information; a full-time physiotherapist working as part of a medical department in a top-level team with significant resource may want features such as video storage and complex sport science integration. A uniform standardised medical records system therefore may need to have different layers of functionality, perhaps with more expensive expansive versions that have more complex bespoke features, but based on an established skeleton that can provide the coding and data that would facilitate a model like the STAYFIT-HURT project. Regardless of this, with respect to the largest and wealthiest clubs, it is unlikely they would depart from their already purchased and established electronic systems, and neither should they be obliged to, avoiding the previously highlighted unlawful monopoly for a specific product.

Sport science has been referenced throughout the STAYFIT-HURT project. The role within a football club of the sport scientist varies but is often a position that bridges the gap between medical departments and the coaching staff. There is a shift in priority where the focus of this job is player performance optimisation rather than health and welfare, indeed in many clubs the role of 'Head of Performance' is a sport scientist. When this role works well in a management structure this bridge can be very successful and mutually beneficial to coaches and medical staff. There is also the potential for conflict of interest. Therefore, it is the view of the STAYFIT-HURT research team that the typical sport science role should not include access nor involvement in a medical records system. There may be an ideal system where different professional roles could have different levels of access to information, thereby keeping all information in one place and integrating sports science data such as GPS as a channel to identify injury aetiology. Another future project direction may be to investigate how to optimise this integration within GDPR. The concept of differing levels of access may also facilitate documentation of more sensitive personal data. A good example of this may be a club doctor consulting a player about his or her mental health related to their private life. It may not be appropriate for this information to be shared and available to a wider medical team, but the clinician is obliged to document this somewhere, not least to protect themselves from future criticism.

It is important to acknowledge the perception of injury in football, and indeed other professional sports. This is inextricably linked with availability to play and hence perceived weakness in the injured party from colleagues and management. It is this culture in football that often leads to players participating in games or training when they are either not fully fit or being advised by medical staff against it. A fear of losing their place in a team or losing value in future contract or transfer negotiations plays into this. Despite having generally excellent individual relationships with players, medical teams are often seen through a negative lens as a barrier to players playing, or players signing for new clubs. This issue was referenced in the evaluation phase and bears further consideration. Players may see a centralised comprehensive medical record as a threat. They may even wish aspects of their medical or injury history to be concealed. An electronic medical records system therefore could be a source of conflict, or even result in a player avoiding contact with clinicians for fear of the negative consequences of thorough documentation. Furthermore, it may be player fitness could be unintentionally undermined by over analysis of medical data created and so documentation and clinical decisions must always maintain the individual player at the centre as part of an overall picture.

The ScribePro® app development was neither a target nor outcome measure of the STAYFIT-HURT project. The team were not involved in this development beyond providing feedback to the ScribePro® company as part of their beta testing platform. The previous discussion regarding the changes to app and key issues encountered are meaningful in the core question of creating a feasible medical record system. Crucially, the ambition of the company and app developers, Daysix®, was to create a medical records app that would be transferrable to multiple contexts outside football and remain affordable. This kept the process applicable to all clubs in the SPFL pyramid. It is also important to recognise that although the STAYFIT-HURT project methodology was based around the use of a developing app for mutual benefit to developer and researcher, the priority of a medical records system is storing data in a useful format, not creating output for research.

The injury data output has been discussed in detail already. The evaluation process highlighted some considerations for the stability of this data. One of the physiotherapists raised the issue of how different clinicians document injuries and interpret their clinical findings. In trying to create multiple simple stable data points a medical records system will use one of the aforementioned coding systems (such as Orchard) but also binary questions such as injury recurrence ‘yes or no’. The physiotherapist explained that the dilemma may be whether an injury is continuing or a new recurrence. This issue is discussed, and solutions offered in the *IOC Consensus Statement (71).* This is also an example of a variable that is open to individual interpretation and hence difficult to interrogate reliably.

6.e.i The Future

IOC Consensus Statement: Methods for Recording and Reporting of Epidemiological Data *(71)*

During the collation of this document, a new football-specific extension of the IOC Consensus Statement on methods for recording epidemiological data on injuries in sport was published (January 2023). Given the obvious relevance to the STAYFIT-HURT project, a retrospective consideration of these recommendations and how they apply is pivotal to the project’s future application. Importantly the reviewing group consisted of individuals of different genders, a broad age range and included *sports scientists and physiotherapists, mirroring the recognition of the STAYFIT-HURT project that a diverse group of clinicians work in sport. Interestingly the views of two players and a coach were also sought, an aspect for a future project to consider. The most relevant aspects are discussed below.*

The report recognised at its core that methods and study reporting needed standardisation and that this should be aligned with more up to date science and technology. Key amendments from previous consensus statements were to use football-specific terminology, improve definition of return to play after a health problem, to classify the severity of a player's health problem and to better define degree of injury exposure. All these key recommendations dovetail with issues and themes discussed in the STAYFIT-HURT project, and indeed raise the same discussion point of how these can be achieved in Scottish Football.

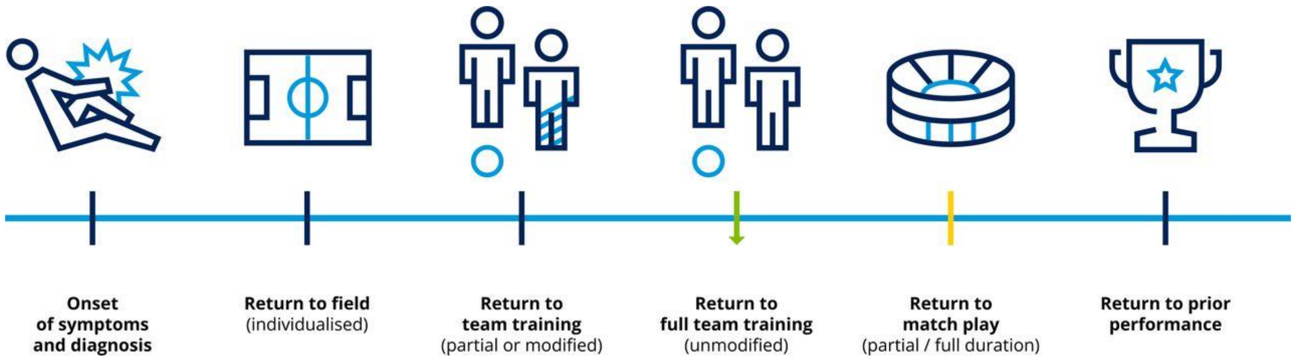
*The report is comprehensive in recommendations for definition and classification of health problems; among these, classifying injury severity according to days unavailable (0, 1-3 days, 4-7 days, 8-28 days, 29-90 days, 91-180 days and >180 days) would provide a key methodology framework for assessing the impact of injury in a future project but would still rely on accurate reporting of availability. It also highlights playing level and whether amateur or professional as key considerations, as suggested in the STAYFIT-HURT methodology, but it is recommended the term 'semi-professional' is not used as there is variety as to what this means in different settings. The terms recommended to describe anatomy and type of injury reflect those used in the S*cribePro® app in close correlation with the Orchard classifications. Injury incidence is defined as Injuries/1000 hrs (95% CI), Median time-loss as Days and Injury burden as Days lost/1000 hrs (95% CI) which would be key outcome measures from the STAYFIT-HURT project if more data were available.

There is an interesting focus on subsequent, recurrent and/or exacerbation of health problems which also corresponds to the planned STAYFIT-HURT theme of identifying players who are playing while injured, and still getting treatment, using the example in their paper of tendinopathy. This group recommends interrogating this phenomenon by recording such episodes as injury recurrence:

"A typical football-relevant example of an exacerbation is gradual-onset tendinopathies, where players can often play matches in parallel with modified football training and rehabilitation. Consequently, this injury is counted only once rather than recording several early reinjuries, which would distort the overall injury statistics"

"We recommend reporting details on injury recurrence in days rather than the categorisation of 'early' (within 2 months following return to football), 'late' (two to twelve months) and 'delayed' (more than twelve months) recurrence"

A further key issue discussed in the consensus statement is return to football. This was where the failure in STAYFIT-HURT data capture was most apparent despite using a very simple tool to classify availability based on full fitness, partial fitness with ongoing treatment, or unavailable in the *S*cribePro® app. Regular reporting and updating of injury episodes are key to this, whichever framework is used. This football-specific group goes further in illustrating how, even if these dates are available, definition of return to play (whether match or training) could influence statistics such as injury burden. Below is a copied figure using muscle injury to illustrate the point (72).



Overview of key time points in the return to football continuum modified from Ardern and Pruna. The green arrow highlights the recommended end time-point following a time-loss injury/illness in surveillance studies (first full team training). The yellow line highlights the date of the first match (partial or full duration), used if occurring prior to the first full team training

Ardern C, Pruna R et al. Return to play in football: a dynamic model. In Muscle Injury Guide: Prevention of and Return to Play from Muscle Injuries. Barca Innovation Hub, 2018: 80–1

A final key relevant recommendation is to use the STROBE-SIIS checklist (61) to standardise the reporting of epidemiological research in sport and the STAYFIT-HURT project has been aligned with this.

6.e.ii Artificial Intelligence

To consider a developing medical records app, data capture and interrogation of this data in our expanding medical technology environment without considering the emergence of artificial intelligence (AI) technology would be remis. A detailed analysis of the current evidence base is beyond this project but the potential applications of this in football are myriad. At the highest level of professional football, players are already carefully monitored in sports science departments to identify when their injury risk is statistically unacceptably likely, often known as the ‘red zone’. In elite football AI even offers the opportunity to monitor player health and fitness issues real-time and inform in-game decisions about player welfare. The most common example of this is GPS data based on distance covered by an athlete but with there are also examples of blood biomarkers, urine, sweat and sleep quality analysis being used to aid decisions on a player's fitness to play. A further interesting example is in women's elite professional football where a bioanalytic company Orreco has produced the FitrWoman® app which monitors the athlete's menstrual cycle and can inform training practice and nutrition with the aim of injury risk reduction.

The relevance to the STAYFIT-HURT project that included teams with limited financial resource may be more in the retrospective analysis of match, training, and injury data to inform future decisions rather than those in-game. The key to this analysis is the production of high-quality data. With enough data AI could be employed as an adjunct to clinician-player (and possibly coach) dialogue and decisions about fitness by identifying high-risk training or match load. As an aid to clubs and clinicians rolling injury patterns at individual clubs could also be generated, using AI to pinpoint issues arising within that population of players and inform preventative strategy. A development of this could be that a more accurate prognosis or expected injury burden of an individual injury episode could be offered based on club or league experience, and eventually with enough personalised data, even a bespoke individualised anticipated injury prognosis based on wider datasets combined with an individual's history.

AI can also be employed to monitor more holistic parameters and how these interact with levels of performance. A good example of this is using serial wellbeing measurements or player-completed questionnaires regarding mental health and correlating these with performance levels that could inform specific clinical intervention.

Another development using AI as a clinical aid could be in head injury monitoring, recovery and management of concussion. If using an algorithm based on a SCAT tool that takes account of an individual's baseline status, it would be likely that concerning symptoms and signs in recovery could be flagged early and protect players from unacceptable head injury risk.

In this aspect the discussion can broaden to include other aspects of technology-reliant medicine where AI is already integrated such as radiology. A recent survey of European radiologists found the majority of respondents described AI as useful and reliable but that it didn't reduce workload (73). In the UK it has been suggested there needs to be a national registry of AI clinical apps (74). Recently the MHRA (Medicines and Healthcare products Regulatory Agency) has established a 'Software and AI as a medical device change programme' to help regulate this integration into clinical practice. There is no doubt AI will change medical practice in the UK, and although we remain at the very early stages of this incorporation into mainstream medicine, that evolution is progressing fast. There are already instances of AI outperforming regression analysis in injury prediction in professional sport (75,76).

6.e.iii Further Research

There are lessons to be learned in future methodology in professional football injury surveillance studies, however **the framework of the STAYFIT-HURT project has demonstrated that a uniform mobile electronic medical records system can be used to provide useful data in injury surveillance of professional football. New methods to ensure higher quality data are provided from football clubs are necessary to realise the potential of an injury surveillance system.** Optimising these methods and ensuring clinician engagement would improve the standard of data in areas such as injury duration and severity and allow enhanced detailed analysis of parameters such as injury burden. In turn this kind of outcome allows specific financial cost analysis. In the end it may be this aspect that moves these issues to the top of a football club's agenda. Key clinical questions remain unanswered such as the significance of pitch surface in the aetiology of injury during matches and training.

The central areas identified that would influence the traction in a future similar project would be in information technology and administrative support for the technology used; regular follow-up and communication with participants; agreements on technology system stability; challenging prevailing football attitudes; inclusion of technology engagement in governing body licensing; and an increased understanding of the needs and wishes of clinicians working in football. Multiple suggestions for optimising methodology to address these areas are discussed throughout this document.

Given that engagement was such an issue, among the methodological developments for a future project would be to seek information from researched clubs and stakeholders in the planning phase, an important step overlooked by the STAYFIT-HURT project. Engagement may be maximised by asking directly what information would be most useful to a club.

The Place for STAYFIT-HURT

A summary of the STAYFIT-HURT project would be to describe an ambitious plan to develop a significant database of injuries in Scottish professional football using a novel app-based medical records system. Although enough injury data was collated to produce some basic analysis and team reports, disappointing engagement and challenging circumstances meant the project path became a study of methodology and investigation of the barriers that prevented the achievement of this. The project discussion became a demonstration of the need for methods to optimise clinician engagement in a step towards the ideal of a high-quality uniform medical records system. This could allow a comprehensive injury surveillance system with the aim of national clinical governance and an unprecedented research platform. The STAYFIT-HURT team suggest an electronic medical records system may need to be mandatory as part of professional club licensing, likely requiring a degree of data input monitoring, to navigate the pervasive attitudes encountered in the project before this could become a reality. This would be a powerful outcome recommendation of the project and would certainly move the field forwards.

An alternative evolution of the project that considers the above suggested developments in methodology, adopts consensus recommendation from the sports medicine research community, and embraces developing technology would be to investigate a more focused population in professional football or investigate a specific issue. This could utilise the directions learned during STAYFIT-HURT as a roadmap for app-based rolling data collection and could employ a more mature version of a funded medical records system, such as the current version of ScribePro®. The STAYFIT-HURT project has shown that this model is feasible.

If a simple outcome of the STAYFIT-HURT project were to be that medical records in Scottish professional football were improved, both player care and research would certainly have moved forwards.

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Appendices

1

List of Search Terms

(Player Injuries and Demographics)

With respect to *player injuries and demographics*, a detailed PubMed and Google Scholar literature review was undertaken across a breadth of search terms listed below, each time 'football' was searched a duplicate search for 'soccer' was checked:

Patterns of football injury / football injury meta-analysis / football injury systemic review;
Risk factors football injuries; Football injuries age; Football injuries position, Football injuries playing surface / artificial playing surface / natural playing surface; Football injury climate / temperature / winter break / seasonal variation; football injury exposure / fixture intensity; Head injury football; Types football injury; Football injury classification

2

GDPR Quotations

Below are the most relevant articles and recitals to the STAYFIT-HURT project from GDPR 2018

Article 5 of the GDPR requires that any personal data must be:

a) processed lawfully, fairly and in a transparent manner in relation to individuals;

b) collected for specified, explicit and legitimate purposes and not further processed in a manner that is incompatible with those purposes; further processing for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes shall not be considered to be incompatible with the initial purposes;

c) adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed;

d) accurate and, where necessary, kept up to date; every reasonable step must be taken to ensure that personal data that are inaccurate, having regard to the purposes for which they are processed, are erased or rectified without delay;

e) kept in a form which permits identification of data subjects for no longer than is necessary for the purposes for which the personal data are processed; personal data may be stored for longer periods insofar as the personal data will be processed solely for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes subject to implementation of the appropriate technical and organisational measures required by the GDPR in order to safeguard the rights and freedoms of individuals; and

f) processed in a manner that ensures appropriate security of the personal data, including protection against unauthorised or unlawful processing and against accidental loss, destruction or damage, using appropriate technical or organisational measures."

Article 5 (2) requires that:
The controller shall be responsible for, and be able to demonstrate, compliance with the principles

The lawful basis for processing data is detailed in article 6. At least one of the following must apply:

a) Consent: the individual has given clear consent for you to process their personal data for a specific purpose.

b) Contract: the processing is necessary for a contract you have with the individual, or because they have asked you to take specific steps before entering into a contract.

c) Legal obligation: the processing is necessary for you to comply with the law (not including contractual obligations).

d) Vital interests: the processing is necessary to protect someone's life.

e) Public task: the processing is necessary for you to perform a task in the public interest or for your official functions, and the task or function has a clear basis in law.

f) Legitimate interests: the processing is necessary for your legitimate interests or the legitimate interests of a third party unless there is a good reason to protect the individual's personal data which overrides those legitimate interests. (This cannot apply if you are a public authority processing data to perform your official tasks.)

The legal basis for the STAYFIT-HURT project is based on a) Consent.

As described regarding planned data capture, the STAYFIT-HURT project will also include special categories personal data which necessitates further consideration within GDPR as it is potentially more sensitive. This type of data represents a higher risk to an individual's legal rights and freedoms. Special categories data includes race, ethnic origin, politics, religion, genetics etc; information about which the project will not receive any data, but the project will receive information about biometrics, gender and health. As such GDPR mandates that a specific condition under article 9 must also be satisfied. The conditions that are listed in Article 9(2) of the GDPR are:

a) the data subject has given explicit consent to the processing of those personal data for one or more specified purposes, except where Union or Member State law provide that the prohibition referred to in paragraph 1 may not be lifted by the data subject;

b) processing is necessary for the purposes of carrying out the obligations and exercising specific rights of the controller or of the data subject in the field of employment and social security and social protection law in so far as it is authorised by Union or Member State law or a collective agreement pursuant to Member State law providing for appropriate safeguards for the fundamental rights and the interests of the data subject;

c) processing is necessary to protect the vital interests of the data subject or of another natural person where the data subject is physically or legally incapable of giving consent;

d) processing is carried out in the course of its legitimate activities with appropriate safeguards by a foundation, association or any other not-for-profit body with a political, philosophical, religious or trade union aim and on condition that the processing relates solely to the members or to former members of the body or to persons who have regular contact with it in connection with its purposes and that the personal data are not disclosed outside that body without the consent of the data subjects;

e) processing relates to personal data which are manifestly made public by the data subject;

f) processing is necessary for the establishment, exercise or defence of legal claims or whenever courts are acting in their judicial capacity;

g) processing is necessary for reasons of substantial public interest, on the basis of Union or Member State law which shall be proportionate to the aim pursued, respect the essence of the right to data protection and provide for suitable and specific measures to safeguard the fundamental rights and the interests of the data subject;

h) processing is necessary for the purposes of preventive or occupational medicine, for the assessment of the working capacity of the employee, medical diagnosis, the provision of health or social care or treatment or the management of health or social care systems and services on the basis of Union or Member State law or pursuant to contract with a health professional and subject to the conditions and safeguards referred to in paragraph 3;

i) processing is necessary for reasons of public interest in the area of public health, such as protecting against serious cross-border threats to health or ensuring high standards of quality and safety of health care and of medicinal products or medical devices, on the basis of Union or Member State law which provides for suitable and specific measures to safeguard the rights and freedoms of the data subject, in particular professional secrecy;

j) processing is necessary for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes in accordance with Article 89(1) based on Union or Member State law which shall be proportionate to the aim pursued, respect the essence of the right to data protection and provide for suitable and specific measures to safeguard the fundamental rights and the interests of the data subject.

The STAYFIT-HURT project satisfies article 9 on the basis of <u>a) the data subject has given explicit consent to the processing of those personal data for one or more specified purposes.</u>

In applying the GDPR and privacy law principles the STAYFIT-HURT research was further helped by consideration of a number of recitals. The following were deemed the most relevant:

*Recital 26 Not Applicable to Anonymous Data**

[1]The principles of data protection should apply to any information concerning an identified or identifiable natural person. [2]Personal data which have undergone pseudonymisation, which could be attributed to a natural person by the use of additional information should be considered to be information on an identifiable natural person. [3]To determine whether a natural person is identifiable, account should be taken of all the means reasonably likely to be used, such as singling out, either by the controller or by another person to identify the natural person directly or indirectly. [4]To ascertain whether means are reasonably likely to be used to identify the natural person, account should be taken of all objective factors, such as the costs of and the amount of time required for identification, taking into consideration the available technology at the time of the processing and technological

*Recital 33 Consent to Certain Areas of Scientific Research**

[1]It is often not possible to fully identify the purpose of personal data processing for scientific research purposes at the time of data collection. [2]Therefore, data subjects should be allowed to give their consent to certain areas of scientific research when in keeping with recognised ethical standards for scientific research. [3]Data subjects should have the opportunity to give their consent only to certain areas of research or parts of research projects to the extent allowed by the intended purpose.

*Recital 65 Right of Rectification and Erasure**

[1]A data subject should have the right to have personal data concerning him or her rectified and a 'right to be forgotten' where the retention of such data infringes this Regulation or Union or Member State law to which the controller is subject. [2]In particular, a data subject should have the right to have his or her personal data erased and no longer processed where the personal data are no longer necessary in relation to the purposes for which they are collected or otherwise processed, where a data subject has withdrawn his or her consent or objects to the processing of personal data concerning him or her, or where the processing of his or her personal data does not otherwise comply with this Regulation. [3]That right is relevant in particular where the data subject has given his or her consent as a child and is not fully aware of the risks involved by the processing, and later

wants to remove such personal data, especially on the internet. [4]The data subject should be able to exercise that right notwithstanding the fact that he or she is no longer a child. [5]<u>However, the further retention of the personal data should be lawful where it is necessary</u>, for exercising the right of freedom of expression and information, for compliance with a legal obligation, for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller, on the grounds of public interest in the area of public health, for archiving purposes in the public interest, <u>scientific</u> or historical research purposes or <u>statistical purposes</u>, or for the establishment, exercise or defence of legal claims.

Art. 89 GDPR Safeguards and derogations relating to processing for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes

1. *[1]Processing for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes, shall be subject to appropriate safeguards, in accordance with this Regulation, for the rights and freedoms of the data subject. [2]Those safeguards shall ensure that technical and organisational measures are in place in particular in order to ensure respect for the principle of data minimisation. [3]Those measures may include pseudonymisation provided that those purposes can be fulfilled in that manner. [4]Where those purposes can be fulfilled by further processing which does not permit or no longer permits the identification of data subjects, those purposes shall be fulfilled in that manner.*
2. *Where personal data are processed for scientific or historical research purposes or statistical purposes, Union or Member State law may provide for derogations from the rights referred to in Articles 15, 16, 18 and 21 subject to the conditions and safeguards referred to in paragraph 1 of this Article in so far as such rights are likely to render impossible or seriously impair the achievement of the specific purposes, and such derogations are necessary for the fulfilment of those purposes.*
3. *Where personal data are processed for archiving purposes in the public interest, Union or Member State law may provide for derogations from the rights referred to in Articles 15, 16, 18, 19, 20 and 21 subject to the conditions and safeguards referred to in paragraph 1 of this Article in so far as such rights are likely to render impossible or seriously impair the achievement of the specific purposes, and such derogations are necessary for the fulfilment of those purposes.*

4. *Where processing referred to in paragraphs 2 and 3 serves at the same time another purpose, the derogations shall apply only to processing for the purposes referred to in those paragraphs.*

*Recital 156 Processing for Archiving, Scientific or Historical Research or Statistical Purposes**

[1]The processing of personal data for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes should be subject to appropriate safeguards for the rights and freedoms of the data subject pursuant to this Regulation. [2]Those safeguards should ensure that technical and organisational measures are in place in order to ensure, in particular, the principle of data minimisation. [3]The further processing of personal data for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes is to be carried out when the controller has assessed the feasibility to fulfil those purposes by processing data which do not permit or no longer permit the identification of data subjects, provided that appropriate safeguards exist (such as, for instance, pseudonymisation of the data). [4]Member States should provide for appropriate safeguards for the processing of personal data for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes. [5]Member States should be authorised to provide, under specific conditions and subject to appropriate safeguards for data subjects, specifications and derogations with regard to the information requirements and rights to rectification, to erasure, to be forgotten, to restriction of processing, to data portability, and to object when processing personal data for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes. [6]The conditions and safeguards in question may entail specific procedures for data subjects to exercise those rights if this is appropriate in the light of the purposes sought by the specific processing along with technical and organisational measures aimed at minimising the processing of personal data in pursuance of the proportionality and necessity principles. [7]The processing of personal data for scientific purposes should also comply with other relevant legislation such as on clinical trials.

*Recital 157 Information from Registries and Scientific Research**

[1]By coupling information from registries, researchers can obtain new knowledge of great value with regard to widespread medical conditions such as cardiovascular disease, cancer and depression. [2]On the basis of registries, research results can be enhanced, as they draw on a larger

population. [3]Within social science, research on the basis of registries enables researchers to obtain essential knowledge about the long-term correlation of a number of social conditions such as unemployment and education with other life conditions. [4]Research results obtained through registries provide solid, high-quality knowledge which can provide the basis for the formulation and implementation of knowledge-based policy, improve the quality of life for a number of people and improve the efficiency of social services. [5]In order to facilitate scientific research, personal data can be processed for scientific research purposes, subject to appropriate conditions and safeguards set out in Union or Member State law.

*Recital 159 Processing for Scientific Research Purposes**

[1]Where personal data are processed for scientific research purposes, this Regulation should also apply to that processing. [2]For the purposes of this Regulation, the processing of personal data for scientific research purposes should be interpreted in a broad manner including for example technological development and demonstration, fundamental research, applied research and privately funded research. [3]In addition, it should take into account the Union's objective under Article 179(1) TFEU of achieving a European Research Area. [4]Scientific research purposes should also include studies conducted in the public interest in the area of public health. [5]To meet the specificities of processing personal data for scientific research purposes, specific conditions should apply in particular as regards the publication or otherwise disclosure of personal data in the context of scientific research purposes. [6]If the result of scientific research in particular in the health context gives reason for further measures in the interest of the data subject, the general rules of this Regulation should apply in view of those measures.

3

Full Ethical Submission

University of Glasgow | College of Medical, Veterinary & Life Sciences

College of Medical, Veterinary & Life Sciences Ethics Committee for Non-Clinical Research Involving Human Subjects

APPLICATION FORM FOR ETHICAL APPROVAL

NOTES: **THIS APPLICATION FORM SHOULD BE TYPED NOT HAND WRITTEN.** **ALL QUESTIONS MUST BE ANSWERED. "NOT APPLICABLE" IS A SATISFACTORY ANSWER WHERE APPROPRIATE.**

Project Title:
Study of A Year in Football Injuries and Trauma (STAY FIT)

Has this application been previously submitted to this or any other ethics committee? Yes/No
Yes
If 'Yes', please state the title and reference number.
Project title: Study of A Year in Football Injuries and Trauma (STAY FIT) Pilot
Applicants: xxxxxxxxx

Is this project from a commercial source, or funded by a research grant of any kind? Yes/No
No
If 'Yes', has it been referred to Research Support Office?
Has it been allocated a project Number?
Give details, and ensure that this is stated on the Informed Consent Form.

