Determining the feasibility of a prehabilitative injury prevention programme for netball players in South Africa

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in the Department of Physiotherapy, University of the Western Cape

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Abstract

Background: The South African government has taken a stance to prioritise sporting codes within South Africa that report high participation and is inclusive of the population demographic of South Africa. Netball has been highlighted as one of these sixteen named sporting codes. Linked to the high participation of netball players in the sport is a high prevalence of injuries, which is well documented throughout the literature. Injury management within a South African context presents a number of challenges due to the current environment of health care in the country as well as an array of barriers that directly impact the netball players themselves as well as netball as a federation. Injury prevalence results in a need to both manage and prevent sporting injuries. The purpose of this study was to develop an injury prevention programme for netball players in South Africa and to establish the feasibility of such a programme for implementation.

Method: The study took place under the auspices of Netball South Africa and the injury prevalence data was collected at a national netball tournament at the University of Pretoria. Sequential mixed methods was used as a framework to guide the study, and included a range of research methods as part of that process. The problem was identified in two phases using a cross sectional self-administered questionnaire and a qualitative aspect using semi-structured interviews. The design of the injury prevention programme that aimed to address the problem was informed by a systematic review of literature. The process that guided the development of the injury prevention programme was intervention mapping. This process led to the development of an injury prevention programme that included a coach's educational booklet, an injury prevention exercise protocol and an administrative structure of a National Physiotherapy Association. The evaluation for feasibility for the implementation of the injury prevention programme was evaluated via a Delphi study.

Results: The needs assessment concluded that netball within South Africa has a high prevalence of ankle and knee injuries. Stakeholders within netball are able to define sport

injuries and name both extrinsic and intrinsic factors that impact injury management within the current structure. Although few intervention studies are described in the literature for injury prevention in netball, studies do exist for other sports, which emulate similar movement patterns exhibited in netball. Intervention mapping provides a framework for the development of intervention strategies merging theories with clinical practice. The final results showed that the coach's educational booklet and the National Physiotherapy Association, two aspects of the designed injury prevention programme for netball, are feasible for implementation as advocated by stakeholders in the Delphi study. The exercise protocol was developed based on the systematic review of literature, however the Delphi panel advocated for a number of recommendations of change. It was therefore concluded that in order for the exercise protocol to be feasible for implementation it would have to be studied under a clinical trial using the recommended changes advocated by the Delphi panel as a control.

Discussion: While intervention studies are a complex undertaking with many challenges, evidence presented in this study demonstrated that the development of an injury prevention programme within the South African climate is possible through the engagement of stakeholders and the review of current literature. The design principles offer clinicians and researchers a framework upon which to construct intervention studies where the theories of literature can be merged with clinical practice. However, researchers and clinicians should be aware that intervention science is emerging within the realm of elite sport and if we are to be truly successful with regard to implementing intervention strategies, stakeholders will have to be convinced.

Conclusion: Two aspects of the designed injury prevention programme are feasible for implementation within South African netball. The exercise protocol should be tested in a clinical trial setting using the recommendations of the Delphi panel as the control. The study design provides a platform for the development of intervention strategies merging theory with clinical practice.

November, 2013

Keywords

Injury prevention

Intervention programme

Netball

Physiotherapy

Prehabilitative

Declaration

I declare that: Determining the feasibility of a prehabilitative injury prevention programme for netball players in South Africa is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Name: _____ Date: _____

Signed: _____

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Dedication

For Aya, my grandmother, who I miss very much. I know you watch me from above. You are the foundation upon which I build my life.

For Rani, my mother, my best friend.

For Sundru, my father, you always dream big

And for the athletes who have inspired this project.

Publications

This research project has resulted in the following research output:
Chapter three of this thesis was published in Nov 2012:

Pillay T & Frantz JM. (2012). Injury prevalence of netball players in South Africa: The need for injury prevention. *The South African Journal of Physiotherapy*. Vol. 68: 3, 7-10.

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Chapter One: Introduction

1.1 Background

South Africa is country that is unified by sport; it has become a part of our culture and heritage. According to Pelak (2005), sport is central to the nation-building process; however, the focus has primarily included elite male sports administrators and male-dominated sporting codes. The experiences of athletes at the grassroots level and those in sporting codes dominated and controlled by women are given very little attention. As sports participation tends to increase, it is postulated that the burden of injury will increase proportionately (Sherrard, Lenne, Cassell, Stokes & Ozanne – Smith, 2002).

The National Sport and Recreation Plan (NSRP) outlines the implementation plan for the sports and recreation policy framework captured in the White Paper on Sport and Recreation (Department of Sport and Recreation for the Republic of South Africa [DRSA], 2010). While it is envisaged that the White Paper will remain relevant until 2019, the NSRP is reviewed annually in order to ensure that equal opportunities exist for all South Africans to participate and excel in sport and recreation through the adoption of deliberate transformation initiatives. In Vision 2020, as stipulated in the White Paper, the expected outcomes and ideal future for a South African sports system are expressed.

The South African government has highlighted 16 sporting codes as priority sporting codes (DRSA, 2010). By prioritising sporting codes best suited to broadening the participation base or achieving international success, the return on investment is maximised. In developing a winning nation, it is important to improve international sports successes by supporting sportspeople at all levels of participation. The following strategic objectives of the NSRP aim to achieve this:

- Identifying and developing talented athletes through the implementation of a structured system
- Improving the performance of athletes and coaches by providing them with access to a comprehensive range of support programmes.

Netball is one of the sporting codes identified by Department of Cultural Affairs and Sport (DCAS) and the Department of Sport and Recreation South Africa in 2010 as a priority code (DRSA, 2010). With the governments focus on increasing sports participation at all levels to maximise investment, adequate athlete support related to injury prevention and injury occurrence is required. This would include injury-prevention strategies such as well-planned and periodised conditioning that is monitored, full medical screenings, the accurate assessment and management of injuries, full injury rehabilitation and return to sports protocols. Only then will can we ensure the longevity of athletes' career from club level through to national level participation.

Considering the background of netball in South Africa, little has been done to establish the exact severity of injuries within the sport as well as the type of injury, mechanism and contributing factors related to injuries. This lays a poor foundation for preventive strategies and for establishing the most appropriate types of interventions. To counteract this negative effect by means of preventive programmes, the extent and nature of the sports injury problem need to be identified to define target groups for injury prevention (Emery, Meeuwisse & McAllister, 2006).

1.2 The need for an injury-prevention protocol

Hergenroeder (1998) states that 25% to 30% of youth injuries occur in organised sport and another 40% occur in unorganised sport. It has been documented that the risk of sustaining an acute injury seems to vary between endurance sports and high-risk sports. Injuries in popular team sports such as soccer, volleyball, basketball and netball lie between these extremities (De Loes, 1990; Kujala et al., 1995). Despite the large participation numbers and the controversy surrounding netball, which is often defined as "a game prone to ankle and knee injuries" (Steele, 1990), there is a notable lack of formal, controlled evaluations of the effectiveness of injury-prevention countermeasures (McGrath & Ozanne-Smith, 1998). Studies to date have tended to focus on the incidence and nature of injuries occurring in netball in

an attempt to identify causative mechanisms (Steele, 1990). Research has generally revealed that strategies designed to prevent sports injuries can be effective. Interventions involving large groups of participants, which are effective enough to measurably alter injury profiles, have included changes in rules or improvements in equipment (Schieber et al., 1996).

Sports injuries are a cost burden on both individuals and society with respect to the duration and nature of treatment, amount of sport and working time lost, permanent damage and disability, reduced quality of life and monetary costs (Parkkari, Kujala, & Kannus, 2001). Sports injuries are predictable incidents that are amenable to prevention. Bonnie, Fulco and Liverman (1999) report that there are many risk factors predisposing to sport injuries. Sports injury risk factors can also be described as intrinsic and extrinsic (Kannus, 1993). Intrinsic, or internal, factors are related to the physical and mental health of the athlete, whereas extrinsic, or external, factors are those that impinge externally on the athletes' performance (e.g. injured when falling over due to an uneven surface). **Table 1.1** below details the intrinsic and extrinsic factors associated with netball injuries.

Table 1.1: Intrinsic and extrinsic factors associated with netball

Intrinsic	Extrinsic
Pre-season conditioning	Training
Technique	Warm-up
Nutrition	Footwear
Strapping/Bracing	Surface
Orthotics	Environment
Rehabilitation	Strapping/Bracing
Return to play when fit	Orthotics
Pre-existing medical conditions	Rehabilitation
	Adequate water intake
	First aid
	Rules of the game
	Rest, ice, compression, elevation

Attacking the goal of netball injury prevention by McGrath and Ozanne-Smith, (1998) is a good example of an injury-prevention protocol. In this report, the

authors not only focus on the epidemiology of netball injuries, but also present a detailed examination of the range of countermeasures promoted to prevent injuries. Medical screening and the correct assessment and management of sports injuries decrease the chances of the athlete further predisposing to injury. This allows the medical team to resolve any existing injuries and to guide the coaching staff as to what the athlete can and cannot participate in, thereby facilitating the rehabilitation process. Within a South African context, we have no references with regard to preventing injuries in netball or understanding our own context of what injury prevention needs to target.

Currently, few injury-prevention and injury-management protocols within netball exist at a provincial level and club level that are standardised, continually reviewed and implemented as best practice principles, thereby weakening the support of the player pool at the base feeding into the national tier. Despite these shortfalls, federations are expected to perform at an international level. The treatment of sports injuries is often difficult, expensive and time consuming, and therefore preventive strategies and activities are justified on medical as well as economic grounds (Parkkari et al., 2001). The restructuring of medical policies and interventions in this code would be groundbreaking within a South African context and would serve as a pilot to other federations.

1.3 Current research models in sports injury-prevention research

Much of the current injury-prevention research is focused on determining the causative factors contributing to injury. According to McManus, Stevenson and Finch (2006), many studies aim to highlight the prevalence of netball injuries in contrasting populations as well as how these injuries occur and the type of injuries experienced through injury-surveillance studies. These studies lay the foundation for intervention studies and advocate that risk and protective factors can be used as the basis for the development of evidence-based injury-prevention strategies seeking to reduce the risk of injury in sport. The literature further explains that injury-prevention strategies should focus on

the development of effective training programmes that include sport-specific skills, activities and movements (McGrath & Ozanne-Smith, 1998). This would further the investigation into mechanisms associated with the risk and protective factors identified and would provide further understanding of why these factors increase or decrease the risk of injury. The expression 'injury surveillance', as reported by Parkkari et al. (2001), means an ongoing collection of data describing the occurrence of, and factors associated with, injuries. The success of any sports injury-surveillance system and its wide scale applicability are dependent upon valid and reliable definitions of sports injury, injury severity and sports participation (Finch, 1997). If injury-prevention studies are to be developed, they need to be grounded in theory. Deriving an applicable model from theory ensures a solid framework against which the study could be developed.

The most commonly cited model of sports injury prevention over the past decade has been one initially articulated by Van Mechelen, Hlobil and Kemper (1992), illustrated in Figure 1.1. This represented a translation of the standard public health-prevention model (Robertson 1992) to the sports injury context.

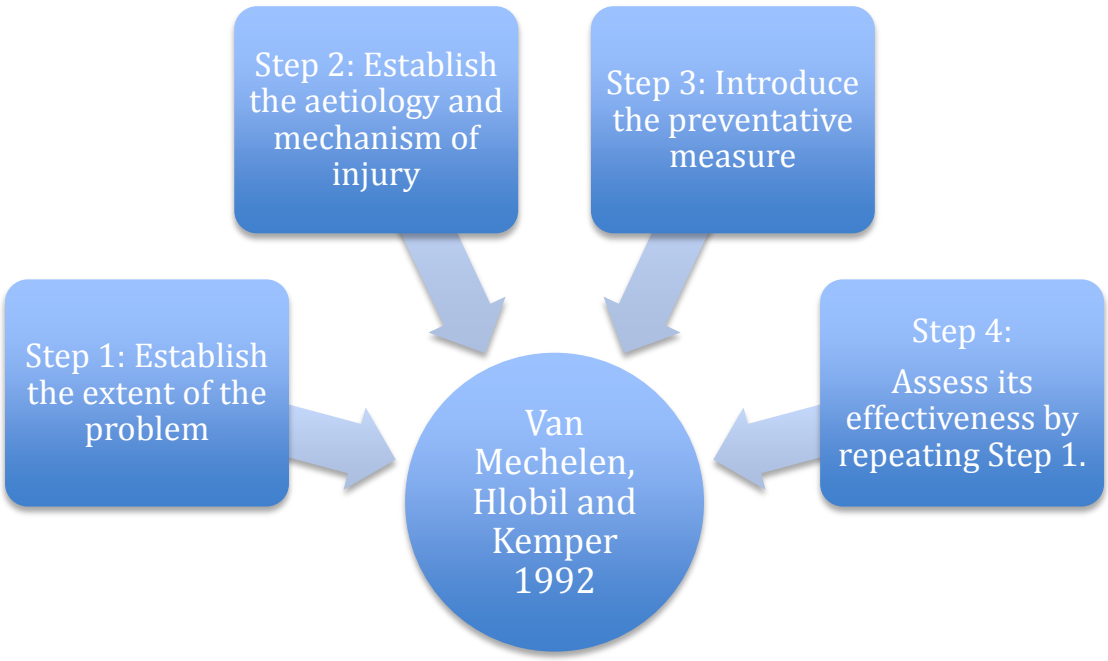


Figure 1.1: Sports injury-prevention model (Van Mechelen et al., 1992)

There is no doubt that the four-step model of sports-injury prevention has been a valuable tool in guiding injury research over the past decade. From a research development point of view, it clearly outlines the direction of required evidence needed to build our evidence base on sports injuries and their causal factors. A multifactorial model, illustrated in Figure 1.2, assessing causation in sports injury, was introduced by Meeuwisse (1994). He proposed that the model be used not only to examine the contribution of various factors to injury aetiology, but also to explore their interrelationship. Meeuwisse's model highlights that in order to implement prevention strategies, it is imperative to understand the internal and external risk factors predisposing the athlete to injury and then to understand the 'inciting event' – the injury. This further expands on Van Mechelen's model by first examining the cause of the event and then understanding how frequently the event occurs.

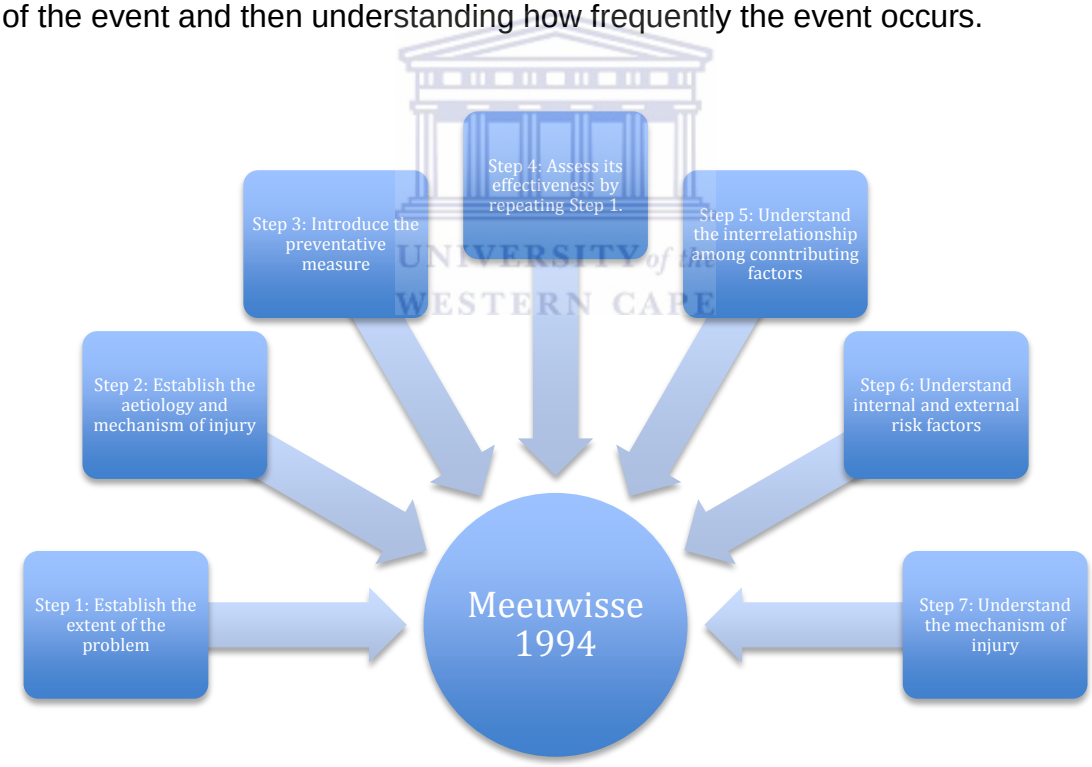


Figure 1.2: Sports injury-prevention model (Meeuwisse, 1994)

Finch (2006) introduced the Translating Research into Injury Prevention Practice (TRIPP) framework for research leading to real-world sports injury prevention. This model builds on the fact that only research that can and will be adopted by athletes, their coaches and sporting bodies will prevent injuries

(Finch, 1997). In this six-step framework, illustrated in Figure 1.3, Finch outlines that the following steps should be undertaken towards sports injury prevention.

