Injury Incidence and Prevalence in Basketball New Zealand

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Abstract

Introduction. Basketball is among the fastest-growing sports in New Zealand, with participation quickly rising across all age groups and genders. This increased participation has coincided with a significant increase in basketball-related injuries. Despite the increase in popularity, minimal research has been conducted to assess the growing injury burden, or the incidence and prevalence of injuries in New Zealand Basketball.

Purpose. To determine the injury incidence and prevalence in Basketball New Zealand (BBNZ)

Methods. The study design was a 28-week cross-sectional observational study. The participants were New Zealand National and International athletes ranging from 16-to 30-years old who sustained an injury during gameplay from the following tournaments: U18 and U20 New Zealand Nationals, University Championships, the secondary school National Championship, FIBA men's U17 Oceania Cup, FIBA women's World Cup qualifiers, Asia Cup and the New Zealand women's tour to Japan. Injury and time-loss definitions were applied to all competition-acquired injuries and recorded by tournament and team physiotherapists. Demographic data was analysed descriptively to assess normality using Statistical Package for Social Sciences for Mac (SPSS; V31.0.2.0). Descriptive analysis determined injury incidence and prevalence. Chi-square tests were used to determine injury frequency by body site and gender. Binary logistic regression examined relationships between body site and time loss.

Results. The total number of participants was 1556, with 886 male athletes and 670 female athletes. Injury incidence was 16.40 injuries per 1000 hours of athlete exposures (AE). Time-loss injury incidence was 7.01 per 1000 hours of AE. Injury prevalence for BBNZ was 10.98. The most prevalent body site was the lower limb, markedly the ankle and knee. The head and spine resulted in greater time loss ($p < 0.05$).

Conclusion. This research has provided baseline injury data for BBNZ and future recommendations for nationwide injury surveillance and prevention models.

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Attestation of Authorship

"I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor used artificial intelligence tools or generative artificial intelligence tools (unless it is clearly state, and referenced along with the purpose of use), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning"

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Co-authorship Contributions within this Thesis

<u>Student and Supervisor Approvals</u>

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I would also like to thank Basketball New Zealand, who have supported and encouraged me to investigate the incidence and prevalence of sports injuries through surveillance to inform recommendations on ongoing surveillance and injury prevention planning.

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Ethics Approval

Ethical approval for this research was granted by the Auckland University of Technology Ethics Committee (AUTEC). The AUTEC reference is 25/62 with approval granted on 21st May 2025 (Appendix G).

Chapter One – Introduction

This thesis will be presented in four chapters. This first chapter will introduce the purpose of this study and then state the problem of injury incidence and its significance for basketball. The second chapter is a literature review. The literature review will explain the importance of injury prevention and surveillance in sport, injury surveillance challenges, the range of injury definitions used in sport, and a comprehensive review of current literature on injury incidence in basketball from around the world. The third chapter will be presented in the format for publication in the Physical Therapy in Sport Journal. This chapter will present the prospective cross-sectional observational study that examined injury incidence in Basketball New Zealand (BBNZ). It will also discuss comparisons to the literature examined in Chapter 2 and the importance of ongoing injury surveillance in BBNZ. The fourth and final chapter will further summarise key results from the prospective cross-sectional observational study, compare them with recent literature, and then draw conclusions and recommendations for BBNZ regarding injury surveillance models and ongoing data collection.

1.1 Statement of the problem

Basketball is a five-a-side contact team sport played predominantly on an indoor court. This high-intensity sport can be played on various-sized courts, depending on the level and competition played. For example, the international standard-sized court is 28m x 15m, the popular American National Basketball Association (NBA) sized court is 28.65m x 15.24m, whilst community or school courts may be scaled down further (Basketball New Zealand, 2018; Scrucca & Karlis, 2025). This high-intensity, fast-paced sport places significant physical demands, with repeated landing and pivoting during four 10–12-minute quarters, depending on the level and type of competition (Bullock et al. 2021).

The International Basketball Federation (FIBA) reports that basketball has over 610 million participants, with leading countries being China, India and the United States of America (USA) (Fédération Internationale de Basketball (FIBA), 2025). Additionally, a FIBA consumer research study conducted in 2023 found that globally, more than 3.3 billion fans follow and watch the game, making it the second most popular fan-based sport (Fédération Internationale de Basketball (FIBA), 2025). As seen globally, the popularity of basketball in New Zealand has been rapidly increasing, particularly since 2020, post-COVID-19, among both adult and adolescent participants (Taylor, Lander & Rayner, 2024). Adult participation in New Zealand rose by 46% in a five-year period from 2016, whilst School Sports New Zealand found a 62% growth in adolescent basketball participation since 2020 (Basketball New Zealand, 2021; Basketball New Zealand, 2024). This 62% rise in adolescent participation has made basketball the second most popular sport in secondary schools in New Zealand, with a 58% increase in female participation (Accident Compensation Corporation, 2023; Basketball New Zealand, 2021). The Basketball New Zealand (BBNZ) Annual Report found that there are over 85,583 registered basketball participants, of whom 27,287 are secondary school students (Basketball New Zealand, 2025). In addition, the BBNZ women's and men's professional competitions: G.J. Gardner Homes Tauihi Basketball Aotearoa (Tauihi) and the Sal's National Basketball League (NBL), respectively, experienced increased popularity from the 2023 season to the 2024 season (Basketball New Zealand, 2025). The Tauihi experienced a 30% increase in viewership, a 46% increase in local game attendance and a 650% increase in global viewership with more than 5.6 million viewers (Basketball New Zealand, 2025). Whilst the NBL had a 10% increase in viewership, with more than 160,000 fans enjoying the games live (Basketball New Zealand, 2025).

Increased basketball participation may contribute to higher injury rates. This risk is amplified by the sport's high intensity demands, including rapid changes of direction, pivoting and jumping and landing with minimal time for decision-making (Bullock et al., 2021). In the USA, professional basketball has higher injury rates than college or amateur competitions (Bullock et al., 2021). This is due to a greater number of fixtures and higher game intensity, both of which place a greater physical demand on the athletes (Bullock et al., 2021).

It is estimated that time-loss injuries in the NBA cost up to 300 million US Dollars each season (Bullock et al., 2021). Locally in New Zealand, the large increase in basketball participation has coincided with an increase in basketball injury claims to the Accident Compensation Corporation (ACC). In 2023, basketball in New Zealand was the fourth largest contributor to sports-related injuries in both cost and volume to ACC, with over 20,000 claims (Accident Compensation Corporation, 2023). From 1st November 2017 to the 28th of February 2025, the three most common basketball-related injury sites were ankle, finger/hand, and knee, with 156,766 injury claims submitted to ACC (Accident Compensation Corporation, 2025). The ankle accounted for 34,686 injury claims, the finger/hand accounted for 27,984 injury claims, and the knee accounted for 21,204 injury claims (Accident Compensation Corporation, 2025). Of these 156,766 injury claims from the seven-and-a-half-year period, the active cost to ACC was calculated to be over 160 million dollars (Accident Compensation Corporation, 2025).

In New Zealand, ACC is a government-run no-fault injury insurance scheme which provides comprehensive injury cover for everyone in New Zealand, including children, students, workers, the unemployed, the retired and visitors (Accident Compensation Corporation, 2022). Injuries must occur in New Zealand to be eligible, except that New Zealand citizens who are injured overseas can have ACC cover after returning to New Zealand, provided that the citizen typically resides in New Zealand and has been away for less than six months (Accident Compensation Corporation, 2020). To be eligible for the ACC scheme, the injury must be caused by an accident, which is a specific event or series of events involving the application of a force or resistance external to the body. An example of this is a motor vehicle accident, a fall or a collision during sports (Accident Compensation Corporation, 2025a; Accident Compensation Corporation, 2025b; Accident Compensation Corporation, 2025c). If a claim is accepted by ACC, the scheme offers medical and other treatment costs, loss of income compensation, social rehabilitation, which is aimed at restoring independence, vocational rehabilitation that is aimed at restoring work independence and the potential for lump sum payments for a permanent impairment (Accident Compensation Corporation, 2025c).

Despite basketball's rapid growth in participation in New Zealand and the increasing burden on ACC, there is minimal published literature examining the incidence of basketball-related injuries in the New Zealand population. Injury is a significant barrier to both participation in sport and performance (Raysmith and Drew, 2016; Staley et al., 2024). Raysmith and Drew (2016) found that athletes are seven times more likely to achieve their performance goals if they are available and involved in at least 80% of their planned training weeks. Therefore, it is important to reduce the time lost due to injury, resulting in less time lost from planned training sessions.

In New Zealand, in addition to limited published research on injury incidence among basketball players, injury data for high-performance New Zealand representative basketball athletes are not readily available. A large part of this is that many of their campaigns, tours, and competition games take place overseas, and ACC does not capture this data, making it less accessible than other sources. The reason for this is that most of our international athletes reside overseas in other international competitions, thus do not qualify for the ACC scheme, adding another layer of data collection challenges. Additionally, injuries captured by ACC lack specificity in injury recording. Often injuries are broadly categorised into a Read code, which only captures body site and sprain. It does not include any detail on burden, severity or mechanism

1.2 The significance of the problem

As part of ACC's injury and accident cover, a key goal is to reduce injury incidence and improve injury prevention in sport (Accident Compensation Corporation, 2024). Injury prevention models have already been implemented for other sports in New Zealand, such as FIFA11+ for Football and Netball Smart for Netball (Belcher et al., 2011; Sadigursky et al., 2017). Although there is a significant injury problem in both national and international BBNZ, the limited understanding of the BBNZ injury incidence landscape for both national and international athletes hinders the development of an effective prevention plan. Currently, there is no injury surveillance model in place to collect BBNZ related injuries at either the national or international level. Injury surveillance is imperative for the development of injury prevention planning and programmes (van Mechelen et al., 1992). Injury surveillance also allows for reassessment of injury incidence to assess the effectiveness of an implemented prevention plan, discussed in the next section (van Mechelen et al., 1992). The second chapter will review the literature on different injury surveillance models, the importance and challenges of injury surveillance, and then the injury incidence found in basketball in a systematic literature review.

1.3 Purpose of this study

Given New Zealand's injury reporting challenges, the primary question of this study is what is the incidence and prevalence of injuries among Basketball New Zealand (BBNZ) athletes? The secondary questions are: are lower limb injuries more prevalent than injuries to other body regions among BBNZ athletes? Additionally, injury data that incurred the greatest time loss from basketball competition nationally and internationally will be assessed.

1.4 Definitions

The following definitions clarify key terms used throughout this thesis.

1.4.1 Injury surveillance

Injury surveillance in sport refers to the ongoing and systematic collection, monitoring and analysis of injury data within a defined population (Wasserman et al., 2018). Injury surveillance facilitates the identification of injury patterns and informs the planning and implementation of injury prevention and mitigation strategies (Wasserman et al., 2018).

1.4.2 Injury severity and time loss

Injury severity is defined by Fuller et al. (2006, p. 84) as "the number of days that have elapsed from the date of injury to the date of the player's return to full participation in team training and availability for match selection". A time loss injury is defined as an injury that causes a player to be unable to participate in full training or match play (Fuller et al., 2006).

For this study, injury severity was determined according to the amount of match time that was lost as a result of the injury. A low-severity injury was defined as an injury that allowed a player to complete the game in which the injury occurred. A moderate-severity injury was defined as an injury that prevented the player from returning to the game in which the injury occurred, resulting in one match of time loss. A high-severity injury was defined as an injury that prevented the player from returning to both the game in which the injury occurred and the subsequent game, resulting in more than one match of time loss.

1.4.3 Medical attention injury

A medical attention injury refers to an injury that requires assessment or treatment by a health professional, including a doctor or physiotherapist.

1.4.4 Injury incidence

Injury incidence refers to the occurrence of new injuries within a defined population during a specified period of time (Bahr et al., 2020). In this study, injury incidence refers to the number of new injuries occurring during gameplay across the included tournaments.

1.4.5 Injury prevalence

Injury prevalence is defined as the number of existing injuries that are present during a specific period of time for a specific population (Bahr et al., 2020).

1.4.6 Athlete Exposure

Athlete exposure refers to the amount of participation time during which an athlete is exposed to the potential risk of injury, such as during training or competition (Danielsen et al., 2025). Athlete exposure is commonly used in injury surveillance to account for differences in participation when calculating injury rates (Danielsen et al., 2025).

In this study, athlete exposure was calculated by multiplying the number of athletes on each participating team in each tournament by the number of games that team played. The sum of all participating teams' athlete exposures was then used to give a total athlete exposure variable.

1.4.7 Injury rate

Injury rate refers to the frequency of new injuries relative to the amount of athlete exposure within a defined sporting population and specified period. Injury rates are commonly expressed as the number of injuries per 1,000 athlete exposures (Bahr et al., 2020)

1.4.8 Injury incidence and prevalence calculations

In this study, Injury incidence was expressed per 1000 athlete exposures. The injury incidence rate was calculated by dividing the total number of injuries by the total athlete exposure and multiplying the result by 1000. Injury prevalence was calculated by dividing the total number of reported injuries by the total study population and multiplying the result by 100 to express the prevalence as a percentage (Junge et al., 2006).

Chapter 2 - Literature Review

This chapter is separated into five sections. The first section will explain the importance of injury prevention in sport for both participation and performance. Multiple injury prevention models will be introduced in this section, and their role in injury prevention will be discussed. The second and third sections will discuss the importance of injury surveillance and the challenges it faces. The fourth section will outline injury definitions, and the fifth will discuss and compare injury incidence among basketball athletes internationally. The nature of this material allows for a narrative review to be undertaken (Greenhalgh, Thorne & Malterud, 2018).

2.1 Injury Prevention Models

Injury prevention refers to the deliberate use of evidence-based strategies and interventions to reduce the likelihood, frequency, and severity of injuries by identifying and modifying their underlying risk factors and mechanisms. Typically, injury prevention has been undertaken using a model or framework to ensure a systematic approach takes place. Four models which are used readily in sport are the van Mechelen et al. (1992) sport-specific injury prevention model, the Finch (2006) Translating Research into Injury Prevention Practice (TRIPP) framework and the O'Brien team-sport injury prevention cycle.

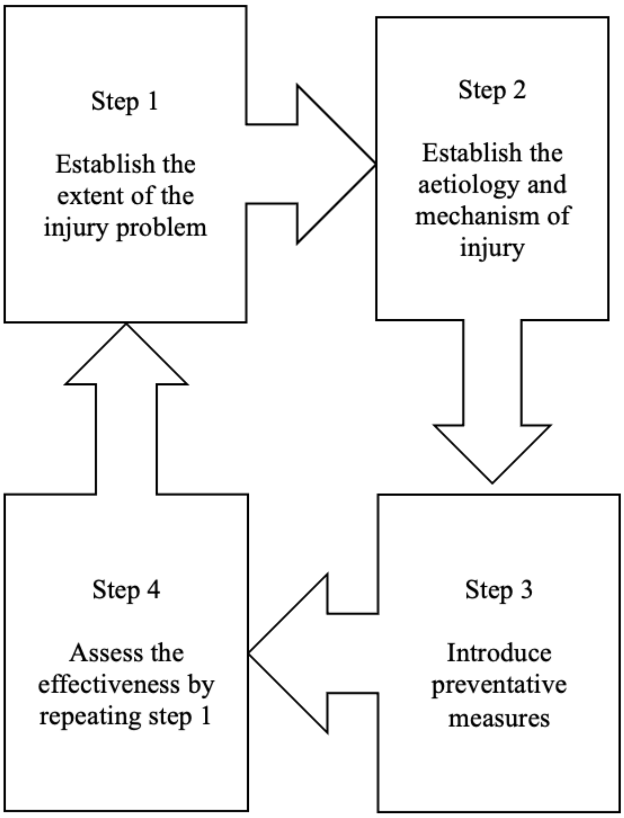
2.1.1 The van Mechelen et al. (1992) Sports Specific Injury Prevention Model

The most used and referenced injury prevention model is the one created by van Mechelen in 1992 (van Mechelen et al., 1992). The van Mechelen et al. (1992) sports-specific injury prevention model was developed to better inform injury prevention planning decisions. Initially, this injury-prevention model was developed for football. The van Mechelen et al. (1992) sports-specific injury prevention model involves four different phases shown in Figure 1.