Insurance Coverage and Restrictions:
****Please Note: The Insurance restrictions set out below relate to research of a clinical nature. Non clinical research is not subject to restriction and no additional insurance is required****

The University insurance cover is restricted under specific circumstances, including, but not limited to the following -

- **work conducted outside of the European Union.**
- **work involving the use of research subjects outside Great Britain, Northern Ireland, the Channel Islands or the Isle of Man.**

- **the use of hazardous materials.**
- **number of participants in excess of 5000.**
- **work involving research subjects known to be pregnant at the time of the project.**

All such projects must be referred to Research Support Office and coverage confirmed before ethical approval is sought. Please contact Dr Debra Stuart in the University's Research Governance Office: debra.stuart@glasgow.ac.uk

Please tick here if this project has been referred to Research Support Office to confirm adequate insurance coverage. ☐

Date of submission:
14.5.19

Name of all person(s) submitting research proposal:
Dr. William H. Miller
Dr. John MacLean
Dr. Katy Stewart
Dr. Thomas F. Kaye

Position(s) held:
Dr. Miller: Lecturer (Medicine); Associate Academic (Institute of Cardiovascular and Medical Sciences)
Dr. MacLean: Honorary Clinical Associate Professor (Sport and Exercise Medicine); Programme Director (Sport and Exercise Medicine)
Dr. Stewart: Honorary Lecturer (Sport and Exercise Medicine)

School/Group/Institute/Centre:
School of Medicine, Dentistry and Nursing
University of Glasgow

Address for correspondence relating to this submission:
Dr. William H. Miller PhD FHEA
School of Medicine, Dentistry and Nursing
University of Glasgow

Email address:
William.h.miller@glasgow.ac.uk

Name of Principal Researcher (if different from above, e.g., Student's Supervisor):

Position held:

Undergraduate student project:
Yes/No *Yes* If 'Yes', please state degree being undertaken:

Involvement of BSc MedSci undergraduate

Postgraduate student project:
Yes/No *Yes* If 'Yes', please state degree being undertaken:

Doctor of Medicine
Re: Dr. Thomas F. Kaye
MBChB DGM MRCGP MScSEM

1. Describe the purposes of the research proposed. Please include the background and scientific justification for the research. Why is this an area of importance?

Sport and Exercise Medicine is a rapidly expanding field within clinical medicine with association football at the forefront. With ever more financial and media interest being attracted to professional football at the highest level and the incorporation of a complex sport science platform to optimise player performance, there is not only an enormous opportunity for clinical research, but a duty for clinicians involved with these athletes to generate high quality clinical care, good clinical research and hence clinical governance. There is recognition at the upper echelons of major football governing bodies, most notably UEFA and FIFA, that medicine in professional football requires increased support and to generate specific expertise (1). High quality clinical research of injury patterns in professional football is sporadic and within the professional and semi-professional game in Scotland, rare.

The top four tiers of Scotland's male football pyramid comprise the Scottish Professional Football League. Forty-two professional and semi-professional teams are divided into four leagues. The number of players used in each club's first team squad may reach thirty to forty individuals in more senior clubs. A study of a single football season that encompasses every player used in competitive games or injured as part of a first team squad when not playing is likely to encompass a thousand players. This is likely to involve as many as sixty games for some teams per season. As a result, the quantity of data that could be created in a single football season in Scotland is very substantial. If high quality information regarding player injuries could be harnessed from each of the above clubs, the potential research platform could be unparalleled.

<u>Existing Evidence</u>

Demographics

Hawkins et al looked at the frequency and severity of injury at three levels of football, international, premier league in England and the second tier of professional league football (2). No significant difference in injury rate or severity was identified based on the level of competition and no significant difference based on player position. Previous research however has suggested a higher injury incidence at higher levels of competition (3,4). A prospective three-year study limited to a single Scottish premier team in the early 1990s reported 79% of injuries occurred during matches and that midfielders where more prone to injury with 39% of the total (5). They also reported that players over 26 years old where more likely to be injured but despite a relatively long study period, the actual number of different players limit the conclusions that can be drawn. Of more validity in this study was that the number of matches played did not significantly affect injury rate. This finding was supported by another study which looked at two French Ligue 1 clubs (6). This paper also reported that injury incidence was not associated with the number of days separating games.

Another paper originating from the UEFA Elite Club Injury Study, discussed below, found that among the factors identified to increase the likelihood of muscle injury in the lower limb was older age, although this seemed to only be relevant for calf injuries (7). The same paper, perhaps unsurprisingly, identified that goalkeepers were much less likely to sustain lower limb muscle injuries but no other specific player positional variation was identified. A further paper produced by this study contradicts the French Ligue 1 paper and states that fixture congestion was associated with increased muscle injury rates (8). One prospective paper in the Czech Republic reporting on multiple levels of football followed nearly 400 players over 1 year (9). They identified that multiple factors influenced the occurrence of severe injuries including: age, physical conditioning, previous injuries, inadequate treatment or rehabilitation, amount of training, foul play and playing field conditions.

UEFA Elite Club Injury Study Comparison

The key ongoing research platform in European football is the UEFA Elite Club Injury Study, initiated in 2001 and reporting annually to its elite participating football clubs (10). Over 16 years this project has generated some of the gold standard research that investigated injury pattern and incidence in elite football. In Scotland streamlining this data collection process and generating a system for constant data collation and analysis is key to expanding to a larger database, especially ensuring good engagement for football clubs with fewer staff and resources. Research of Scottish football provides an opportunity to develop further some themes from the UEFA study such as: fixture congestion; climate and seasonal variation (which varies much more across a European study than it would do in Scotland); and full-time compared to part-time contracted players. The methodology of this research will also provide an excellent opportunity to collect data on head injury rehabilitation, a relatively rarely researched but extremely topical subject in professional sport. A further specific new angle that this research will benefit from is the increased comparison of playing / training surface and will look to add to the debate regarding the risks or benefits of artificial playing surfaces.

Artificial Pitches

Artificial pitch surfaces in professional sport, not only football, are controversial. There has long been recognition that injuries in football may be surface-related and linked to the pattern of friction with footwear (11). Ekstrand et al also discuss the potential importance of alternating between different playing surfaces. In Scotland many professional footballers believe artificial pitches may contribute to injury and prefer to play on grass (12). The evidence however remains unclear. One identified meta-analysis in professional football identified eight studies that included exposure time and injury occurrence (13). The conclusion was that the overall injury rate ratio comparing artificial turf and natural grass was 0.86, ($p < 0.05$), suggesting a significantly lower overall injury risk on artificial turf. It is worth noting that one limitation of the research analysed is that there was no consideration in any of the papers given to environmental or weather conditions; only one of the studies addressed any difference between contact and non-contact injury; and none investigated the degradation of the surface. A more recent review paper in 2011 looked at 11 experimental papers that gave strong evidence of comparable injury rates between new generation artificial surfaces and natural grass with a notable exception that ankle injury rates were higher on third and fourth generation artificial surfaces (14).

Types of Injury

The types of injuries sustained in football, a contact sport, are widespread with a variety of mechanisms. From the UEFA Elite Club Injury Study, Ekstrand et al demonstrated that on average a footballer would sustain 2.0 injuries each season, the most common type of injury being a thigh strain, comprising 17% of the total injury number (15). Interestingly a re-injury represented 12% of the total injuries. The Czech study (9) over a single season gave the following percentages as pertaining to 113 severe injuries: Joint sprains 30%, fractures 16%, muscle strains 15%, ligament ruptures 12%, meniscal tears and contusions 8%. Anatomically knee injuries were most prevalent 29%, followed by injuries to the ankle 19% and spine 9%.

A high-profile research project funded by the English Football Association and Player's Football Association started in January 2017 at the University of Glasgow to investigate retrospectively 'Football's Influence on Lifelong Health and Dementia Risk'(16). This focusses on the impact of repeated head trauma. This is a very topical and wide-ranging topic that transcends football into a variety of other sports and links to the developing understanding of Chronic Traumatic Encephalopathy. The project here proposed in Glasgow has the potential to dovetail as an observational prospective design and help generate current local data on incidence, mechanism, recovery and observation of consensus guidelines by professional clubs. Indeed Scotland was the first country to produce national concussion guidelines (17).

References

(1) Ekstrand J, Dvorak J, D'Hooghe M. Sport medicine research needs funding: the international football federations are leading the way. British Journal of Sports Medicine 2013;47:726-8

(2) Hawkins RD, Fuller CW. An examination of the frequency and severity of injuries and incidents at three levels of professional football. British Journal of Sports Medicine 1998;32:326-332

(3) Nielsen AB, Yde J. Epidemiology and traumatology of injuries in soccer. American Journal of Sports Medicine 1989;17:803-7

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(5) McGregor JC, Rae A. A review of injuries to professional footballers in a premier football team (1990-93). Scottish Medical Journal 1995 Feb;40(1):16-8.
(6) Carling C, Orhant E, Le Gall F. Match injuries in professional soccer: inter-seasonal variation and effects of competition type, match congestion and positional role. International Journal of Sports Medicine 2010, 31 (4). pp. 271-276
(7) Hägglund M, Waldén M, Ekstrand J. Risk Factors for Lower Extremity Muscle Injury in Professional Soccer: The UEFA Injury Study. The American Journal of Sports Medicine 2012 Vol 41, 327 – 335
(8) Bengtsson H, Ekstrand J, Hägglund M. Muscle injury rates in professional football increase with fixture congestion: an 11-year follow-up of the UEFA Champions League injury study. British Journal of Sports Medicine 2013;47:743-747
(9) Chomiak J, Junge A, Peterson L, Jiri Dvorak J. Severe Injuries in Football Players. The American Journal of Sports Medicine 2000. Vol 28, Issue 5_suppl, pp. 58 - 68
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(11) Ekstrand J, Nigg BM. Surface-related injuries in soccer. Sports Medicine. 1989;8:56–62.
(12) PFA Scotland. 3G Professional Player Survey results. 2013.
(13) Williams JH, Akogyrem E, and Williams JR. A Meta-Analysis of Soccer Injuries on Artificial Turf and Natural Grass. Journal of Sports Medicine 2013, 380523
(14) Williams S, Hume PA, Kara S. A Review of Football Injuries on Third and Fourth Generation Artificial Turfs Compared with Natural Turf. Sports Medicine 2011, 41: 903.
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(16) 'Football's Influence on Lifelong Health and Dementia Risk'. University of Glasgow. PFA / the FA
(17) IF IN DOUBT, SIT THEM OUT. Scottish Sports Concussion Guidance: Grassroots sport and general public. Modified from World Rugby's 'Guidelines on Concussion Management for the General Public'

2. Describe the design of the study and methods to be used. Include sample size and the calculation used to determine this. Statistical advice should be obtained if in doubt.

Aims / Design

This study takes the form of a prospective observational study which aims to encompass a sample size of 42 professional and semi-professional clubs playing in Scotland's professional football leagues. The aim is to generate a large anonymised database of player injuries and demographics to investigate potential patterns of injury and hence address future risk and prevention. Data will be collected for the duration of the football season 2019-20.

Recruitment

The methodology of this research revolves around harnessing data from football clubs. Medical representatives and administrative secretaries of each club have been contacted with information about the study. A number of club medical staff have also received presentations and demonstrations of the data collection system at a variety of Scottish Football Association-related educational events. Included in the above information is an explanation of the research aims, the benefits of involvement and details of data collection, and individual club staff will be met face-to-face during pre-season to introduce and instruct how to practically collect data.

Data

Data will be collected to investigate the key themes listed below:

1. **Player / match demographics and how this relates to injury patterns**:
- Age
- Player position
- Number of games played / minutes on the pitch / match frequency
- Part time vs Full time contracted players
- Injury occurring during match vs training

2. **Pitch surface**:

As well as looking at simple injury rates on artificial surfaces vs grass, there are distinct groups of players as follows:

- Training on artificial surface / playing matches on grass
- Training on artificial surface / playing matches on artificial
- Training on grass surface / playing matches on grass
- Training on grass surface / playing matches on artificial
- Do the above groups relate to specific types of injury or confer a different risk of overall injury?
- Do the teams playing on predominantly artificial surfaces differ in injury rates and can this be associated with precise type of artificial pitch and how well maintained / when installed?

3. **Seasonal variation**:

- Is there a pattern of variation in player injury depending on season / climate?
- Is there a pattern of seasonal variation that depends on pitch surface?

4. **Type of Injury**:

- A review of incidence of different anatomical injuries (related to above variables but also tabulated to correspond to individual clubs)
- A review of incidence of different injury mechanisms including contact or non-contact (related to above variables but also tabulated to correspond to individual clubs)
- A review of injury severity – measured by number of days unavailable and hence ‘injury burden’.

5. **Injury rehabilitation and head injuries**:

- Are national head injury guidelines being adhered to?
- Is SCAT (Sport Concussion Assessment Tool) being used appropriately?
- Do recovery rates vary depending on above variables?

The cornerstone of this project’s data collection and what will provide a much more comprehensive set of athletic population data is the use of the ScribePro® app. Dr. Jonny Gordon, Emergency Medicine Consultant at the Queen Elizabeth University Hospital, SFA pitch-side doctor, UEFA medical adviser and medical director of Promote Scribe®, has been instrumental in the development of an app designed to be used by clinicians to record and report patient contacts or consultations. A branch of this app has been developed specifically for clinicians working in football to generate injury reports and create a rolling patient / player record. This research project will also form a beta testing platform for practical use of the app and provide key information in its development.

There are some key population exclusions that were considered. The women's professional and amateur game is growing steadily in Scotland and with a thriving national team there is a marked research potential within this cohort of players. At a generic club level however, it was felt that medical provision is not sufficient to allow regular and reliable data generation and capture. Despite this it is hoped that this may form a key expansion group in the future. The same argument can be applied to football at a level below the SPFL, including Highland and Lowland leagues. Only players over 16 years old will be included.

The medical terminology used within this data collection app will mirror the anatomical breakdown and terminology used in the UEFA Elite Club Injury Study, but the proposed reporting and analysis is intended to differ significantly in some of the aforementioned new variables. It is well recognised that 'injury burden' and hence player availability, rather than simple injury rate, is perhaps the key information that impacts on club performance and finance. So, in this element the intention is to be able to provide a direct comparison to the UEFA study. UEFA define injury burden as a combined measure of the injury rate and severity, measured by days´ absence, and expressed as days absent for every 1000 hours of exposure.

The key to engagement of clinicians with little time is to make the app faster and more user-friendly than existing forms of documentation and injury reporting. The design of the app therefore has an option for rapid processing of an individual's status if no significant medical or injury issues exist. There are multiple other features within the app to facilitate documentation of variables such as number of minutes played, drugs prescribed or referrals made. Also player records can be populated with pre-participation screening results, drug testing and key clinical information such as baseline SCAT results. Only injury data and key demographics will be anonymously extracted for research.

Analysis

Analysis for the pilot study will use the SPSS or R statistics engine with a view to replicating some of the UEFA Elite Club Injury Study format to feedback anonymised results to individual clubs relative to other clubs in their division. The outcomes and analysis of the study may be of great benefit in future injury prevention and education at individual club level but will also provide a platform for analysis of injuries across a significant population.

3. Describe the research procedures as they affect the research subject and any other parties involved. It should be clear exactly (i) what will happen to the research participant, (ii) how many times and (iii) in what order.

The Clubs involved have agreed to the use of the app as a storage device for their medical records. The research subjects (players) will be asked by their club to consent to the creation of a medical record as would be normal procedure to facilitate medical care at their football club. This medical record will be in the form of the app designed for handheld use. As detailed in section 5 the app owners / developers Promote Scribe® will ensure data confidentiality with storage on a secure server. They will have a data sharing agreement with the University of Glasgow research team for use of anonymised data for research purposes. This data sharing agreement, data indemnification process and the relevant contracts are being produced at the time writing. Please see also section 13 regarding consent.

After consenting to the creation of the medical record the player may opt out from having data extracted for research. The players' medical treatment and care will thereafter be unaffected. Medical information is intended to be recorded for every clinical contact and limited data will be extracted continuously for research.

It is intended that the clinicians, predominantly team physiotherapists and doctors, will input clinical data regularly with each clinical contact documenting their normal clinical findings, investigations if relevant, management and whether or not the player is available for training or selection. The app will also have the facility for clinicians to document extensive background medical information, cardiac screening, drug testing and historical injury records but these will not be available for data extraction under the remit of this study. It is hoped that this will reduce the workload for those caring for the research subjects by replacing existing records.

Anonymised summary data will be circulated back to clubs to facilitate clinical governance and provide a breakdown of how their injury profile compares to competitor clubs in their league.

4. How will potential participants in the study be (i) identified, (ii) approached and (iii) recruited? Give details for cases and controls separately if appropriate.

All professional and semi-professional clubs in the SPFL have been contacted by email / letter via administrative and medical staff and have been offered inclusion in the study. Each individual player registered as available for the first team squads aged 16 or over will be asked to consent to involvement as discussed later in detail.

Consent will be obtained from players by the Club doctor/physiotherapist to allow their data to be used for research purposes.

5. What are the ethical considerations involved in this proposal? You may wish, for example, to comment on issues to do with consent, confidentiality, risk to subjects, etc.

There are a number of key ethical considerations to this proposal. These are as follows:

1. ***Consent***

The process for obtaining consent is detailed further in section 13 but a two-stage consent process is necessary. Firstly, for the creation of a medical record on the app, which will take the form of an electronic consent and privacy statement as part of the app construction. This is part of Promote Scribe's® development and will be supplemented by a paper university consent (as well as Privacy Notice) to create a medical record and is attached to this proposal as an appendix. Secondly, a consent process for players to have the opportunity to opt in or out of research data being extracted from their records, also included in the attached player consent form. As part of the issues surrounding consent it is also important to minimise any coercive element to the clubs' involvement that may influence an individual player's consent. Hence the player consent form is designed to minimise this.

2. ***IT Security / Confidentiality***

IT security is detailed in section 2 of the proposal as follows.

Data safety on device (usually android phone):

All data from the app is stored encrypted by default on the device. If the phone or tablet was stolen, the information is stored behind an android lock screen.

Data transfer to/from server:

This step is also encrypted. This is achieved by all data being sent over HTTPS, a secure version of the main web transfer protocol. This means data is encrypted before leaving the device and only decrypted once it arrives on the server.

Data security on the server:

(I) Hack Defence: Some security against hacking comes from the internet service provider while standard cloud services are designed to cope with attack, examples being Microsoft Azure, Google Cloud or Amazon AWS.

(II) Data Encryption: All data is stored on the server encrypted. Only once it's loaded into the server's memory is it decrypted.

(III) Data Access: In many ways this is the key to using the app as a working tool with both researchers and clinicians needing to access data. At present an API system is proposed which will allow authenticated clinical users to directly pull data from the server. This would be implemented using secure webservices. Authenticated researchers, including those involved in this proposal, will be given a communication key to securely pull data. Critically, that key can be mapped to specific data, meaning that only data authorised to be accessed can be seen. As a result, only the data points deemed necessary to that third party (this research team) will be available. Data extracted by the primary data holder (Promote Scribe®) is sent to the research team in an anonymised form hence the research team do not hold data that can link to the participants identity.

(IV) Data Anonymisation: Data will be processed after storage to separate personal from clinical data.

(V) Data Server Separation: If additional security is required, data can be stored on a dedicated server, separate from the website and public web services. The public server is the only computer that can access the data server. All other access is blocked.

GDPR Permissions:

All case data will be stored along with GDPR permissions. Any data access provided to third parties would automatically limit access to data that has the appropriate permissions. This will be built into the app with the appropriate defaults.

Promote Medical® are utilising the Firebase cloud-based server that is integrated into the Google platform and GDPR compliant.

Media

By virtue of the media attention that Scottish professional football receives, complete confidentiality and anonymity is unrealistic. If, for example, the research team is analysing data of a relatively unusual injury, it is highly likely that it would be possible to identify the individuals affected given that the date and player demographics are being analysed alongside the injury details and mechanism. However, as this information is also likely to be in the public domain due to media reporting it is unlikely this represents a major conflict for either clubs or players.

3. The Identification of Hazardous Care

In the process of collecting data it is possible that sub-optimal or hazardous care may be identified. This research is neither a monitoring project nor a punitive tool and although this information may be used as part of the analysis it will not be acted upon other than in the form of a learning point fed back to all clubs as part of their anonymised league summary data.

6. Outline the reasons why the possible benefits to be gained from the project justify any risks or discomforts involved.

There is a duty of care to provide robust clinical research and hence governance in any clinical population. Professional football in Scotland lacks such research and there is no widespread injury profiling to date. Arming clinicians involved in player care with injury data and associated education may be pivotal in preventative strategies at club level and could have a wider influence in policy and rule decisions, perhaps even in other sports or lower levels of amateur sport. The ethical considerations and risks in section 5 are key but, if minimised, should be outweighed by this potential gain.

Although all data in this study will be treated confidentially and will be anonymised, there is a possibility that a player could be identified if there is a specific/unusual injury, the information on which would already be in the public domain.

7. Who are the investigators (including assistants) who will conduct the research? What are their qualifications and experience?

The medical and injury data will be entered into records by medical and physiotherapy staff at each individual club.

Data collation and formulation of results for the study will be performed by Dr Thomas Kaye. Key relevant qualifications are: MBChB, DGM, MRCGP, MScSEM, FIFA Diploma in Football Medicine. This data and analysis will be overseen by Dr William Miller, Dr John MacLean and Dr Katy Stewart. Dr Kaye has experience of various research projects at undergraduate and post-graduate level including a dissertation in Sports Medicine and a post-graduate module in research methods.

8. Are arrangements for the provision of clinical facilities to handle emergencies necessary? If so, briefly describe the arrangements made.

Not applicable

9. In cases where subjects will be identified from information held by another party (e.g., a doctor or hospital), describe how you intend to obtain this information. Include, where appropriate, which Multi Centre Research Ethics Committee or Local Research Ethics Committee will be applied to.

Subjects identified directly by football clubs as all playing staff registered in the first team squad.

10. Specify whether subjects will include students or others in a dependent relationship and, where possible, avoid recruiting students who might feel to be, or be construed to be, under obligation to volunteer for a project. This is most likely to be when a student is enrolled on a course where the investigator is a teacher. In these circumstances, the recruitment could be carried out by one of the other investigators or a suitably qualified third party.

Not applicable

11. Specify whether the research will include children or participants with mental illness, physical disability or intellectual disability. If so, please explain the necessity of involving these

individuals as research subjects and include documentation of the suitability of those researchers who will be in contact with children (e.g., Disclosure Scotland or membership of the PVG Scheme).

It is the responsibility of clinicians working with these individuals to have the appropriate Disclosure Scotland or PVG scheme documentation up to date. Dr Kaye who will be handing data also has this appropriate clearance.

Although the involvement of individuals with physical or significant intellectual disability is unlikely in professional or semi-professional football, the prevalence of mental health issues in sport is the focus of much media and research interest. Although not a primary aim of this study, mental health may represent an important facet of player availability issues and hence may emerge as a theme as to why players are unavailable. No specific data pertaining to player mental health will otherwise be sought.

12. Will payment or other incentive, such as a gift or free services, be made to any research subject? If so, please specify, and state the level of payment to be made and/or the source of the funds/gift/free service to be used. Please explain the justification for offering an incentive.

There is no pecuniary interest and no incentive will be offered to any player involved in the research. It is proposed that the anonymised collated data will be presented back to individual football clubs as a means of internal governance of their injury rates, how these compare to other teams, and any specific issues that may have been raised.

There is also the planned facility within the app that football clubs will be able to adopt the format as a means of keeping player medical records, indeed this could replace any existing framework. Individual players could then hold a ‘read-only’ electronic copy of medical records that could follow them to other clubs in Scotland or representative teams. In effect there is the potential for a complete national player medical records system, with far reaching positive consequences for players, clinicians and football clubs alike.

13. Please give details of how consent is to be obtained. A copy of the proposed consent form, along with a separate information sheet, written in simple, non-technical language MUST ACCOMPANY THIS PROPOSAL FORM.

The research subjects will be asked to consent to their anonymised data being extracted from their electronic record. This medical record will be in the form of the app designed for handheld use and the app owners / developers Promote Scribe® will have a separate data sharing agreement for all data to remain confidential and stored on a secure server. The players will be asked to consent to limited anonymised data being extracted from the app via a specific data sharing agreement between Promote Scribe® and the research team. Please see attached consent and information sheets.

14. Comment on any cultural, social or gender-based characteristics of the subjects which have affected the design of the project or may affect its conduct.

This research will focus on professional and semi-professional football clubs with male playing staff. It is an aspiration that this research may extend to female professional football in Scotland, but it is not clear if the medical support staff infrastructure is sufficiently consistent to facilitate relevant data capture yet.

15. Please state (i) who will have access to the data, (ii) how the data will be stored, how will access be restricted, and (iii) what measures will be adopted to maintain the confidentiality of the research subjects and to comply with data protection requirements.

(i) As stated previously Dr Thomas Kaye will have primary access to the extracted anonymised data. The supervising research team, Dr William Miller, Dr John MacLean and Dr Katy Stewart, will also have access to data if needed

(ii) The raw data comprising the medical records will be encrypted and stored on a server, as detailed in Section 5 part 1. Dr Kaye will have access and store anonymised data for analysis on an encrypted home computer once extracted from injury records.

(iii) See section 5

In regard to (ii) above, please clarify (tick one) how the data will be stored:

[ ] **(a) in a fully anonymised form (link to subject broken),**

[X] **(b) in a linked anonymised form (data +/- samples linked to subject identification number but subject not identifiable to researchers), or**

[ ] **(c) in a form in which the subject could be identifiable to researcher.**

If data are stored in linked anonymised form, please state who will have access to the code and personal information about the subject.

The data will be held securely for a period of ten years after the completion of the research project, or for longer if specified by the research funder or sponsor, in accordance with the University's Code of Good Practice in Research.
(http://www.gla.ac.uk/media/media_227599_en.pdf**)** **Please tick** [✓]

16. To your knowledge, will the intended group of research subjects be involved in other research? If so, please justify.

Not applicable

17. Proposed starting date:

Full study - June 2019

Expected completion date:

End of Academic year 2020-21

18. Please state location(s) where the project will be carried out.

Data to be collected from professional and semi-professional football clubs within Scotland.

Research and analysis at the University of Glasgow.

19. Please state briefly any precautions being taken to protect the health and safety of researchers and others associated with the project (as distinct from the research subjects), e.g., where blood samples are being taken.

Not applicable

20. Please state all relevant sources of funding or support for this study.

The Scottish Football Association and the Hampden Sports Clinic will support the research but there is no specific funding.

21a). Are there any conflicts of interest related to this project for any member of the research team? This includes, but is not restricted to, financial or commercial interests in the findings. If so, please explain these in detail and justify the role of the research team. For each member of the research team please complete a declaration of conflicts of interest below.

Researcher Name: Dr Thomas Kaye conflict of interest **Yes** / No

One of Dr. Kaye's clinical roles is as a Sports Physician working at Falkirk Football Club. This has provided a significant benefit in the pilot phase of streamlining the process of reporting and data collection. During the full study an ongoing practical working knowledge of the data collection process is also key. There may also be a conflict in that as an employee of Falkirk Football Club the anonymised data for injuries will already be known to him at the point of analysis. However, maintaining the highest standards of probity, transparency and clinical care should mitigate against any reporting bias in injury data being entered into the medical records.

Researcher Name: Dr William Miller conflict of interest Yes / **No**

Researcher Name: Dr John MacLean conflict of interest Yes / **No**

Researcher Name: Dr Katy Stewart conflict of interest Yes / **No**

21b). If there are any conflicts of interest, please describe these in detail and justify conducting the proposed study.