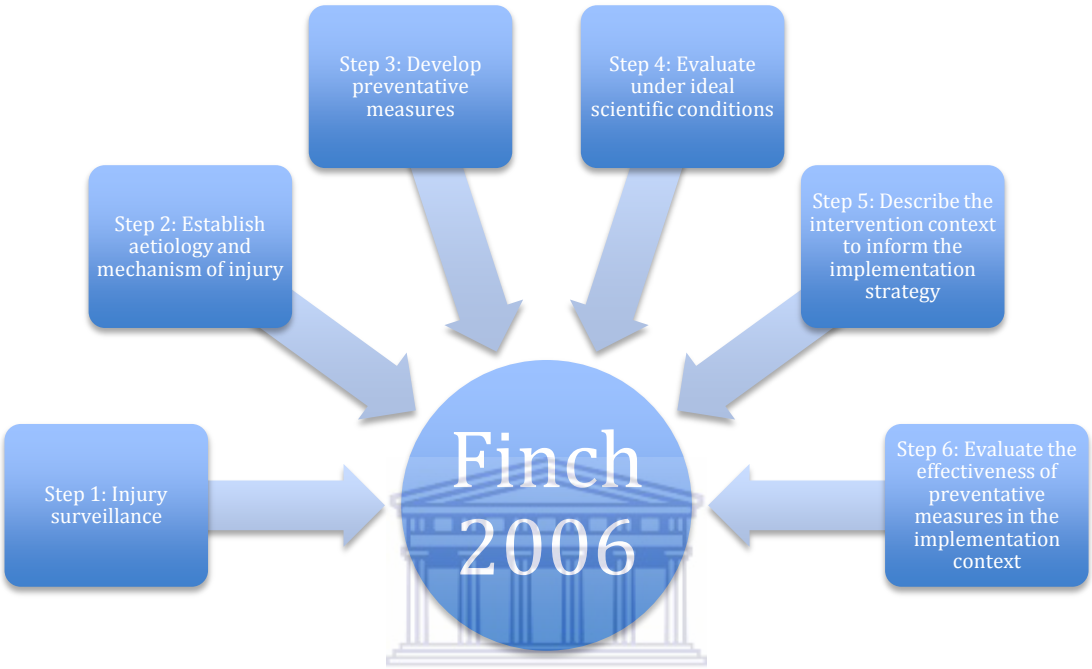


Figure 1.3: Sports injury-prevention model (Finch, 2006)

These models have contributed to a wide array of proven preventive measures for a variety of sports-related injuries (Cumps, Verhagen, & Meeusen, 2007). In addition, adaptations of the conceptual models have been put forward and new conceptual insights have been formulated and described. Examples of such insights refer to the implementation phase of interventions and to the fact that sports injury prevention requires above all behavioural change.

Future advances in sports injury prevention will only be achieved if research efforts are directed towards understanding the implementation context for injury prevention, as well as continuing to build the evidence base for the efficacy and effectiveness of interventions. There is no doubt that intervention research in the sporting field can be difficult and many challenges need to be

overcome; however, this should not be a barrier towards undertaking said research.

The challenge lies in the lack of literature on multi-faceted prehabilitation protocols for sports injury prevention. The intrinsic factors predisposing to injury as described by Meeuwisse (1994) are addressed in isolation to the extrinsic factors that would complement the holistic approach to injury prevention. In many instances, these protocols are difficult to implement within amateur team setups due to the fact that the extrinsic factors such as lack of medical structures, referral networks, overtraining and do forth are still compounding the predisposition to injury.

A combined effort of sports medicine specialists, sports coaches, managers and players provides the best opportunity to put in place effective and applicable injury-prevention protocols. Over the next few years, sports injury researchers will need to think carefully about the 'best' study designs and analysis tools to achieve this. All reported sports injury studies, of whatever design, should include information on key implementation factors such as player/club recruitment rates and other biases as well as the rate of uptake of the interventions being tested, including reasons for use or non-use thereof.

1.4 Theoretical framework of this study

The focus of the model designed by Van Mechelen et al. (1992) is on assessing the effectiveness of an intervention. Meeuwisse (1994) focuses on understanding the contributing factors to injury prevalence, in other words aetiology. Finch (2006) focuses on the validity of the study under scientific conditions and the context within which it can be implemented. In its simplest form, a feasibility study represents a definition of a problem or opportunity to be studied, an analysis of the current mode of operation, a definition of requirements, an evaluation of alternatives, and an agreed-upon course of action.

Assessing the effectiveness of injury prevention, as described by Van Mechelen et al.'s model, emulates elements in ascertaining feasibility. Therefore, the theoretical framework of this study is based on Van Mechelen et al.'s sequence of prevention model and the steps in an adapted operational feasibility study as described by Castro and Mylopoulos (2002). Van Mechelen et al. (1992) present a 'sequence of prevention' model that can be incorporated by sporting codes on which successful intervention strategies can be based. In this model, Van Mechelen et al. attempt to identify the problem, design and implement an intervention and evaluate the intervention. Throughout this model, all key stakeholders are included at every stage of the process. The four-stage model of sports injury prevention has been a valuable tool to guide injury research over the past decade and was therefore chosen as the theoretical framework for this study. From a research development point of view, it clearly outlines the required evidence needed to build an evidence base on sports injuries and their causal factors. Furthermore, it adopts a broad risk management/epidemiological control model to address the problem similar to those proposed for general injury control (Anderson & Menckel, 1995; Lett, Kobusingye, & Sethi, 2002). The end goal of Van Mechelen's model is to assess the effectiveness of an injury-prevention programme by re-evaluating the extent of the problem. Therefore, the applicability of assessing the feasibility and effectiveness of the injury-prevention programme for implementation becomes important, as it ensures than an optimum process is implemented. According to Bryce (2008), the feasibility study

> … should provide management with enough information to decide the following: whether the project can be done; whether the final product will benefit its intended users; what are the alternatives among which a solution will be chosen and if there is a preferred alternative to the proposal.

It is advised that during the feasibility study phase, the present organisational system, including users, policies, functions and objectives, should be scrutinised. Problems with the present system, inadequacies in functionality and requirements for the new system should also be noted. Castro and

Mylopoulos (2002) recommend using the PIECES framework, which can help in identifying problems to be solved during a feasibility study. The PIECES framework focuses on the following aspects:

Performance: Is current throughput and response time adequate?
Information: Do end users and managers get timely, pertinent, accurate and usefully formatted information?
Economy: Are services provided by the current system cost-effective? Could there be a reduction in costs and/or an increase in benefits?
Control: Are there effective controls to protect against fraud and to guarantee information accuracy and security?
Efficiency: Does the current system make good use of resources: people, time and flow of forms?
Services: Are current services reliable? Are they flexible and expandable?

In an operational feasibility study, an attempt is made to define the problem and determine the acceptability of proposed solutions to the problem. It also aims to evaluate whether all stakeholders will utilise the proposed system after development. This type of framework allows for the inclusion of people-oriented and social issues.

The PIECES framework is commonly used in operational feasibility studies, as it can assist in identifying the problems, current challenges and possible solutions and evaluating the solution. The link between a sports model of prevention and an economic model of prevention is presented below and the key areas of similarities are highlighted. **Table 1.2** below summarises the commonalities of the theoretical approaches upon which this study is based.

Table 1.2: Theoretical approaches upon which the study is based

	Van Mechelen's model	**Feasibility study**
What is the problem?	Establish the extent of the problem	What is the current mode of operation
Why is there a problem?	Risk factors and possible causes of the problem	Effects of the current mode of operation on key stakeholders
How can it be resolved?	Design an intervention based on the problem	Design a new system
Evaluation	Evaluate the effects of the intervention	Evaluate the feasibility of the new system by evaluating how key stakeholders will use it

Finally, if the field of sports injury prevention is to advance, multidisciplinary collaboration will be required, along with the involvement of the sports community. Chalmers (2002) further states that "injury prevention should become part of the game" – contrary to the saying that "injury is just part of the game". However, designing and implementing strategies that are not evidence-informed will not be useful, and this highlights the need for feasibility studies.

1.5 Problem statement

Netball has been identified as a priority code in South Africa for inclusion at all levels of participation and within all age groups. However, linked to this increase in participation in the sport is an increase in netball injuries. Against the political backdrop of South Africa, pre 1995, access to sports science and medical services was reserved for a select few. The formation of Netball South Africa (NSA) marked a major change in the political structure within netball. No policies focusing on injury-prevention protocols existed and thus medical science services were still mainly available to those that were able to afford it. An injury-prevention protocol would thus further contribute to bridging the gap in netball by providing a system that is accessible to all players. A structured injury-surveillance system at all levels would ensure that all injuries are monitored correctly and therefore aid in the correct assessment, treatment, referral and follow-up of these injuries.

The present study was conducted under the auspices of NSA and included several stakeholder participants, such as school-going, provincial and national netball players, coaches and administrators. If netball as a priority code is to reach the status intended by the South African government, attention needs to be given to injury-prevention strategies in this code. A need thus exists for the development and implementation of an injury-prevention protocol and structure that will meet the needs of the netball fraternity, which includes players, coaches and managers in NSA. The formalisation of this structure will provide a platform for improving coach education with regard to injury management, the monitoring of injuries, and the correct referral of athletes' injuries. The limited resources available can be streamlined to provide a system that will enable the management of netball injuries, and the injury protocol would give athletes the knowledge required to implement preventive strategies.

1.6 Definition of terms

The following terms are used throughout the text of this thesis and are defined to give context to the manner in which they have been used.

Injury: Any physical complaint sustained by a player that results from a match or training, irrespective of the need for medical attention or time loss from activities. An injury that results in a player receiving medical attention is referred to as a ''medical attention'' injury, and an injury that results in a player being unable to take a full part in future training or match play as a ''time loss'' injury (Fuller, Ekstrand & Junge, 2006).

Operational feasibility: A definition of a problem or opportunity to be studied, an analysis of the current mode of operation, and an agreed-upon course of action (Bryce, 2008).

Prehabilitation: The ambition to reduce the incidence of injuries by the systematic targeting of vulnerable areas of the body through strength and

conditioning. This presupposes that it is possible to identify a cause(s), establish that the cause is rectifiable and that a suitable intervention exists and demonstrate a clear effect between an intervention and an outcome (Jaques, 2009).

1.7 Aim of the study

The aim of the study was formulated as follows: To determine the feasibility of an injury-prevention protocol for netball players in South Africa.

1.8 Objectives of the study

The following objectives of this study were based on Van Mechelen's sequence of prevention model (1992) and the steps in an adapted operational feasibility study as described by Castro and Mylopoulos (2002).

1. Define the size of the problem

a. To determine the prevalence and type of injuries as well as risk factors and mechanisms of injuries sustained among South African school, provincial and national netball players and thereby highlight the needs in netball regarding injury surveillance
b. To explore the challenges experienced by netball sports managers and sports medicine personnel in managing injured players within the current system

2. Determine what is known about the current situation

a. To determine what the most effective evidence-based injury-prevention programmes for netball are

3. Design an injury-prevention protocol for netball players

a. To design an injury-prevention protocol with a clear injury-prevention programme, injury-screening tool and referral system
b. To design outcomes and indicators relevant for each stage of the protocol

4. Evaluate the feasibility of the proposed protocol

a. To evaluate the relevance of the proposed tool among netball stakeholders

b. To evaluate responses of key stakeholders to the feasibility of implementing the proposed protocol

1.9 Significance of the study

Within a South African context, it was highlighted at the 14th Biennial South African Sports Medicine Congress in Johannesburg (18–20 October 2011), that health professionals focus most primary health-promotion efforts on the prevention of degenerative diseases because these are the leading causes of death amenable to risk factor modification and, in the case of sports medicine, focus on the prevention of injuries. However, not enough is being done to prevent the overall burden of injuries. Stafford (2011) reported that the burden of injury advocated a greater public health injury-prevention role for sports medicine and related allied health practitioners. This highlights the need for injury-prevention strategies to become a major public health goal.

Netball is the most widely played sport among women in South Africa, (Ferreira & Spamer, 2010) and has been identified as a priority code. Currently, the structures for injury prevention at all levels of netball in South Africa are being challenged and questioned. The study aimed to design a structure that will meet the needs of NSA and therefore contribute to assisting the key stakeholders in NSA in meeting their obligations as a priority code in South Africa. The success of this study will greatly assist in moving the code of netball forward in South Africa. Smaller federations will be more willing to buy into a proposal when they are able to see the viability for implementation from all angles. Promotion of the project to bigger stakeholders such as the South African Sport Confederation and Olympic Committee (SASCOC) and the LOTTO may also be simplified. The prehabilitation protocol will also then be of a holistic nature, as input from all stakeholders would have been sought, which will lay a solid foundation for implementation.

1.10 Summary

Although existing injury-prevention protocols are published internationally, they are costly to implement and monitor within a South African context. As reviewed in the literature, an injury-prevention protocol can only be implemented once the extent and the cause of the problem have been determined. A thorough examination of the literature was required to review what strategies had been employed in netball, as the injury-prevention protocol is required to be sport-specific. The evaluation of the feasibility of implementation was required, as buy-in from role players such as coaches and the executive committee is crucial for the successful implementation of such a protocol. Within small federations, basic but effective strategies need to be utilised to ensure accessibility to all athletes. Determining the feasibility of an injury-prevention protocol will also ensure that limited funds are utilised wisely within smaller federations.

1.11 Outline of the thesis

Each of the chapters in this thesis consists of one or a combination of studies addressing the research questions set forth below.

1.11.1 Research Question 1

What is the extent of the problem of netball injuries in South Africa and what are the challenges experienced by netball sports managers and sports medicine personnel in managing injured players within the current system?

Netball is played on a daily basis in schools and clubs and at regional level. According to Venter and Potgieter (2003), it is the most important team game for women in South Africa, and has unrivalled international popularity among females, with more than seven million participants from more than 70 countries (NSA, 2010). The immense impact of sports injuries is highly reported, with costs at individual and socio-economic levels, providing justification for this thesis. Although injury prevalence in netball is highly

documented internationally, few studies exist within South Africa. The first research question was to define the size of the problem in South Africa. This objective of the research was conducted in two stages, using both quantitative and qualitative research methods. A cross-sectional quantitative research design was used to determine injury prevalence, mechanisms and types of injuries. In the qualitative aspect of the study, interviews were conducted to explore the challenges experienced by players, managers, sports medicine practitioners, coaches and administrators with regard to injuries in netball and the management thereof in the current system. This provided a current overview to determine the prevalence and type of injuries as well as risk factors and mechanisms of injuries sustained among South African school, provincial and national netball players and thereby highlighed the needs in netball regarding injury-intervention programmes and medical structures.

1.11.2 Research Question 2

What is the current evidence for injury-prevention programmes for netball players?