Step one involves identifying the extent of the injury problem within a given sport. Step two then takes the identified injury problem and establishes the aetiology and mechanisms of those injuries in that specific sport. The third step is when decision-making and implementation of an appropriate injury prevention plan take place. Finally, in the fourth stage, the cycle is repeated to determine whether the preventative plan has had the intended effect on the injury problem found in step 1 (van Mechelen et al., 1992).

Figure 1

Sports Injury Prevention Model adapted from Van Mechelen et al. (1992)



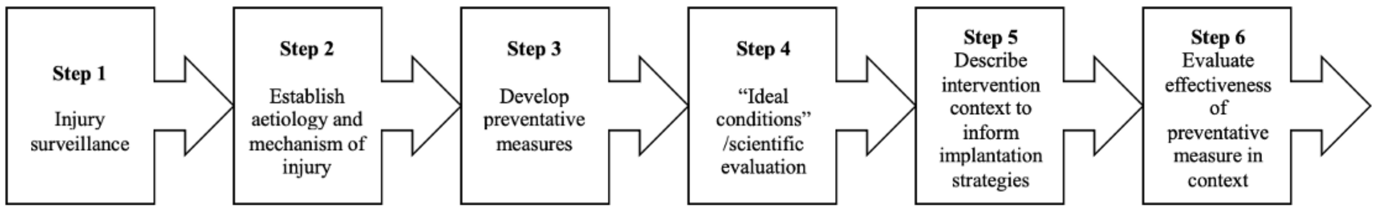
Note. Adapted from Van Mechelen et al. (1992).

2.1.2 The Finch (2006) TRIPP (Translating Research into Injury Prevention Practice) Framework

A significant limitation of the van Mechelen sports-specific injury prevention model is that it does not sufficiently outline the necessary directions for research focused on directly preventing injuries (Finch, 2006). Therefore, Finch (2006) developed the TRIPP (Translating Research into Injury Prevention Practice) framework to close the gap between injury prevention research and its real-world application. It provides a structured approach for developing and implementing effective prevention strategies in practical settings. The goal of the TRIPP model is to ensure that research outcomes are not only proven effective but also embraced, adopted, and followed by stakeholders in

Figure 2

TRIPP Framework adapted from Finch (2006)



Note. Adapted from Finch (2006)

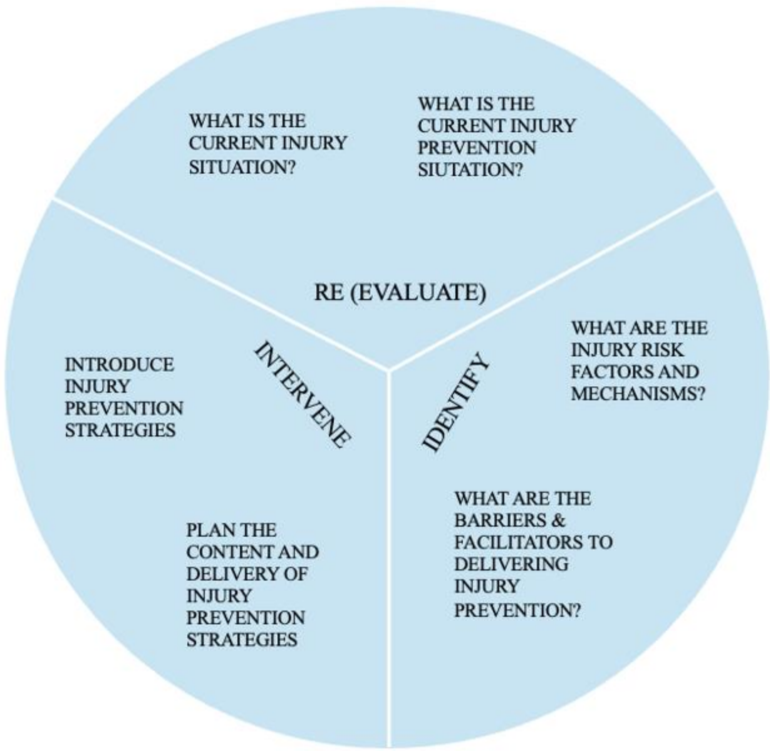
sport, such as athletes, coaches, and sporting organisations, ultimately reducing injury incidence (Finch, 2006). The TRIPP model builds on the van Mechelen sports-specific injury prevention model and has six stages, as shown in Figure 2.

2.1.3 The O'Brien et al. (2019) TIP (Team-sport Injury Prevention) Cycle

A third sports injury prevention model was created by O'Brien et al. (2019) and was intended for use by sports teams and their sports medicine or sports science practitioners. This model is called

Figure 3

TIP Cycle adapted from O'Brien et al. (2019)



Note. Adapted from O'Brien et al. (2019).

the Team-Sport Injury Prevention (TIP) cycle. The TIP cycle involves a simple three-step process: (re)evaluate, identify, and intervene, as shown in Figure 3 (O'Brien et al., 2019).

This injury prevention model is more appropriate for use with a single team, in which the second phase examines the individual barriers and facilitators that this specific team may face when planning or implementing an injury prevention plan (O'Brien et al., 2019).

Because every team or multi-disciplinary sports environment is unique, this prevention model could not be easily applied to a larger population or to the sport in its entirety.

2.2 Importance of Injury Surveillance

Musculoskeletal injuries are common in sports, including basketball. Injuries in team sports negatively affect players' health and team performance (O'Brien et al., 2019). The most obvious impacts of sports injuries for an athlete are functional impairments, time loss from sport or activity, and restrictions on performance or ability (Gallagher et al., 2017). Multiple studies have found an increased risk of osteoarthritis among athletes compared with the non-athletic population, especially following a traumatic injury (Drawer et al., 2001; Elleuch et al., 2008; Krajnc et al., 2010; Turner et al., 2000). In addition, an athlete or player can experience short-term or persistent psychological well-being effects following an injury, both in their sporting performance and in their daily life (Dacus et al., 2023). A large aspect of this is athlete identity. When an athlete's performance or participation in their sport has been limited by injury, it has been found to negatively affect their individual athlete identity (Dacus et al., 2023). This negative impact has been found to increase their risk of participating in their sport to maintain their identity, potentially worsening injury or performance (Dacus et al., 2023).

The time-loss burden from injuries can negatively affect a team's or an individual's performance (Hägglund et al., 2013). This reduced performance is observed not only at the elite professional level but also in community age-group teams (Hägglund et al., 2013). If both team injury incidence and injury severity are low, a team and/or athlete has a greater chance of reaching their performance goals (Hägglund et al., 2013; Raysmith and Drew, 2016).

In addition to the impact on athletes and their teams, there is a considerable financial impact on ACC following a traumatic sports injury. The burden of an injury on ACC includes the financial cost of potential surgery for more severe injuries, rehabilitation time with appropriate health professionals, i.e. physiotherapists or sports physicians, as well as the greatest burden of being off work. If an individual is injured and unable to work, ACC provides financial compensation until they are fully fit to return to their job.

For the BBNZ elite and professional athlete population, an injury not only physically or psychologically impacts them, but also financially. Many elite and professional athletes rely on their performance and involvement in sport to gain sponsorship, work contracts and prize money (Couvelaere & Richeliu, 2005; Thacker, 2007). Therefore, the importance of injury prevention is high for many reasons, whether at the community or professional level.

2.3 Injury Surveillance Challenges

Despite injury surveillance playing a key role in injury prevention in high-performance and community sports, it does not come without its challenges. Firstly, injury surveillance varies by sport, level, athlete, management and health team characteristics, level of engagement, and the environment (Costello et al., 2024).

2.3.1 Lack of engagement, compliance and poor communication

A commonly reported limitation of injury surveillance is limited engagement from key members of the sports community, such as athletes, coaches, and medical staff. This lack of engagement can significantly reduce the consistency and accuracy of data collection (Ekegren et al., 2014; Finch, 2006). It is common for athletes and coaches to view injury surveillance as a time-consuming task that diverts time and focus from training, performance preparation, and competition demands (Finch & Donaldson, 2010). The greater the demand for injury reporting data, e.g., daily surveillance questionnaires, the poorer the compliance and engagement (Finch & Donaldson, 2010). In addition to time commitments, athletes and coaches may not see the value of injury surveillance, further contributing to disengagement. Coaches, medical teams, performance staff, and athletes often struggle to see the benefits of injury surveillance because of a lack of immediate benefits, delayed or poorly communicated feedback or data, or data not being translated into actionable recommendations (Ekegren et al., 2014). Thus, if no immediate or clear benefit is evident from injury surveillance, motivation to comply is lower. Poor communication between those implementing injury surveillance and the relevant stakeholders can compound these challenges (Bahr et al., 2020).

2.3.2 Under-reporting of injuries

A significant contributing factor to poor injury surveillance success is the under-reporting of injuries, typically from athletes (Clarsen et al., 2014). Athletes may be reluctant to report an injury to medical or performance staff because of concerns about selection, game minutes, or perceived ability to tolerate pain (Clarsen et al., 2014). This is particularly evident in high-performance environments, where competition is intense, and selection or deselection may be more significant. Outside of athletes, coaches may be inclined to under-report injuries they witness out of fear that prominent athletes will be physically restricted by medical staff or the team, potentially impacting training or competition performance (Clarsen et al., 2014). Under-reporting of injuries in an injury surveillance system can result in a significant underestimation of the injury burden for that specific sport, team, or athlete (Meeuwisse et al., 2011).

2.3.3 Funding

A lack of appropriate funding can be significant for a medical or performance support team, or for an athlete. This is because a medical team's role is often already overloaded, and resources from sporting organisations for data collection platforms are limited (Ekegren et al., 2014). A medical or performance staff team is typically overloaded with athlete care, administrative duties, communication demands, travel, training and competition coverage, and performance and screening duties. These include acute injury assessment and management, return-to-play or rehabilitation sessions, manual therapy, clinical documentation, meetings with coaching and performance staff, long on-field or court sessions with limited admin time, pre-season screening or GPS/workload tracking, just to name a few. In other non-professional environments, these challenges are even greater, with medical and performance staff facing constraints such as limited time, inadequate staffing and administration support and insufficient funding. This can hinder the implementation of even the most basic injury surveillance systems.

2.4 Injury Definitions

It is well established that inconsistencies in injury definitions and research methods used to capture injury data lead to considerable differences in findings and conclusions regarding sports injuries (Fuller et al., 2006). Additionally, without a clear definition of injury in a surveillance system, there may be discrepancies in the number of identified injuries due to under- or over-reporting (Kluitenberg et al., 2016). Furthermore, a clearly outlined injury definition is imperative for identifying potential risk factors, which is an important part of step two for both the van Mechelen model, TRIPP model and the identification step of the TIP injury prevention model (Lacey et al., 2024). Thus, if the identification of potential risk factors for injuries is negatively impacted, the success of a prevention plan may be reduced. The effectiveness and wider applicability of any sports injury surveillance system rely on the use of clear, valid and consistent definitions of sports injuries, injury severity and sport participation. A consensus statement in studies of football injuries by Fuller et al. (2006, p. 84) defined an injury as “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”. Fuller et al. (2007, p. 329) expanded this definition to the following: “Any physical complaint, which was caused by a transfer of energy that exceeded the body’s ability to maintain its structural and/or functional integrity, that was sustained by a player during a rugby match or rugby training”. Injuries can be categorised into medical attention injuries, time-loss injuries, and any physical complaint (Fuller et al., 2006; 2007; Pluim et al., 2009).

A ‘medical attention’ injury refers to an injury when a player requires medical attention. An injury that requires medical attention can result in both under- and over-reporting, depending on the environment in which a team or athlete is. For example, a professional or national team in New Zealand will often have a team physiotherapist and sports physician; therefore, those with minor injuries may seek medical attention due to convenience and proximity. However, in a secondary school team or club setting, medical attention is not always readily available, and only people with. serious injuries may seek medical advice, leading to under-reporting. When there is either over- or under-reporting of injuries, it may be difficult to determine conclusive risk factors (Lacey et al., 2023; Lacey et al., 2024; Verhagen et al., 2024).

A ‘time loss’ injury refers to an injury that causes a player to be unable to participate in full training or match player (Fuller et al., 2006). However, if a time loss injury definition has a time restraint on it, e.g. at least one week of time loss from training or games, minor, less severe injuries may not require such a stand down or recovery period; therefore, they may be missed and not recorded (Lacey et al., 2024). Furthermore, in a professional high-performance setting or even during an important regional tournament, players may continue training or playing games with either training adaptations or ‘pushing through’ for the benefit of the team. Time-loss injuries may also cause discrepancies when injuries occur at the end of a tournament and are not correctly recorded (Orchard & Hoskins, 2007).

Overuse injuries, as defined by Clarsen et al. (2014), are injuries that gradually develop in the absence of a specific event. These injuries result from repetitive microtrauma to tissues caused by excessive load or insufficient recovery, which exceeds the affected tissue’s ability to adapt and heal.

Injury severity as described by Fuller et al. (2006, p. 84) is “the number of days that have elapsed from the date of injury to the date of the player’s return to full participation in team training and availability for match selection”.

A complication in injury surveillance is the distinction between new and recurrent injuries. A recurrent injury has been defined as “an injury of the same type and at the same site as an index injury and which occurs after a player’s return to full participation from the index injury. A recurrent injury occurring within two months of a player’s return to full participation is referred to as an ‘early recurrence’, one occurring 2-12 months after a player’s return to full participation as a ‘late recurrence’, and one occurring more than 12 months after a player’s return to full participation as a ‘delayed recurrence’” (Fuller et al., 2006, p. 84). It is widely recognised that a subsequent injury can be influenced heavily by a previous injury (Finch and Cook, 2014). Therefore, Finch and Cook (2014) created the subsequent injury classification system (SIC). This system is used to achieve greater capacity to classify subsequent injuries, aiding understanding of aetiology and the effect an initial injury may have had on a re-injury, ultimately aiding prevention planning. Similar to the

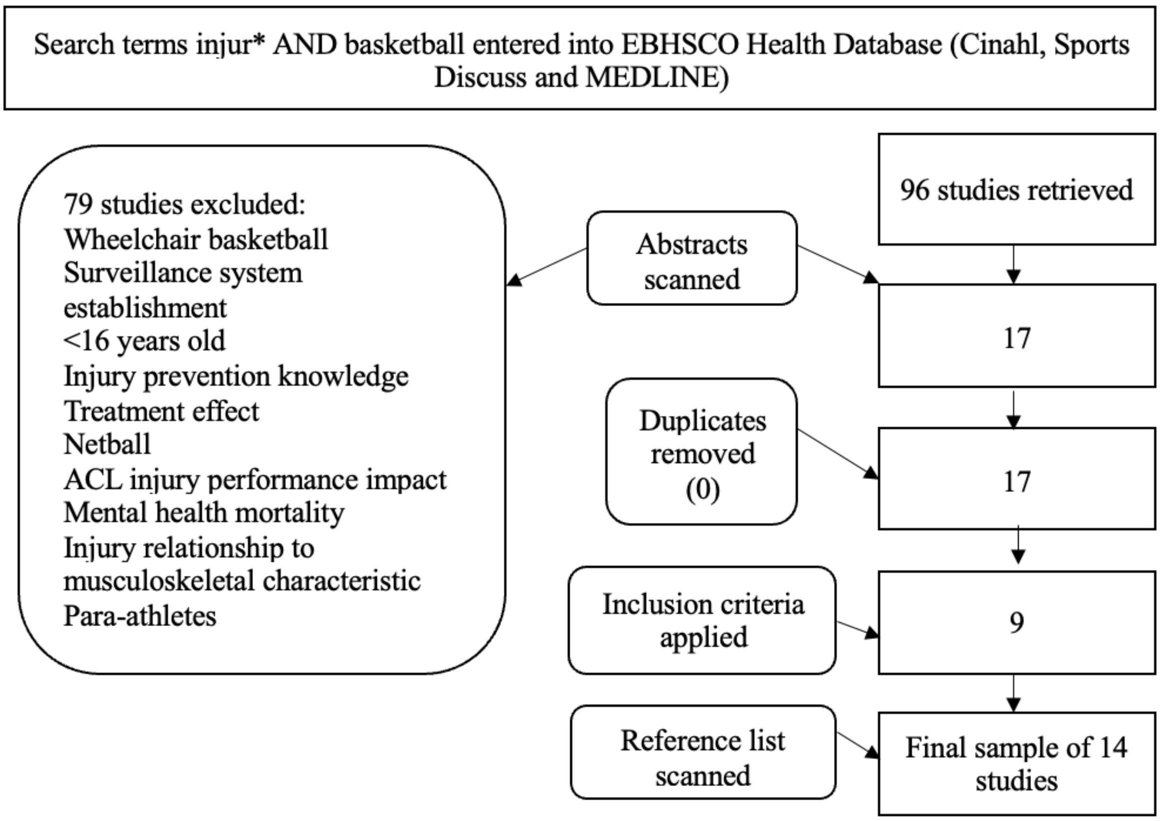
OSTRIC overuse injury questionnaire, the SIC model may be more suitable for injury surveillance within a particular team that a practitioner or sports scientist is working with, as they have the time, resources, and smaller populations needed for this to be feasible. When assessing a sport in total with many involved tournaments, teams and players, it becomes very difficult to collect all this information accurately.