No other conflict of interest

22. How do you intend to disseminate the findings of this research?

Clinical findings from the research will be fed back to individual clubs as summary data which identifies their club against anonymised peer clubs in their league. The wider research findings will be reported as part of the MD written report, scheduled to be produced during academic year 2020-21. There is also the potential for submissions to scientific or medical journals and presentations to conferences.

I confirm that have read the University of Glasgow's Data Protection Policy.
[http://www.gla.ac.uk/services/dpfoioffice/policiesandprocedures/dpa-policy/]

Please initial box WM

Name _______Dr. William Miller______________________ Date _________________
(Proposer of research)
Please type your name on the line above.

For student projects:

I confirm that I have read and contributed to this submission and believe that the methods proposed and ethical issues discussed are appropriate.

I confirm that the student will have the time and resources to complete this project.

Name ____ Date _________________
(Supervisor of student)
Please type your name on the line above.

Please upload the completed and signed form, along with other required documents by logging in to the Research Ethics System at - https://frontdoor.spa.gla.ac.uk/login/

STAY FIT Study

STudy of A Year in Football Injuries and Trauma

Season 2019-20 **14/5/19**

Information Sheet for Club Players

Invitation paragraph

You are being invited to take part in this research that aims to develop an anonymised database to support research to prevent and treat injuries in Scottish professional football. Before committing to being involved it is important that you are fully informed about the aims of this research and what is involved. Please read the following information in detail and discuss it with other players or staff at your club if you wish. The research group would welcome any questions and if you decide to participate you can retain this information sheet and a copy of the attached signed consent form. Thank you for reading this.

What is the purpose of the study?

The purpose of this study is to generate a unique research platform in professional football that will help physiotherapists, sport scientists and doctors working with teams to provide the best possible standardised care for players. This research will last for the 2019/20 season and all players at clubs across the four tiers of the Scottish Professional Football League will be invited. The injury data collected from each club will be used to investigate injury patterns as they relate to a number of variables. This will include number of matches, intensity of training, pitch surface type, player age and professional status. This nationwide research project is being undertaken at the University of Glasgow in conjunction with the Scottish Football Association and aims to contribute to a Medical Doctorate degree. It will utilise data obtained via the *ScribePro®* injury reporting app, developed by the team at *Promote Scribe®,* which will be provided to participating clubs without charge.

Why have I been invited to participate?

All clubs' medical staff and an administrative representative from each have been contacted regarding the project. Medical staff at your club will discuss with you and agree with you whether you wish to use the electronic record. They will receive individual training on use of this unique app designed for handheld devices. If you are using the electronic record and are over the age of 16 then you are eligible for inclusion in the study. It is hoped all players included in the first team squads at SPFL clubs will be involved and each will have a unique player profile created to last until the end of the 2019/20 football season in Scotland.

Do I have to take part?

No. Even if you use the electronic medical record, you do not need to take part. This would not affect your medical care in any way. You may withdraw from the study at any time.

What will happen to me if I take part?

If you agree to take part in the study your confidential anonymised data will form part of a large database. These data will be shared with researchers who will explore various factors related to injuries. Anonymised summaries and findings from this will be fed back to clubs to monitor injury patterns in the SPFL. The *ScribePro*® app has the facility to record investigation results and store images of injuries but these will neither be accessible to the team nor extracted for research.

What are the possible disadvantages and risks of taking part?

The anonymised data that will be extracted for research will include basic player demographics such as age and player position; number of minutes played and surface played on; and crucially, the details of each injury. There should be no disadvantage to any player involved in the study.

The study involves the use of anonymised data. The researchers should not be able to identify individuals but we cannot rule out players being identified if they suffer an unusual serious injury which may be reported in public domain by press or social media.

What are the possible benefits of taking part?

There may be no direct benefits to you. However the information collected during this research will help to build a better understanding of the factors that ensure a player can 'stay fit' and avoid injury.

Will my taking part in this study be kept confidential?

The anonymous data that is collected from player records during the study will be kept in the strictest possible confidence. As mentioned above there may be circumstances where a player could be identified by the research team as injury -related information may already be in the public domain. We will share summary anonymised data with other clubs but we do not hold your identifiable details so clearly won't share this with clubs.

What will happen to my data?

Data will be stored securely in line with the General Data Protection Regulations 2018. This means that the University and *ScribePro*® app are responsible for looking after your information and using it properly. We will not hold any personal data as part of the research. Medical data is inputted into the password protected app on the registered clinician's device. It is then uploaded to a cloud-based server. No data is stored on the individual device permanently. For the research, the stored information is ultimately extracted from the server and exported into a spreadsheet file where player details are anonymised for researchers to analyse.

What will happen to the results of the research study?

The results of the research will be published during the following football season but club-specific data will be fed back to the individual clubs at the end of season 2019/20, including how injury profiles compare to other teams in their league.

Who is organising and funding the research?

This research is supported by *Promote Scribe*®, the University of Glasgow and the Scottish Football Association but no specific funding has been received.

Who has reviewed the study?

The project has been reviewed by the College of Medical, Veterinary and Life Sciences Ethics Committee.

Contact for Further Information

If there is any part of the research about which you would like further information please make contact on the below email address. Thank you again for expressing your interest in this research.

Yours sincerely,

The Research Team

Contact: Dr. Thomas Kaye. University of Glasgow.
StayFit@hampdensportsclinic.com
Supervisor: Dr. William Miller. University of Glasgow
William.H.Miller@glasgow.ac.uk

Privacy Notice for STAYFIT. A Study of A Year of Football Injuries and Trauma

Your Personal Data

The University of Glasgow *will be what's known as the 'Data Controller' of your personal data processed in relation to the STAYFIT study that will investigate injury patterns in Scottish professional football. This privacy notice will explain how The University of Glasgow will process your personal data.*

Why we need it

We are collecting your basic personal data such as name, date of birth and playing position but these datasets will be anonymised before any research in undertaken. We are also collecting limited special categories data relating to injury and illness occurring during the football season in order to generate a large database of information from which patterns and reasons for injury can be identified. The outcome of this is intended to enhance future player safety and wellbeing. We will only collect data that we need in order to provide and oversee this service to you.

Legal basis for processing your data

We must have a legal basis for processing all personal data. In this instance, the legal basis is Article 6(1)(e) public task and, for the special category data, Article 9(2)(j) research purposes. Further consent in included in the participant consent form.

What we do with it and who we share it with

All the personal data submitted is stored by the third party providing the data collection app ScribePro®, parent company Promote Medical®. Anonymised data is then processed by the research team, staff at the University of Glasgow in the United Kingdom. Data is stored within the EEA on an encrypted cloud based server.

How long do we keep it for

Your anonymised data from football season 2019/20 will be retained by the University for 10 years in line with their data storage policy. After this time, data will be securely deleted. Your medical record created with ScribePro® may continue in the future depending on a further agreement with your club and the company but there will be no University of Glasgow involvement in data after football season 2019/20..

What are your rights?*

You can request access to the information we process about you at any time and you can have access to your medical record created at your club. You are not obliged to have a medical record created for you or to be involved in the research. If at any point you believe that the information we process relating to you is incorrect, you can request to see this information and may in some instances request to have it restricted, corrected or, erased. You may also have the right to object to the processing of data and the right to data portability. If you consent to having a medical record created and involvement in the study you may withdraw your consent at any time. Please see the research consent form.

If you wish to exercise any of these rights, please contact dp@gla.ac.uk.

*Please note that the ability to exercise these rights will vary and depend on the legal basis on which the processing is being carried out.

Complaints

If you wish to raise a complaint on how we have handled your personal data, you can contact the University Data Protection Officer who will investigate the matter.

Our Data Protection Officer can be contacted at dataprotectionofficer@glasgow.ac.uk

If you are not satisfied with our response or believe we are not processing your personal data in accordance with the law, you can complain to the Information Commissioner's Office (ICO) https://ico.org.uk/

STAYFIT Study
Consent Form for Doctors and Physiotherapists

The STAYFIT study is being undertaken by researchers at the University of Glasgow in conjunction with the Scottish Football Association. Every club in the four tiers of the SPFL is being invited to take part with the aim of generating a large research platform to investigate injury patterns in professional football in Scotland. It is hoped this will enable physiotherapists, sports therapists and doctors working with teams to provide the best possible standardised care for players in the future.

As a physiotherapist, sports therapist or doctor at one of the 42 SPL Clubs you will have personalised access to the highly developed medical records ScribePro® app. Before ScribePro® can provide access to their app, they will require your name and email address. To pass on this information we need your consent. In providing this information you are not committing to taking part in the research or consenting to the creation of any medical record.

I, ... (name) of ....
(Club) give informed consent to ScribePro® being sent my email address.

Signed ....

University of Glasgow | College of Medical, Veterinary & Life Sciences

Centre Number:

Project Number: xxxxxxxxx

Participant Identification Number for this trial:

Title of Project: **Study of A Year in Football Injuries and Trauma (STAY FIT) Pilot Phase**

Name of Researcher(s): Dr William H. Miller, Dr John MacLean, Dr Katy Stewart, Dr Thomas F Kaye

You have agreed with your Club that you consent to the use of an electronic medical record. As you have agreed to this, you are eligible to take part in a Research Study which will use your anonymised data as part of the project.

CONSENT FORM

Please initial box

I confirm that I have read and understood the Participant Information Sheet version xxxxx dated xx/xx/xxxx. ☐

I have had the opportunity to think about the information and ask questions, and understand the answers I have been given. ☐

I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my legal rights being affected. ☐

I confirm that I agree to the way my data will be collected and processed and that data will be stored for up to X years in University archiving facilities in accordance with relevant Data Protection policies and regulations. ☐

I understand that although my data will be anonymised, there is a possibility I could be identified from information available in the public domain. ☐

I agree that my name, contact details and data described in the information sheet will be kept for the purposes of this research project. ☐

I understand that if I withdraw from the study, my data collected up to that point will be retained and used for the remainder of the study. ☐

I agree to take part in the study. ☐

Name of participant	*Date*	*Signature*
Name of Person taking consent (if different from researcher)	*Date*	*Signature*
Researcher	*Date*	*Signature*

(1 copy for participant; 1 copy for researcher)

4

STAYFIT Pilot Phase Ethical Approval

STAYFIT Pilot Phase Ethical Approval removed due to confidentiality issues.

5
STAYFIT Ethical Approval

STAYFIT Ethical Approval removed due to confidentiality issues.

6
Data Protection Impact Assessment

Step 1: Identify the need for a DPIA

Explain broadly what the service/project aims to achieve and what type of processing it involves. You may find it helpful to refer or link to other documents, such as a project proposal. Summarise why you identified the need for a DPIA.

The STAY FIT (Study of A Year of Football Injuries and Trauma) project is prospective observational study for which two phases of data collection are proposed. The first phase, for which ethical approval has been received, is a pilot study involving 5 football clubs for the remainder of the football season 2018/19; the second phase being collection of injury data across all professional and semi-professional football clubs in Scotland throughout season 2019/20. I have attached the full ethical approval submission document for further information but I would be very happy to forward the original proposal from last year.

The aim of the pilot phase is to evaluate the effectiveness of medical information gathering and data extraction on a relatively small cohort of players in the Scottish Professional Football Leagues. Data will be recorded in the form of a rolling medical record by individual club clinicians using the ScribePro® app. ScribePro® and the parent company Promote Medical® are providing a means of data collection and secure storage. Anonymised data will then be extracted for the research team on specific parameters as listed below. Data processing and compliance with GDPR are at the core of the project. A DPIA will also help clarify the data protection impact of the app with the University and research team as data controllers.

Data will be collected to investigate the key themes listed below:

1. **Player / match demographics and how this relates to injury patterns**:

- Age
- Player position
- Number of games played / minutes on the pitch / match frequency
- Part time vs Full time contracted players
- Injury occurring during match vs training

2. **Pitch surface**:

As well as looking at simple injury rates on artificial surfaces vs grass, there are distinct groups of players as follows:

- Training on artificial surface / playing matches on grass
- Training on artificial surface / playing matches on artificial
- Training on grass surface / playing matches on grass
- Training on grass surface / playing matches on artificial
- Do the above groups relate to specific types of injury or confer a different risk of overall injury?
- Do the teams playing on predominantly artificial surfaces differ in injury rates and can this be associated with precise type of artificial pitch and how well maintained / when installed?

3. **Seasonal variation**:

- Is there a pattern of variation in player injury depending on season / climate?
- Is there a pattern of seasonal variation that depends on pitch surface?

4. **Type of Injury**:

- A review of incidence of different anatomical injuries (related to above variables but also tabulated to correspond to individual clubs)

- A review of incidence of different injury mechanisms including contact or non-contact (related to above variables but also tabulated to correspond to individual clubs)
- A review of injury severity – measured by number of days unavailable and hence ‘injury burden’.

5. **Injury rehabilitation and head injuries**:

- Are national head injury guidelines being adhered to?
- Is SCAT (Sport Concussion Assessment Tool) being used appropriately?
- Do recovery rates vary depending on above variables?

The above categories demonstrate data that may fall into a variety of categories, some of which may be regarded as medical and hence could be considered different as per GDPR, but also some more demographic data.

Having considered the guidelines on DPIA, below are the potential factors that may be ‘high risk’ data processing:

1. data including health / injury parameters
2. sensitive injury / health data
3. full study may encompass 1000 players over up to 70 games in a season – large data quantity
4. participants must be16+, no reason to suspect they will be otherwise vulnerable and all fully consented
5. evaluating /scoring occurring at a club level

Step 2: Describe the processing

2.1 Describe the nature of the processing: how will you collect, use, store and delete data? What is the source of the data? Will you be sharing data with anyone? You might find it useful to refer to a flow diagram or another way of describing data flows. What types of processing identified as likely high risk are involved?

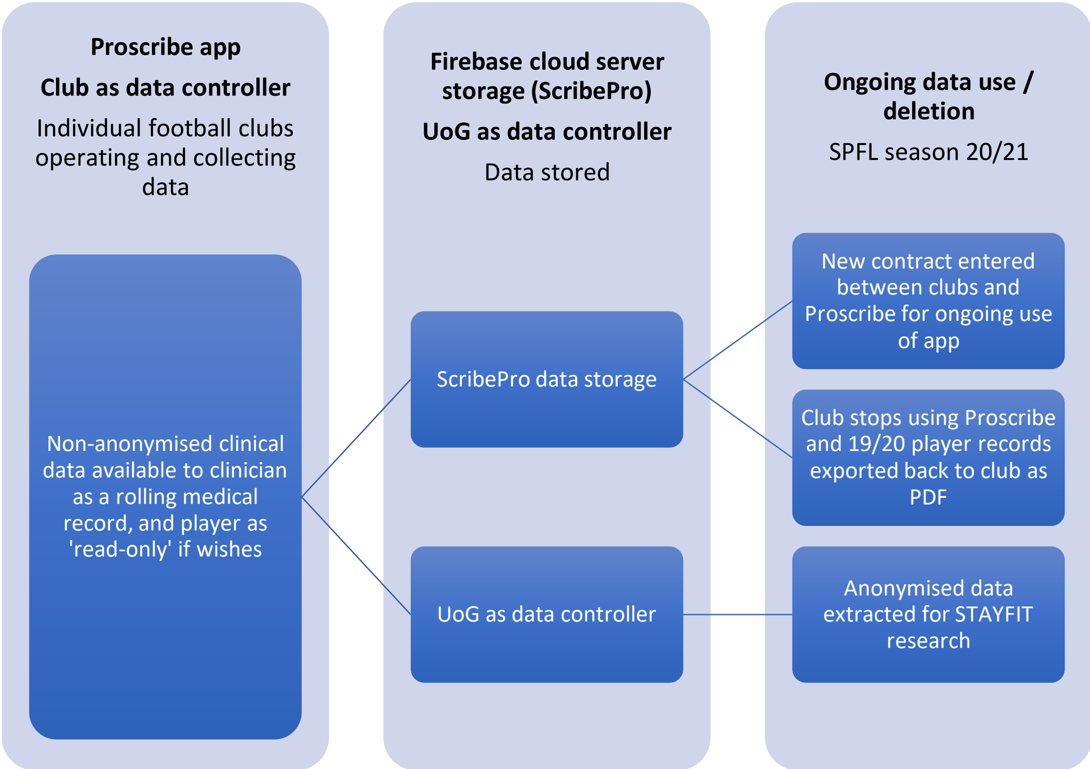
Data will be collected by club clinicians after players have consented to the creation of a player record. Players will also be asked to consent to anonymised data being extracted for research purposes. Data will be inputted into the password protected ScribePro® app on a phone or tablet. Data is then uploaded using Firebase, an elastic cloud-based server with multiple centres worldwide. ScribePro® are using the Europe-West3, physically located in Frankfurt, Germany. This service is integrated into the Google platform and is established as GDPR compliant. No data is stored on the device permanently. The app allows only the registered user to access the raw clinical player data for whom they provide care on their device. Before extraction for analysis ScribePro® will anonymise player data and assign random unique identifiers to the individuals. The injury information stored is ultimately extracted from the server and exported into a csv / excel file held on the University of Glasgow OneDrive for research purposes. As a result of the limited player numbers, datasets being linked to clubs for comparison, the fact that injuries will occur in the public domain and that many of these will be publicised across media platforms, true anonymisation is not possible.

For the duration of the pilot and full study the ScribePro® app is being supplied for use free of charge. After the end of the 2019/20 season there will be an opportunity for the individual football clubs to purchase ongoing use of the app however the University will cease to be involved. The clinical data held from the 19/20 season will remain available to the clinicians as a means of a rolling medical record but research data will be archived and deleted in line with University procedure. As well as the University, individual clubs will be data controllers however this is a situation that already exists as they already compile rolling paper-based medical records. Each club secretary (and hence management) have been informed about this by letter and e-mail as part of the involvement in the study.

The legal basis for data processing is Article 6(1)(e) public task and, for the special category data, Article 9(2)(j) research purposes. Further player consent is included in the participant consent form, constructed in line with the ethics committee requirements and University template.

The anonymised data being used for research will not be shared out with the research team. It is the aim of the research that a summary of all injuries sustained at each football club will be fed back to the club as a means of internal clinical governance.

In terms of data flow, a data sharing agreement will be required between the University and the ScribePro® app team. Below is flow chart to represent the data flow for the full study, season 2019/20



As well as the individual consent forms and participant information sheets, there is a privacy notice built into ScribePro® app but each club and individual participant will also be supplied with the privacy notice produced in line with the University of Glasgow template (see attached privacy notice, consent form and participant information sheet).

2.2 Describe the scope of the processing: what is the nature of the data, and does it include special category or criminal offence data? How much data will you be collecting and using? How often? How long will you keep it? How many individuals are affected? What geographical area does it cover?
The nature of the data is described above. As there is medical data included and the app will have the capability to document illness and medical screening data, the data should be considered a medical record and hence could be considered as special category. During the pilot phase it is intended that data will be collected for 3 or 4 weeks at the end of football season 18/19 across 5 professional clubs. This is likely to include a first team playing squad of around 20 players at each club. It is unknown how many of these players will have an injury or illness to document during this short time but each player will have a medical record created with basic information such as name, date of birth, own GP, height, weight, position, preferred foot and a player photo. For the full study, in season 2019/20, it is the intention to involve all 42 football clubs in the four tiers of the SPFL with the resultant likely inclusion of around 1000 players. These players will only be those registered in Scotland although it is feasible that an injury may occur when playing or training abroad but representing a Scottish club or national team. All data will be held within an EEA server. The STAYFIT study will extract only anonymised data on very specific data points and parameters as this pertains to the above aims. It is the current intent to extract this data monthly to begin analysis. At the end of the 2019/20 season data collection for the university study will cease. Research data will be stored and deleted in line with University protocols.

2.3 Describe the context of the processing: what is the nature of your relationship with the individuals? How much control will they have? Would they expect you to use their data in this way? Do they include children or other vulnerable groups? Are there prior concerns over this type of processing or security flaws? Is it novel in any way? What is the current state of technology in this area? Are there any current issues of public concern that you should factor in? Are you signed up to any approved code of conduct or certification scheme (once any have been approved)?
The research team will have no direct relationship with the vast majority of the individuals. Each club clinician will have received face-to-face training in how to use the app and enter data. As mentioned above, each player will receive a participant information sheet and consent form. The research team is made up of a postgraduate MD research student and three existing staff members at the University of Glasgow. As a result there will be no data access to any person not affiliated with the University. The team includes doctors who have clinical roles working with professional players. When working in these clinical roles they will be using the app and functioning as per any other clinician in football, entering data on episodes of care. Although they will know this cohort of individuals personally there will be no coercive element to player involvement. Players will be able to see what is entered in their medical records if they wish as per GDPR but will be unable to edit these, this responsibility will be in the clubs' domain as data controllers. Data will be in those aged 16+ only and should involve no specific vulnerable groups. The use of an app / online platform in creation of a player medical record is not novel and used regularly at upper echelons of professional football but standardising a reporting system across multiple teams and leagues is a new development. Other than the university code of conduct and medical / GMC obligations / PVG status, there are no other specific certification schemes / approved codes of conduct yet involved.
2.4 Describe the purposes of the processing: what do you want to achieve? What is the intended effect on individuals? What are the benefits of the processing for you, and more broadly?
The intent of the project is to provide an important means for research of football injuries and clinical governance in Scotland, where at present there is none. This should improve player safety, welfare and medical care. The research team has no pecuniary interest in the project nor the app but it is hoped this will provide the basis for an MD for the lead researcher – Dr. Thomas Kaye MBChB DGM MRCGP MScSEM

Step 3: Consultation process

Consider how to consult with relevant stakeholders: describe when and how you will seek individuals' views – or justify why it's not appropriate to do so. Who else do you need to involve within your organisation? Do you need to ask your processors to assist? Do you plan to consult information security experts, or any other experts?

The key technological expertise comes from within the Proscribe / Promote medical team and the relevant app developers. In terms of security the issues closely dovetail with the key ethical concepts of the project and these are summarised below.

4. ***Consent***

   The process for obtaining consent is two-stage. Firstly for the creation of a medical record on the app, which will take the form of an electronic consent and privacy statement as part of the app construction. This is part of ScribePro® development and will be supplemented by a paper university consent to create a medical record and is attached to this proposal as an appendix. Secondly, a consent process for players to have the opportunity to opt in or out of research data being extracted from their records, also included in the attached player consent form. As part of the issues surrounding consent it is also important to minimise any coercive element to the clubs' involvement that may influence an individual player's consent. Hence the player consent form is designed to minimise this.

5. ***IT Security / Confidentiality***

   IT security is detailed in section 2 of the proposal as follows.

   Data safety on device (usually android phone):

   All data from the app is stored encrypted by default on the device. If the phone or tablet was stolen, the information is stored behind an android lock screen.

   Data transfer to/from server:

   This step is also encrypted. This is achieved by all data being sent over HTTPS, a secure version of the main web transfer protocol. This means data is encrypted before leaving the device and only decrypted once it arrives on the server.

   Data security on the server:

   (I) Hack Defence: Some security against hacking comes from the internet service provider while standard cloud services are designed to cope with attack, examples being Microsoft Azure, Google Cloud or Amazon AWS.

   (II) Data Encryption: All data is stored on the server encrypted. Only once it's loaded into the server's memory is it decrypted.

   (III) Data Access: In many ways this is the key to using the app as a working tool with both researchers and clinicians needing to access data. At present an API system is proposed which will allow authenticated clinical users to directly pull data from the server. This would be implemented using secure webservices. Authenticated researchers, including those involved in this proposal, will be given a communication key to securely pull data. Critically, that key can be mapped to specific data, meaning that only data authorised to be accessed can be seen. As a result, only the data points deemed necessary to that third party (this research team) will be available. Data extracted by the primary data holder (ScribePro®) is sent to the research team in an anonymised hence the research team do not hold data that can link to the participants identity.

(IV) Data Anonymisation: Data will be processed after storage to separate personal from clinical data.

(V) Data Server Separation: If additional security is required, data can be stored on a dedicated server, separate from the website and public web services. The public server is the only computer that can access the data server. All other access is blocked.

GDPR Permissions:

All case data will be stored along with GDPR permissions. This will be built into the app with the appropriate defaults.

ScribePro® are utilising the Firebase cloud-based server, as discussed previously, that is integrated into the Google platform and GDPR compliant.

(details: https://firebase.google.com/support/guides/locations)

Media

By virtue of the media attention that Scottish professional football receives, complete confidentiality and anonymity is unrealistic. If, for example, the research team is analysing data of a relatively unusual injury, it is highly likely that it would be possible to identify the individuals affected given that the date and player demographics are being analysed alongside the injury details and mechanism. However, as this information is also likely to be in the public domain due to media reporting it is unlikely this represents a major conflict for either clubs or players.

6. The Identification of Hazardous Care

In the process of collecting data it is possible that sub-optimal or hazardous care may be identified. This research is neither a monitoring project nor a punitive tool and although this information may be used as part of the analysis it will not be acted upon other than in the form of a learning point fed back to all clubs as part of their anonymised league summary data.

Step 4: Assess necessity and proportionality

Describe compliance and proportionality measures, in particular: what is your lawful basis for processing? Does the processing actually achieve your purpose? Is there another way to achieve the same outcome? How will you prevent function creep? How will you ensure data quality and data minimisation? What information will you give individuals? How will you help to support their rights? What measures do you take to ensure processors comply? How do you safeguard any international transfers?

The pilot study was designed to ensure the data collection and anonymised extraction works. Collection of data from the full study will create an unprecedented database in professional football over one season and hence a platform for research that should achieve all of the intended goals. The research team believes that this process is the only feasible means by which to collect robust unbiased injury data across a large population in professional football.

The data extracted for the research team will be limited to the intended parameters of the study only. There should be no function creep as a result.

The participant information sheet and consent form are attached with the ethical approval documentation.

Step 5: Identify and assess risks

Describe the source of risk and nature of potential impact on individuals. Include associated compliance and corporate risks as necessary.	Likelihood of harm	Severity of harm	Overall risk
	Remote, possible or probable	Minimal, significant or severe	Low, medium or high
The key risk to individuals is that their clinical information being extracted for research purposes may not be completely anonymous. This is based in the fact that their injuries often occur and are reported in the public domain. It is likely therefore that researchers may be inadvertently able to identify an individual.	Remote	Minimal / nil	Low
It is the intent of the research team to feedback a club injury summary at the end of season 19/20 as a means of internal club clinical governance. Injury profiles will be compared anonymously to other clubs in the same league. This will be supplied to the club medical staff but if medical staff pass this information to non-medical staff or management there is the possibility this could create internal club conflict.	Remote	Minimal	Low
Breaches of confidentiality by club clinicians in data inputting, however this will be part of club responsibility as data controllers. Although a significant risk, individual clinicians are governed by their own codes of practice and will be briefed about the confidentiality features of the app at training. The research lead and data processor has undertaken UoG GDPR training module and data management modules as part of MD.	Possible	Significant	Medium

Step 6: Identify measures to reduce risk

Identify additional measures you could take to reduce or eliminate risks identified as medium or high risk in step 5

Risk	Options to reduce or eliminate risk	Effect on risk	Residual risk	Measure approved

	As noted above	Eliminated, reduced or accepted	Low, medium or high	Yes/no

Step 7: Sign off and record outcomes

Item	**Name/date**	**Notes**
Measures approved by:		Integrate actions back into project plan, with date and responsibility for completion
Residual risks approved by:		If accepting any residual high risk, consult the ICO before going ahead
DP & FOI Office advice provided:	Helen McKellar	DP & FOI Office should advise on compliance, step 6 measures and whether processing can proceed

Summary of DPO advice:

- Requirement to put in place a data processing agreement with Promote Medical for use of the ScribePro app in order that the University is in compliance with Article 28 of GDPR. Taken forward by the Contracts Team.
- Ensuring club management/secretariat is aware of the project and use of the ScribePro app in relation their own obligations as data controllers.