Currently, sports administration in netball is struggling to manage all the players with regard to conditioning and injury management from club level through to national participation. The majority of players have not been educated with regard to injury management and effective conditioning. This vacuum presents a problem, where the number of players returning to sport in braces, without rehabilitation and poorly conditioned is on the rise. Due to the poor rehabilitation of players, the reoccurrence of injury and risk for new injuries are problematic. Netball in South Africa is also lacking structure and continuity with regard to medical support staff and scientific interventions at levels that feed into the national squads. This lack of medical support and scientific interventions could prove to be costly, as a bottleneck effect emerges at national level. Within the South African rugby context, provincial unions are professionally run, therefore there is great depth with regard to structures within the medical departments, scientific evidence-based interventions, budgets for evidence-based recovery protocols and a host of

data capturing mechanisms, reporting systems and follow-up interventions. However, this kind of structure is lacking in netball. At the 2009 South African Sports Science and Medicine Association (SASMA) Conference, the president of SASMA advocated a much-needed medical structure to be established within each federation. According to Chalmers (2002), in the area of injury prevention, very few studies have gone past Step 1 of Van Mechelen's model. The second objective of the study was to establish what is currently known about injury-prevention programmes that could address injuries most sustained by netballers, as described in objective one. The second phase of this objective was guided by a systematic review of the literature. This chapter focuses on interventions that have been implemented among a variety of populations in varying settings.

1.11.3 Research Question 3

What would be the content of a proposed injury-prevention protocol designed for netball players in South Africa?

Intervention mapping was used as a tool to formulate the injury-prevention protocol. The intervention protocol designed for this study was based on information obtained from the systematic review of literature conducted. A cross-sectional quantitative research design, was used to determine the injury prevalence, mechanisms and types of injuries. The needs assessment, objective one of this study and step 1 in the intervention mapping process, was concluded with semi-structured interviews, which were aimed at determining the challenges experienced by netball players, managers, coaches and administrators in managing injured players within the current system. Step 2 of the intervention mapping process is to identify programme objectives and performance objectives, which are specific goals and objectives that should lead to the desired change in order to address the needs assessment. Step 3 presents the theoretical methods selected for the development of the interventions derived from the systematic review of literature. This describes how the theoretical methods were translated into practical strategies and how these relate to the implementation of the

intervention. In Step 4, the intervention protocol was designed. In the current study, validity of the study was ensured through the use of mixed methods with a sound theoretical base and different sources of data collection. All information generated was thoroughly examined by the study supervisor, and these include the original transcripts, data-analysis documents, comments from the member checking, and the text of the thesis itself. The protocol design details the outcomes and indicators relevant for each stage of the implementation providing a framework that could be implemented by similar non-professional federations.

1.11.4 Research Question 4

What are the views of key stakeholders in netball regarding the content and relevance of the proposed protocol with regard to feasibility for implementation?

Gabbe (2006) comments that the field of sports injury-prevention research has progressed significantly over the past decade. Recently, there has been a shift towards development and evaluation of injury-prevention measures. While published studies have described the effectiveness of interventions in the controlled environment of a research project, the feasibility and necessary approaches to translate the research findings into the ‘‘real world’ are often neglected. In order to enable the process of adoption and implementation of an injury-prevention protocol, it is important to evaluate the participants’ receptivity to the proposal and to establish what they perceive as feasible and as barriers to implementation. A Delphi study was used to reach consensus on the relevance of the proposed tool among netball stakeholders and to evaluate the responses of key stakeholders to the feasibility of implementing the proposed protocol.

Chapter Two: Methodology

2.1 Introduction

This chapter provides an overview of the methodology used in this study. A detailed description for each phase is provided in successive chapters.

2.2 Research Setting

During the 1980's netball became the most popular sport among South African women of all racial and class backgrounds from rural and urban communities (Sport Information & Science Agency, 1997). Netball South Africa (NSA) is divided into nine provincial structures with 47 regions that included district/local municipalities, wards, schools and clubs. NSA has various associate members such as tertiary education institutions, schools, defense force, police, correctional services and organizations for the disabled. The study was conducted under the auspices of Netball South Africa and consisted of five research settings. National competitions are frequently held where netball players from all over the country participate. The prevalence data was collected at one such national tournament held at the University of Pretoria, commonly known as TUKS, during the 2010 netball season.

2.3 The Overall Study Design

The overall design of the research undertaken was a sequential mixed methods approach. A mixed methods study involves the collection or analysis of both quantitative and/or qualitative data in a single study in which the data are collected concurrently or sequentially, are given priority, and involve the integration of the data at one or more stages in the process of research (Tashakkori & Teddlie, 2003). According to Creswell, Fetters and Ivankova (2004), this form of research is more than simply collecting both quantitative and qualitative data; it indicates that data will be integrated, related, or mixed at some stage of the research process. There is wide consensus that mixing different types of methods can strengthen a study (Greene & Caracelli, 1997.) In this study neither a purely quantitative or qualitative method was sufficient to capture the trends and detail for the

content of the study. When combined the data collected from both research methods complimented each other and allowed for individual analysis but combined integration of the outcomes to add value to the study. This is an operational feasibility study that will employ a mixed methods approach. An operational feasibility study is “a measure of how well a proposed system solves the problems, and takes advantage of the opportunities identified during scope definition and how it satisfies the requirements identified” (Castro & Mylopoulos, 2002). The design assists in determining an appropriate intervention for netball using all key stakeholders, which incorporates their involvement at each stage of the study, guiding the research process to develop a protocol that can be incorporated operationally.

2.4 Data collection methods

2.4.1 Objective One: Define the size of the problem and risk factors

Research question One:

What is the size of the problem and what are the challenges experienced by stakeholders with regard to injuries and injury management.

Research design

This objective was conducted in two phases using both quantitative and qualitative research methods. A cross-sectional quantitative research design was used to determine the injury prevalence, mechanisms and types of injuries. The qualitative aspect of the study used interviews to explore the challenges experienced by players, managers, coaches and administrators with regard to Injuries in Netball and the management thereof in the current system.

Phase 1

Population and sampling

Currently there are more than 2000 netball players registered with netball South Africa. Players are subdivided into national team players, provincial

players (9 provinces) and regional players (62 regions). According to the Yamane formula for a ±5% precision rate for a population of 2000 participants' 333 respondents are required. A convenient national tournament was selected to collect the survey data. At the tournament there were 360 players from 9 provinces and 38 regions. All players were targeted for inclusion into the study. The final study sample consisted of 254 players, which were inclusive of 152 provincial players, 55 regional players 52 and national players. The sample was thus inclusive of the provincial, regional and national players as well as school players.

Data Collection Method:

A cross-sectional descriptive study design using a self - administered questionnaire was used ***[Appendix 2.1]***. The injury prevalence questionnaire was designed based on literature (Louw, Grimmer & Vaughan, 2003). The questionnaire was piloted for content validity using experts in the area of injury prevention and for face validity using a subsample of netball players (n=20) that was not included in the main study. Reliability testing of the instrument was done using a 1-week test – retest technique on another subset of netball players (n=20). The correlation co-efficient was used to measure the reliability of the instrument. The instrument surveyed netball players regarding injury prevalence, possible risk factors and establish baseline information for players at different levels of participation. Data was analysed using SAS V.9 (SAS Inc. Cary, USA). Descriptive statistics were used and results presented as percentages, means and standard deviations.

Phase 2

Population and Sampling

Morse (1991) suggests that four types of sampling are used in qualitative research: the purposeful sample, the nominated sample, the volunteer sample and the sample that consists of the total population. She states that 'when obtaining a purposeful sample, the researcher selects participants according to the needs of the study. Patton (1990) views that all types of sampling, in qualitative research, may be included under the broad term of 'purposeful

sampling'. He states that 'qualitative enquiry typically focuses in depth on relatively small samples, even single cases, selected purposefully. Patton (1990) further describes 15 different strategies for purposefully selecting information rich data. The underlying principle that is common to all these strategies is selecting information rich cases to fit the study. For this aspect of the study 6 participants were identified which were considered key stakeholders for netball. These include two coaches, two managers and two players. All participants had been involved with netball at all levels including club level and international level for a number of years. They were therefore considered to have a good understanding of injury management strategies, the challenges currently experienced with implementation and the current structures in place from club through to national level. All participants have different roles within the netball fraternity and they were therefore purposefully selected to participate in the study. The final sample included six participants who agreed to take part in the study and gave their informed written consent before participation **[Appendix 2.2].**

Data Collection Method

Semi-structured interviews, **[Appendix 2.3],** were used to explore the challenges experienced by players, netball sport administrators and coaches in managing injured players within the current system. Interviews were conducted in the language of the participant and permission was obtained to record all interviews. Data was transcribed and content analysed descriptively in nature by reporting how many times certain phenomena are mentioned.

2.4.2 Objective Two: To determine the current situation

Research Question Two

What do we know about current effective evidence based injury prevention programmes for netball players?

Research Design

A systematic review of both local and international literature was conducted to determine the most effective evidence based injury prevention and monitoring programmes for netball that could address injuries most sustained by netballers. Information obtained was critiqued and summarized in a narrative form. The search parameters included full-text articles published in English between 2001 and 2011, and included studies with both positive and negative outcomes to reduce publication bias. A systematic approach to the review was adopted and reported in a narrative form **[Appendix 2.4]**. All published randomized controlled trials (RCTs) were assessed for inclusion in the review. However, in the absence of RCTs, controlled trials, quasi-randomized controlled trials, cohort studies, experimental and non-experimental studies, prospective studies, descriptive studies, before-and-after studies were considered. Other research designs, such as systematic reviews and observational studies were reviewed and articles referenced in the articles that fitted the inclusion criteria of this study were included in this study.

Literature Source

Examples of databases included are Academic Search Premier, CINAHL (Cumulative Index to Nursing and Allied Health) and MEDLINE via Ebscohost, Sportdiscus and BioMed Central. The review includes articles published in English between 2001 and the present, in order to capture recent developments in the field, as well as to establish baselines of practice in the past ten years. Clear inclusion and exclusion was set for the review.

Data Collection Method

Two reviewers using selected databases, namely Medline, CINAHL, Ebscohost and Sport Direct for the period of 2001 – 2011, conducted an initial search. These sources were identified during the preliminary literature review. A search was also undertaken using Google and Google Scholar to identify relevant articles. Manual searching of reference lists was also undertaken and articles referred to the author by experts in the field were also included.

Search terms were constructed after some review of relevant literature which included injury prevention, health education, injury management, treatment, rehabilitation, lower limb, ankle, knee, sport, netball, basketball, volleyball, proprioception, range of movement, strength, balance and joint stability. When the titles of the articles were not sufficiently descriptive to make a decision, the abstracts were consulted.

During the review process the reviewers assessed all articles and discrepancies were addressed verbally until consensus was reached. Once all articles had been collected, the author conducted an initial review to ensure that only relevant studies were included in the critical appraisal. Then, a second review was conducted with another reviewer to the same effect. Following the review the methodological quality of studies was determined independently by the two reviewers using CASP critical appraisal tools for randomised control trials, non-randomised control trials and quantitative studies to exclude poor quality studies. Discrepancies were discussed verbally to reach consensus and scores were then adjusted on the CASP scoring form accordingly. In the final step a self-developed data extraction form was used to extract the data from the studies, using criteria that were determined prior to the data extraction.

2.4.3 Objective Three: To design an injury prevention protocol for netball players

Research Question Three:

What is the content of the proposed injury prevention protocol designed for netball players in South Africa?

Injury Prevention Protocol: Intervention mapping as a tool for design

Intervention Mapping is a stepwise approach for theory and evidence based development and the implementation of interventions. It comprises six steps; each leading to a product that guides the next step (Bartholomew, Parcel &

Kok, 1998). These steps include: a needs assessment, the identification of change and performance objectives, the selection of theory based methods and practical strategies, the development of a planned holistic programme, the identification of a plan for implementation and an evaluation of the adopted plan. For this study the intervention mapping process was implemented from Steps 1 -3.

Step 1: Needs assessment

Following a summative report of phase 1 and 2, the researcher then designed the proposed protocol. At the start of the study a survey was conducted to determine the extent of the injuries in netball. In this phase a cross-sectional quantitative research design was used to determine the injury prevalence, mechanisms and types of injuries in the sport of netball in South Africa. In addition, semi-structured interviews were used to explore the challenges experienced by players; netball sports managers, administrators and sports medicine personnel in managing injured players within the current system. To understand the barriers and facilitators associate with injury management in netball, stakeholders were interviewed on the various aspect of injury management. This included types of treatment that should be administered, current structures available to access injury management, and possible solutions from the stakeholders that could facilitate injury management. The outcome of this needs assessment served as an evidence base for the goals of the injury prevention protocol.

Step 2: Identifying programme objectives and performance objectives

During this phase, the needs of the various stakeholders were identified through the analysis of the semi-structured interviews and programme objectives for each were derived. The needs assessment for this study highlighted the need for an injury prevention programme. Performance objectives are the expected sub behaviours that have to be accomplished by

the target group to achieve the programme objectives. The performance objectives were formulated for this study by answering the question: ‘what do the various participants who will benefit from the injury prevention protocol need in order to effectively implement the protocol? According to Dalum, Schaalma and Kok (2012), during this phase, one needs to identify the goals and define the objectives, which are specific actions that should lead to the desired change. During this step, the target groups’ (players, coaches, managers and health professionals) views and opinions were analysed together with the survey to ensure the input of all key stakeholders was addressed. This aspect was guided by the key components identified in the needs assessment undertaken.

Step 3: Selecting suitable theoretical and practical methods

Bartholomew states that the goal of intervention mapping step 3 is to use a conceptual model or theory to guide the identification of appropriate intervention methods and delivery strategies. These methods that are then matched to the objectives stated in Step 2.

Search terms were chosen after a preliminary review of relevant literature yielded commonly used words and phrases, which were finalised after consultation with an experienced researcher. Both researchers then conducted the search based on the guidelines previously mentioned in Step 2. The aim was to identify which interventions tools and activities were most suitable for addressing the selected change objectives. The researcher had to take into account the given determinants outlined in step 2. This led to the choice of several practical intervention techniques derived from theory-based methods which were identified in the literature and translated into practical ideas based on the target groups’ (players, coaches, managers and health professionals) views and opinions to ensure the input of all key stakeholders was addressed. The design of the injury prevention programme outlines a clear injury prevention strategy to address injuries prevalent in netball. It is a player-centered approach that deals with injury prevention from the perspective of the coach, the player and the administrator. It addresses the needs identified by the self-administered questionnaire and those determined

by stakeholders within netball. It comprises an educational coaches pocket size booklet empowering the coaches with the necessary knowledge to prevent injury. The national sport physiotherapy association is an administrative structure, which centralizes the approach to injury management and facilitates and co-ordinates injury management. It also guides the minimum standards and accredits the experience of physiotherapists working with national federations using netball as the example. This was done through an adaptation of the South African Sport Medicine and Association's (SASMA) accreditation form **[Appendix 2.7]**. The injury prevention protocol is a 6-week cycle of exercises that has been adapted from studies validating preventing injury by the implementation of the exercises in a controlled scientific environment. Although the exercises were not derived from netball studies, they were derived from sports, which had similar injuries with similar mechanisms of injuries comparative to the accelerative, decelerate, jump and land movements associated with netball.

2.4.4 Objective Four: To evaluate the feasibility of the proposed programme

Research Question four

What are the views of netball key stakeholders to the content and relevance of the proposed programme with regard to the feasibility for implementation?

Research Design

The aim of this phase of the study was to evaluate the relevance and feasibility of the proposed programme among netball stakeholders. A Delphi study was also conducted during this phase. The Delphi method has been identified as being suitable to produce information that is useful for decision making, through a series of questionnaires aimed at experts (Adler & Ziglio, 1996). Two rounds of the Delphi study were conducted via the internet using both a qualitative and quantitative research design.

Development of the qualitative questionnaire

The qualitative questionnaire was developed to cover 'The Elements of a Good Feasibility Study', as described by Bryce (2008). These include the project scope, strengths and weaknesses, requirements, the approach, the evaluation and the review. This questionnaire used a qualitative structure with free text responses to open-ended questions that covered aspects described above.