2.5 Injury Incidence in Basketball

A comprehensive literature search was carried out using EBSCO Health Databases, including CINAHL, MEDLINE and SPORTDiscus. Assistance from a health research librarian was used to refine the search terms before initiating the search. The keywords used were injur* AND basketball. The inclusion criteria were English-language, full-text academic articles published since 2000. This resulted in 14 studies being reviewed. A flow diagram outlining the literature search of injuries in basketball is found in Figure 4.

Figure 4

Flow diagram outlining literature search undertaken for injuries in Basketball



Seven of the 14 studies looked at professional NBA or Women's National Basketball Association (WNBA) basketball athletes (Baker et al., 2020; Bullock et al., 2021; Drakos et al., 2010; Mack et al., 2025; Martin et al., 2021; McCarthy et al., 2013; Starkey et al., 2000). Four studies looked at female or male collegiate basketball athletes (Agel et al., 2007; Dick et al., 2007; Fraser et al., 2017; Morris et al., 2021). Two studies examined talented male and female basketball players (Campos et al., 2015; Richardson et al., 2017). One study looked at high school basketball players (Kuzuhara et al., 2022).

Of these 14 studies, two had mixed-gender populations (Fraser et al., 2017; Kuzuhara et al., 2022). Four had examined women's basketball athletes (Agel et al., 2007; Baker et al., 2020; McCarthy et al., 2013; Richardson et al., 2017) while eight focused only on male basketball athletes (Bullock et al., 2021; Campos et al., 2015; Dick et al., 2007; Drakos et al., 2010; Mack et al., 2025; Martin et al., 2021; Morris et al., 2021; Starkey et al., 2000).

Table 1

Overview of Basketball Studies

Study	Participants	Study Design	Injury Definition	Outcome measures	Results
Agel et al. (2007)	3763 elite women's teams involved. Age and participant number not stated.	Retrospective descriptive epidemiology study	A reporting injury required an event, medication attention and participation restriction.	Injury rates per 1000 athlete exposures Injury rate ratios	1317 injuries 7.68 injuries per 1000 athlete exposures 873 ankle injuries during games (24.6%) 566 knee injuries during games (15.9%)
Baker et al. (2020)	720 professional female athletes. 22 to 38 years old.	Retrospective descriptive epidemiology study	A reporting injury required medical care or time-loss.	Number of injuries Injury rate per athletic exposure Number of games missed Injury frequency Longitudinal impact	Lower extremity injuries were the most common (73%) Ankle injuries: 20%, 1.19 per 1000 athletic exposures Torn anterior cruciate ligaments caused most games missed (28%)

Bullock et al. (2021)	1369 professional male athletes. Age not stated.	Retrospective descriptive epidemiology study	Tissue damage or derangement that caused at least one game missed.	Injury incidence (per 1000 athlete game exposures (AGEs)) Injury severity (number of games missed)	Most common injuries were ankle (2.47 per 1000 AGEs, knee (2.44 per 1000 AGEs) and groin/hip/thigh (1.99 injuries per 1000 AGEs)
Campos et al. (2025)	103 male athletes. 23 to 33 years old.	Prospective cohort study	Musculoskeletal pain resulting in medical care.	Injury incidence Injury rate per 1000 hours of training or games	122 (74.4%) of musculoskeletal injuries occurred in the lower limbs. 22 (13.4%) occurred in the upper limb. 79.6 injuries per 1000 hours/game. The knee was the most affect area (19.5%).
Dick et al. (2007)	Elite college male athletes.	Retrospective epidemiological study	Not definition	Injury rate per 1000 athlete-exposures Injury frequency by body region	2849 game related injuries 9.9 injuries per 1000 athlete exposures 60% were lower extremity injuries

	No age or participant number stated.			Type of injuries Number of days missed from participation Trends in injury incidence over time	Ankle and knee injuries accounted for 26.2% and 8.9% of injuries respectively >50% were caused by player contact
Drakos et al. (2010)	1643 male professional athletes. Average age of 26.8 years old.	Retrospective descriptive epidemiology study	A reporting injury required medical care or time-loss.	Frequency of injury Games missed due to injury Game exposures Injury rates Injury rate and player demographic correlations	12,594 reported injuries 6278 game related injuries 19.1 injuries per 1000 athlete exposures Lateral ankle sprains were the most common (13.2%) The most games missed: patellofemoral inflammation (17.5%) and ankle sprains (8.8%).
Fraser et al. (2017)	Intercollegiate male and female athletes.	Prospective study	Requiring medical reporting/attention. Must	Injury incidence Injury rates per 10,000 athlete exposures	37 injuries for male athletes. 55 injuries for female athletes.

	No age or participant number stated.		have been in relation to ball contact.	Injury rates ratio	Most common were hand (85.5%) and wrist (76.4%) of injuries
Kuzuhara et al. (2022)	137 high school players. 16 to 18 years old.	Prospective cohort study	A reporting injury required medical care or time-loss.	Injury rates per 1000 athlete hours Injury characteristics (site, type and situation)	13.73 injuries per 1000 athlete game hours (male) 5.94 injuries per 1000 athlete game hours (female) Male game injury rates 2.31 times higher than females Lower limb and contact injuries were the most common
Mack et al. (2025)	3470 professional male athletes. Age not stated.	Retrospective descriptive epidemiology study	A reporting injury required medical care or time-loss.	Injury incidence Game-loss injury rate Injury onset type Injury mechanism	5183 injuries 61.8% lower extremity injuries Lateral ankle sprains (11%) 5.0-to-7.0-time loss injuries per 10,000 player minutes

Martin et al. (2021)	904 rookie professional male athletes. 21 to 27 years old.	Retrospective cohort study	Not defined but categorised by body part.	Injury incidence and ratio rate. Career longevity assessed via Poisson regressions.	Highest injury incidence was ankle injuries Rookie athletes had higher ratio rates compared to veteran athletes in multiple body regions
McCarthy et al. (2013)	496 elite female athletes. 19 to 37 years old.	Retrospective descriptive epidemiology study	No definition stated	Injury incidence	Ankle sprains were the most common (47.8%), Hand injuries accounted for 20.8% The most common surgical intervention was ACL reconstructions.
Morris et al. (2021)	2275 male collegiate basketball athletes. No age specified.	Prospective Study	Injury required medication attention	Injury incidence Injury rate per 1000 athlete exposures Injury rate ratios Body part and injury type	7.28 per 1000 athlete exposures Injuries to the ankle (22.2%) and knee (13%) were the most common

Richardson et al. (2017)	22 female athletes 16 and 18 years old.	Prospective cohort study	No injury definition stated.	Injury prevalence Injury density per 1000 hours of athlete exposure	6.3 injuries per 1000 hours of athlete exposure Ankle injuries were the most common (26%)
Starkey. (2000)	1094 professional male athletes 18 to 43 years old.	Retrospective cohort study	A reporting injury required medical care or time-loss.	Injury per 10,000 competition minutes Injuries per 1000 athlete exposures Percentage of game injuries	65,956 days missed due to injury 43.20% of injuries occurred during game competition Game competition injuries occurred at 21.4/1000 athlete exposures Lower extremity was the most common injury site Ankle injuries were most common (10.78%)

2.5.1 Injury Rates

Out of the fourteen basketball studies identified, thirteen reported injury rates all with reference to injury incidence (Agel et al., 2007; Baker et al., 2020; Bullock et al., 2021; Campos et al., 2025; Dick et al., 2007; Drakos et al., 2010; Fraser et al., 2017; Kuzuhara et al., 2022; Mack et al., 2025; Martin et al., 2021; Morris et al., 2021; Richardson et al., 2017; Starkey et al., 2000). The remaining study reported only injury incidence (McCarthy et al., 2013). The thirteen studies that reported injury rates used injuries per 1000 hours of athlete exposure, except for one study, which used per 10,000 minutes of athlete exposure (Mack et al., 2025). Three studies examined injuries per 1000 athlete exposures (AEs) for both training and games (Agel et al., 2007; Campos et al., 2025; Dick et al., 2007).

Injury rates in competition or games ranged from as low as 1.8 injuries per 1000 hours of AE's (Starkey, 2000) to as high as 19.1 injuries per 1000 hours of AE's (Drakos et al., 2010) and 5-7 injuries per 10,000 player minutes (Mack et al.,2025). There was variation in exposure measurement, with some studies reporting injuries per 1000 AE's (Drakos et al., 2010; Starkey, 2000) and others reporting injuries per 10,000 player minutes (Mack et al., 2025), making comparisons challenging (Bahr & Holme, 2003; Meeuwisse et al., 2007). Typically, AEs do not account for minutes played; thus, injuries per player-minute provide a more precise exposure and may yield higher or lower injury rates depending on other variables (Bahr & Holme, 2003; Meeuwisse et al., 2007). These include substitution or game structure (Bahr & Home, 2003). However, this requires a much more resource-intensive and effort-intensive approach to collect; thus, despite being precise, it may not be a viable or pragmatic option in reality.

2.5.2 Injury Incidence

All 14 studies reported injury incidence. Ankle injuries were the most common in eleven studies (Agel et al., 2007; Bullock et al., 2021; Dick et al., 2007; Drakos et al., 2010; Mack et al., 2025; McCarthy et al., 2013; Martin et al., 2021; Morris et al., 2021; Kuzuhara et al., 2022; Richardson et al., 2017; Starkey, 2000). Additionally, in two studies, ankle injuries were the second-most common injuries (Baker et al., 2020; Campos et al., 2025). In these thirteen studies, ankle injury incidence ranged from 1.32 injuries per 1000 AEs to 3.7 injuries per 1000 AEs. The second most common injury was to the knee and was found to be the most common in two studies (Baker et al., 2020; Campos et al., 2025) and the second most common in four studies (Agel et al., 2007; Bullock et al., 2021; Dick et al., 2007; Morris et al., 2021). Knee injuries ranged from 1.22 injuries per 1000 AEs to 2.44 injuries per 1000 AEs.

2.5.3 Competition Injury Incidence

Four studies reported a difference in injury rates or incidence between basketball games and practices (Agel et al., 2007; Campos et al., 2025; Dick et al., 2007; McCarthy et al., 2013). Dick et al. (2007) reported that athletes' injury rate was twice as high in basketball games as in training, whilst Campos et al. (2025) found a rate of 79.6 per 1000 hours of AEs in games compared to 5.1 per 1000 hours of AEs in practice. Agel et al. (2007) found that athletes were three times more likely to sustain a knee internal derangement injury (1.22 per 1000 AEs) during a game than during practice. Additionally, athletes were two times more likely to sustain an ankle injury and three times more likely to sustain a concussion during a game than in practice (1.89 per 1000 AEs and 0.15 per 1000 AEs, respectively) (Agel et al., 2007).

2.5.4 Injury Incidence related to Position

Four of the 14 studies looked at injury incidence in relation to the three main positions in basketball: guard, forward and centre (Bullock et al., 2021; Martin et al., 2021; Morris et al., 2021; Starkey, 2000). Two studies found very little difference in injury incidence across positions (Bullock et al., 2021; Starkey, 2000). Bullock et al. (2021) also found that the most common body part injured amongst the three positions was similar. Centres were found to have the lowest injury incidence rates, at 15.5% and 21%, by Morris et al. (2021) and Martin et al. (2021), respectively. However, Morris et al. (2021) found that guards had the highest injury incidence, accounting for 48.9% of injuries, whereas Martin et al. (2021) found that forwards had the highest incidence, accounting for 41% of injuries. Therefore, determining whether a position in basketball is more susceptible to injury is too unable to be determined from these studies.

2.5.5 Injury Incidence Related to Demographics

One study (Drakos et al., 2010) examined athletes' demographics and compared them with injury rates. They found no correlation between injury rate and an athlete's height, weight, or years of

NBA experience. This study examined a population of professional male basketball players in the United States of America (USA).

2.5.6 Time Loss

Four of the fourteen studies did not include time loss as an outcome measure (Campos et al., 2025; Kuzuhara et al., 2022; McCarthy et al., 2013; Richardson et al., 2017). Morris et al. (2021) found that 41.1% of all game injuries resulted in time loss from games, whilst 73% of all game-related injuries occurred acutely rather than sub-acute or chronic (Mack et al., 2025). Lower extremity injuries were the most common to cause time loss (Agel et al., 2007; Baker et al., 2020; Dick et al., 2007; Drakos et al., 2010; Mack et al., 2025; Martin et al., 2021; Starkey et al., 2000). Lower limb injuries accounted for 72-88% of all time-loss injuries (Baker et al., 2020; Drakos et al., 2010) and were associated with at least several days missed from participation (Agel et al., 2007). Ankle and knee injuries were the most commonly reported injuries and frequently resulted in time loss (Agel et al., 2007; Baker et al., 2020; Dick et al., 2007; Mack et al., 2025; Morris et al., 2021; Starkey, 2000). Knee injuries were associated with greater time loss, ranging from 10 to 18.3 days missed (Agel et al., 2007; Dick et al., 2007; Morris et al., 2021). In contrast, one study found that despite forearm/wrist/hand injuries being the least common, they resulted in the most games missed (Bullock et al., 2021). Fraser et al. (2017) examined injuries resulting from ball contact and found that 75.7% of injuries among women and 56.4% among men resulted in time loss, with more severe time loss (greater than or equal to 21 days) more common among women. Mack et al. (2025) additionally found that 44.4-52.5% of time loss injuries were a result of contact with another player.

2.5.7 Mechanism of injury

Four studies examined the mechanism of injury in relation to contact with another player, contact with others, and no contact (Agel et al., 2007; Dick et al., 2007; Mack et al., 2025; Kuzuhara et al., 2022). All four studies found that, during games, the most common mechanism of injury was contact with another player. Agel et al. (2007) found that 46% of injuries were due to player contact, whilst Kuzuhara et al. (2022) found that, for their male population, 72.2% of injuries were due to player contact during games. Both Agel et al. (2007) and Dick et al. (2007) compared games to training and found differing results. Agel et al. (2007) found that 47% of injuries during training were non-contact, whereas Dick et al. (2007) found that 43.6% of training injuries were due to player contact and 36.3% to non-contact. In addition, Kuzuhara et al. (2022) found that the most common injury mechanism among their male athletes was contact (72.2%), whereas among their female athletes, it was non-contact (53.3%).