- Ensuring players understand how their personal and special category data will be processed by the University by supplying a Privacy Notice. - Completion of GDPR and Information Security training by the Project team.		
DPO advice accepted or overruled by:		If overruled, you must explain your reasons
Comments:		
Consultation responses reviewed by:		If your decision departs from individuals' views, you must explain your reasons
Comments:		
This DPIA will be kept under review by:		The DPO should also review ongoing compliance with DPIA

7
Data Management Plan

University of Glasgow
Data Management Plan Year 2

1. Overview	
Student name	Dr. Thomas F. Kaye
Supervisor name	Dr. William Miller, Dr. John MacLean, Dr. Katy Stewart
Project title	STAYFIT – STudy of A Year of Football Injuries and Trauma
Funder & award number	Self-Funding. Study in conjunction with Scottish Football Association
Project Summary	The STAY FIT (Study of A Year of Football Injuries and Trauma) project is a prospective observational study designed to collect and analyse injury and illness data in Scottish professional and semi-professional football. The research was based around data collection throughout the football season 19/20, now severely curtailed by the COVID-19 pandemic. The aim of the study is to create a large database of injuries sustained in a single football season from which injury patterns can be investigated.

2. Data
What types of data will be collected or created?

Data has been collected to investigate the key themes listed below:

1. **Player / match demographics and how this relates to injury patterns**:

- Age
- Player position
- Number of games played / minutes on the pitch / match frequency
- Part time vs Full time contracted players
- Injury occurring during match vs training

2. **Pitch surface**:

As well as looking at simple injury rates on artificial surfaces vs grass, there are distinct groups of players as follows:

- Training on artificial surface / playing matches on grass
- Training on artificial surface / playing matches on artificial
- Training on grass surface / playing matches on grass
- Training on grass surface / playing matches on artificial
- Do the above groups relate to specific types of injury or confer a different risk of overall injury?
- Do the teams playing on predominantly artificial surfaces differ in injury rates and can this be associated with precise type of artificial pitch and how well maintained / when installed?

3. **Seasonal variation**:

- Is there a pattern of variation in player injury depending on season / climate?
- Is there a pattern of seasonal variation that depends on pitch surface?

4. **Type of Injury**:

- A review of incidence of different anatomical injuries (related to above variables but also tabulated to correspond to individual clubs)

- A review of incidence of different injury mechanisms including contact or non-contact (related to above variables but also tabulated to correspond to individual clubs)
- A review of injury severity – measured by number of days unavailable and hence 'injury burden'.

5. **Injury rehabilitation and head injuries**:

- Are national head injury guidelines being adhered to?
- Is SCAT (Sport Concussion Assessment Tool) being used appropriately?
- Do recovery rates vary depending on above variables?

The above categories demonstrate data that may fall into a variety of categories, some of which may be regarded as medical and hence could be considered different as per GDPR, but also some more demographic data.

Having considered the guidelines on DPIA, below are the potential factors that may be 'high risk' data processing:

1. data including health / injury parameters
2. sensitive injury / health data
3. full study may encompass 1000 players over up to 70 games in a season – large data quantity
4. participants must be16+, no reason to suspect they will be otherwise vulnerable and all fully consented

What formats will you use?

- Excel spreadsheet data -> .csv format

How much data will you collect?

The aim was to collect demographic and injury data on up to 1000 footballers over an entire football season. As a result of the COVID-19 pandemic the duration of this data collection has been curtailed. The number of clubs involved in submitting data was significantly fewer that the project was designed for. The reasons for this are discussed in detail elsewhere. The format of data in spreadsheet form is much less than the initial limitation of 1TB.

3. Documentation

How will the data be documented and described?

Data will be recorded in the form of a rolling medical record by individual club clinicians using the ScribePro® app. ScribePro® and the parent company Promote Medical® are providing a means of data collection and secure storage. Anonymised data will then be extracted for the research team on specific parameters as listed above. Injuries will be analysed and coded according to the standardised Orchard Injury Coding system.

At the time of writing the above database interrogation has commenced using the SPSS statistics programmes to research potential injury patterns. Data processing and compliance with GDPR are at the core of the project. The previously submitted DPIA also helps clarify the data protection impact of the app with the University and research team as data controllers.

Are there any standards for this in your field of research?
The UEFA Elite Club Injury Study is the gold standard study in the research area. Club clinicians providing data for this research send completed standardised forms to a UEFA processing centre. No uniform standardised electronic tool is being used in other professional football leagues.

4. Ethics and Intellectual Property
Who owns the data in your project?
A data sharing agreement has been signed between the University of Glasgow and ScribePro©. ScribePro© are providing a data collection and storage facility. The intellectual property of the project is owned by the research team named above.
Detail any ethical, legal or commercial considerations relating to your research data
A detailed ethical submission has been made. A DPIA and Privacy notice have also been completed.
How will these concerns be dealt with?
See DPIA / Privacy notice / Ethical approval and Data Sharing Agreement submitted at end of MD year 1.

5. Storage and organisation
How will the data be named, organised and structured?
Data will be named according to standard UoG file naming convention with chronological ordering. Data will be organised into working copy folders with Readme files attached
How will the data be stored for the duration of the project?
Data will be stored in the UoG OneDrive – derived Excel data from ScribePro©. ScribePro© are storing data on an encryted cloud server. The Firebase Cloud is part of the google platform and is based within the EU in Frankfurt. It is GDPR compliant and no data will be taken out of the EU for the duration of the project.
How will the data be backed up during the project?
UoG's OneDrive system performs an automatic back-up
Does access to the data need to be controlled for the duration of the project?
Who has the right to access the data during the project?
The data can be accessed by the above research team only. Player's raw data will also be accessible to players and clinicians as rolling medical record but a separate agreement will be in place between the app developers and clubs.

6. Deposit and long-term preservation
Which data should be retained long-term?

Raw data, statistical analysis and details of outcomes from statistical analysis

How long will data be retained for?

At least 10 yrs as per UoG archiving policy

Where will the data be archived at the end of the project?

University repository – Enlighten: Research Data

What formats will the data be archived in?

7. Data sharing

Is any of the data suitable for sharing?

In future this anonymised data may be suitable for sharing from the University repository.

How will the data be shared?

Shared from University repository

Who should be able to access and use the shared data?

Those undertaking equivalent / relevant research

8. Implementation

Who is responsible for implementing this plan?

Dr. T. Kaye

How will this plan be kept up-to-date?

Annual data management plan update as part of project assessment. Ad-hoc updates as part of running project meetings with supervisory group.

What actions are necessary to implement this plan?

Regular review and correspondence with University supervisory group and ScribePro App developers.

What training or further information are needed to implement this plan?

Further statistics training / re-training for sound data analysis

8

Data Processing and Storage Agreement

DATA CONTROLLER – DATA PROCESSOR

DATA PROCESSING AGREEMENT

between

THE UNIVERSITY COURT OF THE UNIVERSITY GLASGOW

and

SCRIBEPRO LIMITED

Dated: 12 July 2019

Document Template: Data Controller to Processor Agreement (within EEA)
Version Date: 30 April 2018

9

Orchard Sports Injury and Illness Classification System v13.4

Example

OSIICS 13 code	Diagnosis	ody par	Tissue type	athology typ	dical Syst	Etiology	ICD11	CD11 Diagnosi	ICD10 code	ICD9 code	10 code	OSICS10 diagnosis	S9 code	OSICS9 diagnosis
HV1	Head/facial contusion/haematoma	Head	Vessels	Contusion/vascular			NA00.7	Contusion of other or unspecified sites of head	S09.9	910.0	HHXX	Head / Facial Bruising/Haematoma	HH1	Head/facial contusion/haematoma
HVN	Nose contusion/haematoma	Head	Vessels	Contusion/vascular			NA0		S00.3	920.0	HHNX	Nose bruising/Haematoma	HHN	nose contusion/haematoma
HLJ	Jaw bruising/haematoma	Head	Ligament/joint capsule	Ligament			NA05	Injury of blood vessels of head			HHJX	Jaw bruising/haematoma		
HK1	Head/facial laceration	Head	Superficial tissues/skin	Laceration			NA01	Open wound of head	S01	873.0	HKXX	Head laceration/abrasion		
HF1	Nose fracture	Head	Bone	Fracture			NA02.3	Fracture of nasal bones	S02.2	802.0	HFNX	Nasal fracture	HF1	Nose fracture
HF3	Mandible fracture	Head	Bone	Fracture			NA02.7	Fracture of mandible	S02.6		HFMX	Mandibular fracture	HF3	Mandible fracture
HN1	Concussion	Head	Nervous system	Nerve injury			NA07.0	Concussion	F07.2	851.0	HNCX	Concussion	HN1	Concussion
HZN	Head/neck impact not diagnosed as concussion	Head	Non-specific	Unknown			NA0				HXNC			
HO1	Eye injury/trauma	Head	Internal organs	Organ trauma			NA0		H57	371.0	HOOX	Eye injury/trauma	HO1	Eye injury/trauma
HFT	Avulsed/fractured tooth	Head	Bone	Fracture			NA0		S09.8	521.9	HODX	Dental Injury	HG1	Avulsed/fractured tooth
HP1	Functional head pain	Head	Non-specific	Pain without tissue type specified							HZXX	Head Pain/Injury Not Otherwise Specified (Including headache)		
NPH	Cervicogenic headache	Neck	Non-specific	Pain without tissue type specified							HZNX	Cervicogenic headache		
HZ1	Headache/pain undiagnosed	Head	Non-specific	Unknown			NA0		S06.3	851.0	HZZX	Other head pain/injury not otherwise specified	HZ1	Headache/pain undiagnosed
NH1	Neck contusion/haematoma	Neck	Muscle/tendon	Muscle contusion			NA2		S10.0	920.0	NHXX	Neck Soft Tissue Bruising/Haematoma	NH1	Neck contusion/haematoma
NLW	Whiplash/neck sprain	Neck	Ligament/joint capsule	Ligament			NA23.4	Strain or sprain of cervical spine	S16	723.8	NWXX	Whiplash	NJ1	Whiplash/neck sprain
NMT	Neck muscle trigger pts/spasm/torticollis	Neck	Muscle/tendon	Muscle injury			NA2		R25.2	723.8	NMYX	Neck muscle spasm/trigger points incl torticollis	NY1	Neck muscle trigger pts/spasm/torticollis

10
Letter from Ethics for Evaulation

Letter from Ethics for Evaluation removed due to confidentiality issues.

11
SCAT5 Concussion Assessment Tool

1

IMMEDIATE OR ON-FIELD ASSESSMENT

The following elements should be assessed for all athletes who are suspected of having a concussion prior to proceeding to the neurocognitive assessment and ideally should be done on-field after the first first aid / emergency care priorities are completed.

If any of the "Red Flags" or observable signs are noted after a direct or indirect blow to the head, the athlete should be immediately and safely removed from participation and evaluated by a physician or licensed healthcare professional.

Consideration of transportation to a medical facility should be at the discretion of the physician or licensed healthcare professional.

The GCS is important as a standard measure for all patients and can be done serially if necessary in the event of deterioration in conscious state. The Maddocks questions and cervical spine exam are critical steps of the immediate assessment; however, these do not need to be done serially.

STEP 1: RED FLAGS

RED FLAGS:

- **Neck pain or tenderness**
- **Double vision**
- **Weakness or tingling/ burning in arms or legs**
- **Severe or increasing headache**
- **Seizure or convulsion**
- **Loss of consciousness**
- **Deteriorating conscious state**
- **Vomiting**
- **Increasingly restless, agitated or combative**

STEP 2: OBSERVABLE SIGNS

Witnessed ☐ Observed on Video ☐

Lying motionless on the playing surface	Y	N
Balance / gait difficulties / motor incoordination: stumbling, slow / laboured movements	Y	N
Disorientation or confusion, or an inability to respond appropriately to questions	Y	N
Blank or vacant look	Y	N
Facial injury after head trauma	Y	N

STEP 3: MEMORY ASSESSMENT MADDOCKS QUESTIONS[2]

"I am going to ask you a few questions, please listen carefully and give your best effort. First, tell me what happened?"

Mark Y for correct answer / N for incorrect

What venue are we at today?	Y	N
Which half is it now?	Y	N
Who scored last in this match?	Y	N
What team did you play last week / game?	Y	N
Did your team win the last game?	Y	N

Note: Appropriate sport-specific questions may be substituted.

Name: ____________________

DOB: ____________________

Address: ____________________

ID number: ____________________

Examiner: ____________________

Date: ____________________

STEP 4: EXAMINATION GLASGOW COMA SCALE (GCS)[3]

Time of assessment			
Date of assessment			
Best eye response (E)			
No eye opening	1	1	1
Eye opening in response to pain	2	2	2
Eye opening to speech	3	3	3
Eyes opening spontaneously	4	4	4
Best verbal response (V)			
No verbal response	1	1	1
Incomprehensible sounds	2	2	2
Inappropriate words	3	3	3
Confused	4	4	4
Oriented	5	5	5
Best motor response (M)			
No motor response	1	1	1
Extension to pain	2	2	2
Abnormal flexion to pain	3	3	3
Flexion / Withdrawal to pain	4	4	4
Localizes to pain	5	5	5
Obeys commands	6	6	6
Glasgow Coma score (E + V + M)			

CERVICAL SPINE ASSESSMENT

Does the athlete report that their neck is pain free at rest?	Y	N
If there is NO neck pain at rest, does the athlete have a full range of ACTIVE pain free movement?	Y	N
Is the limb strength and sensation normal?	Y	N

In a patient who is not lucid or fully conscious, a cervical spine injury should be assumed until proven otherwise.

3

STEP 3: COGNITIVE SCREENING

Standardised Assessment of Concussion (SAC)[4]

ORIENTATION

What month is it?	0	1
What is the date today?	0	1
What is the day of the week?	0	1
What year is it?	0	1
What time is it right now? (within 1 hour)	0	1
Orientation score		of 5

IMMEDIATE MEMORY

The Immediate Memory component can be completed using the traditional 5-word per trial list or optionally using 10-words per trial to minimise any ceiling effect. All 3 trials must be administered irrespective of the number correct on the first trial. Administer at the rate of one word per second.

Please choose EITHER the 5 or 10 word list groups and circle the specific word list chosen for this test.

I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order. For Trials 2 & 3: I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before.

List	Alternate 5 word lists					Score (of 5) Trial 1	Trial 2	Trial 3
A	Finger	Penny	Blanket	Lemon	Insect			
B	Candle	Paper	Sugar	Sandwich	Wagon			
C	Baby	Monkey	Perfume	Sunset	Iron			
D	Elbow	Apple	Carpet	Saddle	Bubble			
E	Jacket	Arrow	Pepper	Cotton	Movie			
F	Dollar	Honey	Mirror	Saddle	Anchor			
					Immediate Memory Score			of 15
					Time that last trial was completed			

List	Alternate 10 word lists					Score (of 10) Trial 1	Trial 2	Trial 3
G	Finger	Penny	Blanket	Lemon	Insect			
	Candle	Paper	Sugar	Sandwich	Wagon			
H	Baby	Monkey	Perfume	Sunset	Iron			
	Elbow	Apple	Carpet	Saddle	Bubble			
I	Jacket	Arrow	Pepper	Cotton	Movie			
	Dollar	Honey	Mirror	Saddle	Anchor			
					Immediate Memory Score			of 30
					Time that last trial was completed			

Name: ______________________

DOB: ______________________

Address: ______________________

ID number: ______________________

Examiner: ______________________

Date: ______________________

CONCENTRATION

DIGITS BACKWARDS

Please circle the Digit list chosen (A, B, C, D, E, F). Administer at the rate of one digit per second reading DOWN the selected column.

I am going to read a string of numbers and when I am done, you repeat them back to me in reverse order of how I read them to you. For example, if I say 7-1-9, you would say 9-1-7.

Concentration Number Lists (circle one)					
List A	List B	List C			
4-9-3	5-2-6	1-4-2	Y	N	0
6-2-9	4-1-5	6-5-8	Y	N	1
3-8-1-4	1-7-9-5	6-8-3-1	Y	N	0
3-2-7-9	4-9-6-8	3-4-8-1	Y	N	1
6-2-9-7-1	4-8-5-2-7	4-9-1-5-3	Y	N	0
1-5-2-8-6	6-1-8-4-3	6-8-2-5-1	Y	N	1
7-1-8-4-6-2	8-3-1-9-6-4	3-7-6-5-1-9	Y	N	0
5-3-9-1-4-8	7-2-4-8-5-6	9-2-6-5-1-4	Y	N	1
List D	List E	List F			
7-8-2	3-8-2	2-7-1	Y	N	0
9-2-6	5-1-8	4-7-9	Y	N	1
4-1-8-3	2-7-9-3	1-6-8-3	Y	N	0
9-7-2-3	2-1-6-9	3-9-2-4	Y	N	1
1-7-9-2-6	4-1-8-6-9	2-4-7-5-8	Y	N	0
4-1-7-5-2	9-4-1-7-5	8-3-9-6-4	Y	N	1
2-6-4-8-1-7	6-9-7-3-8-2	5-8-6-2-4-9	Y	N	0
8-4-1-9-3-5	4-2-7-9-3-8	3-1-7-8-2-6	Y	N	1
		Digits Score:			of 4

MONTHS IN REVERSE ORDER

Now tell me the months of the year in reverse order. Start with the last month and go backward. So you'll say December, November. Go ahead.

Dec - Nov - Oct - Sept - Aug - Jul - Jun - May - Apr - Mar - Feb - Jan	0 1
Months Score	of 1
Concentration Total Score (Digits + Months)	of 5

4

STEP 4: NEUROLOGICAL SCREEN

See the instruction sheet (page 7) for details of test administration and scoring of the tests.

Can the patient read aloud (e.g. symptom check-list) and follow instructions without difficulty?	Y	N
Does the patient have a full range of pain-free PASSIVE cervical spine movement?	Y	N
Without moving their head or neck, can the patient look side-to-side and up-and-down without double vision?	Y	N
Can the patient perform the finger nose coordination test normally?	Y	N
Can the patient perform tandem gait normally?	Y	N

BALANCE EXAMINATION

Modified Balance Error Scoring System (mBESS) testing[5]

Which foot was tested (i.e. which is the non-dominant foot) ☐ Left ☐ Right

Testing surface (hard floor, field, etc.) ____________________

Footwear (shoes, barefoot, braces, tape, etc.) ____________________

Condition	Errors
Double leg stance	of 10
Single leg stance (non-dominant foot)	of 10
Tandem stance (non-dominant foot at the back)	of 10
Total Errors	of 30

Name: ____________________

DOB: ____________________

Address: ____________________

ID number: ____________________

Examiner: ____________________

Date: ____________________

5

STEP 5: DELAYED RECALL:

The delayed recall should be performed after 5 minutes have elapsed since the end of the Immediate Recall section. Score 1 pt. for each correct response.

Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you can remember in any order.

Time Started ________

Please record each word correctly recalled. Total score equals number of words recalled.

____

____

____

Total number of words recalled accurately: of 5 or of 10

6

STEP 6: DECISION

	Date & time of assessment:		
Domain			
Symptom number (of 22)			
Symptom severity score (of 132)			
Orientation (of 5)			
Immediate memory	of 15 of 30	of 15 of 30	of 15 of 30
Concentration (of 5)			
Neuro exam	Normal Abnormal	Normal Abnormal	Normal Abnormal
Balance errors (of 30)			
Delayed Recall	of 5 of 10	of 5 of 10	of 5 of 10

Date and time of injury: ____________________

If the athlete is known to you prior to their injury, are they different from their usual self?
☐ **Yes** ☐ **No** ☐ **Unsure** ☐ **Not Applicable**
(If different, describe why in the clinical notes section)

Concussion Diagnosed?
☐ **Yes** ☐ **No** ☐ **Unsure** ☐ **Not Applicable**

If re-testing, has the athlete improved?
☐ **Yes** ☐ **No** ☐ **Unsure** ☐ **Not Applicable**

I am a physician or licensed healthcare professional and I have personally administered or supervised the administration of this SCAT5.

Signature: ____________________

Name: ____________________

Title: ____________________

Registration number (if applicable): ____________________

Date: ____________________

SCORING ON THE SCAT5 SHOULD NOT BE USED AS A STAND-ALONE METHOD TO DIAGNOSE CONCUSSION, MEASURE RECOVERY OR MAKE DECISIONS ABOUT AN ATHLETE'S READINESS TO RETURN TO COMPETITION AFTER CONCUSSION.

CLINICAL NOTES:

Name:
DOB:
Address:
ID number:
Examiner:
Date:

CONCUSSION INJURY ADVICE

(To be given to the person monitoring the concussed athlete)

This patient has received an injury to the head. A careful medical examination has been carried out and no sign of any serious complications has been found. Recovery time is variable across individuals and the patient will need monitoring for a further period by a responsible adult. Your treating physician will provide guidance as to this timeframe.

If you notice any change in behaviour, vomiting, worsening headache, double vision or excessive drowsiness, please telephone your doctor or the nearest hospital emergency department immediately.

Other important points:

Initial rest: Limit physical activity to routine daily activities (avoid exercise, training, sports) and limit activities such as school, work, and screen time to a level that does not worsen symptoms.

1) Avoid alcohol

2) Avoid prescription or non-prescription drugs without medical supervision. Specifically:

a) Avoid sleeping tablets

b) Do not use aspirin, anti-inflammatory medication or stronger pain medications such as narcotics

3) Do not drive until cleared by a healthcare professional.

4) Return to play/sport requires clearance by a healthcare professional.

Clinic phone number:

Patient's name:

Date / time of injury:

Date / time of medical review:

Healthcare Provider:

Contact details or stamp

INSTRUCTIONS

Words in *Italics* throughout the SCAT5 are the instructions given to the athlete by the clinician

Symptom Scale

The time frame for symptoms should be based on the type of test being administered. At baseline it is advantageous to assess how an athlete "typically" feels whereas during the acute/post-acute stage it is best to ask how the athlete feels at the time of testing.

The symptom scale should be completed by the athlete, not by the examiner. In situations where the symptom scale is being completed after exercise, it should be done in a resting state, generally by approximating his/her resting heart rate.

For total number of symptoms, maximum possible is 22 except immediately post injury, if sleep item is omitted, which then creates a maximum of 21.

For Symptom severity score, add all scores in table, maximum possible is 22 x 6 = 132, except immediately post injury if sleep item is omitted, which then creates a maximum of 21x6=126.

Immediate Memory

The Immediate Memory component can be completed using the traditional 5-word per trial list or, optionally, using 10-words per trial. The literature suggests that the Immediate Memory has a notable ceiling effect when a 5-word list is used. In settings where this ceiling is prominent, the examiner may wish to make the task more difficult by incorporating two 5–word groups for a total of 10 words per trial. In this case, the maximum score per trial is 10 with a total trial maximum of 30.

Choose one of the word lists (either 5 or 10). Then perform 3 trials of immediate memory using this list.

Complete all 3 trials regardless of score on previous trials.

"I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order." The words must be read at a rate of one word per second.

Trials 2 & 3 MUST be completed regardless of score on trial 1 & 2.

Trials 2 & 3:

"I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before."

Score 1 pt. for each correct response. Total score equals sum across all 3 trials. Do NOT inform the athlete that delayed recall will be tested.

Concentration

Digits backward

Choose one column of digits from lists A, B, C, D, E or F and administer those digits as follows:

Say: *"I am going to read a string of numbers and when I am done, you repeat them back to me in reverse order of how I read them to you. For example, if I say 7-1-9, you would say 9-1-7."*

Begin with first 3 digit string.

If correct, circle "Y" for correct and go to next string length. If incorrect, circle "N" for the first string length and read trial 2 in the same string length. One point possible for each string length. Stop after incorrect on both trials (2 N's) in a string length. The digits should be read at the rate of one per second.

Months in reverse order

"Now tell me the months of the year in reverse order. Start with the last month and go backward. So you'll say December, November ... Go ahead"

1 pt. for entire sequence correct

Delayed Recall

The delayed recall should be performed after 5 minutes have elapsed since the end of the Immediate Recall section.

"Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you can remember in any order."

Score 1 pt. for each correct response

Modified Balance Error Scoring System (mBESS)[5] testing

This balance testing is based on a modified version of the Balance Error Scoring System (BESS)[5]. A timing device is required for this testing.

Each of 20-second trial/stance is scored by counting the number of errors. The examiner will begin counting errors only after the athlete has assumed the proper start position. The modified BESS is calculated by adding one error point for each error during the three 20-second tests. The maximum number of errors for any single condition is 10. If the athlete commits multiple errors simultaneously, only one error is recorded but the athlete should quickly return to the testing position, and counting should resume once the athlete is set. Athletes that are unable to maintain the testing procedure for a minimum of five seconds at the start are assigned the highest possible score, ten, for that testing condition.

OPTION: For further assessment, the same 3 stances can be performed on a surface of medium density foam (e.g., approximately 50cm x 40cm x 6cm).

Balance testing – types of errors

1. Hands lifted off iliac crest
2. Opening eyes
3. Step, stumble, or fall
4. Moving hip into > 30 degrees abduction
5. Lifting forefoot or heel
6. Remaining out of test position > 5 sec

"I am now going to test your balance. Please take your shoes off (if applicable), roll up your pant legs above ankle (if applicable), and remove any ankle taping (if applicable). This test will consist of three twenty second tests with different stances."

(a) Double leg stance:

"The first stance is standing with your feet together with your hands on your hips and with your eyes closed. You should try to maintain stability in that position for 20 seconds. I will be counting the number of times you move out of this position. I will start timing when you are set and have closed your eyes."

(b) Single leg stance:

"If you were to kick a ball, which foot would you use? [This will be the dominant foot] *Now stand on your non-dominant foot. The dominant leg should be held in approximately 30 degrees of hip flexion and 45 degrees of knee flexion. Again, you should try to maintain stability for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you stumble out of this position, open your eyes and return to the start position and continue balancing. I will start timing when you are set and have closed your eyes."*

(c) Tandem stance:

"Now stand heel-to-toe with your non-dominant foot in back. Your weight should be evenly distributed across both feet. Again, you should try to maintain stability for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you stumble out of this position, open your eyes and return to the start position and continue balancing. I will start timing when you are set and have closed your eyes."

Tandem Gait

Participants are instructed to stand with their feet together behind a starting line (the test is best done with footwear removed). Then, they walk in a forward direction as quickly and as accurately as possible along a 38mm wide (sports tape), 3 metre line with an alternate foot heel-to-toe gait ensuring that they approximate their heel and toe on each step. Once they cross the end of the 3m line, they turn 180 degrees and return to the starting point using the same gait. Athletes fail the test if they step off the line, have a separation between their heel and toe, or if they touch or grab the examiner or an object.

Finger to Nose

"I am going to test your coordination now. Please sit comfortably on the chair with your eyes open and your arm (either right or left) outstretched (shoulder flexed to 90 degrees and elbow and fingers extended), pointing in front of you. When I give a start signal, I would like you to perform five successive finger to nose repetitions using your index finger to touch the tip of the nose, and then return to the starting position, as quickly and as accurately as possible."