Expert Panel

According to Cambell, Shield, Rogers and Gask (2004), panelists are selected to participate in a Delphi Study according to the relevance of their expertise to the survey being conducted. For this study experts affiliated with SASCOC, which are currently involved with national federations were invited to participate in the study. Ten coaches, ten medical administrators and ten medical experts were selected for their work in related fields and their valued expert opinion. A qualitative questionnaire was initially conducted. Participants were asked to review one section of the injury prevention programme that was in their area of expertise. After the selection process was completed, the panel was emailed informing them of the study and of their requested participation. The email also contained a link to the section of the programme they were required to review as well as a link to the qualitative questionnaire.

Panel Survey

Prior to the distribution of the questionnaires to the participants, the questionnaires were tested for content validity by circulating them to experts that could comment on the content and structure. In round 1 the qualitative questionnaire was sent to coaches ***[Appendix 2.8]***, administrators ***[Appendix 2.9]*** and medics ***[Appendix 2.10]*** together with the part of the injury prevention programme relevant to their area of expertise. Items were reviewed with my supervisor for content, clarity and neutrality and were refined as needed. To avoid bias, questions were worded in neutral term. Once the responses were received the researcher tabled the responses and drew themes from the recommended changes.

Development of the survey to reach consensus using the 5-point Likert Scale

The survey instrument included statements to which the panel members responded according to their level of agreement on a Likert scale. The five-point Likert scale ranged from one representing “strongly disagree” to five representing “strongly agree,” and three was defined as “neutral”. The statements were derived from the themes that emerged from the qualitative questionnaire.

Expert Panel

All participants that were included in round one of the Delphi Study were invited to participate in round two. Therefore the same representative sample of ten coaches, ten medical administrators and ten medical experts were initially invited to score the Likert scale survey.

Panel Survey

The recommendations were then constructed into statements with on a five point Likert scale ***[Appendix 2.11].*** All participants, coaches, medical experts and administrators scored the same 5 point Likert scale survey and received all three aspects of the injury prevention programme with the highlighted changes ***[Appendix 2.12]*** for review together with the survey for completion. Consensus was then evaluated and the amended changes highlighted and included in the finalised Injury prevention programm ***[Appendix 2.13].***

2.5 Reliability and Validity of the study

Validity of the study was ensured by the use of mixed methods with a sound theoretical base and different sources of data collection. Ferlie and McNulty (1997) characterize high quality research as built up of two aspects, namely of internal validity and external validity. The *internal validity* deals with the rigor of the theoretical, methodological and empirical bases underlying the research

project, whereas the *external validity* reflects the relevance and accessibility to user groups outside the research community. Piloting all relevant tools enhanced reliability of the study and determining sound evidence based practices for injury prevention through a well-designed systematic review. The questionnaire used in the quantitative aspect of objective one in this study, was based on an injury prevalence questionnaire that had been validated in a previous study by (Louw et al., 2003; Walker, 2010). The revised version of the questionnaire, **[Appendix 2.1]**, was piloted for content validity using experts in the area of injury prevention and for face validity using a sub-sample of netball players (n=20). Reliability testing of the responses was done using a one-week test – retest technique on a subset of netball players (n=20). The responses were compared to assess the players' ability to recall their injury occurrence. There was 100% agreement on 90% of the variables. In objective two of the study, determining the current situation, two reviewers using selected databases namely Medline, CINAHL, Ebscohost and Sport Direct for the period of 2001 – 2011 conducted an initial search.

Following the review, the methodological quality of studies was determined independently by the two reviewers using the CASP critical appraisal tools for randomised control trials, non-randomised control trials and quantitative studies to exclude poor quality studies. Discrepancies were discussed verbally to reach consensus and scores were then adjusted on the CASP scoring form accordingly. In the final step, a self-developed data extraction form was used to extract the data from the studies, using criteria that were determined prior to the data extraction process by the two reviewers.

2.6 Trustworthiness

The aim of trustworthiness in a qualitative inquiry is to support the argument that the inquiry's findings are "worth paying attention to" (Lincoln & Guba, 1985) . Four issues of trustworthiness demand attention: credibility, transferability, dependability, and confirmability. To address credibility, I included all stakeholders involved in the sporting code in order to ensure information was obtained from various sources. This technique, while not meeting the technical definition of "triangulation" (Lincoln et al., 1985),

provided a richer and more credible data set than if information was only obtained from one source. In addition the study aimed to pilot the tool for its feasibility and implementation using a Delphi study. Member checking was also used during the qualitative aspect of objective one and objective four of this study. In objective one participants were given the opportunity to review a summary of the data analysis procedure and a summary of the final results of the semi structured interviews. In objective four participants were given the opportunity to review the injury prevntion programme with the highlighted changes as per their comments from the qualitative aspect **[Appendix 2.12].** To address transferability, the data analysis documents used to generate the answer to the research questions was made available. The complete set of data analysis documents is on file and available upon request. To address the issues of dependability and confirmability, I relied on an independent audit of my research methods by a competent peer such as my supervisors. All information generated was thoroughly examined by my supervisor and these include the original transcripts, data analysis documents, comments from the member checking, and the text of the dissertation itself.

2.7 Reflexivity

Maxwell, (1996), argues in favour of *critical subjectivity*, which he describes as, a quality of awareness in which we do not suppress our primary experience; nor do we allow ourselves to be swept away and overwhelmed by it; rather we raise it to consciousness and use it as part of the inquiry process. During 2009 and 2010 I worked with the national team as the team physiotherapist. I was also, during this period, simultaneously working with SA Rugby. This gave me an insight as to the challenges that faced Netball South Africa with regard to injury management and was the motivation for pursuing my research. Rugby with strong financial backing and a developed medical structure didn't seem to present the same challenges and as a keen sport physiotherapist it was important for me to understand how the stakeholders within netball experienced injury management and whether the perceived

challenges presented were understood and interpreted in the same manner by the stakeholders. This would provide a strong motivation and foundation for the development of an injury management programme. To ensure that the responses were neither misinterpreted nor bias in their translation, the interviews were transcribed verbatim and quotes were included to support the participants' experiences of the themes and sub-themes.

2.8 Limitations of the Study

The study is limited to the South African Netball playing community and therefore the data collected with regard to injury prevalence and mechanism of injury is exclusive to South Africa and its external barriers facing players with regard to training and participation, i.e. Surfaces, training and competition schedules, access to health care providers, adequate rehab post injury and socioeconomic status. The injury prevention protocol was designed to target these areas highlighted and is therefore not generalizable to other netball playing countries.

2.9 Ethical Considerations

Permission to conduct the study was be sought from the faculty Higher Degrees Committee at the University of the Western Cape, the Senate Higher Degrees Committee, the Registrar of the university and the head of the physiotherapy department that was involved **[Appendix 2.13].** The Faculty of Community and Health Sciences Research Ethics committee of the University of the Western Cape outlined the ethical practices pertaining to the study of human subjects and the study was conducted in accordance as specified. The study was conducted under the auspices of Netball South Africa. A letter of written consent was sought from the federation to conduct the study as well as to endorse the protocol once it has been developed **[Appendix 2.5].** Participants were also required to complete a written consent form on administration of the questionnaire **[Appendix 2.6].** Anonymity and confidentiality was ensured at each stage of the project, and no personally

identifiable information was gathered. For the Delphi study the panel was surveyed twice with the use of web-based software google docs to protect confidentiality and to limit the possibility of bias. An ethical statement was also included in both the quantitative and qualitative aspects of this study ensuring participants that the study was registered with the project registration number, that participation was voluntary, and that there was no obligation to participate in the study.

Email addresses were collected strictly for administrative purposes. The results of the study will be made available to Netball South Africa. Table 2.1 summarises the phases of this study.

Table 2.1: Phases of the study:

Phases	Objectives	Population	Method	Outcome
Phase 1	Defining the size of the problem and risk factors	Pilot study: 20 netball players Survey: 254 netball players Interviews: 2 players, 2 coaches, 2 managers, 2 sports administrators	Survey and interviews	Provided information on the injury profile of netball players To understand the challenges in dealing with injuries sustained by key stakeholders
Phase 2	Determining what is known about the current situation	Literature	Systematic review	Have knowledge and information about current practices and best practices
Phase 3	To design an injury prevention protocol for netball players	Phase one and phase two of the study	Intervention Mapping	Design the injury prevention protocol
Phase 4	Evaluate the feasibility of the protocol	Netball players, coaches, managers and netball SA executive council	Delphi study	Have an understanding of the feasibility and acceptability of the tool among key stakeholders

Objective One: Define the size of the problem and risk factors

Chapter Three: Injury prevalence of netball players in South Africa

3.1 Introduction

Objective one of the study consisted of two phases. In phase one, determining the size of the problem, a cross sectional quantitative injury prevalence questionnaire was administered. In phase two interviews with key stakeholders were conducted. Chapter three presents the survey information and chapter four the information from the interviews.

3.2 Literature Review

South Africa is a country that is unified by sport and this has been central to our nation building process through victories such as the 1995 Rugby World cup, celebrated with icons like Nelson Mandela. Netball in particular has received much support from the government, being recognized as a very popular woman's sport with high rates of participation and being noted as one of the 16 priority codes of sport in the country. This reflects in line with the goals of the White Paper (DRSA, 2010) where it is stated that sports are made priority sports due to the large participation numbers and addressing issues of previous inequality.

Linked to the high participation in the sport is a high prevalence of injuries. However, literature has shown that if effective injury prevention strategies are not in place, then the benefits of sport and in particular in relation to non-professional sporting codes, may be lost (Chalmers, 2002). As injury prevention has become a major public health issue, the lack of systematic collection of sports injury-related data, particularly at a non- professional level, is of concern both nationally and internationally (Chalmers, 2002; Macera & Pratt, 2000), creating a vacuum of validated data that forms the basis of injury prevention models. To counteract this negative effect by means of preventative programmes, the extent and nature of the sports injury problem needs to be identified to define target groups for prevention (Parkkari, Kujala & Kannus, 2001). Within a South African context in Langeveld, Coetzee and

Holtzhausen (2012), published the epidemiology of injuries in Elite South African Netball Players. South African research is now starting to highlight that epidemiological studies provide the proof of risks for sports injuries, as well as the effects of preventative and therapeutic intervention. The objective of their research was to assess the incidence and severity of injuries in a cohort of elite South African netball players. The subjects were players (N=1280) who participated in three elite netball tournaments during the 2009 season. A high incidence of 500.7 injuries per 1000 playing hours was reported. Most injuries occurred to the ankle joint (34%), followed by the knee (18%), fingers, hand and wrist (15%). Ligaments were the most commonly injured structures. The majority of injuries were minor. Factors associated with injuries included tournament play, previous injury, lack of core stability, neuromuscular and proprioceptive training. In order to reduce the amount of injuries to the lower extremities Langeveld et al. (2012) recommended that netball players follow a structured programme to enhance core stability, neuromuscular control, and proprioception and to optimise biomechanical execution of functional movement patterns.

Sport injuries are a cost burden on both individuals and society with respect to the duration and nature of treatment, the amount of sport and working time lost, permanent damage and disability, reduced quality of life and monetary costs (Murphy, 1998). It is therefore evident that preventative measures with regard to injury prevention strategies within South African sport are needed.

Netball is a physically demanding game that requires high levels of endurance, strength, speed, power, agility and flexibility (Steele & Milburn, 1987). It has a high impact on joints due to the stop-start nature of the sport and the aerial requirements further predispose joints to injuries with considerable forces associated with landing. McNitt-Gray (1991) noted vertical ground reaction forces up to 6.8 x the body weight during landing. Joint motion and muscle activity are important in decreasing the impact forces associated with landing (Ferreira & Spammer, 2010). The body parts most affected by injury among netball players according to international literature are the ankle joints (39.13%), with the most common mechanism of injury being incorrect landing techniques (52.17%) (Van Mechelen & Verhagen,

2005). Thus an understanding of these factors and mechanisms of injury can contribute to designing effective prevention and rehabilitation programmes. Once identified, preventative measures should be implemented and their efficiency evaluated. Van Mechelen et al. (2005) reported that measures to prevent sports injuries in young people should be based on knowledge of the incidence, likely severity of the particular injury and mechanisms that contribute to the risk of sustaining sport-related injuries. Once identified, preventive measures should be implemented and their efficacy evaluated. The authors emphasize that this process is important for all health professionals involved in sports medicine including the physiotherapist.

The aim of this study was to establish baseline data for injury prevalence, mechanism of injury, injury severity and management of injuries in netball players in South Africa, in order to establish a platform for further research in this study for developing preventative measures.

3.3 Methods

This aspect of the study employed a cross-sectional, descriptive design as this presents a good framework to collect data on individual characteristics, including exposure to risk factors, alongside information about the outcome of injuries sustained. In this way cross-sectional studies provide a 'snapshot' of the outcome and the characteristics associated with it, at a specific point in time. The population for this study was netball players participating in a national netball tournament at TUKS University during the 2010 netball season. The self-administered questionnaire used in this study was based on an injury prevalence questionnaire that had been validated in a previous study (Louw et al., 2003; Walker, 2010). An injury was defined as any physical complaint sustained by a player that occurred during a match or training, irrespective of the need for medical attention or time loss from practices and matches (Fuller, Ekstrand, Junge, Anderson, Bahr, Dvorak et al., 2006). The main categories questioned were exposure time, type and location of the injury, injury severity and injury management. The revised version of the questionnaire was piloted for content validity using experts in the area of

injury prevention and for face validity using a sub-sample of netball players (n=20). Reliability testing of the responses was done using a one-week test – retest technique on a subset of netball players (n=20). The responses were compared to assess the players' ability to recall their injury occurrence. There was 100% agreement on 90% of the variables.

Data was collected at the Spar senior netball championships in 2010. The players were representative of 38 out of the 62 regions in South Africa, although netball is only played in 47 regions. The total number of players at the tournament was 360 and all were invited to participate in the study. A written letter detailing the aim and purpose of the study together with the letter of permission from Netball South was attached to each questionnaire. Ethical clearance was obtained for the study from the ethics committee of the University of the Western Cape. (Ref.: 11/1/22) and permission to conduct the study was obtained from Netball SA and the tournament officials. Informed written consent was obtained from all the participants prior to completion of the questionnaire and confidentiality and anonymity was ensured to all participants in a written letter detailing the purpose and procedures of the study. These were sorted into packs for each region together with stationery to complete the questionnaire and were handed to each region's manager. Managers were briefed at the manager's meeting on day one of the three day tournament and were given a time and place for collection of the completed questionnaires. The packs were consolidated against the register of participating teams and all packs were collected including those not completed. Data was analysed using SAS V9 (SAS Inc. Cary, USA). Descriptive statistics were used and results presented as percentages, means and standard deviations.

3.4 Results

The total population targeted for this study was 360 netball players but a sample of 254 netball players responded of which 55 were club players, 147 provincial players and 52 national players, thus yielding a response rate of

71%. Table 3.1 summarises the ages, starting age and playing years per each division.

Table 3.1: Sample description by age (N=254)

Playing level	n	Label	Mean	STD Dev.	Min	Max
Club	55	Age	24.13	6.27	16.00	44.00
		Starting age of playing	12.01	3.24	6.00	21.00
		Years played	12.11	6.23	0.00	28.00
Provincial	147	Age	23.89	5.10	14.00	42.00
		Starting age of playing	11.48	4.61	5.00	33.00
		Years played	12.40	6.15	0.00	31.00
National	52	Age	24.32	4.25	18.00	36.00
		Starting age of playing	11.23	4.66	7.00	28.00
		Years played	13.09	5.30	1.00	26.00

The mean number of weekly training sessions reported was 3.7 and the mean number of gym sessions per week was 3.4 with at least 2 match days per week at all levels. Of the total number of participants, 61.8% (n=157/254) of players reported an injury within the last season. The injury prevalence at various levels was 54.5% (n=30/55) at club level, 59.2% (n=84/147) among provincial players and 84.3% (n=43/52) amongst national players.