2.5.8 Surveillance Methodology

Nine of the studies were retrospective descriptive studies (Agel et al. 2007; Baker et al. 2020; Bullock et al., 2021; Dick et al., 2007; Drakos et al., 2010; Mack et al., 2025; Martin et al., 2021; McCarthy et al., 2013; Starkey, 2000), while five were prospective descriptive studies (Campos et al., 2025; Fraser et al., 2017; Kuzuhara et al., 2022; Morris et al., 2021; Richardson et al., 2017). Retrospective studies are beneficial for injury surveillance in sport because they can be conducted using existing medical records or databases in which injury data have been recorded, and thus often require fewer resources (Ekegren et al., 2014). Additionally, if historical medical injury data are available, larger datasets may be examined, which could highlight long-term trends (Drakos et al., 2010). In contrast, because prospective studies occur in real time, strict injury definitions can be used consistently, and recall bias is reduced, both improving data completeness and enhancing internal validity (Bahr & Holme, 2003).

2.5.9 Limitations

Several limitations should be considered when examining the results from the studies in the literature search. One is the substantial heterogeneity in how the research studies measured AE and rates. Some studies reported injuries per 1000 athlete exposures (Agel et al., 2007; Baker et al., 2020; Bullock et al., 2021; Dicke et al., 2007; Drakos et al., 2010; Morris et al., 2021; Richardson et al., 2021; Richardson et al., 2017; Starkey, 2000) or per 1000 hours (Campos et al., 2025; Kuzuhara et al., 2022) or by 10,000 player exposures (Fraser et al., 2017) and by 10,000 player minutes (Mack et al., 2025; Starkey, 2000). This variation in injury rate reporting complicates direct comparison across all studies and may lead to over- or underestimation of true injury risk. Additionally, not all studies consistently reported on key outcomes such as time loss or injury mechanism, thus limiting further comparisons (Campos et al., 2025; Kuzuhara et al., 2022; McCarthy et al., 2013; Richardson et al., 2017).

Predominantly, all the studies were retrospective study designs, which introduces the potential risk for recall bias, misclassification, and incomplete injury reporting (Agel et al. 2007; Baker et al. 2020; Bullock et al., 2021; Dick et al., 2007; Drakos et al., 2010; Mack et al., 2025; Martin et al., 2021; McCarthy et al., 2013; Starkey, 2000). Lastly, despite 10 of the studies using comparable definitions of injury requiring medical attention and/or time loss, four studies had no stated injury definition (Dick et al., 2007; Martin et al., 2021; McCarthy et al., 2013; Richardson et al., 2017).

2.6 Summary

The quality and consistency of basketball injury surveillance studies varied considerably across the literature. While injury incidence was commonly reported, substantial differences existed among exposure measurements, injury definitions, and outcome reporting. This limits meaningful comparison between studies. In particular, the use of differing exposures, such as athlete exposures versus player minutes, reduces the methodological consistency and complicates the interpretation of injury rates. Although ankle and knee injuries were consistently identified as the most prevalent injuries across studies, variability in study design, reporting of time-loss and analysis of injury mechanisms weakens the strength of broader conclusions.

Most studies were conducted in professional or collegiate basketball populations in the USA, with limited representation of international, female, or youth athletes, thereby limiting generalisability. Furthermore, few studies examined demographic or positional risk factors in depth, and those that did reported conflicting findings. The predominance of retrospective study designs introduces additional concerns regarding data completeness and reporting accuracy. Collectively, these limitations highlight the need for standardised injury surveillance methodologies and greater representation of diverse basketball populations, presenting an opportunity for future research to address these gaps. No studies were identified that specifically examined the BBNZ population. Consequently, it is difficult to determine current injury trends in the BBNZ cohort and to compare them with international findings.

Chapter 3 – Injury Incidence and Prevalence in New Zealand Basketball

Preface to Chapter 3

Chapter three presents a prospective cross-sectional observational study examining injury incidence and prevalence in Basketball New Zealand (BBNZ). This chapter will provide insight into New Zealand's real-time injury incidence and prevalence data for basketball among both national and international representative athletes. In addition to presenting the overall injury incidence and prevalence data for the BBNZ population, it will compare these figures with current literature examining basketball injury incidence from around the world.

This study will be presented in the format required for publication in the Physical Therapy in Sport Journal and is intended to be read as a self-contained manuscript.

Abstract

Aim

To determine the injury incidence and prevalence in New Zealand Basketball

Study Design

28-week cross-sectional observational study

Participants

BBNZ national and international representative athletes ranging from 16 years to 30 years old who sustained an injury during gameplay from the following tournaments: U18 and U20 New Zealand Nationals, University Championships, the secondary school National Championships, FIBA men's U17 Oceania Cup, FIBA Women's World Cup Qualifiers and Asia Cup and the New Zealand women's tour to Japan.

Methods

Injury and time-loss definitions were applied to all competition-acquired injuries and recorded by tournament and team physiotherapists. Demographic data were analysed descriptively to assess normality using the Statistical Package for Social Sciences for Mac (SPSS; V31.0.2.0). Descriptive analysis determined injury incidence and prevalence. Chi-square tests were used to determine injury frequency by body site and gender. Binary logistic regression examined relationships between body site and time loss.

Outcome measures: Injury incidence and injury prevalence

Results

The total number of participants was 1556, with 886 male athletes and 670 female athletes. Injury incidence was 16.40 injuries per 1000 hours AE. Time-loss injury incidence was 7.01 per 1000 hours of AE. Injury prevalence for basketball in New Zealand was 10.98. The most prevalent body site was the lower limb, markedly the ankle and knee. The head and spine resulted in greater time loss ($p < 0.05$).

Conclusion

This research has provided baseline injury data for BBNZ and future recommendations for nationwide injury surveillance and prevention models.

INTRODUCTION

Basketball is a globally popular sport with the International Basketball Federation (FIBA) reporting over 610 million participants. The popularity of basketball in New Zealand has been rapidly increasing for both adult and adolescent participants (Taylor, Lander & Rayner, 2024). Basketball participation in New Zealand has increased markedly, with a 46% rise in adult participation since 2016, a 62% increase in adolescent participation and 58% increase in female participation since 2020 (Accident Compensation, 2023; Basketball New Zealand, 2021). These rapidly growing participation numbers nationwide have coincided with an increase in injury claims accepted by the Accident Compensation Corporation (ACC).

ACC is a New Zealand government-run no-fault injury insurance scheme that provides injury and rehabilitation cover and records claims resulting from an accident, which is a specific event or series of events involving the application of a force or resistance external to the body. In 2023, basketball in New Zealand was the fourth largest contributor to sports-related injuries in both cost and volume to ACC, with over 20,000 claims (Accident Compensation Corporation, 2023). Over a seven-and-a-half-year period from 2017 to 2025, the active cost to ACC for basketball-related injury claims was calculated to be over 160 million NZD (Accident Compensation Corporation, 2025).

In addition to the financial burden in New Zealand associated with the rapid growth in basketball participation, injury represents a significant barrier to both sport participation and performance (Raysmith and Drew, 2016; Staley et al., 2024). Injury-related time loss from training is particularly important, as athletes are seven times more likely to achieve performance goals when they participate in at least 80% of planned training sessions (Raysmith and Drew, 2016). A significant goal of sport in New Zealand and of ACC as part of their injury and accident cover is to reduce injury incidence and improve injury prevention in sport (Accident Compensation Corporation, 2024). Other sports in New Zealand already have various injury surveillance and prevention models in place. New Zealand Cricket have a nationwide injury surveillance system that records injuries among both elite domestic and international cricketers (Dovbysh, Reid & Shackel, 2021). Netball and Football both have injury-prevention warm-up models in place: Netball Smart and FIFA11+, respectively (Belcher et al., 2011; Sadigursky et al., 2017).

Reducing injury incidence and improving injury prevention in sport is dependent on effective, regular injury surveillance. The van Mechelen et al., (1992) sports specific injury prevention model is a highly regarded four-stage injury surveillance framework involving injury problem identification, determining injury causation, prevention introduction and then re-evaluation. In New Zealand, despite the rapidly growing participation in basketball, the increasing financial burden on ACC and the rising success of our international teams, there is minimal published literature examining the injury incidence or injury burden of our basketball population for both national and international athletes. An understanding of the injury incidence and prevalence for BBNZ athletes is in keeping with current injury prevention recommendations and will also allow New Zealand Basketball to look at accurate and population-specific injury prevention planning, allowing a model to be implemented for regular injury prevention (van Mechelen et al., 1992; Finch, 1997).

Therefore, the primary research question of this study is: what are the incidence and prevalence of injuries among Basketball New Zealand (BBNZ) athletes? The secondary questions are: are lower limb injuries more prevalent than injuries to other body regions among BBNZ athletes? and are there differences in injury incidence according to gender and ethnicity among BBNZ athletes? Additionally, injury data that incurred the greatest time loss from basketball competition nationally and internationally will be assessed.

METHOD

The STROBE-SIIS (Sports Injury and Illness Surveillance) Statement checklist recommendations have been used to guide the reporting of this observational study (Bahr et al., 2020). The completed checklist is provided in Appendix A. Ethical approval for this research was granted by the Auckland University of Technology Ethics Committee (AUTEC). The AUTEC reference is 25/62 with approval granted on the 21st of May 2025.

Study Design

All injuries requiring medical attention and occurring during gameplay were collected in this prospective cross-sectional observational study. An injury recording sheet was used to record the injury data. These anonymous injury recording sheets (see Appendix B) included the following outcome measures: athlete age, gender, ethnicity, body site injured, mechanism of injury (contact or non-contact), and severity/time loss, measured by the ability to continue play or not return to remaining tournament games. Each injury recording sheet included the following injury definition: Any physical complaint sustained by a player during the match resulting in one of the following: the drop in performance due to restriction e.g. pain, but able to complete the match, the inability to continue in the match and the need for medical attention/examination (Fuller et al. 2006;2007). As shown on the injury recording sheet (see Appendix B), athletes were categorised by their ethnicity into Māori/Pasifika or other. In New Zealand, it is well known that there are significant and persistent inequities in health outcomes for the Māori and Pasifika population (Sullivan et al., 2023). Therefore, this inclusion would allow the data to reveal any inequities, or higher rates present in the Māori/Pasifika population; thus, a more targeted, culturally appropriate prevention plan may be implemented.

Setting

This 28-week cross-sectional observational study took place from 30th of May 2025 through to 13th of December 2025. The national tournaments included in the research were the 2025 U20 and U18 New Zealand Nationals in Tauranga and Christchurch, the 2025 University and Tertiary Sport New Zealand (UTSNZ) Championships in Auckland, and the 2025 Secondary School AA and A National

Championships in Palmerston North. The international tournaments that were included in the research were the Junior Tall Blacks FIBA Men's U17 World Cup in Samoa, the 2 degrees Tall Ferns FIBA Women's World Cup Qualifiers in Mexico, the 2 degrees Tall Ferns FIBA Women's Asia Cup in China, and the 2 degrees Tall Ferns Tour to Japan.

Participants

The sample under investigation was male and female national and international representative athletes from New Zealand who were older than 16 years of age. Athletes were excluded if an injury occurred prior to the start of the tournament, occurred outside of gameplay, if they were younger than 16 years old or did not consent to be a part of the research.

Data Collection

Two weeks prior to the start of each tournament, Basketball New Zealand (BBNZ) emailed the national team's managers and the international team's physiotherapist with the study information sheets, injury recording forms, and consent forms (Appendix B, C, D, E, and F). These key team members were chosen for their ability to record, collect, and hand in injury data for their team as it occurred during each tournament. Once the team managers and physiotherapists consented to assist, BBNZ instructed them to email the study information and consent forms to their respective players. Athletes could consent by returning their consent forms to the primary researcher (OH) via email or in person, courtside at the national tournaments. Athletes were also made aware that if they chose to no longer be part of the study, any previously submitted injury forms could not be removed because they were anonymous. At the national tournaments, the injury recording forms were handed in in person, courtside, to the primary researcher (OH), while the international tournament injury recording forms were sent via email to the primary researcher (OH). As injury recording forms were handed in or emailed to the primary researcher (OH) prospectively, the data was immediately entered into a spreadsheet. The primary researcher (OH) is a physiotherapist. An important note is that after the first attended tournament (U20 New Zealand Nationals in Tauranga), an immediate complication arose in the data collection process. Team managers were too time-poor and under-funded in their voluntary positions to prioritise completing injury data collection forms. Therefore, the pre-organised employed physiotherapists by BBNZ to aid in injury and sideline emergency management for the national tournaments were approached and consented to complete injury recording forms and athlete consent forms for all injuries that required medical attention. Therefore, after this first national tournament, the above process was completed to ensure that athletes and team managers had the opportunity to understand the study. BBNZ also contacted the physiotherapy team supporting that tournament to obtain their consent and confirm their ability to assist with data collection.

Statistical Methodology

Data was entered and analysed into the Statistical Package for Social Sciences for Mac (SPSS; V31.0.2.0). The assistance of a statistician was used in the analysis. The data was analysed using both descriptive statistics and logistic regression.

Descriptive statistics in SPSS were used to analyse the study variables: age, injury body site frequency, and injury incidence across gender, ethnicity, body part, injury mechanism, and injury severity (represented as time loss). Descriptive statistics were also used to examine relationships between categorical variables through cross-tabulation. Age was analysed as a continuous variable to calculate the minimum, maximum, mean, and standard deviation for the study population. A split-file analysis was conducted to compare these variables across the different tournament groups: 2025 U20 Nationals, 2025 U18 Nationals, UTSNZ, NZSS, 2-degree Tall Ferns tournaments and the Junior Tall Blacks tournament. Independent T-tests were used to assess if there was a significant difference between male and female athletes and their age and ethnicity.

A cross-tabulation analysis was used to examine the relationship between injured body part (row variable) and several categorical variables (column variable), including gender, ethnicity, national versus international athletes, tournament group, contact versus non-contact injury mechanisms and severity (time loss). Several variables in the cross-tabulation analysis were collapsed into a single category. The body parts injured were collapsed from thirteen items (ankle, foot, knee, lower leg, upper leg, hip, lower back, upper back, neck, head, shoulder, elbow, hand/wrist), to five (ankle and foot, knee, lower limb, upper limb and head and spine). The six different tournament groups were collapsed into national versus international, and the severity (time loss) variable was collapsed from three options to two: no time loss and any time loss. Additionally, the mechanism of injury was collapsed into contact and non-contact categories. These variables were collapsed into broader anatomical regions, groups, and time-loss categories to ensure adequate cell counts for chi-square analysis and to improve the statistical stability and interpretability of results, thereby reducing type 1 and type 2 errors.

Binary logistic regression was conducted in SPSS to examine the association between body site of injury and severity (time loss). A binary logistic regression was selected as the dependent variable had only two options: no time loss and any time loss. The dependent variable was time loss, whilst the body site injured was used as a categorical independent variable. The Hosmer-Lemeshow goodness-of-fit test and 95% confidence interval for the odds ratio were used to assess statistical significance. Body site was collapsed into broader anatomical regions to improve statistical stability by reducing sparse-data bias and improving the interpretability of the regression estimates, thereby reducing type 1 or type 2 errors.

Time loss was calculated to include a game when a participant was injured and could not return to that game, and to include the number of games the athlete missed that remained in the tournament for their team. Athlete exposure (AE) was calculated by multiplying the number of athletes on each participating team in each tournament by the number of games that team played in its respective tournament. For example, a team of 12 players who played 7 games would give an athlete 84 games of exposure. The sum of all participating teams' AEs was then used to give the total AEs variable. The injury incidence rate was defined as the number of injuries per 1000 AEs (Junge et al., 2006). This was calculated by the following: (number of injuries / total AEs) x 1000. Injury prevalence was defined as the total number of reported injuries divided by the total sample population (Büttner & Müller, 2015).

RESULTS

There were 1,556 participating, eligible athletes (886 males; 670 females) across all tournaments during the 28-week study period. Of the international athletes, 60 were female, and 12 were male. 173 injuries were recorded over the 28-week time-period and were made up of 46.2% male athletes and 53.8% female athletes with an age range of 16 years to 30 years (mean 18.6 years, SD: 3.4). An independent t-test noted that there was a significant difference between male and females age ($p<0.001$; 95% CI [-2.98, -1.02]). The mean male age was 17.55 years (SD: 1.45), while the mean female age was 19.55 years (SD: 4.24). An independent t-test found no significant difference in ethnicity between male and female athletes ($p> 0.05$).