References

1. McCrory et al. Consensus Statement On Concussion In Sport – The 5th International Conference On Concussion In Sport Held In Berlin, October 2016. British Journal of Sports Medicine 2017 (available at www.bjsm.bmj.com)
2. Maddocks, DL; Dicker, GD; Saling, MM. The assessment of orientation following concussion in athletes. Clinical Journal of Sport Medicine 1995; 5: 32-33
3. Jennett, B., Bond, M. Assessment of outcome after severe brain damage: a practical scale. Lancet 1975; i: 480-484
4. McCrea M. Standardized mental status testing of acute concussion. Clinical Journal of Sport Medicine. 2001; 11: 176-181
5. Guskiewicz KM. Assessment of postural stability following sport-related concussion. Current Sports Medicine Reports. 2003; 2: 24-30

CONCUSSION INFORMATION

Any athlete suspected of having a concussion should be removed from play and seek medical evaluation.

Signs to watch for

Problems could arise over the first 24-48 hours. The athlete should not be left alone and must go to a hospital at once if they experience:

- Worsening headache
- Drowsiness or inability to be awakened
- Inability to recognize people or places
- Repeated vomiting
- Unusual behaviour or confusion or irritable
- Seizures (arms and legs jerk uncontrollably)
- Weakness or numbness in arms or legs
- Unsteadiness on their feet.
- Slurred speech

Consult your physician or licensed healthcare professional after a suspected concussion. Remember, it is better to be safe.

Rest & Rehabilitation

After a concussion, the athlete should have physical rest and relative cognitive rest for a few days to allow their symptoms to improve. In most cases, after no more than a few days of rest, the athlete should gradually increase their daily activity level as long as their symptoms do not worsen. Once the athlete is able to complete their usual daily activities without concussion-related symptoms, the second step of the return to play/sport progression can be started. The athlete should not return to play/sport until their concussion-related symptoms have resolved and the athlete has successfully returned to full school/learning activities.

When returning to play/sport, the athlete should follow a stepwise, **medically managed exercise progression, with increasing amounts of exercise.** For example:

Graduated Return to Sport Strategy

Exercise step	Functional exercise at each step	Goal of each step
1. Symptom-limited activity	Daily activities that do not provoke symptoms.	Gradual reintroduction of work/school activities.
2. Light aerobic exercise	Walking or stationary cycling at slow to medium pace. No resistance training.	Increase heart rate.
3. Sport-specific exercise	Running or skating drills. No head impact activities.	Add movement.
4. Non-contact training drills	Harder training drills, e.g., passing drills. May start progressive resistance training.	Exercise, coordination, and increased thinking.
5. Full contact practice	Following medical clearance, participate in normal training activities.	Restore confidence and assess functional skills by coaching staff.
6. Return to play/sport	Normal game play.	

In this example, it would be typical to have 24 hours (or longer) for each step of the progression. If any symptoms worsen while exercising, the athlete should go back to the previous step. Resistance training should be added only in the later stages (Stage 3 or 4 at the earliest).

Written clearance should be provided by a healthcare professional before return to play/sport as directed by local laws and regulations.

Graduated Return to School Strategy

Concussion may affect the ability to learn at school. The athlete may need to miss a few days of school after a concussion. When going back to school, some athletes may need to go back gradually and may need to have some changes made to their schedule so that concussion symptoms do not get worse. If a particular activity makes symptoms worse, then the athlete should stop that activity and rest until symptoms get better. To make sure that the athlete can get back to school without problems, it is important that the healthcare provider, parents, caregivers and teachers talk to each other so that everyone knows what the plan is for the athlete to go back to school.

Note: If mental activity does not cause any symptoms, the athlete may be able to skip step 2 and return to school part-time before doing school activities at home first.

Mental Activity	Activity at each step	Goal of each step
1. Daily activities that do not give the athlete symptoms	Typical activities that the athlete does during the day as long as they do not increase symptoms (e.g. reading, texting, screen time). Start with 5-15 minutes at a time and gradually build up.	Gradual return to typical activities.
2. School activities	Homework, reading or other cognitive activities outside of the classroom.	Increase tolerance to cognitive work.
3. Return to school part-time	Gradual introduction of schoolwork. May need to start with a partial school day or with increased breaks during the day.	Increase academic activities.
4. Return to school full-time	Gradually progress school activities until a full day can be tolerated.	Return to full academic activities and catch up on missed work.

If the athlete continues to have symptoms with mental activity, some other accomodations that can help with return to school may include:

- Starting school later, only going for half days, or going only to certain classes
- More time to finish assignments/tests
- Quiet room to finish assignments/tests
- Not going to noisy areas like the cafeteria, assembly halls, sporting events, music class, shop class, etc.
- Taking lots of breaks during class, homework, tests
- No more than one exam/day
- Shorter assignments
- Repetition/memory cues
- Use of a student helper/tutor
- Reassurance from teachers that the child will be supported while getting better

The athlete should not go back to sports until they are back to school/learning, without symptoms getting significantly worse and no longer needing any changes to their schedule.

Davis GA, *et al. Br J Sports Med* 2017;**0**:1–8. doi:10.1136/bjsports-2017-097506SCAT5

OFFICE OR OFF-FIELD ASSESSMENT

Please note that the neurocognitive assessment should be done in a distraction-free environment with the athlete in a resting state.

STEP 1: ATHLETE BACKGROUND

Sport / team / school: ______________________

Date / time of injury: ______________________

Years of education completed: ______________________

Age: ______________________

Gender: M / F / Other

Dominant hand: left / neither / right

How many diagnosed concussions has the athlete had in the past?: ______________________

When was the most recent concussion?: ______________________

How long was the recovery (time to being cleared to play) from the most recent concussion?: ______________ (days)

Has the athlete ever been:

Hospitalized for a head injury?	Yes	No
Diagnosed / treated for headache disorder or migraines?	Yes	No
Diagnosed with a learning disability / dyslexia?	Yes	No
Diagnosed with ADD / ADHD?	Yes	No
Diagnosed with depression, anxiety or other psychiatric disorder?	Yes	No

Current medications? If yes, please list:

____

____

____

____

____

____

Name: ______________________

DOB: ______________________

Address: ______________________

ID number: ______________________

Examiner: ______________________

Date: ______________________

2

STEP 2: SYMPTOM EVALUATION

The athlete should be given the symptom form and asked to read this instruction paragraph out loud then complete the symptom scale. For the baseline assessment, the athlete should rate his/her symptoms based on how he/she typically feels and for the post injury assessment the athlete should rate their symptoms at this point in time.

Please Check: ☐ **Baseline** ☐ **Post-Injury**

Please hand the form to the athlete

	none	mild		moderate		severe	
Headache	0	1	2	3	4	5	6
"Pressure in head"	0	1	2	3	4	5	6
Neck Pain	0	1	2	3	4	5	6
Nausea or vomiting	0	1	2	3	4	5	6
Dizziness	0	1	2	3	4	5	6
Blurred vision	0	1	2	3	4	5	6
Balance problems	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling like "in a fog"	0	1	2	3	4	5	6
"Don't feel right"	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
Confusion	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
More emotional	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervous or Anxious	0	1	2	3	4	5	6
Trouble falling asleep (if applicable)	0	1	2	3	4	5	6

Total number of symptoms:	of 22
Symptom severity score:	of 132
Do your symptoms get worse with physical activity?	Y N
Do your symptoms get worse with mental activity?	Y N
If 100% is feeling perfectly normal, what percent of normal do you feel?	

If not 100%, why?

____

____

____

Please hand form back to examiner

12
UEFA Elite Club Injury Study
Example Team Report

STAYFIT-HURT
290

The UEFA Elite Club Injury Study (ECIS) was initiated by and is funded and supported by UEFA.

This report has been produced on behalf of the UEFA Medical Committee by:
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Former first vice-chairman of the UEFA Medical Committee

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Table of Contents

1 Participating clubs

This season report contains fictional results from July to May of the 2018/19 season for 25 Example Teams.

2 Presentation

The report is divided into nine sections, with data on exposure, general injuries, training injuries, match injuries, severe injuries, muscle injuries, ligament injuries, re-injuries, and, squad attendance/availability and absence. These sections contain data of the 2018/19 season from your club in comparison with other participating clubs described as means of the whole season as well as specifically for each month (July-May). Each section also contains historic data which gives you the opportunity to compare the current season with data from your club and other participating clubs in previous seasons. The injury sections are generally split into four sub-sections:

- **Injury patterns:** the relative distribution of injuries of this kind, looking at injury location, type, overuse/trauma, contact/non-contact, severity and re-injury rate.

- **Injury rate:** the number of injuries of this kind relative to exposure time, allowing the individual injury rate to be evaluated. Injury rate is expressed as the number of injuries/1,000 hours of exposure.

- **Days' absence:** the mean number of days lost because of injuries of this kind.

- **Injury burden:** a combined measure of the frequency (injury rate) and severity (days´ absence) of injuries of this kind giving the burden of injury for the player and the consequences for the team. Injury burden is expressed as the number of days of absence/1,000 hours of exposure. Example: Team A with 10 injuries in 5,000 hours, each resulting in an absence of 10 days on average, has an injury burden of 20 days/1,000 hours. Team B with 20 injuries in 5,000 hours, each resulting in an absence of 5 days on average, also has an injury burden of 20 days/1,000 hours.

3 Interpretation of results

When comparing your club's results with those of other participating clubs, please bear the following in mind:

- Because of the limited amounts of data collected over one season, the injury rates presented are sometimes based on just a few actual injuries. This means that some results should be interpreted with caution.

- The overall number of injuries varies between clubs, mainly because of the number of minor injuries. It is therefore important to look not only at the overall injury rate, but also at the data on severe injuries and squad availability, as these variables may have a greater impact on the club.

- In the case of players who were still injured at the end of the season, we have used either the club's estimated return date or an approximation of severity based on the mean absence for this particular injury. Some data on the number of days' absence and injury risk presented in the report could therefore be based on approximate values/estimates.

We hope that you will find this report useful in your daily work treating and preventing injuries at your club. Please do not hesitate to contact FRG if you have any questions about how to interpret the results.

4 Exposure

In total, 180 000 hours of exposure were recorded during the season in the 25 Example Teams, with approximately 150 000 training hours (83%) and 30 000 match hours (17%). Team x reported 8 000 hours of total exposure, with 7 000 training hours (88%) and 1 000 match hours (12%).

On average, teams reported 230 training sessions and 60 matches over the review period. Since the reporting period differed between teams, we have also calculated a monthly training and match load. On average, teams had 21 training sessions and 4.9 matches each month, giving an average training-to-match exposure ratio of 6.0 hours of training for each hour of match play.

Figure 1. Number of training sessions per month

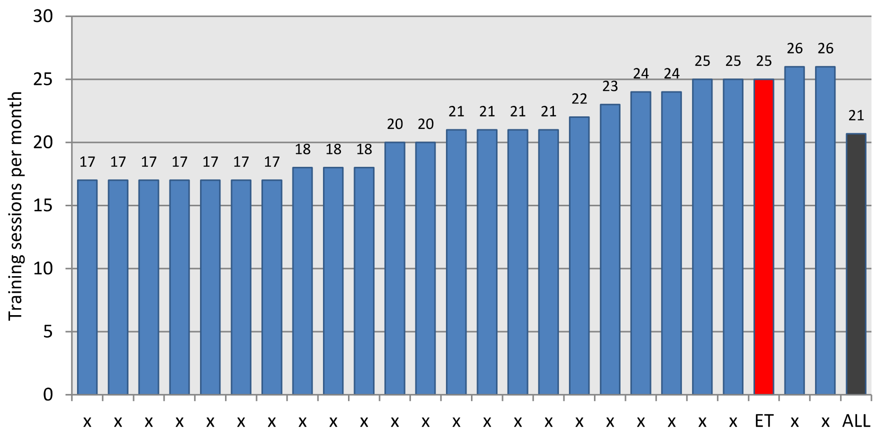


Figure 2. Number of matches per month

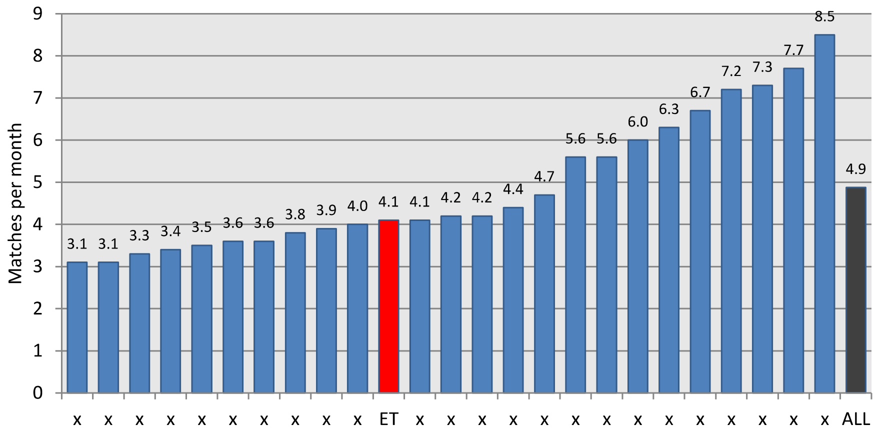


Figure 3. Number of training sessions (blue bars) and matches (red bars) for Team X over the season

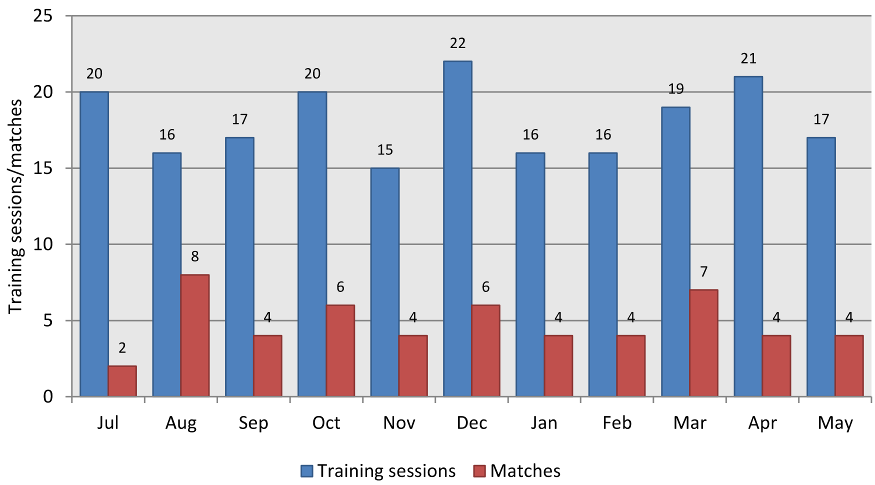


Figure 4. Ratio of training hours to match hours

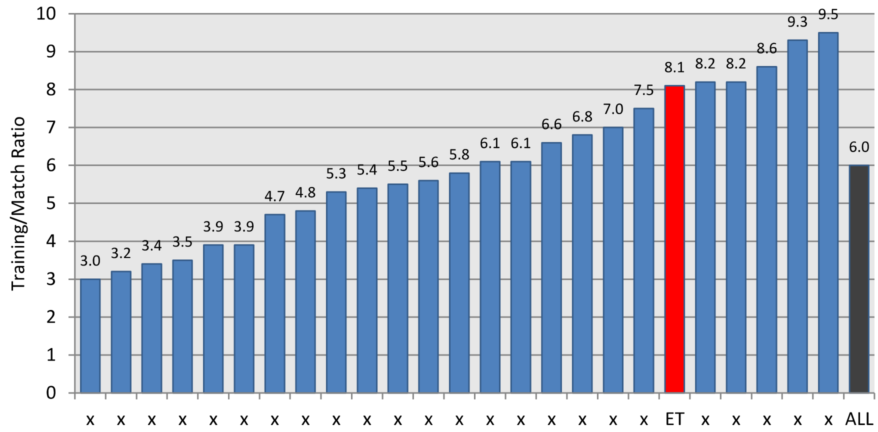
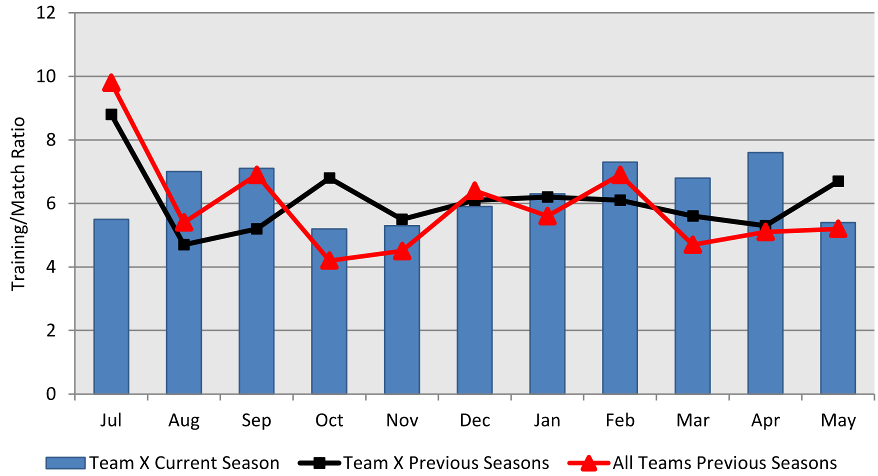


Figure 5. Ratio of training hours to match hours for Team X over the season in comparison to previous seasons



5 General injuries

5.1 General injury patterns

The figures below show the relative distribution (%) of different injuries. In total the 20 UEFA Champions League teams reported 868 injuries, with 410 training injuries (47%) and 458 match injuries (53%). There were 177 severe injuries (20%), 437 muscle injuries (50%) and 126 ligament injuries (15%).

Team x reported xx injuries (xx training injuries; xx match injuries) during the season, including xx severe injuries, xx muscle injuries and xx ligament injuries.

Figure 6. Distribution of injury locations

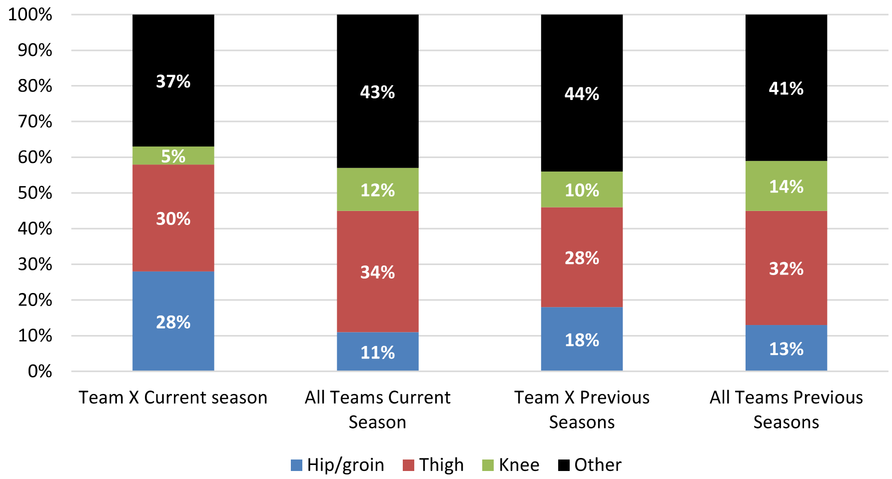


Figure 7. Distribution of injury types

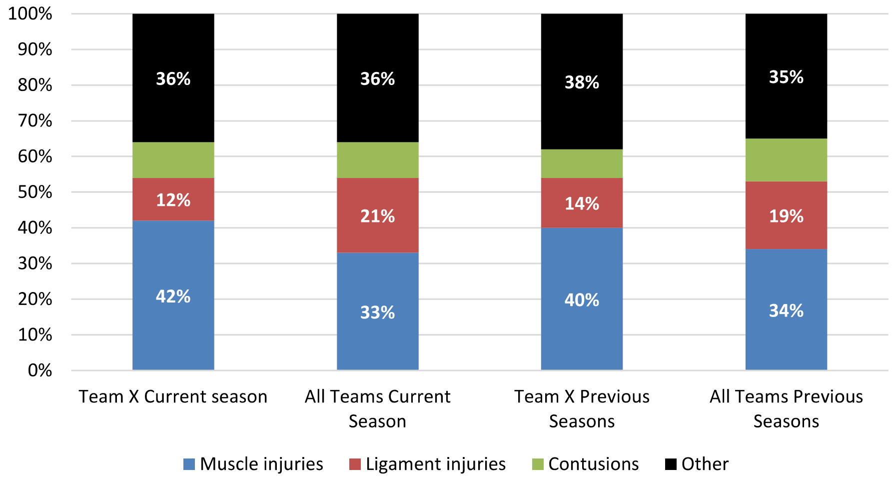


Figure 8. Distribution of overuse/traumatic injuries

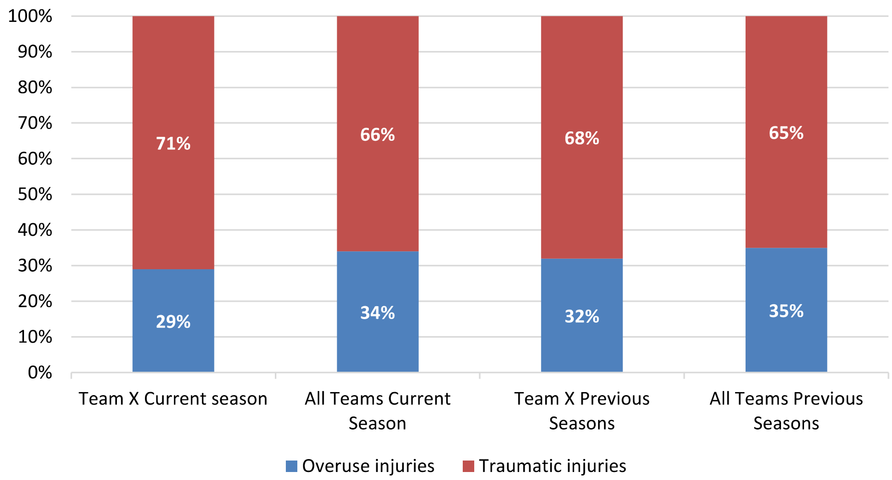


Figure 9. Distribution of contact/non-contact injuries

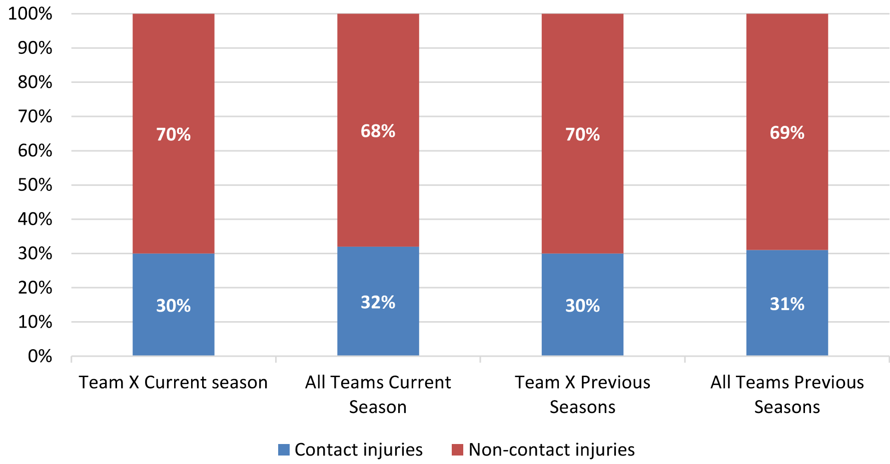


Figure 10. Distribution of injury severities

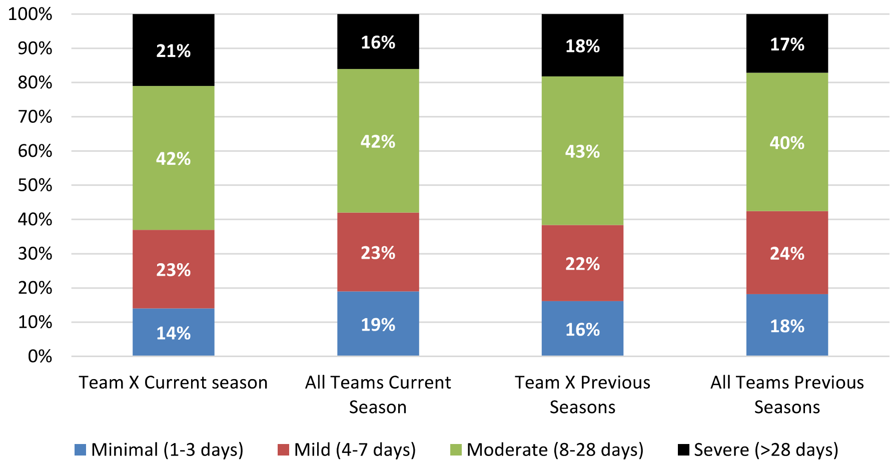
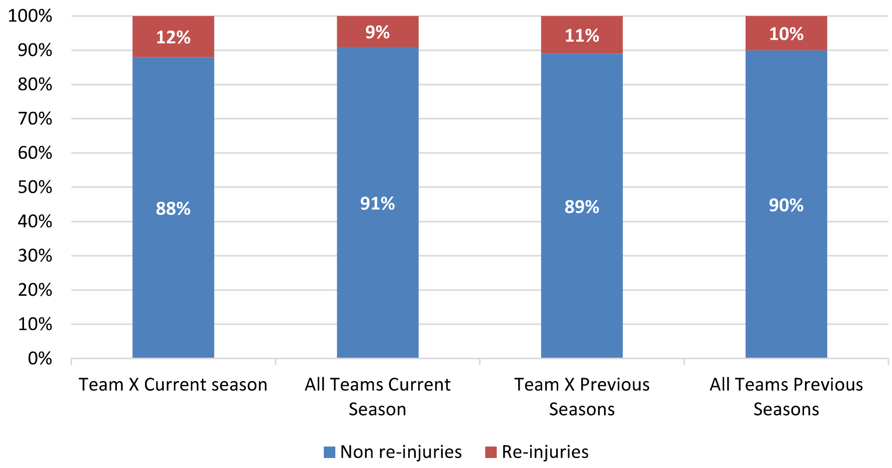


Figure 11. Distribution of re-injuries



6 Training injuries

6.1 Training injury rate

The mean training injury rate for all teams was 1.7 injuries for every 1 000 training hours, with individual rates ranging from 0.1 to 4.9 at the various clubs.