The injury prevalence according to body region is presented in Table 3.2. Among the 157 injured players, 301 injuries were reported for the last season resulting in an injury rate of 1.9 injuries per player for the past season. The most commonly injured structures were the ankle and the knee.

Table 3.2: General injury rate (N=301)

Body Region	**% (n)**
Ankle	37.5 (113)
Knee	28.6 (83)
Lower leg, calf	7.3 (22)
Hand, wrist	6.7 (20)
Shoulder	6.0 (18)
Back	4.7 (14)
Thigh	3.3 (10)
Head, Neck, Chest	3.0 (9)
Elbow, arm	3.0 (9)

Of the most commonly reported injuries (ankle and knee), the relationship between the playing position and the commonly reported positions are reflected in Table 3.3.

Table 3.3: Reported ankle and knee injuries per playing position

Playing position	**No. of ankle injuries reported (n=113)**	**No. of knee injuries (n=83)**
Wing attack (37)	19% (n=21)	12% (n=10)
Centre (46)	16% (n=19)	28% (n=23)
Wing Defense (33)	15% (n=17)	6% (n=5)
Goal attack (37)	15% (n=17)	19% (n=16)
Goal Defense (38)	13% (n=15)	14% (n=12)
Goal shooter (28)	12% (n=14)	14% (n=12)
Goal Keeper (22)	10% (n=11)	6% (n=5)

Provincial players sustained the highest percentage of ankle injuries 56.7%, followed by club players (22.5%) and national players (20.8%). In contrast, provincial players had the highest prevalence of knee injuries (61%), followed by national players (26%) and club players (13%). The most common

mechanism of injury for both the knee and the ankle injuries were landing with 19% and 29% respectively. Tripping accounted for 8% of injuries in the ankle and 6% in the knee. The most common surface on which injuries occurred was outdoor concrete (29% and 13%) respectively among the knee injuries and ankle injuries.

Ankle and knee injury characteristics were classified as mild, moderate and severe according to symptoms reported by the participants and then further categorized by the researcher. Among the injured participants, 86 (44%) of the athletes' sustained severe injuries, 31(16%) sustained moderate injuries and 78 (40%) sustained mild injuries. Based on the injury severity, 67% of players reported they were able to continue with the game and 33% had to receive medical assistance together with a loss of game and training time. Of those athletes injured, 55% had access to professional help. The most common form of management accessed was physiotherapy, which accounted for 31%, followed by doctor's consultation (17%). Medical personnel cleared 66% of injured athletes for return to play after sustaining an injury. 32.43% of club players accessed professional help in comparison to the 60.19% of provincial players and 73.81% of national players.

3.5 Discussion

Limited literature exists on the prevalence of injuries among netball players in South Africa. This study highlighted an injury prevalence ranging from 55% at club level to 84% amongst national players with an injury rate of 1.9 injuries per player over one netball season. This injury rate is higher (1.1) than that compared to the study by Hume and Steele (2000), but lower (2.6) than the study by McManus, Stevenson and Finch (2006).

The distribution of injuries across one season in the current study highlighted the ankle (37.5%) and knee joint (28.6%) as the most commonly injured structures. These findings compare similarly to a recent study conducted by Ferreira and Spamer (2010) in South Africa, among university netball players who reported an injury prevalence of 39% and 28% respectively for the ankle

and knee across one season. It also compares similarly with the study conducted by Langeveld et al. (2012), which found that Most injuries occurred to the ankle joint (34%), followed by the knee (18%), fingers, hand and wrist (15%). A longitudinal study conducted by Hopper, Elliot and Lalor (1995), over a period of five years in Australia, also reported high ankle injury prevalence. It is thus evident that the ankle and knee are the most common joints injured in netball and thus needs effective injury prevention strategies as these structures are subjected to increased physical stress during the sport.

The primary mechanisms of injury were tripping and landing for both the ankle and knee injuries, which are similar to the findings in other studies (Van Mechelen et al., 2005). Landing has been reported as being directly related to injuries in the joints of the lower extremity (Hewett, Lindendfeld, Riccobene & Nayes, 1999) and was one of the primary causes of lower limb netball injuries. Hopper (1986) and Steele (1990) recommended that all netball players regardless of age, should incorporate specific landing techniques to ensure that players use correct body mechanics when landing, especially after striding forward to receive a pass in order to minimize injury.
In the current study, playing position was not associated with injury. Hopper et al. (1995) reported that players from any position have equal probability of being injured at any stage of the match.

Provincial players sustained the highest number of ankle of both ankle and knee injuries. This could be attributed to the fact that the majority of players who are part of the club and national structures are provincial players. Although no evidence could be found among netball players, Kostoupoulos and Dimitrios (2010) reported, “The potential for game injuries was higher in the high-level player groups”. It is thus evident that additional evidence is needed among netball players to confirm whether there is a relationship between injury incidence and level of play.

The majority of injuries reported were considered either severe (44%) or mild (40%). This even distribution of mild and severe injuries highlights the need for effective education and prevention strategies linked to the management of

all injuries with varying severity, both mild and severe injuries. A shortcoming of this study is that the diagnosis of an injury cannot be confirmed, as injuries were self reported, and thus the characteristics of the injury may have lead to the injury being categorized into a classification more severe than what it could have been on further diagnosis. 55% of the injured sample accessed professional help with 31% of netball players attending a consultation with a physiotherapist. This could possibly be due to the high number of mild injuries reported. However, if left untreated or inadequately managed, the ramifications of minor injuries at club level could impact severely at a national tier by predisposing to further injury.

This highlights a need for sport medicine professionals to focus on preventative measures as well as health promotion and injury prevention education within South African communities. Although preventative solutions are known to be multifaceted, there is a need for a concerted and coordinated intra-and inter-sectoral approach to reducing the magnitude and frequency of the burden of injury in netball. A motivation for this is to ensure that sports medicine adopts best practice principles to dealing with injury prevention. To date, preventative sports medicine has largely ignored the issue of how best to translate research evidence into effective interventions that have high adoption levels and there is a major gap in the international literature about how best to engage the target groups in sport safety to develop and implement injury prevention policies and practices (Finch, 2006; Finch & Donaldson, 2010). Consequently, there is very little guidance to inform decision – making or for identifying appropriate injury prevention strategies for specific sporting codes.

3.6 Conclusion

The aim of this study was to establish baseline data for injury prevalence, mechanism of injury, injury severity and management of injuries in netball players in South Africa, in order to establish a platform for further research in developing preventative measures. The study allowed the researchers to establish specific parameters, which guide the types of injuries in netball that

require to be managed as well as the target audience. Understanding the mechanism of injury and external factors that contribute to the cause of injury guides clinical practice and sport medicine staff, with regard to the interventions that need to be implemented as part of preventative and management strategies. It also further compliments understanding the challenges experienced by stakeholders in netball with regard to injury management. The major findings of the study are coherent with international studies published, and therefore are able to guide a South African audience on the injury prevalence of netball players in South Africa. Injury surveillance is an integral part of developing preventative measures and the study lays a platform for developing these strategies against the backdrop of its findings and comparison with other authors.

3.7 Implications for the current study

Injuries identified in this phase of the study highlights the need to investigate how the injuries sustained are managed and the challenges associated with injury management within the current structures of netball in South Africa.

Chapter Four:
Exploring the challenges experienced by stakeholders with regard to injury management in netball

4.1 Introduction

Phase two of the study explores the challenges experienced associated with netball injuries and injury management. It aims to impart context as to how the stakeholders' deal with the prevalence of injuries established in phase one and how this impacts the sport. This gives the researcher a good understanding of current management practices and the challenges associated with the implementation of intervention strategies within the South Africa netball context.

4.2. Literature Review

Injury prevention strategies needs more than just researchers developing and evaluating interventions. In addition, it is also more just professionals involved in sport implementing these interventions. In order to ensure that a holistic approach was engaged in when considering the development of a sports injury prevention programme for netball players in South Africa, it was essential to understand the views of all key stakeholders within the netball fraternity. Consultative approaches are a necessary approach to ensure and secure for sector wide buy-in into the injury monitoring system.

According to Lim and Spanger-Siegfried (2004) the Adaptation Policy Framework (APF) process can be used to guide studies, projects, planning and policy exercises toward the identification of appropriate adaptation strategies, policies and measures. Part of this policy is that you understand the current context and then link it to short term and long-term goals. They also see engaging stakeholders in the adaptation process as an essential component to each aspect of this framework, and ultimately crucial to the successful implementation of an intervention strategy. Engaging stakeholders requires an active and sustained dialogue among affected individuals and groups (Lim et al., 2004).

In the context of a sports safety policy for New South Wales, this involved understanding the role of significant stakeholders in sports injury prevention, the 'context' or environment in which the policies were formulated and executed, and the 'processes' associated with policy development (the barriers, enablers and motivators to policy development) (Buse, Mays & Walt, 2005). This phase of the current study aimed to understand the needs of key netball stakeholders with regards to netball injuries and their impact. This would assist the researcher in understanding and exploring some of the contributing factors to injuries experienced and the impact on the sport as a whole. The challenges associated with managing these injuries and the role stakeholders viewed pertinent to sport science and medical staff contributes to the planning and the identification of appropriate adaptation strategies and policies. One of the key challenges in taking sports safety forward in a strategic and evidence-informed way was to establish the priorities, understanding and challenges experienced by netball key stakeholders with regard to injuries and injury management and to try and build it into their 'core business' so it is addressed as part of their everyday activity in a suitable way (Polous, Donaldson & Finch, 2010).

The broad outline for this part of the study was thus to explore the perceived barriers, potential motivators and enablers to the development of a sports injury prevention programme for netball players in South Africa, and to provide the necessary background to develop a programme that was feasible for implementation. In order for netball stakeholders to identify possible challenges with netball injuries and consequently managing an injury, it was important to get an understanding of what they would define as a netball injury. This would provide a foundation to understanding the context within which netball stakeholders would view a netball injury and the parameters within which they were managing these injuries. In 2006 an Injury Consensus Group comprising a range of experts involved in the study of football injuries gathered to establish definitions and methodology, implementation and reporting standards for studies of injuries in football and to provide the basis for studies of injuries in other team sports (Fuller et al. 2006). The 2006 consensus document appears to have been generally accepted, and

the definitions and principles outlined are in widespread use in many different sports, judging from the more than 70 citations the paper has received already (Bahr, 2009). In the consensus statement an injury is defined 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. An injury that results in a player receiving ‘medical attention’ is referred to as a ‘medical attention’ injury, and an injury that results in a player being unable to take a full part in future football training or match as a ‘time loss’ injury.”

In planning for injury prevention and control, there has been a historical tension between the use of “active” (behavioral) strategies and “passive” (structural) strategies (National Committee for Injury Prevention and Control, 1989). Passive approaches rely on changing products or environments to make them safer for all, irrespective of the behavior of individuals. Active approaches encourage or require people to take an active role in protecting themselves, despite hazards in their environments. The ultimate goal of any injury prevention programme is to establish ‘buy in’ by the stakeholders and to create an environment for inclusion of the programme to facilitate implementation. In order to facilitate implementation, the researcher needs to have a good understanding of possible barriers and facilitators that could affect the implementation of the intervention programme. To further understand the barriers and facilitators associated with injury management in netball, stakeholders were interviewed on the various aspects of injury management. These included what types of treatment should be administered, current structures available to access injury management and possible solutions from the stakeholders that could facilitate injury management. Finch (2006) stated that advances in sports injury prevention will only be achieved if research efforts are directed towards understanding the implementation context for injury prevention, as well as continuing to build the evidence base for their efficacy and effectiveness.

4.3 Methodology

4.3.1 Research design

A descriptive qualitative research design using semi-structured interviews was used to

explore the challenges experienced by key stakeholders in netball regarding injuries and the management thereof within the netball federation in South Africa. Semi-structured interviews is a technique used to generating qualitative data and is primarily characterized by open-ended questions that are developed in advance and supported by probes (Morse & Richards, 2002). The interview was guided by the schedule rather than dictated by it; and the interviewer was free to probe interesting areas that arose from participants' responses. To ensure that a broad coverage of issues was achieved during the semi-structured interview, the researcher asked focused but not leading questions.

The study followed five procedures endemic to a phenomenological enquiry: a) bracketing of the researcher's preconceived ideas about the phenomenon; b) formulating questions that asked participants to describe their experiences and exploring the meaning thereof; c) conducting interviews with individuals who have experienced the phenomenon; d) analysing data through reduction and statement analysis and e) reporting on the essence of the experience (Cresswell et al., 2004).

4.3.2 Sampling and participants

Patton (1990) states that 'qualitative enquiry typically focuses in depth on relatively small samples, even single cases, selected purposefully. Two coaches, two managers and two players were asked to participate in the study. All participants had been involved with netball at all levels including club level and international level for a number of years. They were therefore considered to have a good understanding of injury management strategies, the challenges currently experienced with implementation and the current structures in place from club through to national level. All participants have different roles within the netball fraternity and they were therefore purposefully selected to participate in the study. The final sample included six participants who agreed to take part in the study and gave their informed written consent before participation **[Appendix 2.2].**

4.3.3 Data Collection Method

Semi-structured interviews, **[Appendix 2.3],** were used to explore the challenges experienced by players, netball sport administrators and coaches in managing injured players within the current system. The data was collected and conducted by one interviewer. The interviewer was the researcher, a physiotherapist that worked within netball structures and with previous experience of conducting qualitative interviews. One method of bracketing is engaging in interviews with an outside source to uncover and bring into awareness preconceptions and biases (Rolls and Relf, 2006). Bracketing interviews held with a non-clinical and non-managerial colleague or research associate, constitute a negotiated, supportive relationship, which serves as an interface between the researcher and the research data. For this study, regular engagement with my supervisor via email and telephonic conversation, allowed me to reflect on the interviews as they were conducted. This process provided a platform to discuss how I as the researcher, interacted with the data. Each interview lasted approximately 40 minutes and took place at a venue convenient to the interviewee. Participants were contacted telephonically and interviews were conducted in person or telephonically and recorded. All the interviews were conducted in a language, which the participant was comfortable with. Permission was sought from the participants to audio tape the interviews and transcribe them verbatim. The interview covered five broad themes. The content was analysed and quotes were extracted that related to the main themes the interview covered. These were the participants ability to define and understand what a sport injury is, contributing factors to injuries in netball, current injury management practices, injury management structures and the challenges associated with accessibility and the role of the medical team. The interview guide was not tested in advance, but after the first interview the author listened to the interview to ensure that the research questions were covered and that the interview addressed the purpose of the study. Each interview began by asking the first question on the interview guide. Following this question and the response received from the respondent, more specific questions, which focused on the participants' feelings, experiences and beliefs in

relation to the focused question were asked.

4.3.4 Data analysis

Data was transcribed and content analysed descriptively in nature by reporting how many times certain phenomena are mentioned. The interviews were analysed using qualitative conventional content analysis. In this study, the coding categories were derived directly from the transcribed verbatim version of the interviews. An inductive approach was used utilizing the quotes expressed by players, coaches and administrators. The views and experiences of stakeholders with regard to injury management, injury management structures, the role of medical teams and the contributing factors to injuries in netball were used as evidence for the themes derived and deductions made from the study, as this information was lacking in the literature (Elo & Kyngas, 2008). Content analysis does not necessarily require an underlying theory (Sandelowski, 2000) and conventional content analysis can be used when existing theory or research literature on phenomenon is limited Hsieh and Shannon (2005). In addition, content analysis is a research method that uses a set of procedures used to make valid statements from the text (Weber,1990). The interviews were read through several times from the start to the end to get an idea of the content and flow. Identifying themes and sub themes addressing the main aim of the study followed this. The various responses were compared on the basis of similarities and differences. The interviews were re-read for reflection and to ensure that the themes matched the purpose of the study and that the responses could by outlined by the themes.