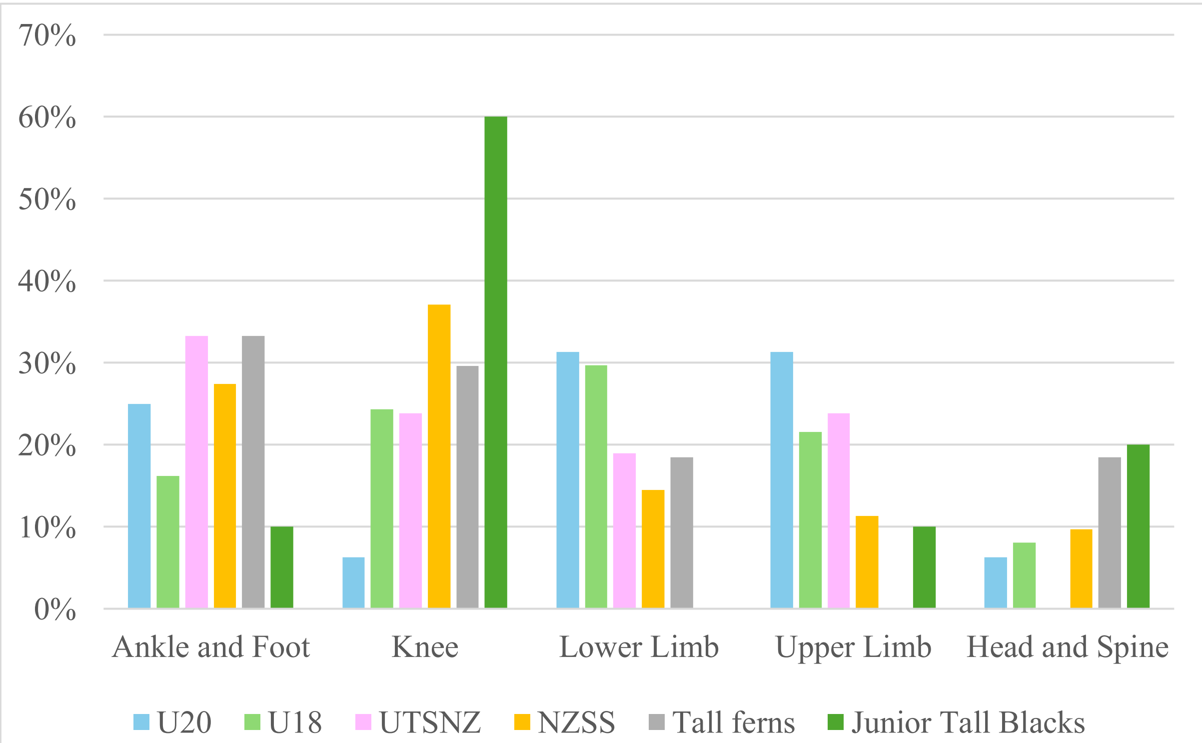
The total injury rate was 16.40 injuries per 1000 AEs, while the injury rate for only time-loss injuries was 7.01 per 1000 AEs. The male injury rate was 12.7 injuries per 1000 AEs, while the female rate was 21.87 injuries per 1000 AEs. The male time-loss injury rate was 5.07 time-loss injuries per 1000 AEs, while the female time-loss injury rate was 9.88 time-loss injuries per 1000 AEs. Females demonstrated a statistically significantly higher overall injury rate (IRR=1.72, 95% CI [1.28-2.31]) and for time-loss injury rates [IRR=1.94, 95% CI [1.23-3.05]) compared to the male athletes.

Of the 173 injuries recorded over the 28 weeks of the study, the most prevalent body sites injured were the knee (52) and ankle (41), accounting for 30.1% and 23.7% of all injuries, respectively. Figure 5 shows the distribution of injuries across collapsed body sites for each tournament and/or team involved in the study. Figure 7 shows the distribution of injuries across all body sites for both national and international athletes. Females appeared to be more likely to injure their ankle and foot, knee and head and spine compared to males, while males appeared to be more likely to injure their lower and upper limbs; however, this was not a statistically significant difference ($p=>0.05$). Figure 6 shows the distribution of injuries across the collapsed body sites for both females and males. There was no statistical significance in age, gender, or ethnicity with respect to the body site injured. When the specific injury body sites were collapsed into ankle and foot, knee, lower limb, upper limb and head and spine, the two most prevalent injured body sites remained as the ankle and foot (25.4%) and the knee (30.1%). When age was collapsed into 16- to 19-year-olds and 20-year-olds and older, it appeared that the younger group was more likely to injure their knees, whilst the older group was more likely to injure their ankles. However, this was not statistically significant ($p > 0.05$).

The severity of injury was determined by the resultant time loss the injury caused. Of the 173 injuries, 99 were mild and resulted in no time loss (57.2%), 32 were moderate and resulted in one game of time loss (18.5%), while 42 were severe and resulted in more than one game of time loss (24.3%). When time loss was collapsed into no time loss or any time loss, head and spine injuries showed a descriptive likelihood of resulting in more time loss than ankle and foot, knee, lower limb, and upper limb injuries, but did not reach statistical significance ($p > 0.05$). Ankle and foot injuries were the second most likely to result in time loss; however, they did not reach statistical significance ($p > 0.05$). Figure 8 shows the distribution of the collapsed body site injuries for both no time loss and any time loss.

Figure 5

Injuries per body site per each tournament or team



Of the 173 injuries recorded, 83 were a result of non-contact (48%), being the most common mechanism of injury. The second most prevalent injury mechanism was contact with another player, accounting for 63 injuries (36.4%). Contact with a fixed object, the ball or the floor was responsible for only a few of the injuries (8.1%, 4.0% and 3.5% respectively).

Figure 6

Injuries per body site per male and female

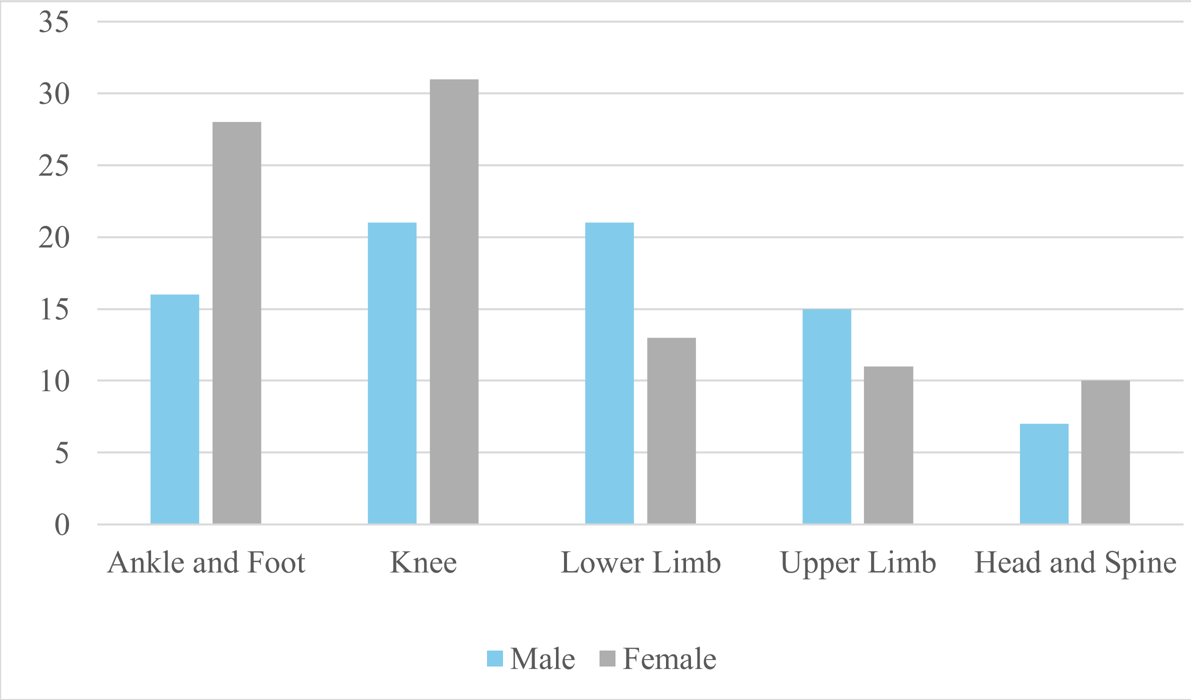


Figure 7

Injuries per body site per national and international athlete group

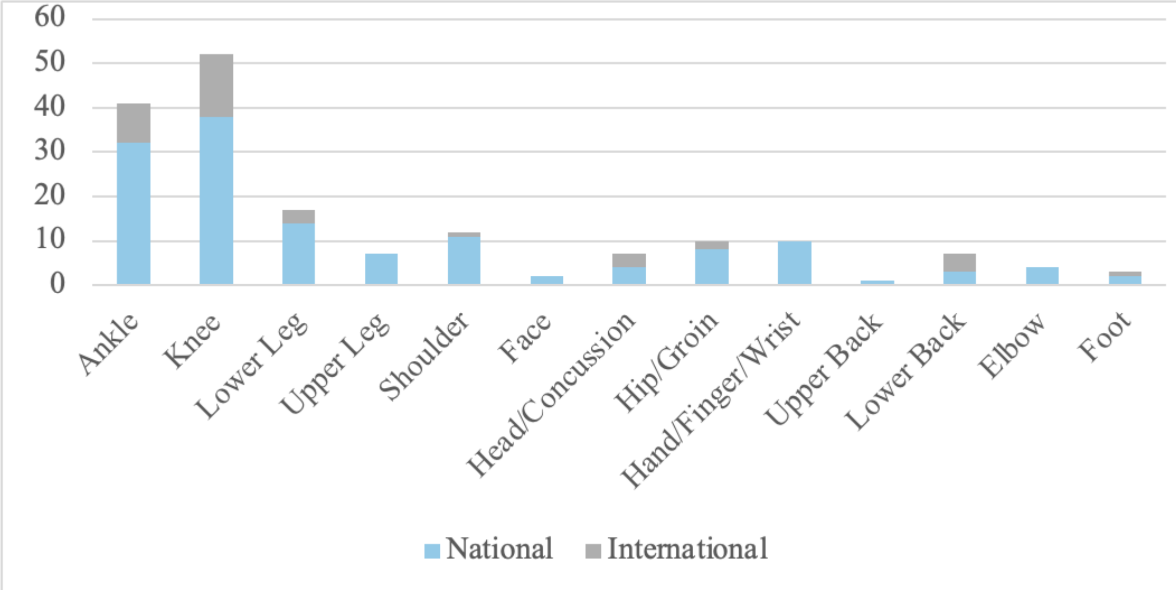
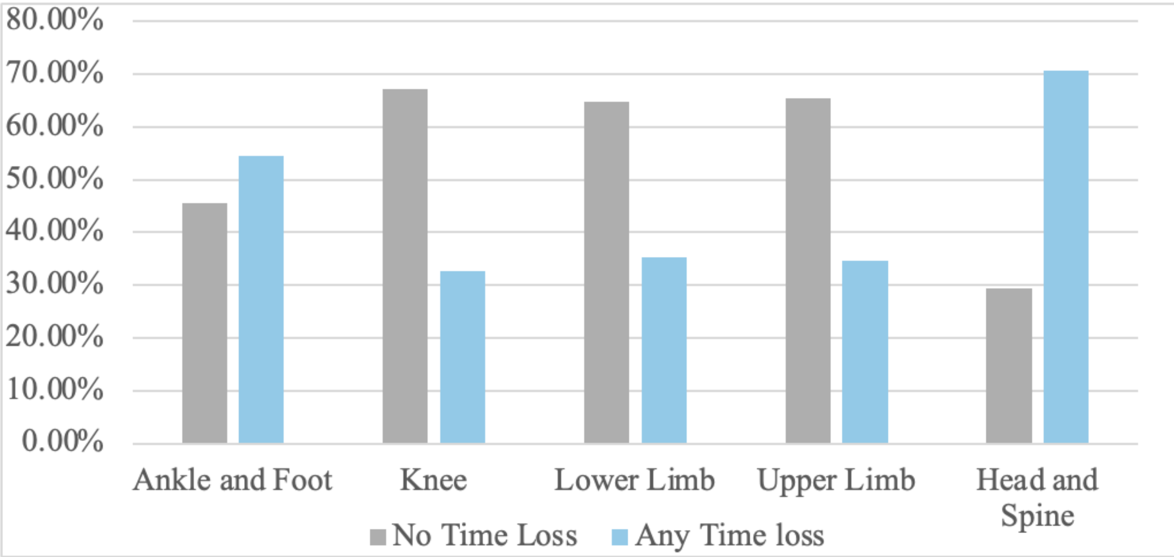


Figure 8

Injuries per no time loss and any time loss



DISCUSSION

This study represents one of the first investigations of basketball injury incidence within the New Zealand population. While this one-year injury data collection has a relatively small sample size compared to other international basketball studies, injury surveillance is essential in sport to monitor injury patterns and inform strategies aimed at reducing risk. This study provides an understanding of the current injury landscape in basketball in New Zealand.

Of the 1556 participants investigated in this study, 886 were male athletes, and 670 were female athletes. 60 of the female athletes and 12 of the male athletes were international representatives. The mean age of the participants was 18.6 years, with females being 19.55 years and males being 17.55 years.

The overall injury incidence in this study was 16.40 injuries per 1000 AEs, including injuries without time-loss. When restricted to time-loss injuries, the incidence was 7.01 per 1000 AEs, which is consistent with previous literature reporting rates between 5.97 and 9.9 injuries per 1000 AEs (Agel et al., 2007; Baker et al., 2000; Dick et al., 2007; Morris et al., 2021; Richardson et al., 2017). These studies examined similar populations, including male and female secondary school athletes, collegiate players and WNBA professionals. Three studies, all examining professional male NBA athletes, reported substantially higher injury incidence rates (17.8–21.4 per 1000 AEs) (Bullock et al., 2021; Drakos et al., 2007; Starkey, 2000). The higher rate in these cohorts likely reflects the increased physical demands of the NBA, including a longer 82-game regular season, 28 potential extra playoff games and a 48-minute game compared to the 40-minute game used in the WNBA, collegiate conferences, FIBA tournaments and the tournaments examined in this study (Baker et al., 2000). Excluding NBA data, recent literature suggests slightly higher injury rates in male athletes (7.28-9.9 per 1000 AEs) compared to female athletes (5.97-7.69 per 1000 AEs) (Agel et al., 2007; Baker et al., 2020; Dick et al., 2007; Morris et al., 2021; Richardson et al., 2017). In contrast, this study found a higher incidence of time-loss injuries among female participants than among males. This difference may be due to contextual differences rather than a true disparity between female and male athletes. The fewer female participants in this study with lower AEs than male participants, paired with a similar injury incidence, may inflate the injury incidence calculation for the female population. A significant contextual influence in this study was that most participating female teams had fewer players; therefore, an increase in fatigue and load is likely due to reduced ability for player rotations. Additionally, female athletes are known to be at a greater risk for significant internal derangement knee injuries, which have significant time-loss consequences (Ireland, 2002). Therefore, if a by-chance cluster of these injuries occurred among the female participants paired with the higher load and fatigue they experienced in this study, this may have elevated their injury incidence.

The most common body sites injured in this study were the knee (30.1%) and ankle (23.7%), with similar proportions among female and male athletes. Both findings align with the existing literature (Agel et al., 2007; Baker et al., 2000; Bullock et al., 2021; Dick et al., 2007; Drakos et al., 2010; Mack et al., 2025; Martin et al., 2021; Morris et al., 2021; Richardson et al., 2017; Starkey, 2000).