Figure 12. Training injury rate

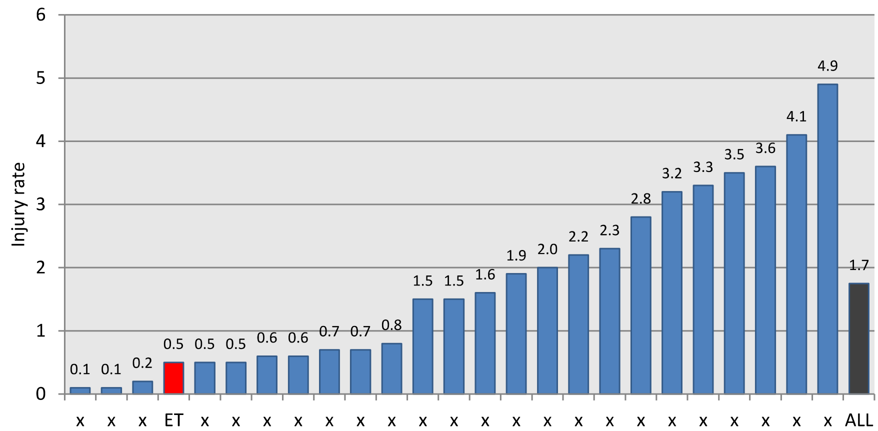


Figure 13. Training injury rates in previous seasons

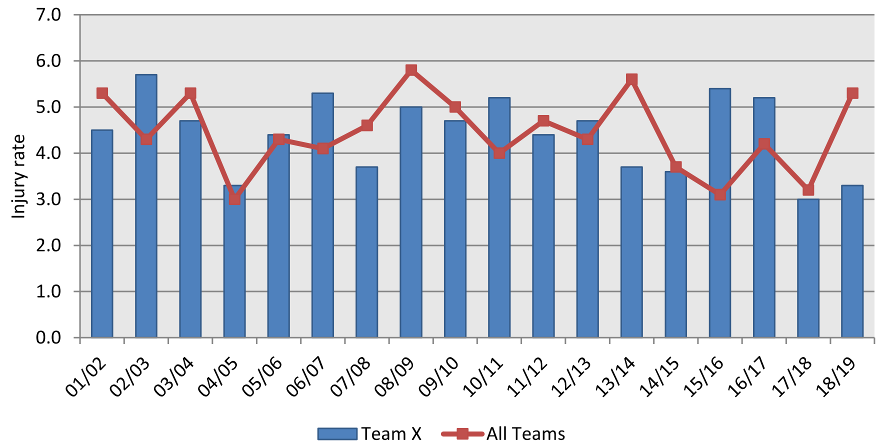
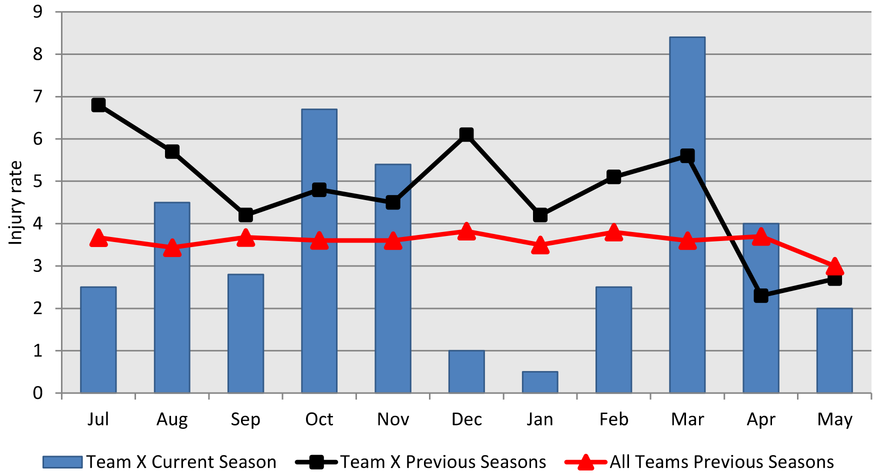


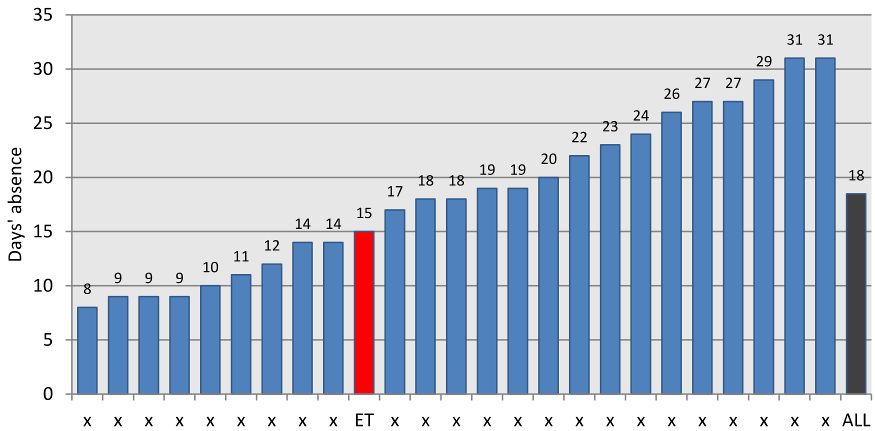
Figure 14. Training injury rates for Team X over the season in comparison to previous seasons



6.2 Days' absence for training injuries

The average absence for training injuries among the teams was 18 days, ranging from 8 to 31 days at the various clubs.

Figure 15. Days' absence for training injuries



6.3 Burden of training injuries

The mean injury burden in training was 36 days' absence/1 000 hours, ranging from 2 to 82 at the various clubs.

Figure 16. Training injury burden

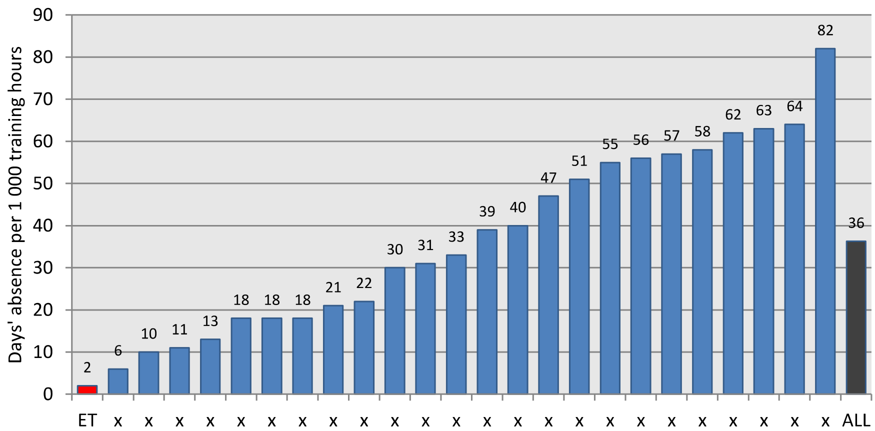


Figure 17. Training injury burden in previous seasons

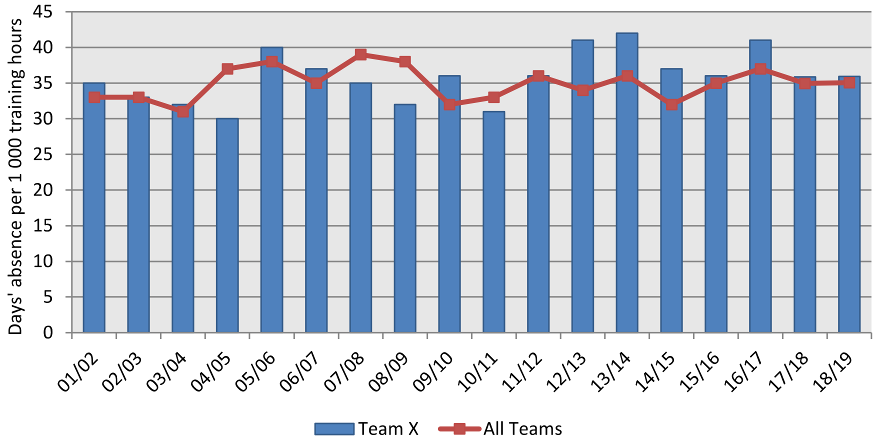
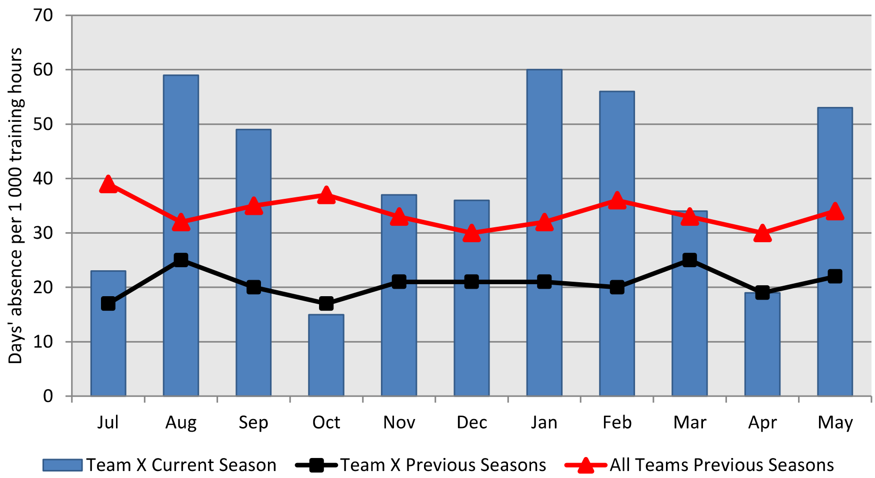


Figure 18. Training injury burden for Team X over the season in comparison to previous seasons



7 Match injuries

7.1 Match injury rate

The mean match injury rate for all teams was 21 injuries for every 1 000 match hours, with individual rates ranging from 8 to 31.

Figure 19. Match injury rate

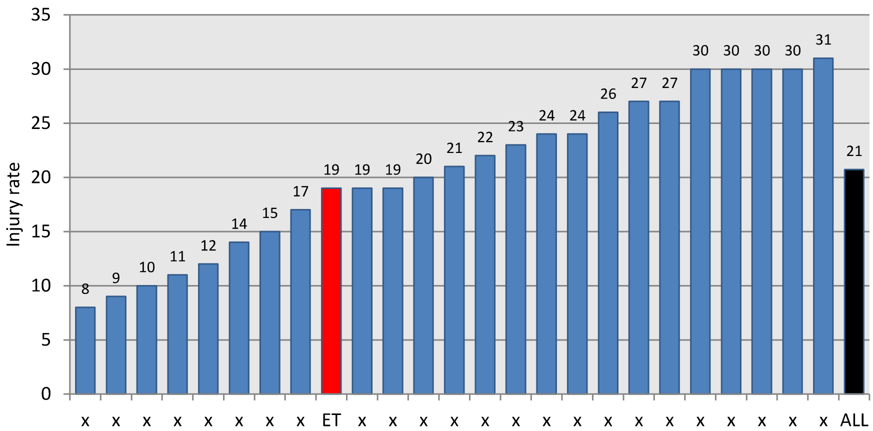


Figure 20. Match injury rates in previous seasons

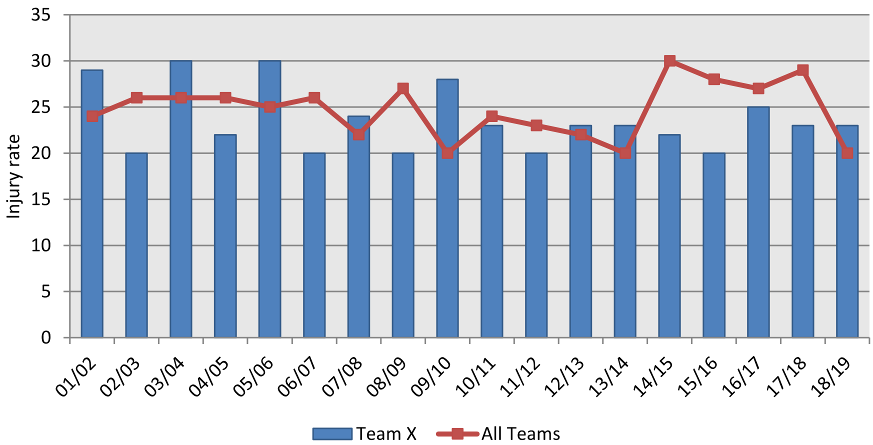
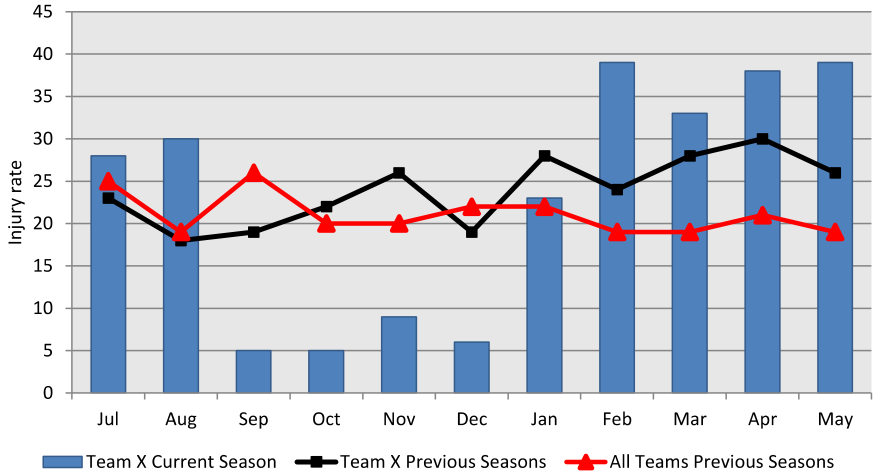


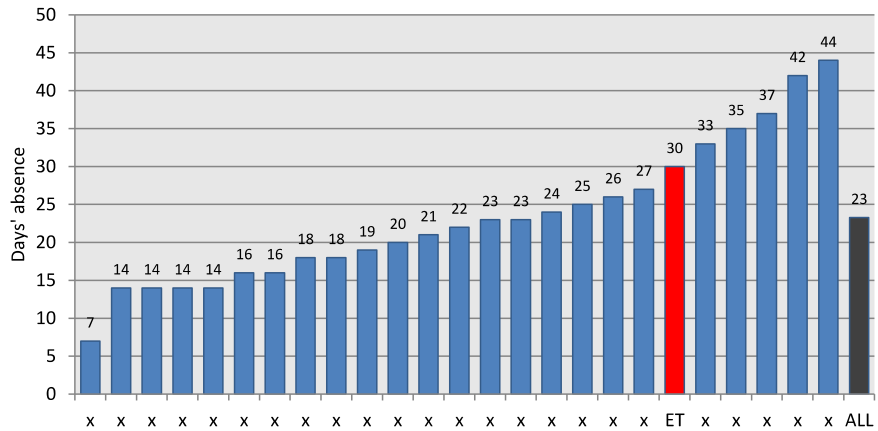
Figure 21. Match injury rate for Team X over the season in comparison to previous seasons



7.2 Days' absence for match injuries

The average absence for match injuries among the teams was 23 days, ranging from 7 to 44 days at the various clubs.

Figure 22. Days' absence for match injuries



7.3 Burden of match injuries

The mean injury burden in match play was 430 days' absence/1 000 hours, ranging from 168 to 694 at the various clubs.

Figure 23. Match injury burden

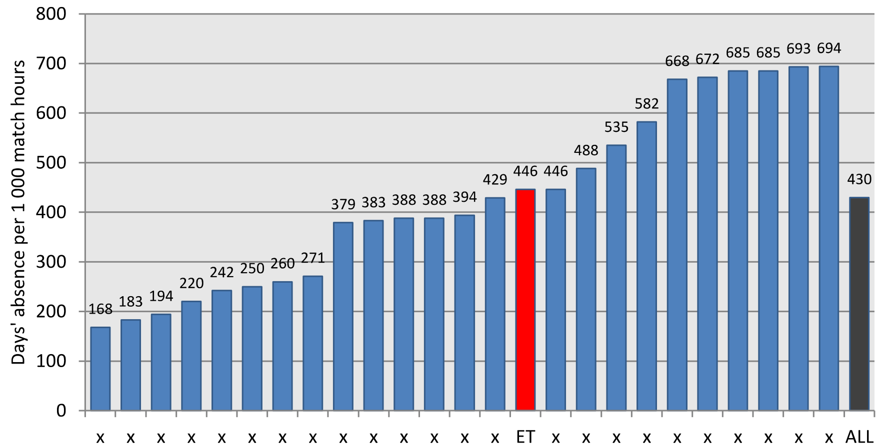


Figure 24. Match injury burden in previous seasons

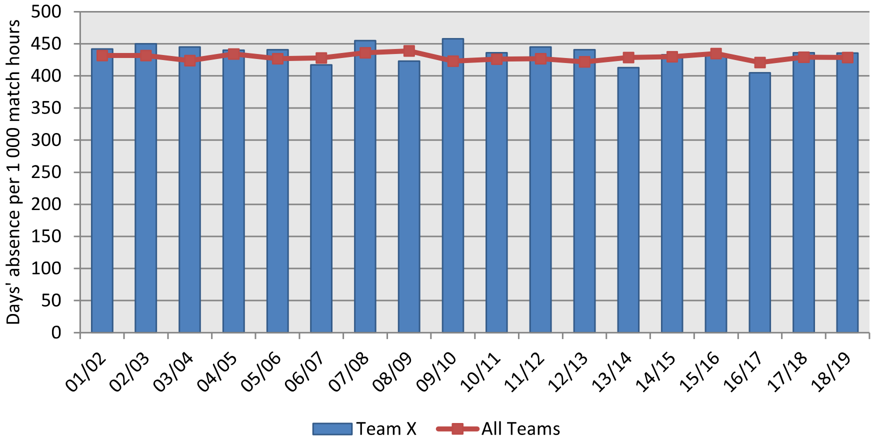
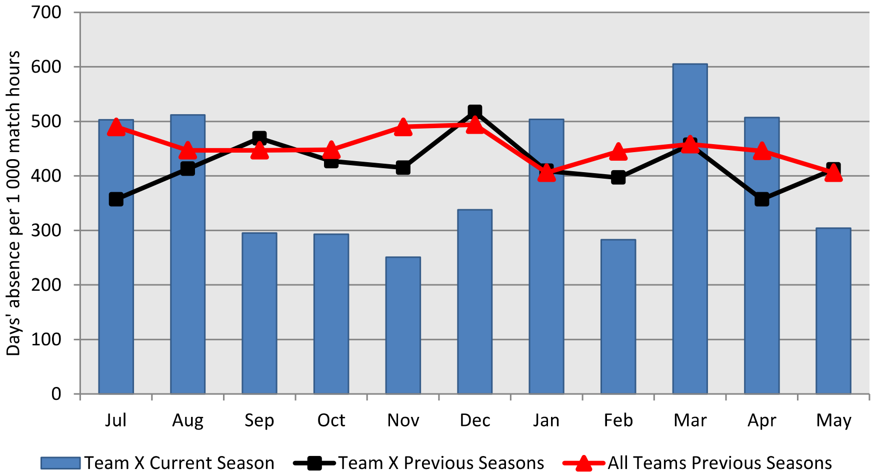


Figure 25. Match injury burden for Team X over the season in comparison to previous seasons



8 Severe injuries

8.1 Severe injury patterns

Injuries resulting in more than four weeks´ absence are classified as severe injuries.

Figure 26. Distribution of severe injury locations

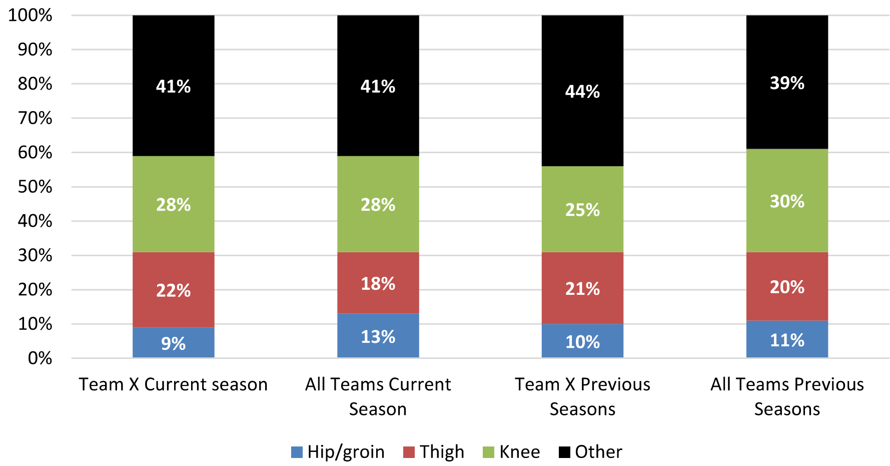
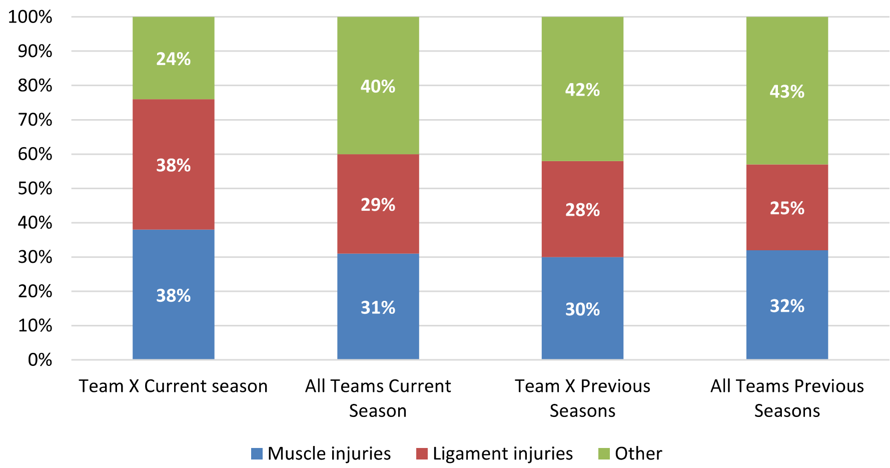


Figure 27. Distribution of severe injury types



8.2 Severe injury rate

The mean severe injury rate for all teams was 1.4 severe injuries for every 1 000 hours, with individual rates ranging from 0.1 to 2.9 Please note that since total absences are unknown where players were still injured at the time of writing, the true figures may differ slightly from those presented here.

Figure 28. Severe injury rate

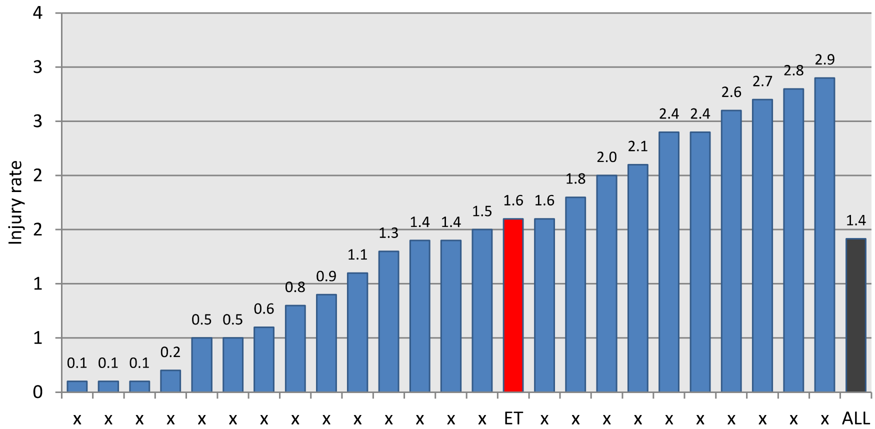
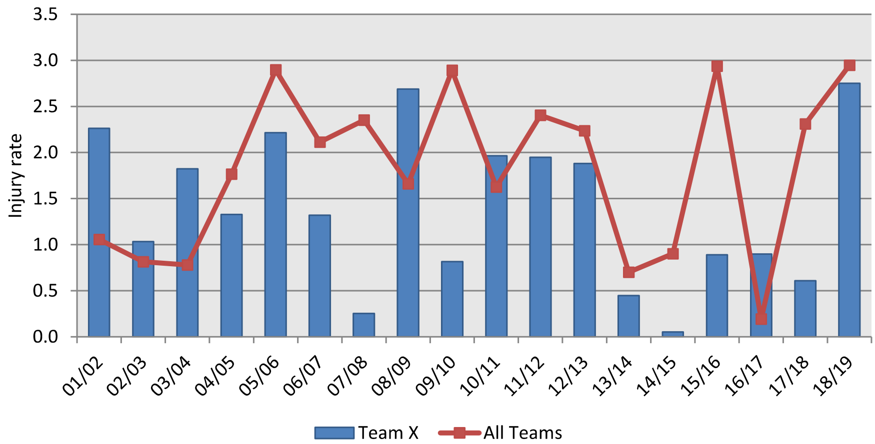
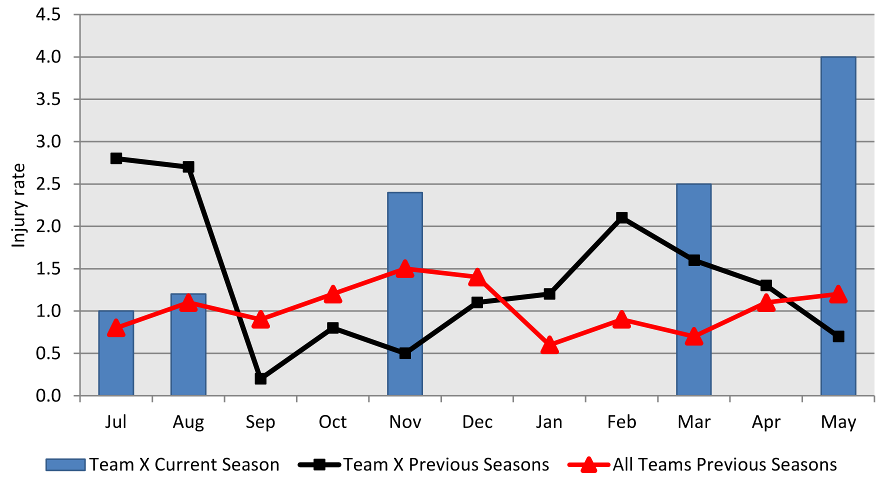


Figure 29. Severe injury rates in previous seasons



STAYFIT-HURT
311

Figure 30. Severe injury rates for Team X over the season in comparison to previous seasons



9 Muscle injuries

9.1 Muscle injury patterns

Figure 31. Distribution of muscle injury locations

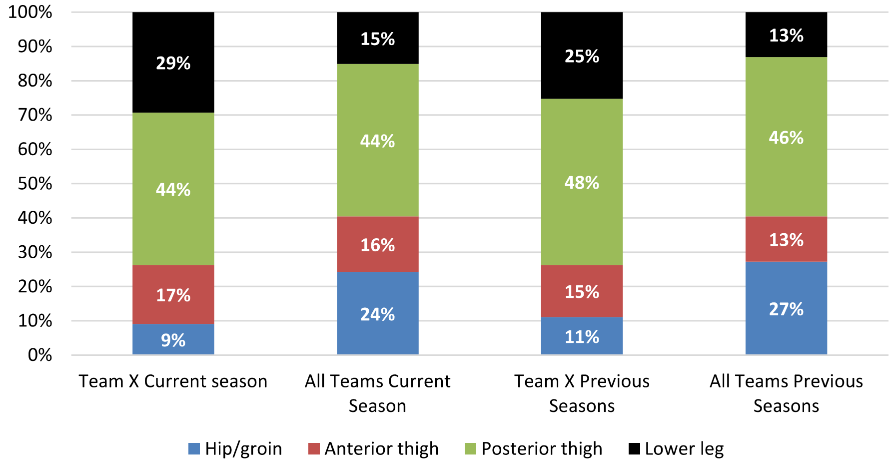


Figure 32. Distribution of muscle injury severities

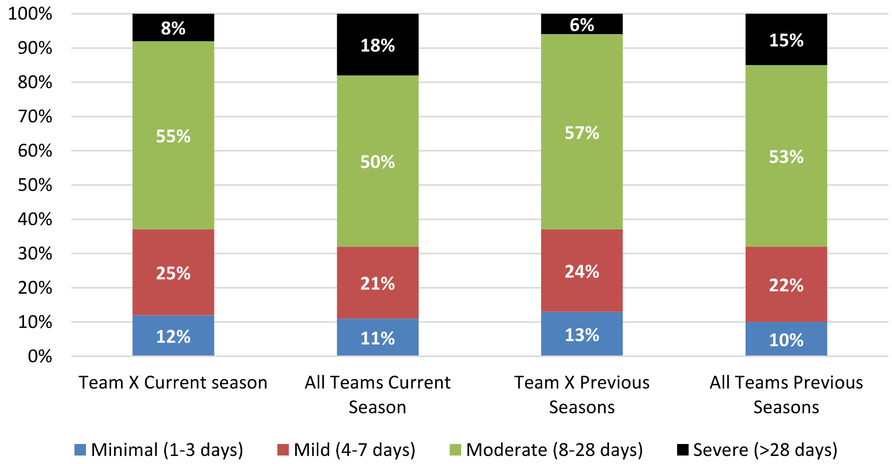
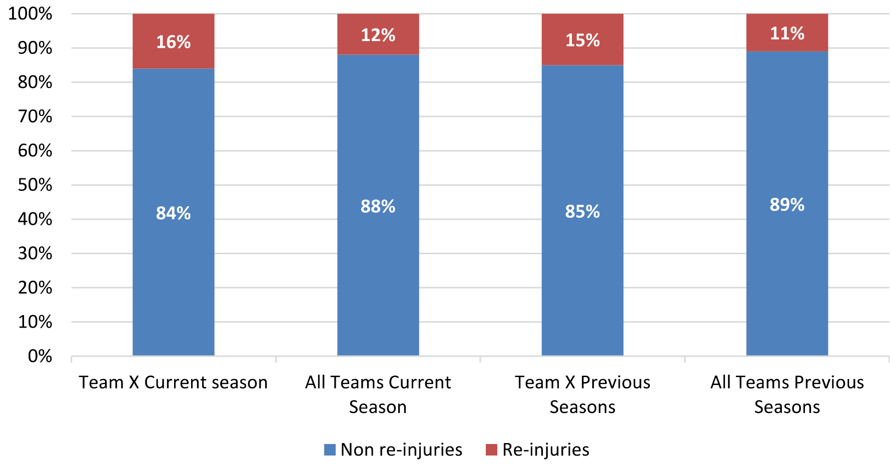


Figure 33. Distribution of re-injuries for muscle injuries



9.2 Muscle injury rate

The mean muscle injury rate for all teams was 2.8 injuries for every 1 000 hours, with individual rates ranging from 0.1 to 5.5.