4.3.5 Trustworthiness, Member Checking

The aim of trustworthiness in a qualitative inquiry is to support the argument that the inquiry's findings are "worth paying attention to" (Lincoln et al., 1985) . Four issues of trustworthiness demand attention: credibility, transferability, dependability, and confirmability. To address credibility, all partcipants were stakeholders involved in the sporting code at various level from club through to international level, in order to ensure information was obtained from various sources. This technique, while not meeting the

technical definition of “triangulation” (Lincoln et al., 1985), provided a richer and more credible data set than if information was only obtained from one source. In addition the study aimed to pilot the tool for its feasibility and implementation using a Delphi study. Member checking was also used and participants were given the opportunity to review a summary of the final results of the interviews. To address transferability, the complete set of data analysis documents are on file and available upon request. To address the issues of dependability and confirmability, I relied on an independent audit of my research methods by a competent peer, my supervisors. All information generated was thoroughly examined by my supervisor and this included the original transcripts, data analysis documents, comments from the member checking, and the text of the dissertation itself.

4.3.6 Reflexivity

Maxwell (1996), argues in favor of *critical subjectivity*, which he describes as, a quality of awareness in which we do not suppress our primary experience; nor do we allow ourselves to be swept away and overwhelmed by it; rather we raise it to consciousness and use it as part of the inquiry process. During 2009 and 2010 I worked with the national team as the team physiotherapist. I was also, during this period, simultaneously working with SA Rugby. This gave me an insight as to the challenges that faced Netball South Africa with regard to injury management and was the motivation for pursuing my research. Rugby with strong financial backing and a developed medical structure didn’t seem to present the same challenges and as a keen sport physiotherapist it was important for me to understand how the stakeholders within netball experienced injury management and whether the perceived challenges presented were understood and interpreted in the same manner by the stakeholders. This would provide a strong motivation and foundation for the development of an injury management programme. To ensure that the responses were neither misinterpreted nor bias in their translation, the interviews were transcribed verbatim and quotes were included to support the participants’ experiences of the themes and sub-themes. Bracketing is a method used in qualitative research to put aside one’s own beliefs about the phenomenon under

investigation or what one already knows about the subject throughout the investigation (Tufford & Newman, 2012).

4.4 Results

The participants selected, described in table 4.1 included various stakeholders involved in the game of netball. The participants included two coaches, two administrators and two netball players. The participants had a minimum of 5 years experience.

Table 4.1. Profile of participants

Current role in netball	**Years of experience**	**Other portfolios in netball**
Coach 1	> 5 years	Player
Coach 2	>10 years	Player
Administrator 1	>10 years	Exco Committee
Administrator 2	> 5 years	Exco Committee
Player 1	>10 years	Coach
Player 2	> 10 years	Coach

4.4.1 Definition of sports injury

According to the 2006 consensus statement an injury was defined as any physical complaint sustained by a player that occurred during a match or training, irrespective of the need for medical attention or time loss from practices and matches (Fuller, et al., 2006). In the current study, participants attempted to define a sports injury and the key words highlighted are illustrated in table 4.2 below.

Table 4.2 Definition of sports injury

Theme	Participants experience	Quotes
Medical expert involvement	An injury that needs to managed by medical experts	"…A sport injury to me will be an injury that has to be looked at by a physio or needs a doctors attention"
When injury occurs	Injury occurs during a match	" …Sports injury is getting injured while you play"
Athlete performance	Causes athlete to be less effective on court	"…It prevents you giving 100%..."
Trauma causing damage resulting in an injury	Resulting in the twisting and tearing of a joint or ligament	"…My experience is that if you tore a ligament…"
Player participation	Stops the player from further participation	"… Can't go on doing what you were doing on court…"

4.4.2. Injury Management

The majority of the participants were aware of the RICE principles and that an injury should be referred to medical staff. They were also knowledgeable as to the type of expert the injury should be referred to. There was consensus that health care is very expensive and that a more affordable solution should be sought. Participants also articulated that injuries are not managed effectively due to cost and the consequence of this was player drop out and poor team performance. Table 4.3 illustrates the themes that emerged with relation to injury management, participants' perceptions and the quotes they verbalized to show their understanding.

Table 4.3. Injury management

Theme	Sub category	Participants experience	Quote
Injury Management	Immediate attention	They were knowledgeable about the RICE principle and also referral.	"…immediately ice…then refer"
	Type of expertise required	Participants understood the role of a sport physician or sport physiotherapist compared to a GP.	"…The right expert…GP's just give pills…"
	Education	Knowledge gained from observing experts.	"…We learn a lot from medical experts…
What assistance is required	Coach and player education	Transalation of knowledge from medical teams to other mangement members is essential.	"…Medical staff should educate…"
	Affordable health care	Participants expressed the concern that players could not afford the expertise needed to manage their injuries.	"… Where we can pay less or on instalments…"
	Introduction of medical structures	As structure should be in put in place that is more accessible.	"…A medical structure per region.."

Theme	Sub category	Participants experience	Quote
Non-management of injuries	Are injuries adequately managed?	Paticipants expressed the concern that injuries were not managed adequately	"…I don't think injuries are managed effectively…they just strap and hope for the best…"
	Early return to play	Participants highlighted that players did not complete the full rehabilitation process for injuries	"…They rush back… don't finish the aftercare.."
	Lack of knowledge	Coaches don't understand the consequences of early return to play	"…Coaches should become more knowledgeable"
Player performance	Players drop out	Talented athletes get injured and then stop playing	"Raw talent…just gets missed out on…"
	Players don't perform at 100%	Players tend to hide the injury	"…You see them holding back…"
	Impact on team performance	Team morale and team preparation are affected	"It affects the team…everyone's not doing their job…"

4.4.3 Role of sport science and medical staff

There was a general consensus that the medical team has a definite role to play within the team management and with regard to injury prevention. Participants understood each medical team member's specific area of expertise well and what they contributed to ensuring the functioning of a good multi disciplinary team and injury prevention. They were also able to specify the type of working relationship that should exist between the general team management and the medical team. The main themes that emerged were around the involvement of the medical team in the management structure, injuries and medical issues and injury prevention. The participants' views are reflected in Table 4.4.

Table 4.4 Role of sport science and medical staff

Theme	Sub category	Participants experience	Quote
Management structure	Significance of the role	Partcipants agreed that the medical team had a significant role to play.	"…definitely …an important role…"
	Influence	Contribute toward fair team selection	"…Send objective results … facilitate player selection…"
	Communicate	The role to complement the technical aspect of the game.	"…Consultation between coaching staff and medical staff…"
	Decision making	Make accurate injury assessment during matches.	"Make accurate decision…on court… within two minute…new rule on court."
Injuries and medical issues	Injury management	Fulfill the primary role of the medical team.	"…Treat the injuries…monitor and refer…"
	Doping	To faciliate clean and fair play.	"…Advise on prohibited subtances…"
	Medical illness	The role of the doctor	"…Doctors treat serious stuff…"
Injury Prevention	Role of warm-up and conditioning	Inclusion of warm ups and conditioning session is essential	" Prepare the bodies for training…"
	Recovery	This should be part of the injury prevention process	"Ice baths…helps stifness…"
	Strapping	Players and coaches see a need for physios to do preventatice strapping	"…They (physios) need to know how to do preventative strapping…"
	Educating the players	See the medical team not only as primarily attending to injuries but an educative role .	"…Teach us about supplimentation, diet and recovery…"

4.4.4. Contributing factors to injuries in netball

Opinions were obtained regarding the factors contributing to injuries in netball. Most of the contributing factors identified by the participants focused on extrinsic factors (n=10). The factors identified could be group into 5 main themes, which included coaches impact (influence and knowledge), injuries (existing injuries and lack of injury management), players lack of knowledge, playing surface and training techniques (warm-up, conditioning, technical skills). The information is highlighted in table 4.5.

Table 4.5. Contributing factors to injuries in netball

Theme	Sub category	Participants experience	Quote
Coaches Impact	Influence	Over-training of athletes and lack of correct coaching of technical execution of technique.	"… we've got lots of netball happening… So more planning…the way they coach the players like how they should land…"
	Knowledge	Poor knowledge of the role of sport science and medical support.	"Coaches must understand… without a sport scientist with the knowledge…its difficult"
Injuries	Existing injuries	Coaches fear of not having players available thus play them with injuries	"… Coaches force them to play, cant do without them…"
	Non – management of injuries	Players are not managing injuries or not being referred for rehabiliation	"… No proper management, no proper recovery and fixing the bad areas."
Players knowledge	Training load	Playing indoor and action netball for numerous teams simultaneously	"… over training and over compensating…"
	Diet	Poor education on healthy eating and poor diet	"…the way the player is not taught how to look after her body…"
Training techniques	Warm up	Non - existent or poor execution	"… stupid mistakes… executing a specific instruction…"
	Conditioning	Poor training discipline	"… conditioning is one of the most causes of injuries…"
	Technical skills	Poor execution of techniques	"… because of incorrect demonstration…"
Playing surfaces	Availibilty of facilities	Playing on any surface that is available.	"… tar or the tennis courts and that's way too hard…"

4.4.5 Current structures and the barriers to accessing sport science and medical services

All participants regardless of whether they were coaches, players or administrators shared similar sentiments that a huge gap exists between what players at national level can access with regard to sport science and medical services and the non-existence of structures at club and provincial level. Barriers to accessing these services included Players knowledge, transport and cost. There was a general consensus that a structure should be put in place to co-ordinate facilitate and monitor players. The information is highlighted in table 4.6.

Table 4.6 Current structures to address sport science and medical services

Theme	Sub category	Participants experience	Quote
Lack of accessibilty of sports science and medical staff	Available facilities	Some clubs have access through affiliation with universities	"…Some clubs get the same treatment offered at national level… others don't"
	Transport	Players don't have their own transport	"Transport to get to physio after work…is a huge issue…"
	Resources	Clubs and provinces don't have the funding	Club level…own resources… Strapping costs R40 a week… Sometime not even any ice…"
	Time	Players feel pressured by the lack of time as they are working	"…It take about 45 min a session..difficult to get off from work…"
Gap between provincial and national players	Funding	Lack of governement support at provincial level	"no funding from government at provinces…we only have fund raising"
	Players knowledge	Club and provincial players don't know what to access	"…Players don't have the knowledge…they don't know where to go…"

Need for injury prevention structures	What do players currently access? Current structures in place What can be done?	National teams have physios and doctors on tour Little or no structures available at club and provincial level Participants viewed a central national structure with a monitoring system such as a university affiliation as being beneficial	"we are looked after by a doctor and physio on tour" "…Club and provincial structures…there's nothing….we use our own resources…" "…Communicating better with provinces..put it together and try and do it in each province…record keeping…fitness testing and send regular results to directors… with universities find a way to meet each other half way…"

4.5 Discussion

4.5.1 Injury definition

Literature has highlighted the importance of having a common definition of sports injury from which to work (Timpka, Jacobsson, Ekberg & Nordenfeldt, 2011). All participants had a good understanding of a component of a sport injury as described by the consensus statement. It is important for the researcher to have an understanding of the concept, as viewed by the stakeholders, of the definition of a sport injury as it lends context to the challenges they express experiencing with the injury management process. Based on Table 4.1 the most common definition of a sport injury in the current study was, “An injury that occurs whilst playing netball that requires the management of a medical expert.”

Bahr (2009) stated that the consensus statement provided not only one but three definitions and further provided recommendations on how standardised methodology can be developed to quantify overuse injuries in surveillance studies. Bahr described that the three consensus definitions are “any physical complaint”, “medical attention injury” and “time-loss injury”. The choice of injury definition will influence the rate of injury reported in studies, as players will not always seek medical attention and even fewer cases will result in “time-loss” injuries. A “physical complaint “ definition will yield a higher injury rate than a “medical attention” definition, and a “time loss” definition will result in the lowest rate. Understanding the definition of a sport injury gives clarity to the type of injury and it can then be understood in context when studying the challenges associated with injury management. Based on Bahr’s discussion of the definition of a sports injury, the study sample were able to identify all three definitions but did not have an understanding of how this affected the rate of injury.

4.5.2 Injury management

With the inherent risk of injuries in sport, there is a need to understand injury management strategies. Sports management is guided by the discipline of sports medicine and thus the professionals involved include various health

professionals. However, it is obvious that these professionals may not be available at all the sites where sports injuries occur. Thus there is a need for other key sport stakeholders such as coaches etc. to have the knowledge about managing sports injuries. In the current study, both coaches felt that they did not have the necessary knowledge to manage a sport injury and that qualified staff should be available.

> "It's pretty dangerous for me…. You sacrificing the team….", "We as coaches are not always knowledgeable."

The management of sport injuries requires both the education of the athlete and coaching staff as well as the application of best practice principles of injury management. By analyzing the responses of the participants it is evident that they have a good understanding of basic injury management principles and that a structured knowledge base needs to be imparted to empower them. They also express the detriment of poor injury management. This is important as it outlines the scope within which stakeholders expect sport science and medical to staff to practice and lays a foundation for advocating for injury prevention methods and the standardization of injury management. Cross, Karges, Mitchell, Salsbery, Smith and Stanley (2011) stated that having coverage at athletic events can allow for proper and quick diagnosis, treatment, and care to be supplied to the injured athlete. If appropriate care is rendered immediately, the chances of the injury worsening are reduced and an environment that promotes healing and recovery of the injury can then be established (Hergenroeder, 1998). Understanding the context of injury management within the netball fraternity facilitates the process of developing an injury prevention programme as it highlights that stakeholders see the challenges associated with injury management and ultimately that 'Prevention is better than cure'.

If health professionals are not easily accessible and available then stakeholders such as coaches should then have a better understanding of the on the field management of sport injuries and the importance of the timeous referral of the athlete to the correct medical expert.

4.5.3 Role of medical team

Participants agreed that the medical team had a significant role to play. The medical management structure was described to have a significant role, to influence, communicate, and assist with decision making to contribute toward fair team selection. Participants understood the role as complementing the technical aspect of the game and making accurate injury assessment during matches. People throughout the world perform physical exercise and play sport. This population has specific needs. According to Franke and Berendonk (1997) a specific branch of medicine known as 'sport medicine' has evolved. The key performance areas of the medical team included the description of Injuries and medical issues. This also included injury management, doping, medical illness and fulfilling the primary role of the medical team. According to Brukner and Khan (2002), professionals from different disciplines provide specialized skills to provide optimal care for the athlete and improve each other's knowledge and skills. Injury prevention, the role of warm-up and conditioning, recovery and strapping and educating the players on inclusion of a warm up and conditioning sessions was said to be essential. This aspect should be considered as part of the injury prevention process. Players and coaches saw a need for physiotherapist to do preventative strapping. The outlook on the medical team is not only as primarily attending to injuries but an educative role. Motram (1999) indicates that sport medicine professionals who provide specialized skills but who are aware of their own limitations and thus, utilize the skills offered by other members of the team provide the best care resulting in the multidisciplinary team approach. These decisions often come with limitations and restrictions placed on the athletes in terms of activity load, diet, playing time etc. In order for interventions to be successful you need the 'buy in' from stakeholders. It is only when the stakeholders understand and respect the role of sport science and medical staff that this 'buy in' becomes viable. Parents, coaches, and athletes expect medical providers to be competent in injury management and return to play decision-making (Mitten & Mitten 1995). The understanding of the role of sports science and medical staff facilitates stakeholder 'buy in' in the implementation of injury prevention or injury management strategies.

4.5.4 Contributing factors

The study participants reported that a coaches influence and knowledge can impact the incidence of sport injuries by over-training athletes and lacking the knowledge of the correct technical execution of techniques. They also stated that poor knowledge of the role of sport science and medical support causes injuries. The participants also understood that existing injuries and the non-management of injuries predisposes players further to injury. Coaches have a fear of not having players available thus play them with injuries. In addition players knowledge was named as a contributing factor with regard to training load and diet. Participants had a good understanding of training techniques and that it included warm up, conditioning and technical skill. They also understood how this contributes to injuries and that playing on the incorrect surface creates a further disadvantage. According to Brukner, et al. (2002) “A good practioner – coach relationship is a win – win situation. The coaches will develop a better understanding of what the clinician has to offer and is more likely to seek help for minor problems which, if managed appropriately, may prevent subsequent major problems.”

Participants understand the impact of contributing factors to netball injuries and they also have knowledge of what these are. They articulate the role of sport science and medical staff in preventing these contributing factors, but still articulate the choice by some coaches to choose participation in the sport over injury prevention.