In this study, head and spine injuries were more likely to result in time loss, contrasting with previous literature that typically reports lower-extremity injuries as the primary cause of time loss (Agel et al., 2007; Baker et al., 2010; Dick et al., 2007; Drakos et al., 2010; Mack et al., 2025; Martin et al., 2021; Starkey et al., 2000). Furthermore, existing literature reports that knee injuries are associated with the greatest time-loss, particularly anterior cruciate ligament injuries, compared to ankle injuries (Agel et al., 2007; Dick et al., 2007; Morris et al., 2021). However, this study found that knee injuries were significantly less likely to result in time loss than ankle injuries ($p < 0.05$). This difference is most likely due to the study's design being unable to track injuries beyond the week-long tournament and to identify specific tissue injuries, i.e., internal derangement of the knee, which is well known for long rehabilitation time frames. Additionally, head and spine injuries likely accounted for the suspected concussion, which results in immediate removal from play following safety protocols, which may inflate time-loss over a short data collection period.

This study has several methodological strengths. The use of the STROBE-SIIS reporting guidelines improved transparency, reproducibility and methodological rigour, while the use of a standardised injury definition (Fuller et al., 2006; 2007) improved the consistency and comparability with existing basketball injury surveillance studies. The prospective design of the study reduces recall bias and improves data accuracy because injuries were recorded in real time rather than relying on long-term recall. It also allowed for the adaptation of data collection methodology; notably, the shift from team manager to physiotherapist collection, which likely improved diagnostic accuracy and consistency. The inclusion of both female and male athletes across multiple competition levels improved the representativeness of the sample and allowed for gender- and level-based comparisons.

However, several limitations should be considered. The relatively small sample size may limit the study's statistical power, although it does provide valuable baseline data for Basketball New Zealand, where injury surveillance data remains currently limited. The injury severity measurement limited the comparability with larger international studies that have greater resources to track players longitudinally. Additionally, only game-play injuries were collected; the findings do not represent the full injury burden on basketball. Finally, the reliance on multiple physiotherapists for injury classification and recording, as well as the inability to confirm exact return-to-play dates, may have introduced variability and potential bias.

CONCLUSION

This study has identified the injury incidence and prevalence across national and international basketball athletes in New Zealand over a 28-week period in 2025. The findings have highlighted the importance of ongoing injury surveillance to regularly monitor injury patterns in New Zealand. The recommendation to implement an ongoing, long-term, simple nationwide injury surveillance system would enable meaningful comparisons across age groups, genders, and playing ability. A longitudinal injury data collection system would enable the identification of injury trends and modifiable risk factors that inform targeted prevention strategies, aligning with the van Mechelen et al., (1992) model. Basketball New Zealand has a responsibility to prioritise both the development and maintenance of this injury surveillance system to ensure the positive impact of implemented injury prevention efforts and to capture seasonality in injury incidence and prevalence. In addition to a simple nationwide system, a higher-resourced, more specific injury surveillance model may be further developed for specific cohorts of athletes, e.g. international or professional teams.

Chapter 4 Discussion

Introduction

This chapter will summarise the key results and see how they compare to the previous literature analysed in the literature review. Factors such as participants and injuries will be expanded on, and the study's limitations will be discussed. Conclusions and recommendations for future research and clinical implications will then be made.

4.1 Participants

All 1556 participants in this study were either BBNZ regional age group, international, university and tertiary or secondary school representative players. All athletes who presented for medical attention consented to participate in the study.

Of the 1556 participants investigated in this study, 886 were male athletes, and 670 were female athletes. 60 of the female athletes and 12 of the male athletes were international representatives. The mean age of the 1556 participants was 18.6 years, with females being 19.55 years and males being 17.55 years. An independent t-test noted that there was a statistically significant difference between male and female mean age ($p<0.001$; 95% CI [-2.98, -1.02]).

The mean age in this study is lower than the ages reported in the literature review. Only eight of the literature review studies stated the mean age of their participants. Six of those who did have mean ages ranged from 22.2 to 28.72 years (Baker et al., 2020; Campos et al., 2025; Drakos et al., 2010; Martin et al., 2021; McCarthy et al., 2013; Starkey, 2000). Two of the literature review studies had comparable mean ages of 17.7 years and 16.6 years (Richardson et al., 2017; Kuzuhara et al., 2022). However, both studies had a secondary school population of 16 to 18-year-olds. The overall lower mean age in this study compared to the literature was not unexpected, as a significant number of talented BBNZ athletes move to the USA after secondary school to play college basketball and pursue further education. Additionally, BBNZ professional leagues such as the Tauihi and NBL have not been included in the data collection, which is where it would be expected that more athletes between 20 years and 30 years would compete.

4.2 Injuries

4.2.1 Injury site

Before the categories were condensed, the most common injury sites in this study were the knee (30.1%) and ankle (23.7%). This is consistent with existing literature in basketball injuries, which identifies the ankle and knee as the two most common injuries (Agel et al., 2007; Baker et al., 2000; Bullock et al., 2021; Dick et al., 2007; Drakos et al., 2010; Mack et al., 2025; Martin et al., 2021; Morris et al., 2021; Richardson et al., 2017; Starkey, 2000). When the data were condensed into ankle and foot, knee, lower limb, upper limb, and head and spine, the two most common injury sites remained the ankle and foot and the knee. However, when split into the two gender categories, male and female, there is a slight difference. The female participants' most injured body sites were the ankle and foot, and the knee, but the male participants were the knee and lower limb. This study's findings remain consistent with those of other studies (Agel et al., 2007; Baker et al., 2000; Bullock et al., 2021; Dick et al., 2007; Drakos et al., 2010; Mack et al., 2025; Martin et al., 2021; Morris et al., 2021; Richardson et al., 2017; Starkey, 2000). The high-intensity, fast-paced demands of basketball, with repeated landing and pivoting amid the chaos of last-minute decision-making, inevitably contribute to the high numbers of ankle, knee, and lower-limb injuries in basketball.

4.2.2 Injury time loss

In this study, head and spine injuries were more likely to result in time loss, which contrasts with previous literature that typically reports lower-extremity injuries as the primary cause of time loss (Agel et al., 2007; Baker et al., 2010; Dick et al., 2007; Drakos et al., 2010; Mack et al., 2025; Martin et al., 2021; Starkey et al., 2000). Furthermore, previous studies report that knee injuries are associated with the greatest time-loss compared to the ankle, resulting in substantially lower time-loss (Agel et al., 2007; Dick et al., 2007; Morris et al., 2021; Martin et al., 2021; Bullock et al., 2021; Drakos et al., 2010). This directly conflicts with the current study, in which knee injuries were found to be significantly less likely to result in time-loss than ankle injuries ($p < 0.05$). Five recent studies found that knee injuries resulting in severe time-loss, compared with other pathologies, included internal derangement and anterior cruciate ligament ruptures (Agel et al., 2007; Bullock et al., 2021;

Dick et al., 2007; Morris et al., 2021; Martin et al., 2021). One study found that patellofemoral knee pain resulted in the greatest time loss burden (Drakos et al., 2010). A key difference between this study and previously published research is that it tracks injuries across entire competitive seasons and often over multiple years, rather than short three-to-seven-day tournaments. This difference means that this study, with a short tournament format, likely underestimates the severity of injuries, particularly those associated with longer time-loss periods, which are associated with both knee internal derangement and ligament injuries. Additionally, a short tournament format, compared to single- or multi-season surveillance designs, misses overuse injuries such as patellofemoral pain, which typically develop over time and are less likely to be identified within a condensed competition period. Therefore, a shorter tournament injury surveillance study similar to this study would effectively collect acute injury data, which would explain why head and spine most likely suspected concussion injuries and acute ankle injuries would be responsible for more time loss than knee injuries.

4.2.3 Injury incidence

The overall injury incidence in this study was 16.40 injuries per 1000 AEs, including injuries without time-loss. When restricted to time-loss injuries, the incidence was 7.01 per 1000 AEs, which is consistent with previous literature reporting rates between 5.97 and 9.9 injuries per 1000 AEs (Agel et al., 2007; Baker et al., 2000; Dick et al., 2007; Morris et al., 2021; Richardson et al., 2017). These studies examined similar populations, including male and female secondary school athletes, collegiate players and WNBA professionals. Three studies, all examining professional NBA athletes, reported substantially higher injury incidence rates (17.8–21.4 per 1000 AEs) (Bullock et al., 2021; Drakos et al., 2007; Starkey, 2000). The higher rate in these cohorts likely reflects the increased physical demands of the NBA, including a longer 82-game regular season, 28 potential extra playoff games and a 48-minute game compared to the 40-minute game used in the WNBA, collegiate conferences, FIBA tournaments and the tournaments examined in this study (Baker et al., 2000). Excluding NBA data, recent literature suggests slightly higher injury rates in male athletes (7.28-9.9 per 1000 AEs) compared to female athletes (5.97-7.69 per 1000 AEs) (Agel et al., 2007; Baker et al., 2020; Dick et al., 2007; Morris et al., 2021; Richardson et al., 2017). In contrast, this study found a higher incidence of time-loss injuries among female participants than among males.

4.3 Strengths and Limitations

In addition to the previously discussed methodological strengths, the study design and inclusion of ethnicity data added further value. The prospective design allowed the researcher to monitor and adapt the data collection process when challenges arose. During the initial tournament, it became apparent that team managers were unable to prioritise injury data collection due to limited time and resources. As a result, medically trained physiotherapists providing sideline medical care became the primary data collectors. This likely improved diagnostic accuracy, the reliability of injury severity assessment, and the consistency of injury recording. Additionally, the inclusion of Māori and Pasifika ethnicity data enables exploration of potential health inequities and supports the development of culturally appropriate injury prevention strategies within the New Zealand sporting context.

Further explanation can also be made on a few of the studies' limitations. The injury severity was measured by the athlete's ability to continue playing or return for the following game. This severity measurement does not capture the exact duration of time loss as reported in many international basketball surveillance studies. In larger professional leagues such as the NBA and the WNBA, they have greater resources and capacity to track players longitudinally, including precise injury diagnosis, minutes lost, and exact return-to-play dates. In contrast, this study was not able to follow athletes beyond the tournament period or for longer seasons to determine precise recovery timelines. Therefore, while this study provides valuable insight into acute injuries in a high-intensity tournament setting, caution should be exercised when comparing these findings to season-based literature, particularly regarding injury severity and time-loss outcomes. Finally, injury severity classification relied on the clinical judgement of physiotherapists to determine whether an athlete could return to subsequent games. This was particularly relevant when injuries occurred during the final game of the tournament, where the athlete's ability to return to play could not be directly observed. Additionally, the use of multiple physiotherapists for injury data recording, who may have different levels of experience, clinical reasoning, and subjective interpretation, may increase variability and the potential for bias.

4.4 Conclusion

This study's purpose was to determine injury incidence and prevalence among national- and international-level basketball athletes in New Zealand. The injury incidence was 16.40 injuries per 1000 AE, while the time loss injury incidence was 7.01 per 1000 AEs. The injury prevalence was 10.98, with the most prevalent injuries occurring in the lower limb, particularly the knee and ankle. Head and spine injuries were the most likely to incur the greatest time loss.

4.5 Clinical Relevance

The findings of this study have important clinical implications for the ongoing monitoring and prevention of injuries within BBNZ. Central to these implications is the need for a structured, nationwide approach to injury surveillance to ensure consistent, high-quality data collection across all levels of the sport. Such a system would enable the timely identification of injury patterns and modifiable risk factors, thereby informing the development of targeted and evidence-based injury prevention strategies. Importantly, aligning these practices with the van Mechelen et al. (1992) model enables not only the implementation of prevention initiatives but also their continuous evaluation and refinement over time. Establishing a sustainable surveillance system is therefore critical to reducing the injury burden in basketball and to supporting long-term athlete health and performance.

4.5.1 Nationwide injury surveillance

For basketball in New Zealand, an appropriate injury prevention foundation is the structured, evidence-based van Mechelen et al. (1992) sports-specific injury prevention model. This model offers BBNZ a systematic approach to collect injury data, identify modifiable risk factors, implement a targeted prevention strategy, and then re-evaluate the effectiveness of that strategy across seasons. As the first step of the van Mechelen et al. (1992) approach is injury surveillance, establishing a regular annual nationwide system is recommended. Existing and trialed New Zealand injury surveillance systems demonstrate a range of data collection and reporting approaches, each with its own strengths and limitations across different settings.

Currently, New Zealand Cricket (NZC) has implemented a physiotherapist-led injury surveillance system for elite male players across domestic and international competitions. Injury and match-exposure data are recorded by the team physiotherapists of the six domestic competition teams and the New Zealand international team (Dovbysh, Reid & Shackel, 2021). This data is then reviewed centrally for accuracy by a dedicated NZC injury surveillance coordinator. The surveillance system uses the clear injury definition of "any injury or other medical condition that prevented a player from being fully available for selection for a major match, or during a major match, caused a player to be unable to bat, bowl or keep wicket when required by either the rules or the team's captain" (Dovbysh, Reid & Shackel, 2021, p. 2). This is consistent with the original cricket injury surveillance consensus statement (Orchard et al., 2005). Team physiotherapists use the Orchard Sports Injury Classification System (OSICS) to classify each injury (Dovbysh, Reid & Shackel, 2021; Orchard et al., 2010). Injuries were reported as acute, new, or recurrent, and included both game and training injuries. The following variables were collected: match incidence expressed per 10,000 player hours, match injury prevalence representing the percentage of players unavailable due to injury and the total number of injury incidents and match days lost (Dovbysh, Reid & Shackel, 2021).

New Zealand rowing has previously implemented a 12-month injury surveillance system specifically examining low back pain among international-level rowers (Newlands, Reid and Parmer, 2015). These high-performance athletes were sent a monthly online questionnaire that included general athlete characteristics, the presence and severity of low back pain in the previous month, athlete training volume, and the type of training completed. These surveys were analysed by a single physiotherapist. Similar to cricket, a clear injury definition was used, including both new injuries, re-injuries, and exacerbations, and all were collected. To aid accurate recall of training volume and programmes, participating athletes were asked to complete a training diary throughout the study.

Another New Zealand injury surveillance study, completed by Scott, Reid and Hamilton (2019), examined injury incidence and prevalence in New Zealand's high-performance sports. Their surveillance methodology included a single time loss injury definition where both training and competition injury data were collected. This data was collected through weekly surveys using an already developed High Performance Sport New Zealand survey. The survey was self-reported and included questions about the number of trainings completed, missed, or modified, and the reasons. If a missed or modified training was due to injury, the following questions were asked: body site, diagnosis, interventions and investigations required.

Finally, New Zealand Futsal has previously utilised a match-based prospective reporting system in which referees recorded injuries on the match report card after every game (Tomsovsky et al., 2021). The injury reporting section of the match card was very similar to the injury reporting form used in this study. The referees were trained to complete the simple-to-follow forms and instructed to hand them in to the court managers as per the normal match report card protocol following the completion of each match. They were then submitted weekly electronically to the research team (Tomsovsky et al., 2021). An injury was defined using the Fuller et al., (2006) definition, with nature, cause and severity in reference to time-loss also being captured.

These four examples of injury surveillance systems across New Zealand sport demonstrate a clear trade-off among data accuracy, feasibility, and completeness of injury recording. Therefore, different systems may be better suited in different contexts depending on the level and resources. The NZC surveillance system provides high-quality medical clinician-reported injury data utilising a standardised injury definition and the internationally recognised and widely used OSICS injury classification system. This ensures that a robust, consistent, accurate, reliable and comparable reporting of injury incidence and severity occurs. Despite multiple medical clinicians responsible for injury recording and classification, a well-defined injury definition will enable consistent reporting. Additionally, the specific injury surveillance coordinator that NZC funds to manage the injury surveillance data and review it for accuracy further improves consistency and accuracy.