Figure 34. Muscle injury rate

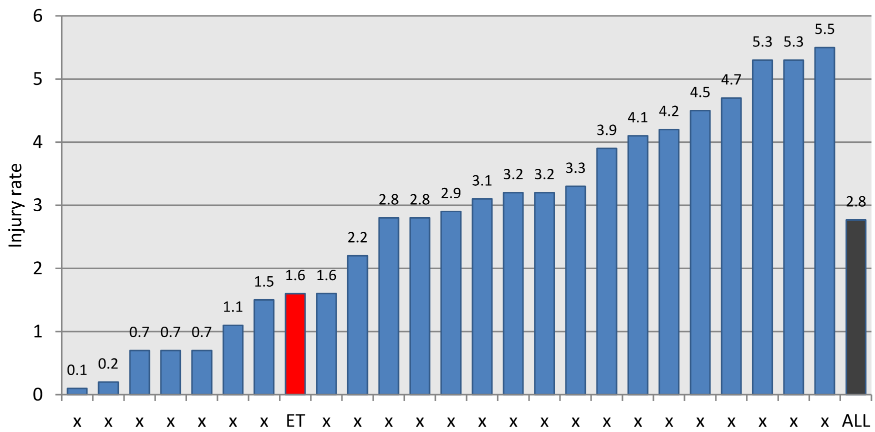


Figure 35. Muscle injury rates in previous seasons

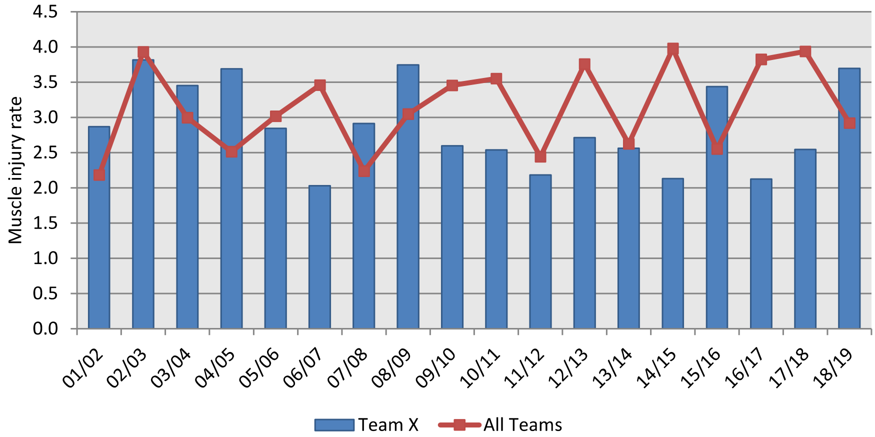
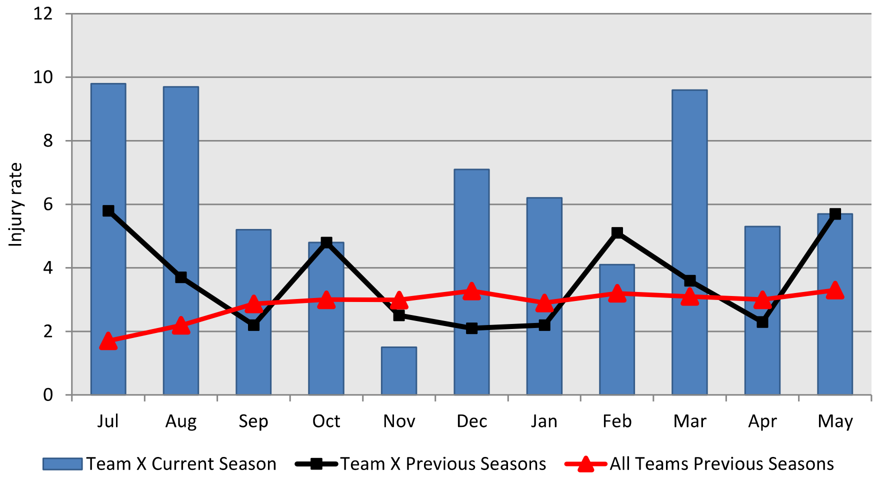


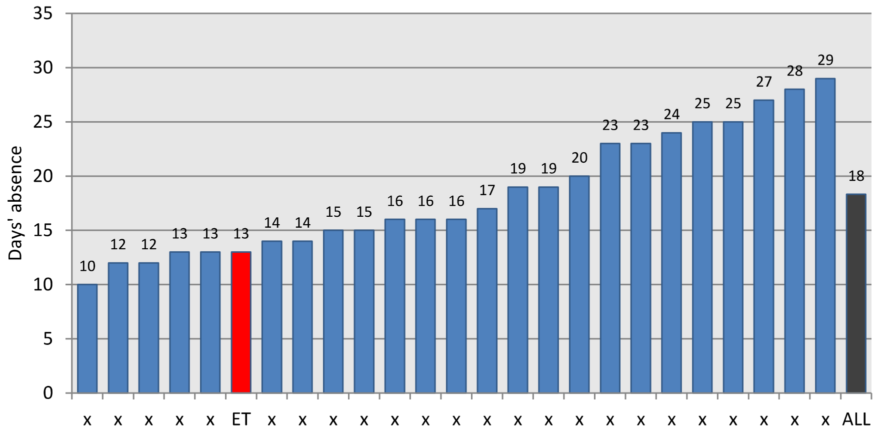
Figure 36. Muscle injury rates for Team X over the season in comparison to previous seasons



9.3 Days' absence for muscle injurie

The average absence for muscle injuries among the teams was 18 days, ranging from 10 to 29 days at the various clubs.

Figure 37. Days' absence for muscle injuries



9.4 Burden of muscle injuries

The mean injury burden for muscle injury was 37 days' absence/1 000 hours, ranging from 12 to 60 at the various clubs.

Figure 38. Muscle injury burden

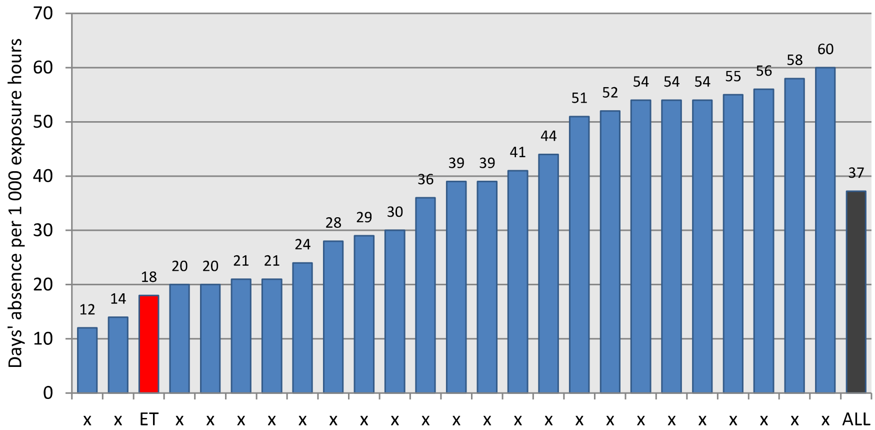


Figure 39. Muscle injury burden in previous seasons

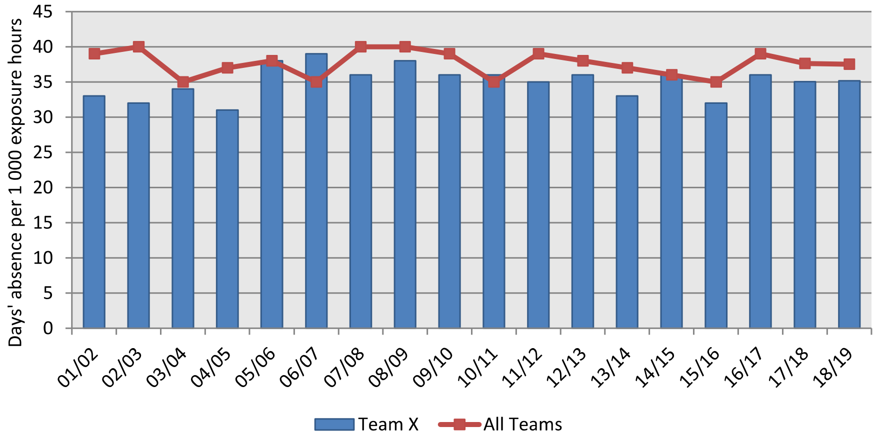
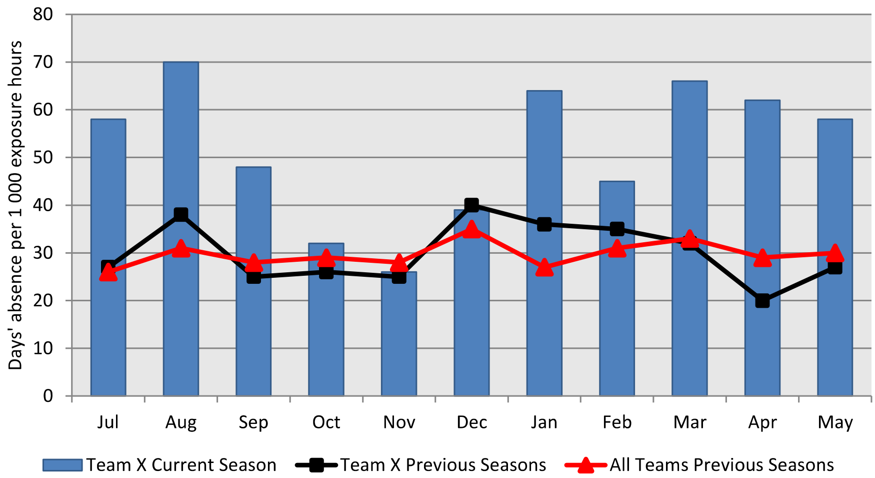


Figure 40. Muscle injury burden for Team X over the season in comparison to previous seasons



10 Ligament injuries

10.1 Ligament injury patterns

Figure 41. Distribution of ligament injury locations

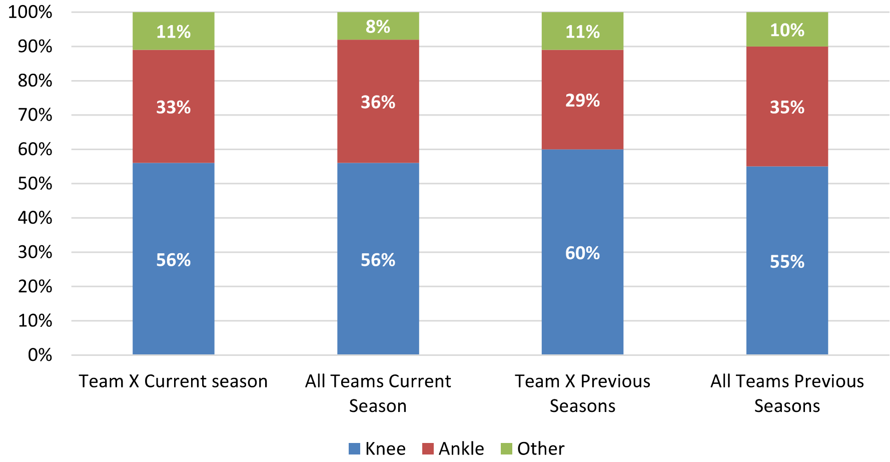


Figure 42. Distribution of ligament injury severities

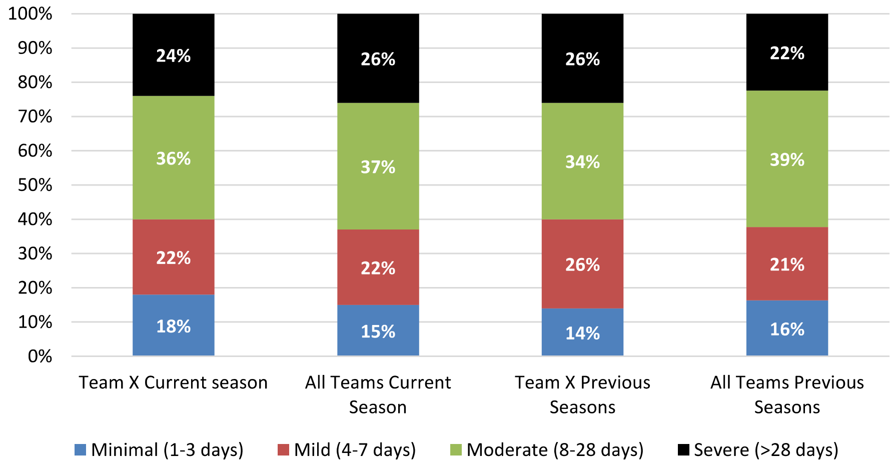
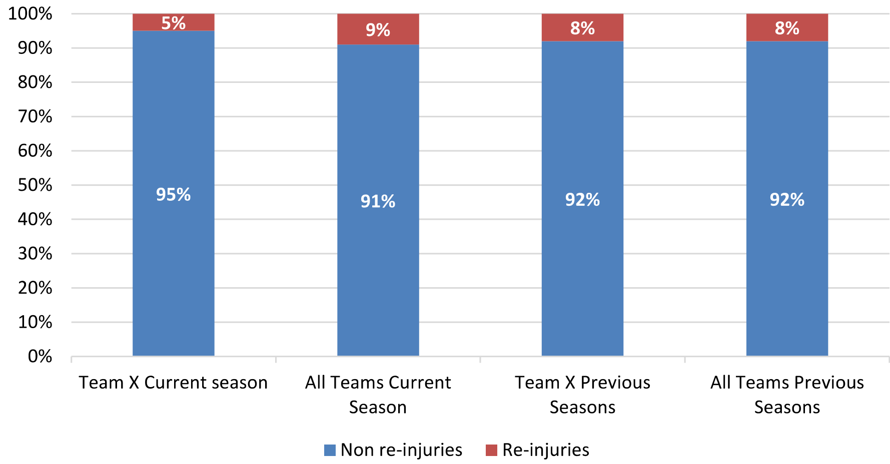


Figure 43. Distribution of re-injuries for ligament injuries



10.2 Ligament injury rate

The mean ligament injury rate for all teams was 1.6 injuries for every 1 000 hours, with individual rates ranging from 0.1 to 2.9 at the various clubs.

Figure 44. Ligament injury rate

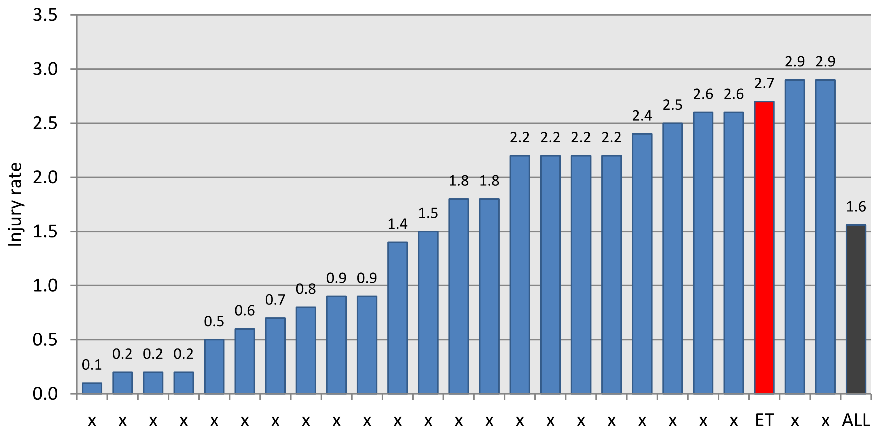


Figure 45. Ligament injury rates in previous seasons

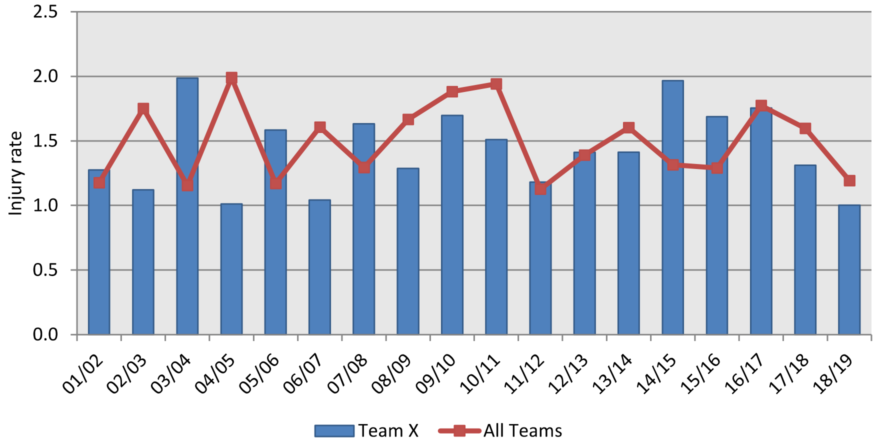
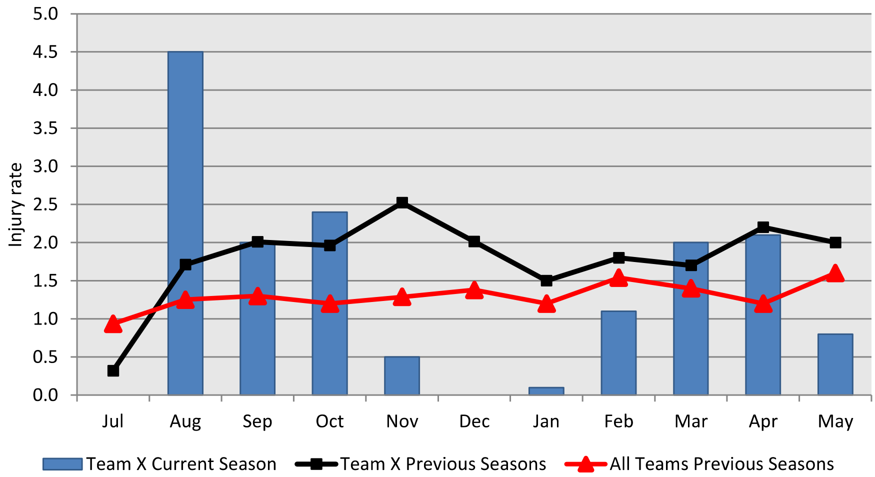


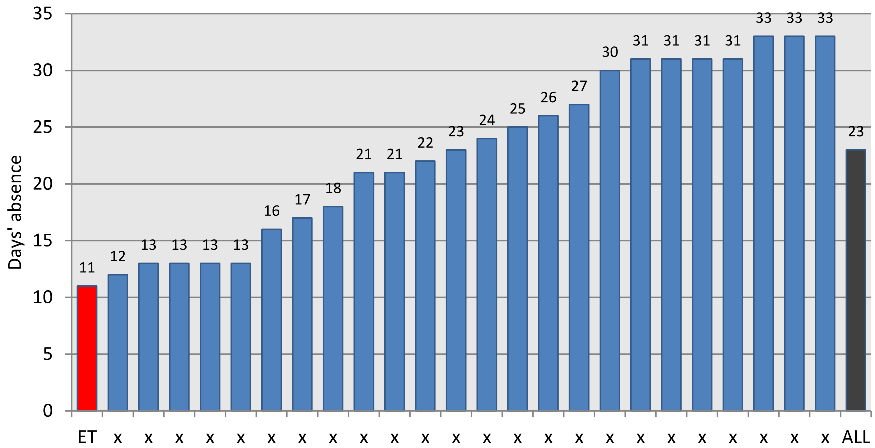
Figure 46. Ligament injury rates for Team X over the season in comparison to previous seasons



10.3 Days' absence for ligament injuries

The average absence for ligament injuries among the teams was 23 days, ranging from 11 to 33 days at the various clubs.

Figure 47. Days' absence for ligament injuries



10.4 Burden of ligament injuries

The mean burden for ligament injury was 35 days' absence/1 000 hours, ranging from 5 to 60 at the various clubs.

Figure 48. Ligament injury burden

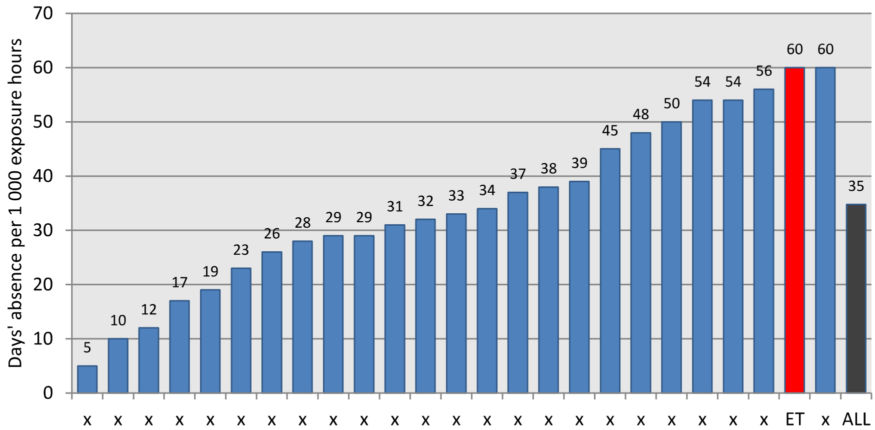
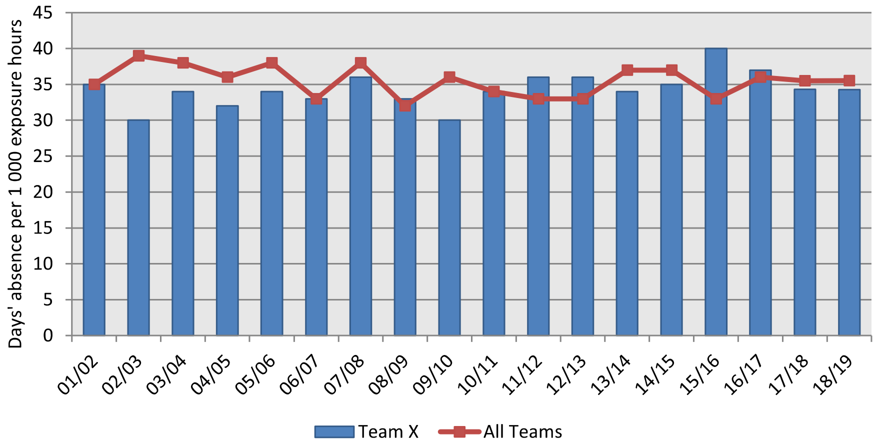
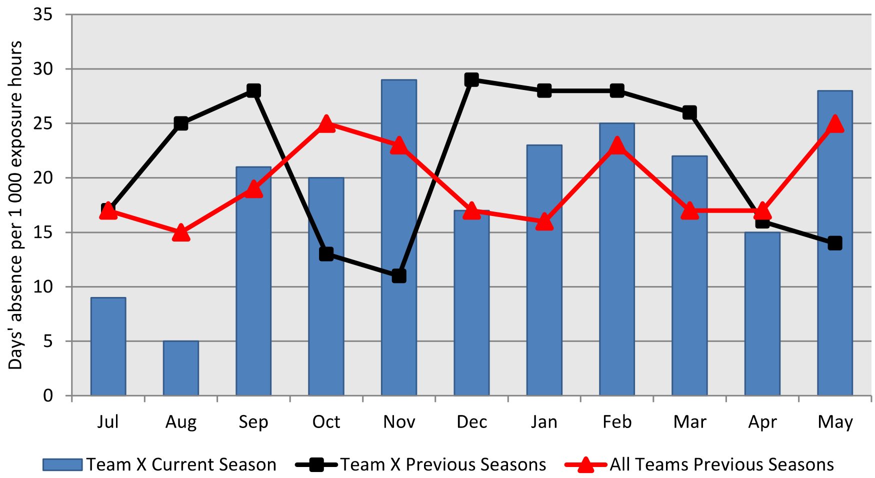


Figure 49. Ligament injury burden in previous seasons



STAYFIT-HURT
323

Figure 50. Ligament injury burden for Team X over the season in comparison to previous seasons