Despite the large participation numbers, netball is often defined as "a game prone to ankle and knee injuries" (Steele, 1990). There is a notable lack of formal, controlled evaluations of the effectiveness of injury prevention countermeasures. Studies to date have tended to focus on the incidence and nature of injuries occurring in netball in an attempt to identify causative mechanisms. McGrath, et al. (1998), discussed that countermeasures for preventing netball injuries can be primary secondary or tertiary and include: factors associated with landing; safe playing environments; stretching;

conditioning and technique programmes before commencing play; education and training; footwear; mouth guards; taping and bracing; adequate rehabilitation; prompt treatment of injuries and enforced codes of conduct. Contributing factors to injury in netball need to be constantly highlighted by sport science and medicine staff in order to facilitate the mind shift from management to prevention.

4.5.5 Current injury management structure available and accessibility

Participants described a lack of accessibility of sports science and medical staff. The availability of funded sport science and medical facilities, transport, resources and time were the barriers identified to accessing these services. Some clubs have access through affiliation with universities, however players don't have their own transport. Clubs and provinces also don't have the funding and players feel pressured by the lack of time as they are working. Through the lack of government support at provincial level, club and provincial players don't know how to access these expert facilities.

According to SASCOC (2012) the experience from dealing with athletes has shown that understanding of the athletes' background and economic and psychosocial status is critical. This assists in the recommendation of appropriate support services for the specific athlete or official. The following are the services that will be rendered by the sport provincial academies, as part of the new strategic framework and sport policy, however, will vary based on the needs assessment conducted for each athlete and official:

- Living expenses (transport to training sessions, meals)
- Coaching
- Medical assessments, screening and interventions
- Scientific support and interventions
- Technological support and interventions
- Life skills and career counseling and guidance
- Information services
- Education and Training

- International exposure (training camps, competitions, exchange programmes)
- Talent identification, development and nurturing

There is currently no designated leader in this area, no existing partnership in place to develop a nationwide sports injury prevention policy, and no immediate funding source available to support sports safety and injury prevention. This being the case, if the contribution of a number of different stakeholders was combined, the overall effect could be significant while keeping the individual contribution of any single stakeholder small.

The challenge is to establish a partnership where contributions from various stakeholders can be effectively channeled and focused on sports safety and injury prevention. However, while such a partnership may be able to drive the development and initial implementation of a sports safety and an injury prevention policy for South Africa, an effective sustainable program will require that the partnership be supported by significant investment to allow it to build capacity across the sector over the long term.

4.6 Conclusion

It is important for the researcher to have an understanding of the concept, as viewed by the stakeholders, of the definition of a sport injury as it lends context to the challenges they express experiencing with the injury management process. Participants had a good understanding of the challenges they experience with regard to the management of injuries experienced in netball. They were able to define netball injuries however, the choice of injury definition will influence the rate of injury reported in studies, as players will not always seek medical attention and even fewer cases will result in “time-loss” injuries (Bahr, 2009). The management of sport injuries requires both the education of the athlete and coaching staff as well as the application of best practice principles of injury management. By analyzing the responses of the participants it is evident that they have a good understanding of basic

injury management principles and that a structured knowledge base needs to be imparted to empower them. They also express the detriment of poor injury management. This is important as it outlines the scope within which stakeholders expect sport science and medical to staff to practice and lays a foundation for advocating for injury prevention methods and the standardization of injury management. The medical management structure was described to have a significant role, to influence, communicate, and assist with decision making and to contribute toward fair team selection. The challenge still exists to establish a partnership where contributions from various stakeholders can be effectively channeled and focused on sports safety and injury prevention. The needs assessment conducted through the quantitative aspect of the self-administered questionnaire and the qualitative aspect of the semi-structured interviews illustrates the 'real world' scenario for which the injury prevention programme will be designed. It also highlights through an inclusive process involving stakeholders, the key areas that injury prevention needs to address with regard to netball injuries in South Africa and provides a comparative view for international literature.

4.7 Implications for the current study

Based on the findings of chapter 3 and 4, it is important to understand what the best current practices are as described by the literature.

Objective Two: To Determine the Current Situation

Chapter Five:

Evidence for injury prevention models for lower limb injuries: a systematic review

5.1 Introduction

The needs analysis in objective one provides the foundation for the study. It provided a framework for the which the injury prevention programme needs to address intervention measures. In order for the intervention measure to be grounded in theory and scientifically based a systematic review of literature was conducted. This chapter extracts best practice principles from research and guides the evidence needed in order to develop injury prevention measures.

5.2 Background

There are multiple internal and external factors that compound the cost of sport injuries and burden individuals and society. Factors which need to be highlighted include the duration and nature of treatment, the amount of sport and working time lost, permanent damage and disability, reduced quality of life and monetary costs (Parkkari et al., 2001). Within a South African context this has been compounded by the fact that we are a developing country and our health care system is somewhat overburdened. With the stress exerted on our government health care system, sport injury management becomes much less of a priority and for the athlete, a very time consuming exercise with treatment administered in less than optimum time frames. Participation in sports such as netball, volleyball and basketball is on the increase and with this increased participation there is the risk of increased injuries (Australian Bureau of Statistics, 2002; Messina, Farney & De Lee, 1999; Ferreti, Papandrea & Conteduca, 1990).

Van Mechelen et al. (1992) presents a “sequence of prevention” model that can be incorporated by sporting codes on which successful intervention strategies can be

based. In this model, researchers are encouraged to uniformly identify the problem, design and implement an intervention and evaluate the intervention. However, currently there exists a gap for the evaluation of evidence-based interventions to inform practice. These interventions can occur in various settings but should have a similar approach to the management of lower limb injuries that is required in landing sports and that can be implemented as home based programmes or within the team setup under the supervision of the coach.

With little medical support at club level to fully-fledged medical teams at national level, players tend to carry injuries from the club setup to the national setup. This proves to make the management of injuries vey challenging at national level. Players are required to train and play matches with the national team, making rehabilitation during competition very difficult. Currently in South Africa medical interventions are primarily focused at national level (Venter, Fourie, Ferreira & Terblanche, 2005). However, players participate at both club and national level and are thus prone to injuries. Venter et al. (2005) further highlights that in order for players to be at optimum performance for selection to national teams, players need to be evaluated at all levels. This highlights the need for evidence based injury prevention programmes to be implemented from grass root level. Netball, volleyball and basketball are sporting codes that tend to place emphasis on landing as part of the game, and many of the injuries that occur are as a result of incorrect landing techniques (Ferreira et al., 2010; Marquez, Masumura & Ae, 2007).

The need for effective injury prevention strategies is evident although limited literature is available for netball specifically. This requires the researcher to review the literature for sports which emulate the stop start, explosive, jump, land nature of netball and to draw from studies that have been conducted in a scientific environment that have been able to reduce the incidence of similar injuries with a similar etiology in order to inform the best practice for netball. Thus the aim of this literature review was to identify injury prevention interventions with regard to the prevention and treatment of lower limb injuries in landing sports in order to

formulate an evidence base for best practice methods in the prevention of lower limb injuries in landing sports.

5.3 Research question

A specific, targeted research question was formulated identifying the population, intervention and outcomes that the review would evaluate (Khan, ter Riet, Glanville, Sowden & Kleijnen, 2001). A research question including the population, intervention and outcomes was thus formulated:

> *What injury and management prevention strategies are used to prevent lower limb injuries among athletes participating in landing sports such as netball, basketball and volleyball?*

5.4 Method

A systematic approach to the review was adopted and reported in a narrative form. A proposal to conduct the review was written before embarking on the systematic review ***[Appendix 2.4]*** to guide and give structure to the process.

The population included athletes participating in netball, basketball and volleyball as they have similar actions in the sport that could lead to lower limb injuries.

The interventions sought were focused to highlight the following:

(i) types of preventative and treatment interventions used to address lower limb injuries in landing sports

(ii) outcomes of injury prevention models and interventions implemented as best practice for the treatment of lower limb injuries in landing sports

The search parameters included full-text articles published in English between 2001 and 2011, and included studies with both positive and negative outcomes to reduce publication bias. All published randomized controlled trials (RCTs) were assessed for inclusion in the review. However, in the absence of RCTs, controlled trials, quasi-randomized controlled trials, cohort studies, experimental and non-

experimental studies, prospective studies, descriptive studies, before-and-after studies were considered. Other research designs, such as systematic reviews and observational studies were reviewed and articles referenced in the articles that fitted the inclusion criteria of this study were included in this study.

Search terms were chosen after a preliminary review of relevant literature yielded commonly used words and phrases, which were finalised after consultation with an experienced researcher.

Table 5.1: Key search terms

Key search terms	*The outcomes of interest will include, but will not be confined to the effects on:*
Injury prevention / health education Injury management / treatment / rehabilitation Lower limb / ankle / knee / sport / netball / basketball / volleyball / proprioception / ROM / strength / balance / joint stability coach education	Range of movement Strength Proprioception Balance Stability of the joint

Two reviewers using selected databases namely Medline, CINAHL, Ebscohost and Sport Direct for the period of 2001 – 2011 conducted an initial search. These sources were identified during the preliminary literature review. A search was also undertaken using Google and Google Scholar to identify relevant articles. Manual searching of reference lists was conducted and articles referred to the researcher by experts in the field were also included. Search terms were constructed after some review of relevant literature, which are reflected in table 5.1.

During the key word search the phrases were typed in with the words, “scholarly articles for…” and then the phrase from the key word table. Table 5.2 below shows the number of hits per phrase retrieved from the search engine.

Table 5.2: Hits per phrase retrieved from the search engine

Key word search term:	***Number of hits:***
Injury prevention	43 100
Health education	262 000
Injury management	65 200
Treatment	337 000
Rehabilitation	93 900
Lower Limb	28 700
Ankle	25 600
Knee	58 400
Sport	60 000
Netball	1660
Basketball	14 400
Volleyball	14 500
Proprioception	14 900
Range of movement	697 000
Strength	356 000
Balance	275 000
Joint stability	90 300
Coach education	42 900

40 articles were initially retrieved that were relevant to the study based on the title. These articles were then printed in full and analysed. The first round of analysis by the researcher excluded 21 articles on the basis of not meeting the inclusion criteria and not providing a relevant lower limb injury prevention programme. Reasons for excluding retrieved studies during the initial analysis (n=21) was that the article was a systematic review (6), injury prevalence study (3), focused on injury prevention frameworks (7) and finally no intervention detailed (5). This left a total of 19 studies that were eligible for the critical appraisal of methodological quality by the researcher and a second reviewer. During this phase, six additional articles were excluded. Reasons for exclusion during the process included poorly described outcome measures (n=2), limited literature review or background

information relevant to the study (n=2), inadequately described samples (n=2), poorly described study designs, interventions or methodologies (n=1) and conclusions not supporting results in the study (n=1). The flow of screening the articles is included in the figure 5.1 below.

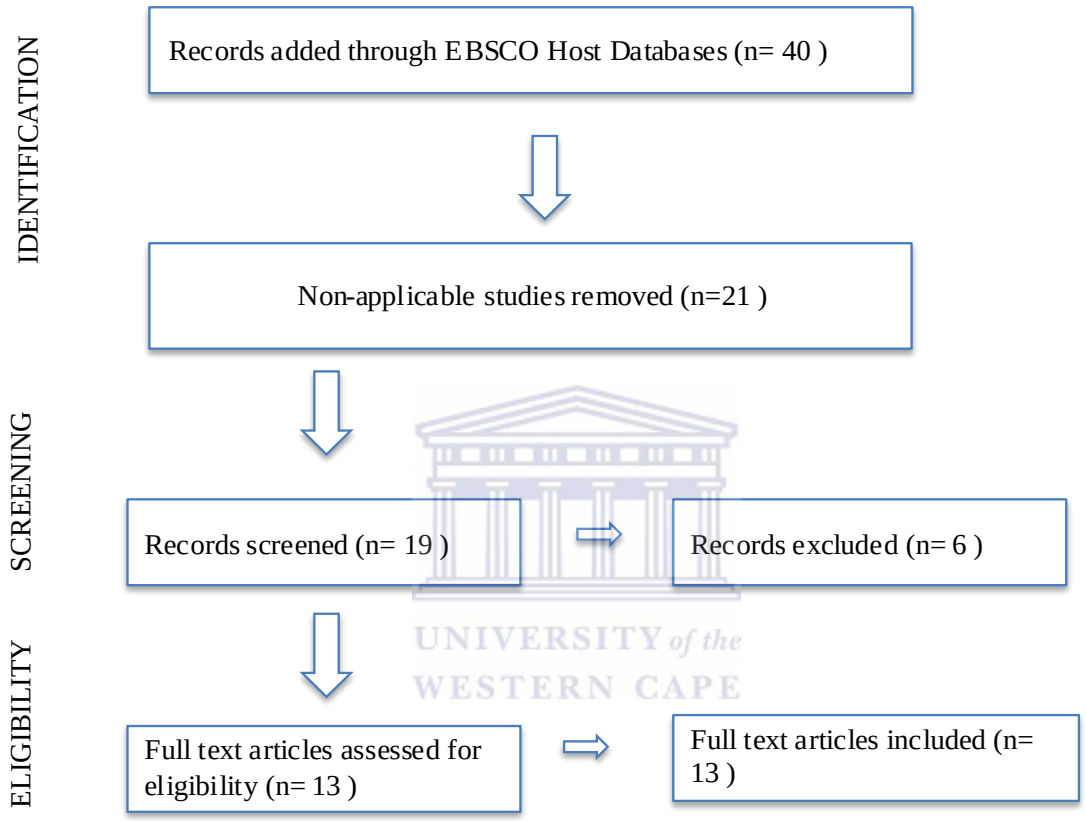


Figure 5.1. Flow chart of the article retrieval selection method

Once the full text of all articles had been collected, the researcher conducted an initial review to ensure that only relevant studies were included in the critical appraisal. A second reviewer confirmed the included articles. Following the review, the methodological quality of studies was determined independently by the two reviewers using the CASP critical appraisal tools for randomised control trials, non-randomised control trials and quantitative studies to exclude poor quality studies.

Discrepancies were discussed verbally to reach consensus and scores were then adjusted on the CASP scoring form accordingly.

In the final step, a self-developed data extraction form was used to extract the data from the studies, using criteria that were determined prior to the data extraction process. 19 articles were screened using the CASP critical appraisal tool. 6 articles were excluded for not having the study results available (n=1), being outside the assigned date timeline (n=1), and not being one of the included sports (n=4). The methodological quality scores of included trials are included in table 2. The range of summary scores was between 7 and 10, with a mean score 8.5. Table 5.3 below presents the final thirteen studies that were chosen following the critical appraisal.

Table 5.3: Methodological Quality Scores of Included Trial using CASP Critical Appraisal Tools

Items of the CASP Critical Appraisal Tool (Abreviations NS, no score; U, unclear; Y, yes)										
Included Trials	Quality Score	Clear focused question	Randomisation	Appropriate participant allocation	Was there blinding	Participants accounted for at conclusion	Data and participants followed up	Appropriate sample size	Where the results precise?	All-important outcomes considered?
Cumps, Verhagen & Meeusen (2007).	7	y	y	u	n	y	n	n	y	y
Emery, Rose, McAllister and Meeuwisse (2007).	10	y	y	y	y	y	y	y	y	y
Elphinston & Hardman (2006).	10	y	y	y	y	y	y	y	y	y
Gianotti, Hume & Tunstall (2010).	8	y	n	y	n	y	y	y	y	y
Jonsson & Alfredson (2005).	8	y	y	y	u	y	n	y	y	y
McGuine & Keene (2006).	7	y	y	y	n	y	n	y	n	y
Moiler, Hall & Robinson (2006).	9	y	y	y	n	y	y	y	y	y

Included Trials	Quality Score	Clear focused question	Randomisation	Appropriate participant allocation	Was there blinding	Participants accounted for at conclusion	Data and participants followed up	Appropriate sample size	Where the results precise?	All important outcomes considered?
Myer, Ford, Mclean & Hewett (2006).	10	y	y	y	y	y	y	y	y	y
Sasinopoulos (2003).	9	y	y	y	u	y	y	y	y	y
Valovich, Armstrong, Miller & Sauers (2009).	7	y	n	y	n	y	n	y	y	y
Verhagen, van der Beek, Twisk, Bouter, Bahr & van Mechelen Willem (2004).	9	y	y	y	y	y	n	y	y	y
Visnes, Hoksrud, Cook & Bahr. (2005).	8	y	y	y	n	y	n	y	y	y
Young, Cook, Purdam, Kiss & Alfredson (2005).	8	y	y	y	n	y	n	n	n	n

5.5 Results and Discussion

Following the process and final exclusions, 13 articles were finally included into the review. The studies included differed in design with 4 RCT's, 2 non – RCT's, 1 pre and post intervention study, 1 controlled laboratory study, 1 descriptive design study, 1 prospective controlled trial, 1 controlled clinical trial, 1 comparative study by three methods and 1 prospective randomised study. Data was extracted from the final articles and is illustrated in Table 5.4.