Despite having a dedicated centralised individual who runs and manages the injury surveillance system, considerable funding, resources, and time are required, which many sports, elite or not, professional or well-funded, do not have available to them. Therefore, if this model were implemented, it may be better suited to elite domestic and international basketball athletes who play on the BBNZ international representative teams, as well as to the two domestic competitions: Tauihi and Sal's NBL. The inclusion of this type of injury surveillance model in the women's Tauihi competition and the men's Sal's NBL would allow for injury incidence, including acute, reoccurring, and overuse injuries, in a season where both training and match exposure can be collected and analysed. A limitation of the NZC nationwide surveillance programme is its reliance on match-time loss definitions and the exclusion of training exposure, which may result in an underestimation of the true injury burden. In contrast, both the injury surveillance systems implemented in rowing (Newlands, Reid & Parmar, 2015) and at High Performance Sports New Zealand (Scott, Reid & Hamilton, 2019) used self-reporting questionnaires to capture injury incidence, training exposure and overuse injuries. These two studies examined high-performance, elite athletes who may or may not be based within a New Zealand season or training base year-round. Therefore, this method may be beneficial for injury surveillance for BBNZ international representative athletes who play in international leagues, for example, the Australian NBL or WNBL or in USA collegiate teams. However, it is important to note that compliance, recall bias, and inconsistent recording may present limitations. Compliance is improved when athletes buy into injury surveillance, and support from coaches and national sporting organisations is high (Scott, Reid & Hamilton, 2019; Newlands, Reid & Parmar, 2015). Therefore, the drive for this must come from BBNZ, and international selection panels, coaching staff and performance staff are imperative. A point to discuss is how often self-reporting surveys should be completed. Newlands, Reid & Parmar (2015) reported high compliance with their monthly questionnaires, whereas Scott, Reid & Hamilton (2019) reported moderate compliance with their weekly questionnaires and were heavily influenced by system support. There are many factors that influence compliance, but it is worth considering whether timing may influence a group of athletes and their compliance. In theory, regular questionnaires and reporting may reduce recall bias, improve reporting of less severe injuries, and increase reporting of more acute injuries or training loads. However, frequent questionnaires may be burdensome for some athletes, potentially affecting both their willingness to complete them and the accuracy of their responses. If longer reporting intervals are chosen, it would be worth considering the inclusion of athlete diary recordings to reduce recall bias (Newlands, Reid & Parmar, 2015).

Meanwhile, the injury surveillance method used in the Futsal study, similar to the design of this study, demonstrates a strong feasibility and scalability in an amateur and community sport setting. The national age-group and secondary school basketball tournaments have employed sideline emergency physiotherapy; therefore, their clinician expertise is preferred over referee-led recording to improve diagnostic accuracy. However, during school or club competitions, physiotherapists are less likely to be readily available on the sidelines and may not be present with every team. Therefore, it may be better suited in these situations for the Futsal model, where referees use a similar injury recording card that is handed in at the end of each match on the normal match recording card. The inclusion of national age groups, secondary nationals, and general community competitions allows for larger sample sizes to be collected and a wider representation of the basketball community, despite slightly compromising diagnostic accuracy and accurate assessment of time-loss severity.

4.5.2 Injury prevention planning

Injury prevention planning is phase three of the van Mechelen et al. (1992) model, and once injury surveillance is well-established, prevention planning can begin. In sport, a common injury mitigation strategy is the implementation of a neuromuscular warm-up programme. Neuromuscular warm-up programmes have been found numerous times to reduce injury risk, hence improve athlete performance (Emery et al., 2007; Emergy & Meeuwisse, 2010; Gianotti, Quarrie & Hume, 2009; Gilchrist et al., 2008; LaBella et al., 2011; Silvers-Granelli et al., 2015). Currently in New Zealand, Netball, Football, and Futsal have all implemented neuromuscular warm-ups: Netball Smart, FIFA 11+, and Futsal Fast Start (Belcher et al., 2011; Sadigursky et al., 2017; Tomsovsky et al., 2021).

A key to injury prevention strategies is that they are specific to injury surveillance findings. Findings from this recent study identified ankle and knee injuries as the most prevalent during the surveillance period. This highlights these lower limb injuries as priority targets for initial injury prevention strategies in BBNZ. Therefore, prevention programmes should focus on mitigating specific knee and ankle sport-specific risk factors associated with these injury types. An important consideration is that injury incidence is not static and may vary from season to season, with fluctuations influenced by factors such as training load, competition demands, and reporting practices. Therefore, it is essential that the effectiveness of any implemented injury prevention programme is continuously evaluated to ensure it produces a meaningful reduction in the injury burden on the sport. Ongoing injury surveillance is critical in this regard, as it enables ongoing identification of emerging trends and supports the adjustments to injury prevention strategies over time to meet the needs of the sport. It allows an implemented injury prevention strategy to be assessed to ensure it has had the desired meaningful impact on injury incidence findings.

The injury incidence patterns found in this recent study were highly comparable across national and international athletes, different genders, and different ethnicities. This consistency suggests that distinct injury prevention strategies at this stage would not need to differ substantially across cohorts. However, different contextual factors may influence what type of injury prevention is implemented. International basketball has substantially more time allocated to appropriate preparation and warm-up before a competition game or training session. Whereas community sport, even age-group representation within BBNZ, can be strictly limited by court space and time. A similar problem arose when New Zealand Futsal considered developing a warm-up comparable to the FIFA 11+, now known as the Futsal FastStart (Tomsovsky et al., 2021). Therefore, despite injury incidence being highly comparable among BBNZ athletes in this study, context may limit the ability to apply a longer, unified approach across all levels. However, because there are key similarities in injury incidence across the different athlete cohorts, a basic neuromuscular warm-up with key principles targeting knee and ankle injuries, paired with specific basketball skills, could be implemented nationwide. It is also possible that, in instances where space and time are not an issue, an extended version of the neuromuscular warm-up can be completed. This type of approach would allow for flexibility across different basketball environments and enhance engagement from the community or younger athletes who see our international and/or professional athletes completing the same or similar game and training preparations. Influencing factors that have been found to negatively affect adherence to injury prevention programmes, such as a neuromuscular warm-up, include coach and athlete buy-in and minimal sport-specific activities (Donaldson et al., 2018; Donaldson & Finch, 2012; Finch, 2006; Soligard et al., 2010). Therefore, the importance of including basketball-specific skills in the warm-up, with environment-specific considerations (e.g., space or time), and involving coaches in implementation are key factors for success and maximising adherence.

4.6 Conclusion and Recommendations

To conclude, BBNZ has a responsibility to build on this research and develop and implement a structured nationwide injury prevention framework. The van Mechelen et al. (1992) model is a good foundation to build upon, prioritising injury surveillance, risk analysis, prevention planning, and re-evaluation. Therefore, the establishment of a consistent and sustainable surveillance system across different competition levels and age groups should be prioritised. It is important that BBNZ assess an appropriate context-specific approach, depending on the athletes and their environment, to balance data accuracy and feasibility.

The establishment of a strong injury surveillance system then allows for evidence-based, sport-specific injury prevention planning, such as a neuromuscular warm-up, to be developed, again taking into consideration the athlete and context across different skill levels. BBNZ need to ensure they create strong buy-in from the sport, athletes, coaches, and appropriate performance teams to maximise compliance and adherence to both an injury surveillance system and a prevention plan. The repetition of a cyclic injury prevention framework is imperative, ensuring that specific annual injury incidence is targeted in prevention planning and then reassessed to ensure a meaningful reduction in injury incidence.

It is important that BBNZ view injury surveillance and injury prevention as a long-term, annual process. The continuous monitoring and evaluation of both injury surveillance from one year to the next and the effectiveness of an implemented injury prevention plan is essential for achieving meaningful change in reducing injury burden and enhancing athlete performance. BBNZ can play a pivotal role not only in reducing injury risk and enhancing athlete health but also in providing long-term performance improvement for BBNZ at all skill levels.

4.6.1 Highlights for BBNZ

- BBNZ has a duty and responsibility for athlete health, reducing injury incidence and improving performance of athletes through the implementation of ongoing longitudinal injury surveillance and injury prevention models

- Implementation of an injury surveillance for international athletes, community players, age group representatives and BBNZ professional players
- Importance that this surveillance is repeated, particularly after an injury prevention plan is put in place to address the problem, e.g. knee and ankle injuries, to assess for any meaningful change in injury reduction and burden on the sport
- Different injury surveillance and injury prevention for different athletes, depending on context, resources and environmental differences

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Appendix

Appendix A STOBE-SIIS (Sports Injury and Illness Surveillance) Statement 1.0 – Checklist of items for the reporting of observational studies on injury and illness in sports

Section/Topic	Item No.	Recommendation	STROBE-SIIS Extension	Page Number(s) where addressed
Title and Abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract		1, 2, 40
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	SIIS-1.1. Include information on the sport, athlete population (sex, age, geographic region) and level of competition	2
			SIIS-1.2. Include the duration of observation (e.g. one season, one year, multiple years)	2
Introduction				
Background/Rationale	2	Explain the scientific background and rationale for the investigation being reported		12, 13, 14

Objectives	3	State specific objectives, including any pre-specified hypothesis	SIIS-3.1. State whether study was registered. Identify the registration number and database used	N/A
			SIIS-3.2. State the specific purpose of your study (e.g. to describe the injury burden associated with Olympic level rowing)	15
Methods				
Study Design	4	Present the key elements of study design early in the paper	SIIS-4.1. Clearly specify which health problems are being observed	40, 41, 42
			SIIS-4.2. State explicitly which approach was used to record the health problem data, including all outcome measures or tools	40, 41, 42
			SIIS-4.3. State explicitly which coding system was used to classify the health problems (OSIICS, SMDCS, ICD etc)	43
			SIIS-4.4. Where relevant, clearly describe how athletes were categorised. Variables to consider could include the type of athlete and/or sport, the	43, 44

			environment in which the sport occurs (e.g. type of course or playing area), the typical duration of the sport, the degree of physical contact permitted in the sport, and the equipment permitted	
Setting	5	Describe the setting, location and relevant dates, including periods of recruitment, exposure, follow-up and data collection	SISS-5.1. Describe the location, level of play, dates of observation and data collection methods (i.e. who, what, where)	43, 44
			SIIS-5.2. Specify the dates of surveillance period and how the data were handled when the study covered more than one season/calendar year	43, 44
			SISS-5.3. Define whether the health problem data were collected prospectively or retrospectively.	43, 44
Participants	6	(a) *Cohort study* – Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	SIIS-6.1.1 Define the population of athletes and how they were selected and recruited	45

		Case-control study- Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Given the rationale for the choice of cases and control *Cross-sectional study*- Give the eligibility criteria, and the sources and methods of selection of participants		
		(b) *Cohort study* – For matched studies, give matching criteria and number of exposed and unexposed *Case-control study* – For matched studies, give matching criteria and the number of controls per case		N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential cofounders and effect modifiers. Give diagnostic criteria, if applicable	SISS-7.1. Justify why you measured your primary and secondary outcomes of interest in the specific way chosen	41, 42
			SISS-7.2. Describe the method for identifying your health problem outcome of interest	43, 44

Data Sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	SISS-8.1. Specify who collected/reported data for the study and their qualifications (e.g. qualified doctor, data analyst, etc)	44
			SISS-8.2. Specify who coded the data for the study and their qualifications (e.g. qualified doctor, data analyst, etc). In many instances, this will not be the same as SIIS-8.1.	43, 44
			SISS-8.3. Specify the direct methods used to collect the data, and the use of physical documents or an electronic tools. If extracting information from existing sources, specify the data source.	43, 44
			SISS-8.4. Specify the timing of and window for data collection (e.g. day health problem occurred or following day. Specify the frequency of data collection (e.g. daily, weekly, monthly).	43, 44, 45
			SISS-8.5. Report the duration of surveillance (e.g. tournament, season, who year, playing career)	43

Bias	9	Describe any efforts to address potential sources of bias	SIIS-9.1. Clearly report any validation or reliability assessment of the data collection of tools	42
			SIIS-9.2. Formally acknowledge any potential biases in associated with data collection method (e.g. self-report, recall bias, reporting by non-medically trained staff, etc).	44, 52, 53
Study Size	10	Explain how the study size was arrived at		47
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groups were chosen and why	SIIS-11.1. Explain in detail how multiple injuries/illness episodes are handled both in individual athletes and across athlete/surveillance periods	N/A
			SIIS-11.2. Specify how injury severity was calculated	45, 46
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	SIIS-12.1. Specify how exposure to risk has been adjusted for and specify the units (e.g. per participant, per athlete exposure, etc).	45, 46
			SIIS-12.2. Specify how relevant risk measures (incidence, prevalence, etc.) were calculation	45, 46

			SIIS-12.3. When relevant to the study aim, specify how injury burden was calculated and analysed.	43, 44, 45
		(b) Describe any methods used to examine subgroups and interactions		43, 44, 45
		(c) Explain how missing data were addressed	SIIS-12.4. For studies reporting multiple health problems, state clearly how these were handled (e.g. time to the first injury only, ignoring subsequent return to play and re-injuries, or modelling of all injuries)	N/A
			SIIS-12.5. Explain how/if athletes not included at outset (e.g. those already injured) were handled in the analyses	43
		(d) *Cohort study* – *I*f applicable, explain how loss to follow-up was addressed *Case-control study* – If applicable, explain how matching of cases and controls was addressed	SIIS-12.6. In longitudinal studies, it is particularly important to explain how athlete follow-up has been managed. For example, what happened if a player was transferred to another team or has been censored (for those no longer part of the study due to removal during the observational period). Censoring can	43, 44

		Cross-sectional study- If applicable, describe analytical methods taking account of sampling strategy	occur when athletes are removed due to transfer out of the team/study, injury/illness or due to study design	
		(e) Describe any sensitivity analyses		N/A
Results				
Participants	13*	(a) Report number of individuals at each stage of study – e.g. numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	SISS-13.1. Clearly state the number of athletes followed-up, the number (and %) of those with the health problem and the number of problems reported among them (a median number of problems per affected athlete could be useful).	47
			SIIS-13.2. For studies over multiple seasons/years, report the total numbers of health problems for each year and numbers common to each period.	N/A
		(b) Give reasons for non-participation at each stage	SIIS-13.3. Report how athletes removed (e.g. due to transfer of teams or time-out due to injury or illness) impact upon data at key data collection/reporting points, ideally with a flow diagram	N/A

Descriptive data	14*	(a) Give characteristics of study participants (e.g. demographic, clinical, social) and information on exposures and potential confounders	SIIS-14.1. Include detail on the level of competition being observed (e.g. by age levels, skill level, sex, etc.).	47, 48
		(b) Indicate number of participants with missing data for each variable of interest		N/A
		(c) *Cohort study*—Summarise follow-up time (e.g. average and total amount)		N/A
Outcome Data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	SIIS-15.1. In many observational studies, individuals will sustain more than one health problem over the surveillance period. Take care to ensure descriptive data representing both the number of health problems and the number of athletes affected. It is important to represent effectively both the analysis and reporting of correct units for frequency data, i.e. the % of affected athletes or the % of injuries, body regions, etc.	N/A
		Case-control study—Report numbers in each exposure category, or summary measures of exposure		N/A

		Cross-sectional study—Report numbers of outcome events or summary measures		47, 48
Main Results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g. 95% confidence interval). Make clear which confounders were adjusted for and why they were included	SIIS-16.1. Report exposure-adjusted incidence or prevalence measures with appropriate confidence intervals when presenting risk measures.	47, 48
			SIIS-16.2. Report details of interest, such as mode of onset	47, 48, 49
		(*b*) Report category boundaries when continuous variables were categorized		47, 48
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period		47, 48
Other Analyses	17	Report other analyses done—e.g. analyses of subgroups and interactions, and sensitivity analyses	SIIS-17.1 Report injury diagnosis information, including region and tissue type in tabular form.	47
Discussion				
Key Results	18	Summarise key results with reference to study objectives		47, 48, 49, 51, 52, 53

Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	SIIS-19.1. Discuss limitations in the data collection and coding procedures adopted, including in relation to any risk measures calculated.	49, 50, 53
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence		47, 48, 49, 50, 51, 52, 53
Generalisability	21	Discuss the generalisability (external validity) of the study results	SIIS-21.1. Discuss the generalizability of the athlete study population, and health problem sub- groups of interest, to broader athlete groups.	47, 48, 49, 50, 51, 52, 53
Other Information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based		N/A
Ethics	23		SIIS-23.1. Outline how individual athlete data privacy and confidentiality considerations were addressed, in line with the Declaration of Helsinki.	11, 43

Appendix B Injury recording sheet

Injury Recording Sheet		
Date	**Age of Athlete**	**Gender of Athlete**

1. Has any player sustained an injury because of the game? *

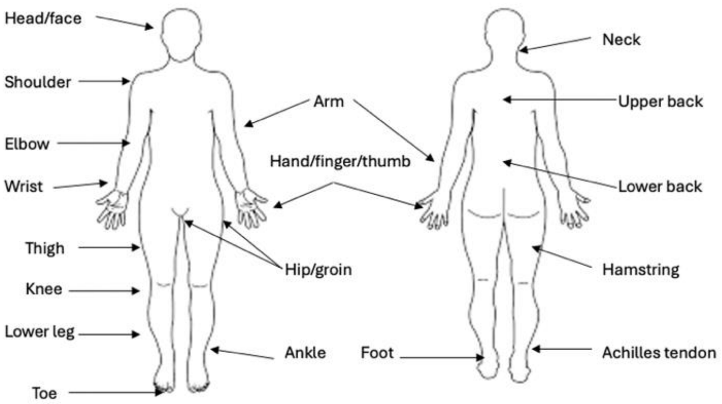
Ethnicity: Māori/Pasifika/Other (circle best option)

*** Injury =** ANY PHYSICAL COMPLAINT sustained by a player during the match resulting in one of the following:
→the drop in performance (e.g. pain), but able to play
→the inability to continue in the match
→ the need for medical attention/examination

☐ Yes ☐ No

Injury Specification

2. Please, circle the body part injured



3. Circle what was the injury caused by contact or a collision?

☐ NO ☐ Yes, ball ☐ Yes, with a player
☐ Yes, with fixed object. ☐ Yes, with (specify)

4. What as the injury severity?

☐ Able to finish the match with NO limitation (e.g. pain)
☐ Able to finish the match BUT with some limitation (e.g. pain)
☐ Unable to finish the match (no medical attention required)
☐ Unable to finish the match (medical attention required)
☐ Unable to return to next match

Appendix C Player information sheet

TE WĀNANGA ARONUI O TĀMAKI MAKAU RAU

Participant Information Sheet

Date information sheet produced: 1st March 2025

Data collection will start of the 30th May 2025

Injury and Illness Incidence in New Zealand Basketball

You are invited to participate in a research study investigating the most common injuries and illness are in New Zealand Basketball. This study is being conducted by Olivia Hay NZ Tall Ferns Physiotherapist, Professor Duncan Reid from Auckland University of Technology and Jennifer Scott the Head of Performance Therapy at High Performance Sport New Zealand. This is student research and will be completed as part of Olivia Hay's Masters in Health Science.

What is the purpose of this research?

Basketball is the fast-growing sport in New Zealand, particularly in the youth age groups. With this rapid participation, the number of injuries being recorded by the Accident Compensation Corporation is also increasing. Despite these increases, there is minimal research that is directly assessing the New Zealand Basketball population regarding the most common injuries and illnesses. Therefore, this study will collect injury and illness data from female and male athletes from the ages 16 to 40 years old who are playing in or representing New Zealand. We aim to collect injury and illness data that occurs during planned tournaments in 2025, for example U20 and U18 Association National Championships. The findings of this research may be used for academic publications and presentations.

How was I identified and why am I being invited to participate in this research?

You have been invited to participate in the research because you are involved in a tournament that has been included in this research. To be eligible to participate in the study, you must be 16 years old or older and be participating in the chosen tournament where we will collect injury and illness data.

How do I agree to participate in this research?

Your participation in this research is voluntary (it is your choice) and whether you choose to participate will neither advantage nor disadvantage you. You have been sent a consent form from your team manager. If you wish to participate you must have this signed and returned to the researcher five days before the start of the tournament at the latest.

You can withdraw from the study at any time by informing the Researcher. However, as this is an anonymous data collection, it will not be possible to withdraw your injury or illness information after you have submitted it.

What will my participation involve?

Your participation will involve your team manager filling out an anonymous short injury and illness reporting sheet and submitting that to the collection point while at the tournament. The injury and illness reporting sheets will only be used during a tournament. The injury related questions in the reporting sheets will include date, age, gender, ethnicity, body part injured, contact or non-contact injury and injury severity but no reference to your name will be collected. The illness related questions in the reporting sheets will include the characteristics of your illness and the illness severity in relation to participation.

What are the benefits?

The benefits of this research for you as a basketball athlete is gaining insight into what injuries and illnesses are specific to your sport. Therefore, you will be able to seek out information from appropriate health and performance professionals to reduce your risk in the future of acquiring these injuries or illness which may prevent you from participation or reaching your highest level of performance. The research will also help to inform future injury and illness prevention strategies, therefore improving the overall health of the sport.

Direct benefits of this research for the researcher is to work towards completion of a Masters in Health Science.

Will the results of the study be published?

The results of this research will be published in a Master's Thesis. This thesis will be available to the general public through the AUT library. Results may be published in peer-reviewed, academic journals. Results will also be presented during conferences or seminars to wider professional and academic communities. You will not be identifiable in any publication.

What will happen to information about me?

Data collected will not be individually identifiable and your identity will never be revealed in any publication or presentation arising from this study. Apart from the study researchers, no one will have access to your information. All data, including consent forms will be kept secure on AUT premises and destroyed ten years after completion of the study.

What opportunity do I have to consider this invitation?

You will have two weeks from the start of your planned tournament consider this invitation form. Your consent form will need to be handed back to your team manager five days before the start of your tournament.

Will I receive feedback on the results of this research?

I will send an anonymous summary of the research to you at the end of the study, if you request this.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, Duncan Reid, (+649) 921 9999 ext 7806

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, *ethics@aut.ac.nz*, (+649) 921 9999 ext 6038.

Who do I contact for further information about this research?

Please keep this Information Sheet and a copy of the Consent Form for your future reference. You are also able to contact the research team as follows:

Researcher Contact Details:

Olivia Hay

nff1626@aut.ac.nz

Project Supervisor Contact Details:

Duncan Reid

duncan.reid@aut.ac.nz

Jennifer Scott

Jennifer.Scott@hpsnz.org.nz

Approved by the Auckland University of Technology Ethics Committee on 21st May 2025, AUTEC Reference number *25/62*

Appendix D Team manager and physiotherapist information sheet

TE WĀNANGA ARONUI O TĀMAKI MAKAU RAU

Team Manager Participant Information Sheet

Date information sheet produced: 1st March 2025

Data collection will start of the 30th May 2025

Injury and Illness Incidence in New Zealand Basketball

You are invited to participate in a research study investigating the most common injuries and illness are in New Zealand Basketball. This study is being conducted by Olivia Hay NZ Tall Ferns Physiotherapist, Professor Duncan Reid from Auckland University of Technology and Jennifer Scott the Head of Performance Therapy at High Performance Sport New Zealand. This is student research and will be completed as part of Olivia Hay's Masters in Health Science.

What is the purpose of this research?

Basketball is the fast-growing sport in New Zealand, particularly in the youth age groups. With this rapid participation, the number of injuries being recorded by the Accident Compensation Corporation is also increasing. Despite these increases, there is minimal research that is directly assessing the New Zealand Basketball population regarding the most common injuries and illnesses. Therefore, this study will collect injury and illness data from female and male athletes from the ages 16 to 40 years old who are playing in or representing New Zealand. We aim to collect injury and illness data that occurs during planned tournaments or campaigns in 2025, for example U20 and U18 Association National Championships. The findings of this research may be used for academic publications and presentations.

How was I identified and why am I being invited to participate in this research?

You have been identified by Basketball New Zealand as a team manager for a team that is participating in a tournament chosen for this study. You are being invited to participate in this study because, as the team manager, you are typically the primary point of contact between your players, medical staff, and tournament officials, and you are usually present at all of your team's games and activities. This makes you an ideal personnel to assist us with injury and illness data collection.

Your participation in this research is voluntary (it is your choice) and whether you choose to participate will neither advantage nor disadvantage you. If you wish to participate in this research, you will sign the consent form.

What will my participation involve?

If you agree to participate this is how you will be involved. Two weeks prior to the tournament starting you will distribute to your teams' players the provided participant information sheet and consent form. Players will return their signed consent forms to you five days prior to the start of the tournament and then if you could please send this onto the email below for Duncan Reid. These consent forms will then be stored in a password protected computer.

During the tournament you will be responsible for filling in the injury and illness recording sheets when an injury or illness occurs no matter how severe for consenting athletes only. You will then physically hand this in to the research desk that will be present at the tournament. This location will be made clear to you closer to the start of the tournament. An example of these injury and illness recording sheets is attached at the end of this information sheet.

There will be training on how to use the injury and illness recording sheets at the managers meeting prior to the start of the tournament. The researcher will also be present at the tournament at the allocated research desk where you can ask any questions that you have.

Injury and illness definitions

An injury is defined as any physical complaint that is sustained by a player during a match which would result in any one of the following:

1. The drop in performance (e.g. pain) but able to play
2. The inability to continue playing in the match
3. The need for medical attention/examination

An illness is a disease or period of sickness effects the body. It can be any physical or psychological complaint that is not related to an injury regardless of whether it received medical attention or not or whether it has any impairment or not on the tournament games. It may include respiratory (lungs or breathing), gastrointestinal (stomach bug), headaches (not related to injury), ear nose or throat (including dental), heat illness and genitourinary illness (urinary or genital organs).

What are the benefits?

The benefits of this research is that basketball athletes, management and coaches will gain insight into what injuries and illnesses are specific to your sport. Therefore, you will be able to help encourage your team's players to seek out the correct information from appropriate health and performance professions to reduce the risk in the future of acquiring these injuries or illness. The research will also help to inform future injury and illness prevention strategies, therefore improving the overall health of the sport.

How will I know whom in my team has consented?

A list of athletes specific to your team whom have consented to take place will be provided prior to the tournament commencing.

Will the results of the study be published?

The results of this research will be published in a Master's Thesis. This thesis will be available to the general public through the AUT library. Results may be published in peer-reviewed, academic journals. Results will also be presented during conferences or seminars to wider professional and academic communities. Athletes and team managers will not be identifiable.

What will happen to information about me?

Data collected will not be individually identifiable and your identity will never be revealed in any publication or presentation arising from this study. Apart from the study researchers, no one will have access to your information. All data, including consent forms will be kept secure on AUT premises and destroyed ten years after completion of the study.

What opportunity do I have to consider this invitation?

You will have one week prior to consent forms being sent out to the athletes to decide on whether you would like to participate or not

Will I receive feedback on the results of this research?

I will send an anonymous summary of the research to you at the end of the study, if you request this.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, Duncan Reid, (+649) 921 9999 ext 7806

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, *ethics@aut.ac.nz*, (+649) 921 9999 ext 6038.

Who do I contact for further information about this research?

Please keep this Information Sheet and a copy of the Consent Form for your future reference. You are also able to contact the research team as follows:

Researcher Contact Details:

Olivia Hay

nff1626@aut.ac.nz

Note that for personal safety reasons, AUTEC does not allow researchers to provide home addresses or phone numbers.

Project Supervisor Contact Details:

Duncan Reid

duncan.reid@aut.ac.nz

Jennifer Scott

Jennifer.Scott@hpsnz.org.nz

Approved by the Auckland University of Technology Ethics Committee on 21st May 2025, AUTEC Reference number *25/62*

Appendix E Player Consent Form

TE WĀNANGA ARONUI O TĀMAKI MAKAU RAU

Player Consent Form

Project title: ***The Injury and Incidence of Basketball in New Zealand***

Project Supervisor: ***Duncan Reid and Jennifer Scott***

Researcher: ***Olivia Hay***

- ○ I have read and understood the information provided about this research project in the Information Sheet dated 01/03/2025
- ○ I have had an opportunity to ask questions and to have them answered.
- ○ I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time without being disadvantaged in any way. However, once injury and illness data is submitted it cannot be withdrawn because it is anonymous.
- ○ I understand that if I withdraw from the study then I will be offered the choice between having any data that is identifiable as belonging to me removed or allowing it to continue to be used. However, once the findings have been produced, removal of my data may not be possible.
- ○ I agree to provide basic information regarding an injury or illness that I acquire
- ○ I agree to take part in this research.
- ○ I wish to receive a summary of the research findings (please tick one): Yes○ No○
- ○ I wish to have my acute injury and illness data collect (please tick one): Yes○ No○

Participant's signature: ....

Participant's name: ....

Participant's Contact Details :

....

....

....

....

Date:

Approved by the Auckland University of Technology Ethics Committee on 21st May 2025, AUTEC Reference number *25/62*

Note: The Participant should retain a copy of this form.

Appendix F Team Manager / Physiotherapist Consent Form

TE WĀNANGA ARONUI O TĀMAKI MAKAU RAU

Team Manager Consent Form

Project title: ***The Injury and Incidence of Basketball in New Zealand***

Project Supervisor: ***Duncan Reid and Jennifer Scott***

Researcher: ***Olivia Hay***

○ I have read and understood the information provided about this research project in the Information Sheet dated 01/03/2025

○ I have had an opportunity to ask questions and to have them answered.

○ I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time without being disadvantaged in any way.

○ I agree to distribute player information sheets and consent forms

○ I agree to assist in data collection by filling out the Injury and Illness Reporting Sheet and handing them in during the tournament

○ I agree to take part in this research.

○ I wish to receive a summary of the research findings (please tick one): Yes○ No○

○ I wish be involved in collecting the injury and illness data (please tick one): Yes○ No○

Team Manager's signature: ....

Team Manager's Name: ....

Team Manager's Contact Details :

....

....

....

....

Date:

Approved by the Auckland University of Technology Ethics Committee on 21st May 2025, AUTEC Reference number *25/62*

Note: The Participant should retain a copy of this form.

Appendix G Ethics Approval

TE WĀNANGA ARONUI
O TĀMAKI MAKAU RAU

Auckland University of Technology Ethics Committee (AUTEC)

21 May 2025

Duncan Reid
Faculty of Health and Environmental Sciences

Dear Duncan

Re Ethics Application: **25/62 The Injury and Illness Incidence in New Zealand Basketball**

Thank you for your responses to AUTEC's conditions.

Your ethics application has been approved for three years until 21 May 2028.

Standard Conditions of Approval

1. The research is to be undertaken in accordance with the Auckland University of Technology Code of Conduct for Research and as approved by AUTEC.
2. All public facing documents must have the AUTEC approval number and be of a high standard of spelling and grammar. Dates on the Information Sheet(s) and Consent Form(s) must be consistent.
3. Any amendments to the project must be approved by AUTEC prior to being implemented.
4. A progress report is due annually on the anniversary of the approval date.
5. A final report is due at the expiration of the approval period, or, upon completion of project.
6. Any serious or adverse events must be reported to AUTEC, this includes unforeseen issues that might affect continued ethical acceptability of the project.
7. AUTEC grants ethical approval only. You are responsible for obtaining management permission for access from any institution or organisation at which your research is being conducted and you need to meet all ethical, legal, public health, and locality obligations or requirements for the jurisdictions in which the research is being undertaken.

The application number and title need to be referenced on all correspondence related to this project.

All forms are available online http://www.aut.ac.nz/research/researchethics

For any enquiries, please contact the Secretariat at ethics@aut.ac.nz
(This is a computer-generated letter for which no signature is required)

The AUTEC Secretariat
Auckland University of Technology Ethics Committee

Cc: oliviacharlottehay@gmail.com

Auckland University of Technology, D-88, Private Bag 92006, Auckland 1142, New Zealand.
T: +64 9 921 9999 ext. 8316: E: ethics@aut.ac.nz; www.aut.ac.nz/researchethics