11 Re-injuries

11.1 Re-injury patterns

Figure 51. Distribution of re-injury locations

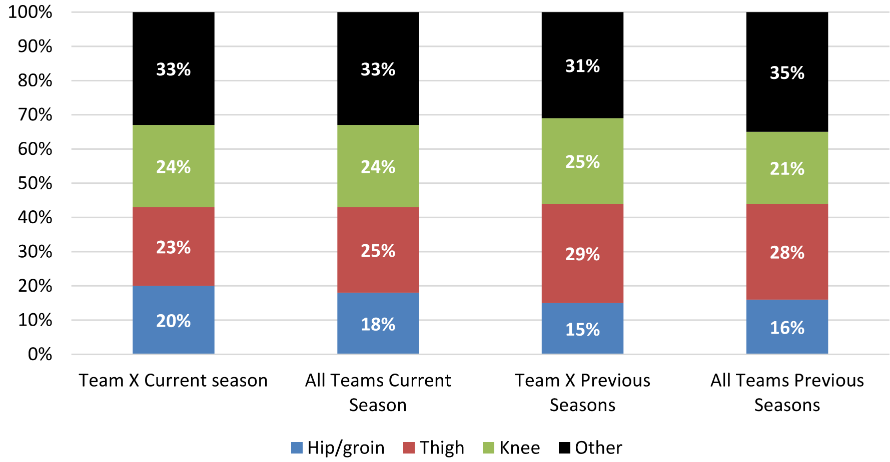


Figure 52. Distribution of re-injury types

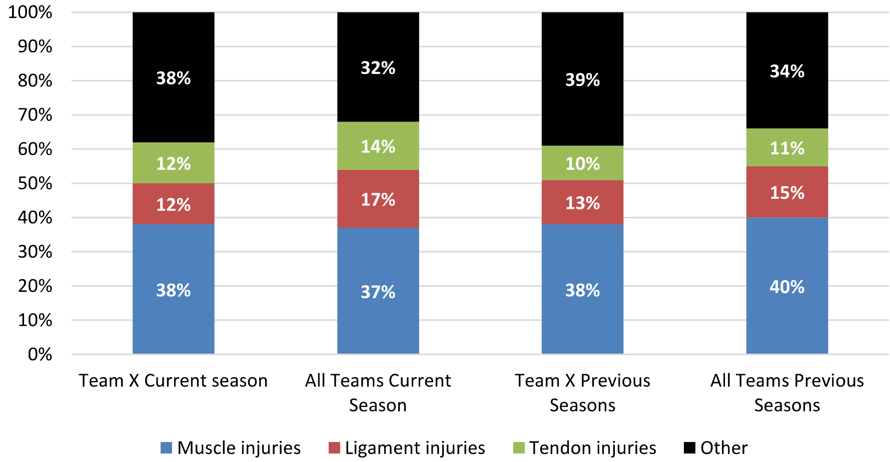
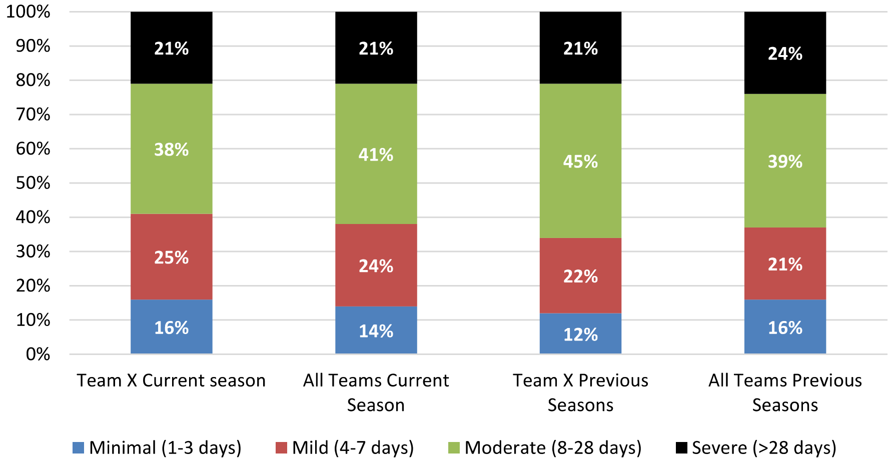


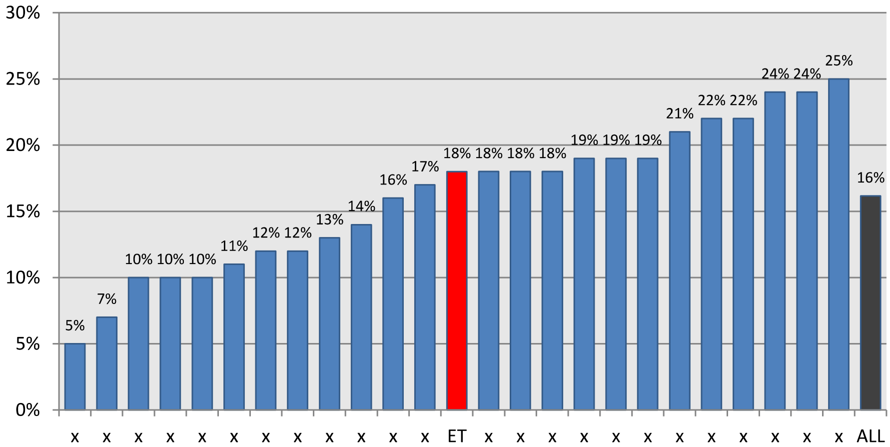
Figure 53. Distribution of re-injury severities



11.2 Re-injury proportion

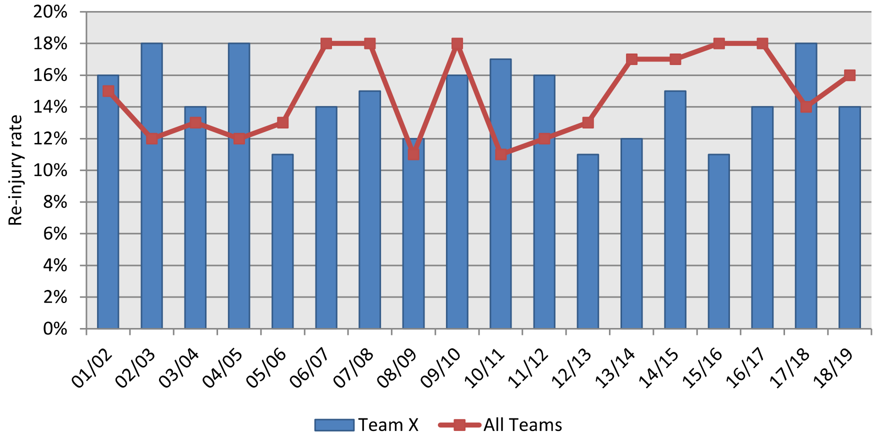
On average, 16% of injuries sustained were re-injuries, ranging from 5% to 25% at the various clubs.

Figure 54. Re-injury proportion



STAYFIT-HURT
326

Figure 55. Re-injury proportions in previous seasons



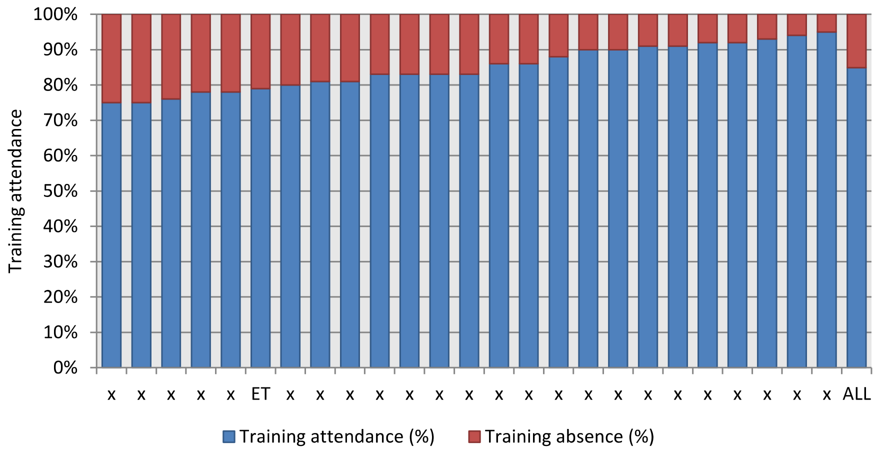
12 Squad attendance/availability and absence

All data in the charts in this section is in the form of percentages.

12.1 Squad attendance/availability

Squad attendance/availability refers to the average percentage of players who participated in training sessions or were available for match selection over the review period. An attendance/availability rate of 100% would mean that no player was absent because of injury, illness, international duty or any other reason.

Figure 56. Squad attendance rates for training



STAYFIT-HURT
328

Figure 57. Squad attendance rates for training in previous seasons

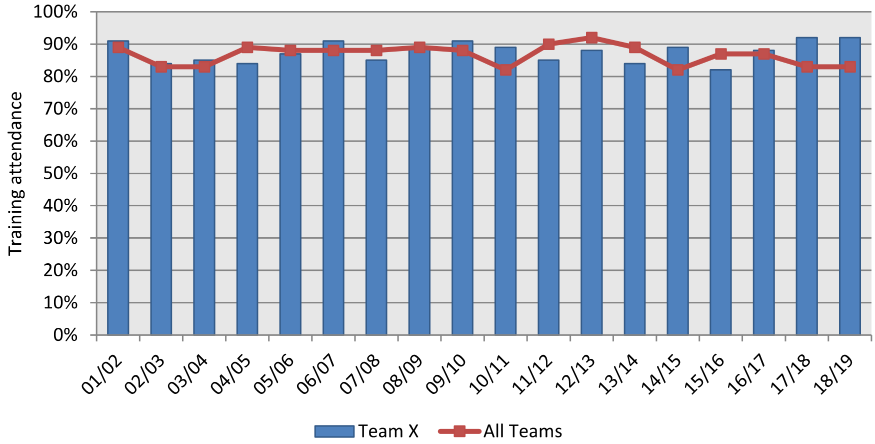


Figure 58. Squad attendance in training for Team X over the season in comparison to previous seasons

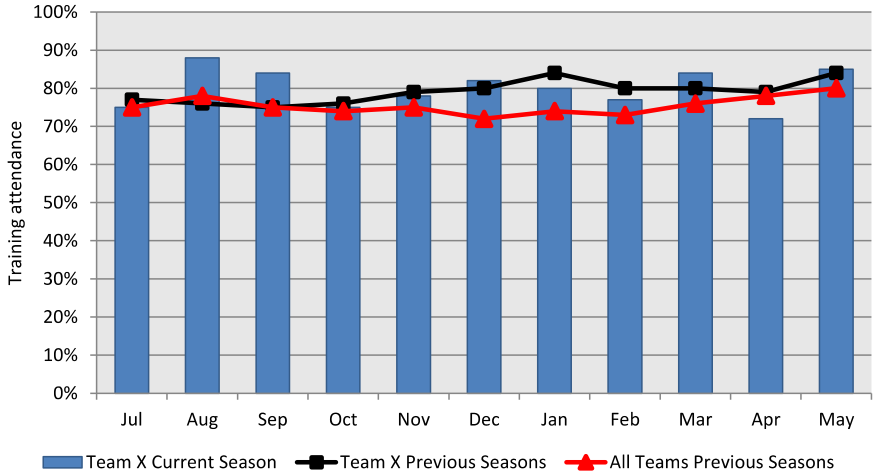


Figure 59. Squad availability rates for matches

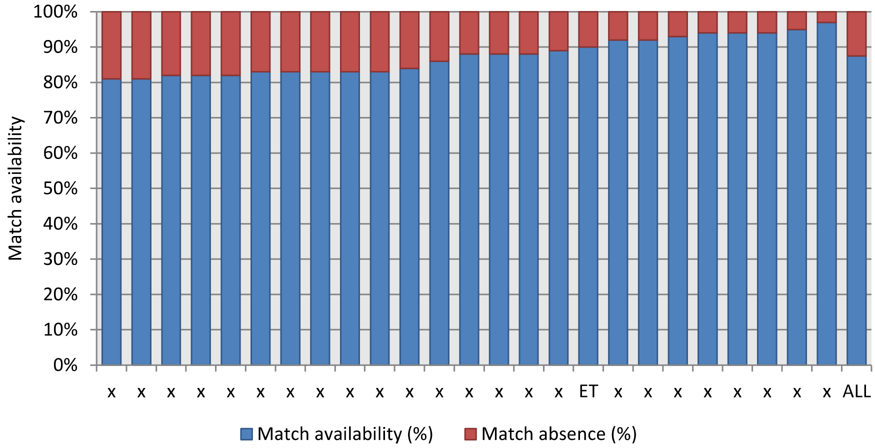


Figure 60. Squad availability rates for matches in previous seasons

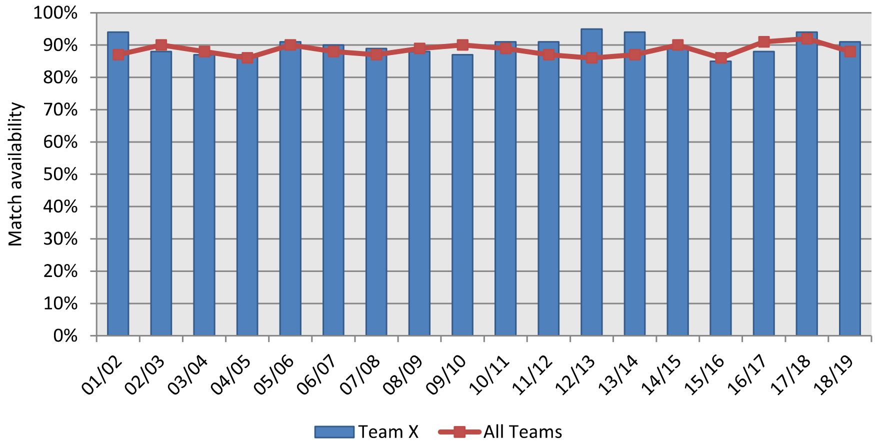
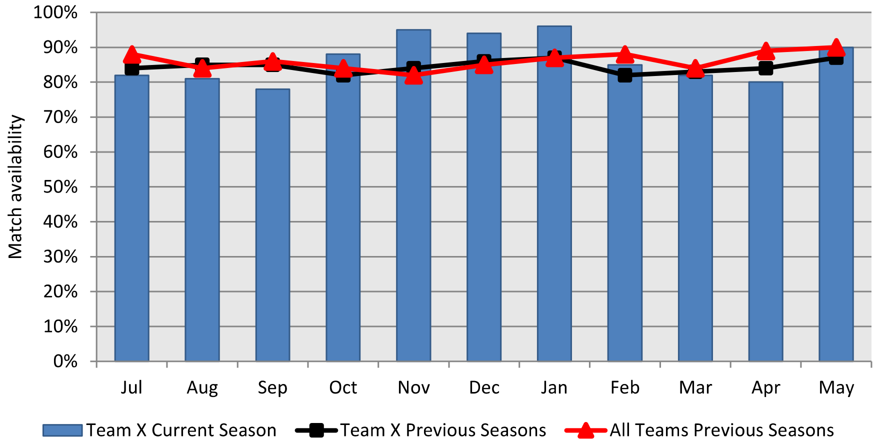


Figure 61. Squad availability for matches for Team X over the season in comparison to previous seasons



12.2 Squad absence

The charts below break players' absences down by reason.

Figure 62. Reasons for absence from training sessions

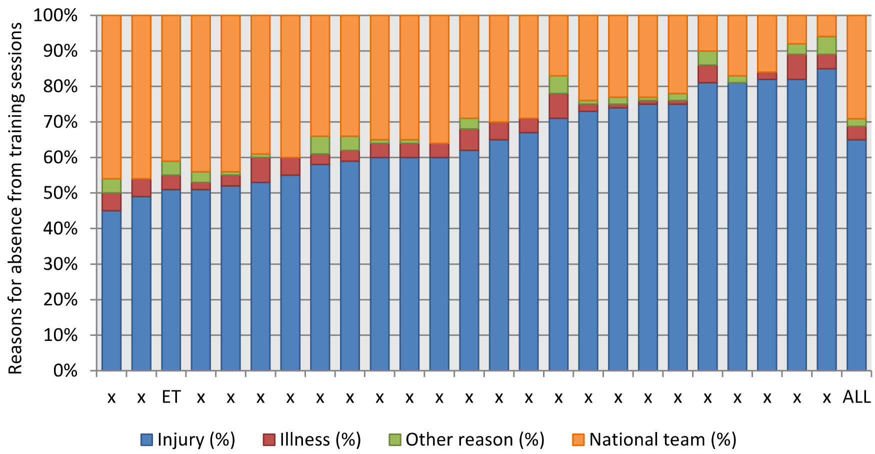
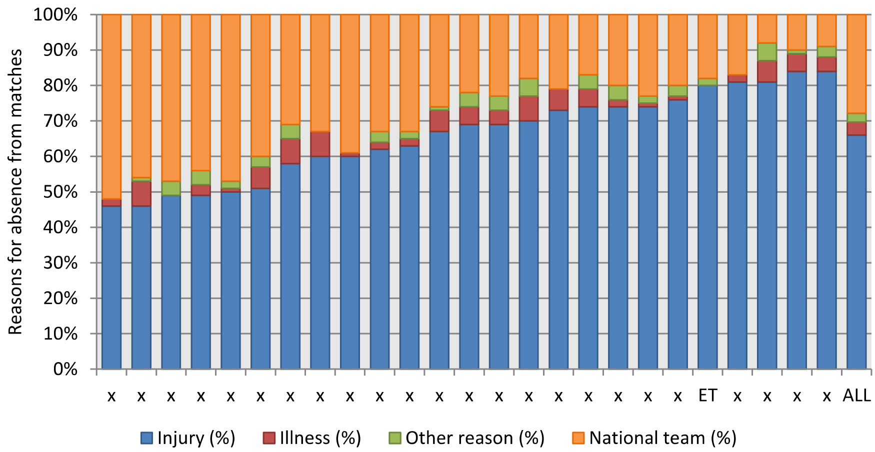


Figure 63. Reasons for absence from matches



12.2.1 Absence due to injury

Figure 64. Absence from training sessions due to injury

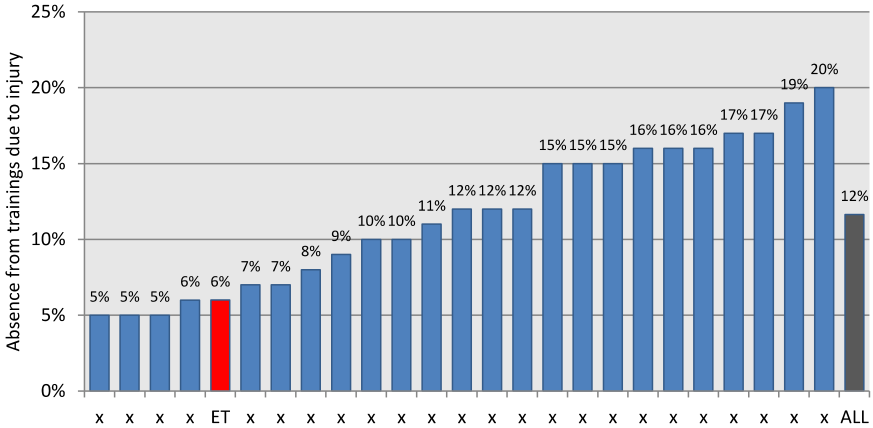


Figure 65. Absence from training sessions due to injury in previous seasons

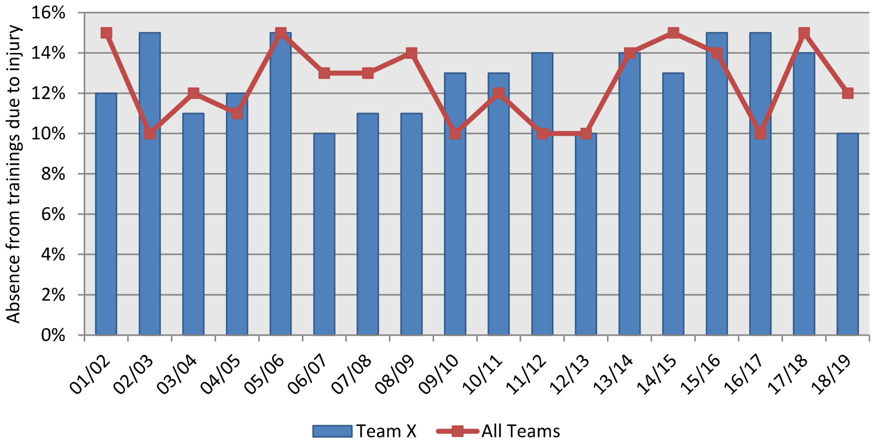


Figure 66. Absence from training sessions due to injury for Team X over the season in comparison to previous seasons

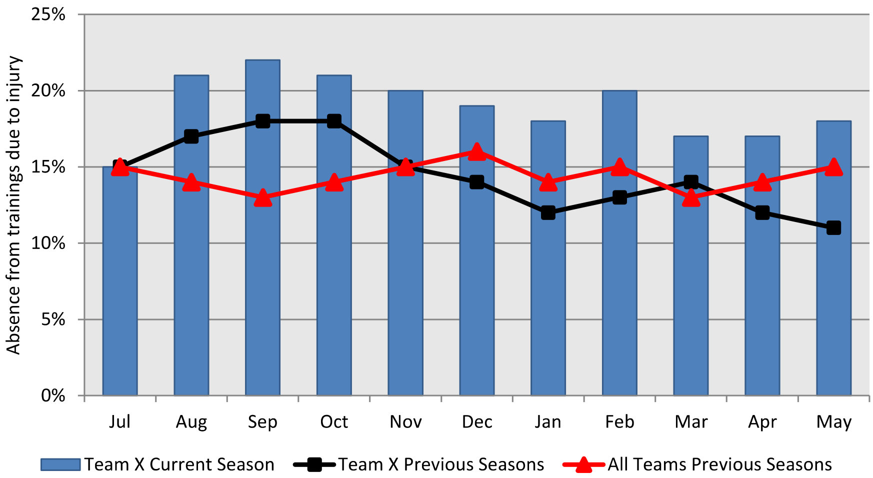


Figure 67. Absence from matches due to injury

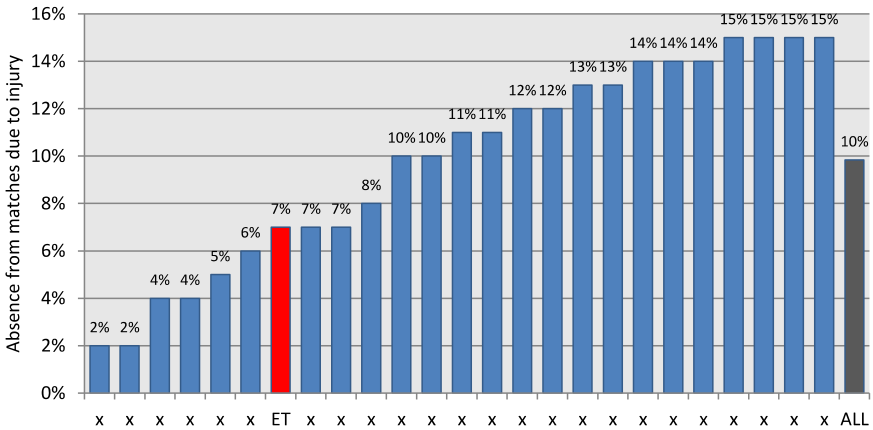


Figure 68. Absence from matches due to injury in previous seasons

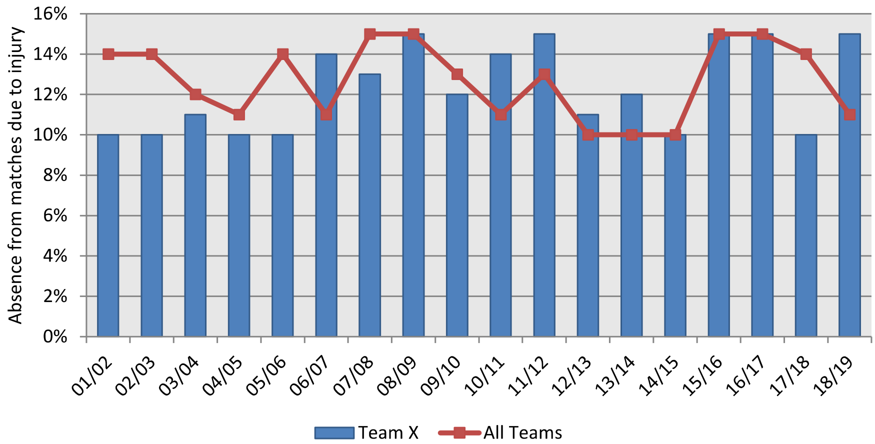
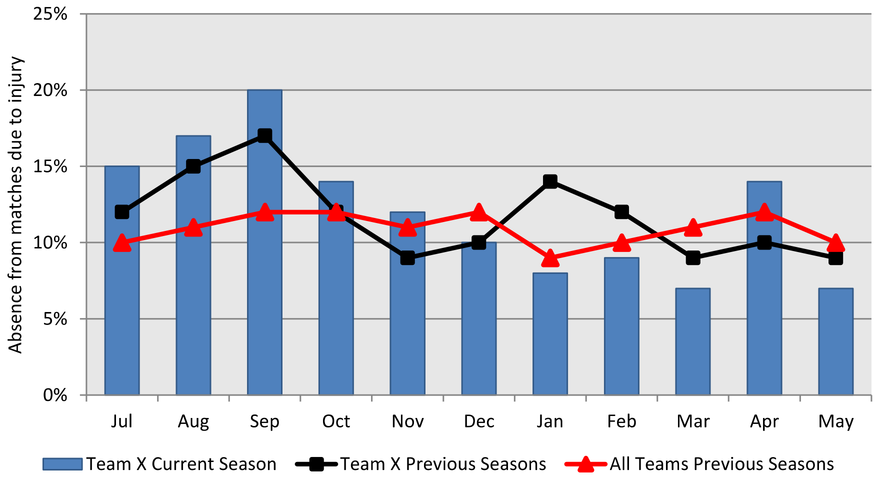


Figure 69. Absence from matches due to injury for Team X over the season in comparison to previous seasons



12.3 Number of training sessions/matches missed because of injury

The consequences of injuries have also been assessed in terms of the number of training sessions and matches that players missed during the review period. On average, across all clubs, each player missed 1.7 training sessions and 0.4 matches each month because of injury. Data specific to each club is presented below.

Figure 70. Number of training sessions missed per player per month owing to injury

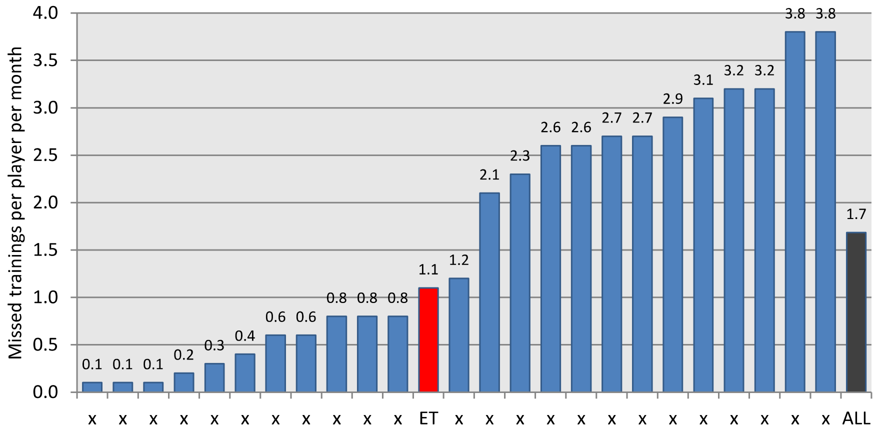
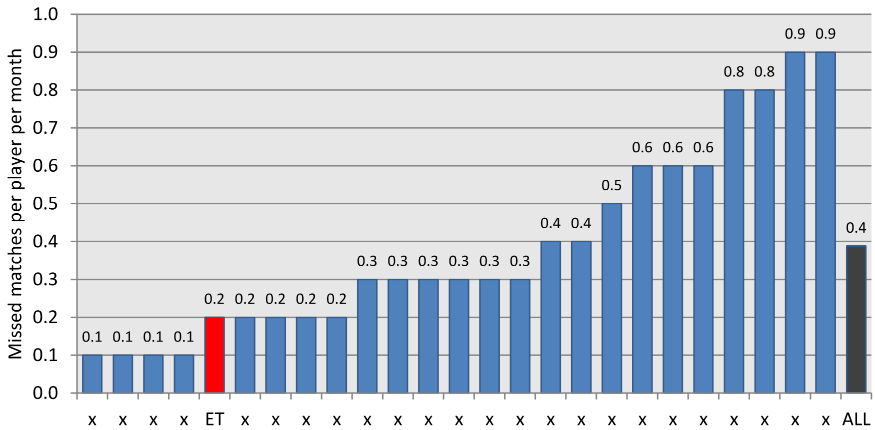


Figure 71. Number of matches missed per player per month owing to injury



13
Example Code for Data Scrape

Example code for data scrape from the SPFL website

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