Table 5.4: Data extraction from the selected articles (n=13)

Citation	Study Design and aim	Control	Participants	Intervention and duration of programme	Outcome
1. Cumps et al. (2007). Efficacy of a sports specific balance training programme on the incidence of ankle sprains in basketball	Controlled clinical trial. The purpose of the study was to determine the efficacy of a 22-week prescribed sports specific balance-training programme on the incidence of lateral ankle sprains in basketball players.	Yes. The control group followed their normal training routine and no other interventions. No blinding	54 subjects of six basketball teams participated in the study. National division, 1st and 2nd regional basketball teams	Basketball specific balance training programme, using balance semi globes on top of their normal training routine. 22-week programme performed 3 times a week for 5 to 10 minutes during warming up. Coach supervised interventions on jump-landing technique sports and injury occurrence	Relative risks showed significantly lower incidence of lateral ankle sprains in the intervention group compared to the control group for the total sample. The risk for new or recurrent ankle sprains was slightly lower in the intervention group.

Citation	Study Design and aim	Control	Participants	Intervention and duration of programme	Outcome
2. Emery et al. (2007). A prevention strategy to reduce the incidence of injury in high school basketball: A cluster RCT.	Cluster RCT. Aim was to examine the effectiveness of a sport specific balance-training programme in reducing injury in adolescent basketball.	Yes, blinded the control group followed their normal training routine and no other interventions.	920 high school basketball players (aged 12 – 18 years).	18-week program.10 min warm up routine. Training group received additional 5 minute sport specific balance programme for warm up prior to training and a 20 minute home programme. Effective in reducing acute-onset injuries in high school basketball.	The protective effect was found with respect to all injury. Lower extremity injury and ankle sprain injury were not statistically significant. Compliance to the home-based programme was poor.
3. Elphinston et al. (2006). Effect of an integrated functional stability programme on injury rates in an international netball squad.	Pre and post intervention study. Multi-disciplinary team. Aim: To address injury rates and support sports performance development in an international netball squad.	No	A Welsh national netball squad, number of participants not indicated. Management: coach, physiologist, physiotherapist bio.	5-week program, which included: weekly profiling sessions, player evaluation, prophylactic aspects and sport specific aspects. Involving players, coach, physiologist, physiotherapist and strength and the strength and conditioning coach (multi-disciplinary team)	Training compliance was increased. Rate of injury in all vulnerable areas were markedly reduced. No training or overuse related injuries were sustained.

Citation	Study Design and aim	Control	Participants	Intervention and duration of programme	Outcome
4. Gianotti et al. (2010). Efficacy of injury prevention related coach education with Netball and Soccer	Descriptive study design. The aim of the study was to determine if coaches found the information provided by coach education of sufficient use and relevance to subsequently incorporate it into their coaching.	No	217 netball coaches with a response rate of 53% and 71 football coaches with a response rate of 20%, representing national teams.	Information on injury prevention behaviours and incorporation into player practices. Courses for the coaches ran for four months.	89% of coaches changed the way they coached relating to warm-up/cool down and stretch (65%), technique (63%), fitness (60%) and nutrition hydration practices (58%). Integrating injury prevention content within coach education and resources reduces injury.
5. Jonsson et al. (2005). Superior results with eccentric compared to concentric quadriceps training in patients with jumpers knee: a prospective randomized study.	Prospective randomised study design. To compare the results of painful eccentric quadriceps training with painful concentric quadriceps training on a decline board athletes taken out of sport for 6 weeks.	No, two training groups one eccentric and one concentric	15 athletes with 19 patellar tendons (13 men and 2 women) with jumper's knee. Participants had a mean age of 24.9yrs	Eccentric and concentric quadriceps training while standing on a decline board. Both training groups were given instructions by the same physio on how to perform the training and increase load. 3 sets of 15 reps, performed twice a day, 7 days weekly 12 weeks.	In the eccentric group 9/10 tendon patients improved. VAS decreased from 73 to 23 and VISA increased from 41 to 83. In the concentric group, 9/9 patients didn't improve with any significant differences in VAS and VISA scores. With patient follow up the eccentric groups were still satisfied

Citation	Study Design and aim	Control	Participants	Intervention and duration of programme	Outcome
6. McGuine et al. (2006). The effect of a balance training programme on the risk of ankle sprains in high school athlete	RCT. Aim: To determine if a programme of balance training implemented in the preseason and maintained throughout the season, reduce the risk of injury	Yes, non - blinded	765 high-school soccer and basketball players (523 girls and 242 boys).	Control group performed only standard conditioning exercises. 5 phase balance training programme. Phase 1 - 4 consisted of 5 exercise sessions per week for four weeks pre-season. Subjects performed the programme 3 times per week for 10 minutes throughout the season. Appropriate for high school soccer and basketball players.	The rate of ankle sprains was significantly lower for subjects in the intervention group. Athletes who performed the programme decreased their risk of a sprain by one half. The ankle sprain rate for athletes without previous sprains was 4.3% in the intervention group and 7.7% in the control.

Citation	Study Design and aim	Control	Participants	Intervention and duration of programme	Outcome
7. Moiler et al. (2006). The role of fibular tape in the prevention of ankle injury in basketball: A pilot study	Prospective non-randomised controlled trial. The objective of this study was to determine the effect of FRT on the incidence and severity of ankle injury in basketball.	Yes on- blinded, they received other taping methods other than FRT	One-hundred twenty-five, amateur and high school male basketball players were assigned at time of play to either the control (209) exposures or FRT (224 exposures) condition in a manner of convenience.	Control participants had the choice on the use and type of prophylaxis, excluding FRT. FRT participants taped by methods described by mulligan. From a possible 433-basketball exposure hours, 374.3 hours of play monitored. This intervention is appropriate for players with regular participation in basketball without a history of ankle surgery or skin allergies to tape.	374.3 measured basketball exposures resulted in 11 ankle injuries. Injuries occurred in subjects with a history of previous ankle sprains. Significantly fewer injuries were sustained by members of the FRT condition (n=2) compared to members of the control condition (n=9). A 95 %confidence interval was shown when taped with FRT. The number treated was 22.

Citation	Study Design and aim	Control	Participants	Intervention and duration of programme	Outcome
8. Myer et al. (2006). The effects of plyometric versus dynamic stabilisation and balance training on lower extremity biomechanics	Controlled lab study. A protocol includes balance training without plyometric training decreases coronal plane hip, knee and ankle motions during landing and won't affect coronal measures.	None, the plyometric group (n=8) performed maximum – effort jumping and cutting exercises. The balance group (n=10) used dynamic stabilisation/balance exercises during training.	Eighteen high school female athletes.	Plyometric training emphasized jumping movements with maximum effort, power and performance. The balance group followed a protocol that emphasized dynamic stabilization and balance.18 training sessions over 7 weeks. Prevents valgus measures at the knee and at risk females for ACL injury	The drop vertical and medial jump, both plyometric and balance training reduced initial contact, maximum hip adduction angle, and maximum ankle eversion angle. Both plyometric and dynamic balance exercises should be included in injury prevention protocols.
9. Stasinopoulos (2004). Comparison of three preventative methods in order to reduce the incidence of ankle inversion sprains among female volleyball players	Comparison of three methods of injury prevention. To investigate which of these three interventions is the most effective in preventing ankle sprain in female volleyball players.	No	52 2nd dev. female Greek, national volleyball players who suffered ankle sprains during the season 1998 – 1999.	Group 1 (n=18) Specific technical training on take off and landing technique for one man and two blocks. Group 2 (n=17) followed proprioceptive training, thirty minutes a day for the whole season. Group 3 (n=17) used orthotics.	The 3 preventative strategies were all effective in preventative further ankle sprain. Technical training was slightly more effective that the other 2 methods. Orthosis was not effective in athletes who suffered ankle sprains more than 3 times during their careers. Technical training and proprioceptive training were equally effective.

Citation	Study Design and aim	Control	Participants	Intervention and duration of programme	Outcome
10. Valovich et al, (2009). Balance improvements in female high school basketball players after a 6-week neuro mm programme.	Non-RCT. Aim: To determine if there are balance gains after participation in a neuromuscular-training programme in high school athletes.	Yes, non-blinded. The control group followed their normal training routine and no other interventions.	62 female high school basketball players from the local high school assigned to training (n= 37) or control (n=25) group.	Training group subjects participated in a six-week neuromuscular training programme that included plyometric, functional strengthening, balance and stability ball exercises. Increases balance and proprioceptive capabilities.	Decrease in total BESS errors in trained group posttest compared with pretest and the control group. Trained subjects had fewer BESS errors on single-foam compared with pre-test. Trained group improved reach posttest compared to control.
11. Verhagen et al. (2004). The effect of a prospective balance board training programme for the prevention of ankle sprains	Prospective controlled trial. To study the effect of a proprioceptive balance board training programme on the incidence of ankle sprains in volleyball players, in a proprioceptive controlled trial.	Yes, blinded control group followed their normal training routine and no other interventions.	116 male and female 2nd and 3rd division national volleyball teams followed prospectively during the 2001 – 2002 season.	Intervention teams followed prescribed balance training programme: control teams: normal training routine. The coaches recorded exposure weekly for players. Players registered injuries within 1 week of onset. Duration of study was one season. For players with no knee injury history.	Fewer ankle sprains in the intervention group compared to control. Significant reduction in ankle sprain risk found for players with history of ankle sprains. Incidence of overuse knee injuries for players with history of knee injury increased in the intervention group. History of knee injury may contraindicate balance board training.

Citation	Study Design and aim	Control	Participants	Intervention and duration of programme	Outcome
12. Visnes et al. (2005). No effect of eccentric training on jumpers knee in volleyball players during the competitive season. A RCT.	RCT to investigate the effect of a newly developed eccentric training programme for patellar tendinopathy in volleyball players during the competitive season.	Yes, non - blinded the control group followed their normal training routine and no other interventions.	Elite first division male and female volleyball teams in Norway. 51 diagnosed with patellar tendinopathy, 29 could be included.	Training group (n = 13) performed squats on a 25° decline board as a home exercise programme (3 x 15 reps twice daily) for a 12 week period during the final half of the season. Control group (n = 16) trained as usual. Effective for players with patella tendinopathy.	No change in VISA score during intervention period in the training pre, intervention or post groups. No change during the follow – up period. Training group completed 8.2 +- 4.6 weekly sessions of eccentric training during the intervention period.
13. Young et al. (2005). Eccentric decline squat protocol offers superior results at 12 months compared with traditional eccentric protocol for volleyball player	Prospective randomised controlled trial. To investigate the immediate (12 weeks) and long term (12 months) efficacy of two eccentric exercise programmes for the treatment of patellar tendinopathy.	No two training groups, one eccentric decline squat protocol vs. traditional eccentric protocol.	17 elite, Victorian State League volleyball players with clinically diagnosed and imaging confirmed patellar tedinopathy	The decline group performed single leg squats on a 25-degree decline board, exercising into tendon pain and progressing their exercises with load. The step group performed single leg squats on a 10 cm step, exercising without tendon pain. A 12-week programme.	Both groups improved significantly from baseline at 12 weeks and 12 months. Analysis of the likelihood of a 20-point improvement in VISA score at 12 months revealed a greater likelihood of clinical improvements in the decline group than the step group. The protocol offers greater clinical gains during a rehab programme for athletes with patellar tendon pain.

The articles included in the systematic review included athletes participating in landing sports namely volleyball, netball and basketball at various levels of play from high school through to national teams. The interventions were also aimed at various target groups with a variety outcome measures varying from pain to education programmes that were required.

5.5.1 Duration of the intervention programmes

The duration of the intervention studies varied considerably depending on the type of programme. Balance training programmes varied from five weeks to twelve months in duration (Valovich et al., 2009; Cumps et al., 2007; Emery et al., 2007; Elphinston et al., 2006; McGuine et al., 2006; Myer et al., 2006 Stasinopoulos, 2004; Verhagen et al., 2004). The eccentric and concentric tendonopathy training programmes were primarily conducted over twelve weeks (Jonsson et al., 2005; Visnes et al., 2005; Young et al., 2005). Both proprioceptive balance board-training programmes were conducted over one season, which was described as being nine months to a year (Stasinopoulos, 2004; Verhagen et al., 2004). Gianotti et al. (2010) conducted the coaches education course for four months with the netball components follow up also after four months.

Based on the current studies, it is evident that the duration of interventions are based upon the type of intervention and the required time to affect a change on the study population as per each individual study conducted and can thus range in duration from five weeks to a year.

5.5.2 Exercise Dosage

Eight of the studies included a balance-training programme or a component thereof. Stasinopolous (2004), conducted the balance training programme thirty minutes daily compared to McGuine et al. (2006) who conducted their programme 3 times per week throughout the competitive season performing the exercises for

30 seconds with a rest interval of 30 seconds. The exercise dosage amongst balance – training programmes is variable, as it is described in the studies as when the interventions were performed and not necessarily as the prescribed dosage in order to affect a change in the intervention groups. Elphinston et al. (2006) described a five-week programme with no specific dosage detailed. The most convenient way to introduce an intervention programme is to include it into the warm up activity, as coaches and players are less likely to 'buy into' intervention-training programmes that are prescribed as an addition to the regular training routine due to daily time constraints.

Verhagen et al. (2004) included the intervention programme into the warm up for five minutes during the 36-week season, no specific dosage was documented. Myer et al. (2006) documented the training time as 90 minutes with no specific dosage. Cumps et al. (2007), reported an exercise dosage of 5 -10 minutes during the warm up three times weekly for 22 weeks. Emery et al. (2007) included a 10 minute warm up as well as described a 5 minute sport specific balance training warm up and a 20 min home exercise wobble board programme with a progression at two and four weeks. Interventions that are included into the warm up sessions are described as being between five and ten minutes long. Home exercise programmes were only detailed in one study, and even in this study it is documented that compliance is poor.

Valovich et al. (2009) conducted 2 sessions per week for six weeks before the start of the season and during the season conducted a five-minute warm up followed by a session of one and a half hours. All of the decline squat programmes concurred with a dosage of 3 sets of 15 reps, twice daily, seven days a week for twelve weeks (Jonsson et al., 2005; Visnes et al., 2005; Young et al., 2005). Both plyometric training sessions were conducted for ninety minutes and included a balance component (Valovich et al., 2009; Myer et al., 2006).

In summary the description exercise dosage is varied depending on the type of exercise being performed and the frequency of when the exercises are performed in conjunction with the regular training programme. This is described by the authors in a variety of ways from daily dosage to weekly dosage. If exercise protocols are to be generalizable then specific exercise dosage should be detailed in order for the study to be reproducible.

5.5.3 Content of the interventions

Four out of the thirteen studies documented warm up activities (Valovich et al., 2009; Emery et al., 2007; McGuine et al., 2006; Myer et al., 2006). Warm ups ranged from five-ten minutes and the most common content of the warm-ups were aerobic exercises and stretches. However, the warm up was usually dependent on the aim of the intervention programme. Emery et al. (2007) included a ten-minute warm up with aerobic, static and dynamic stretches. McGuine et al. (2006), included a warm up but did not include the details thereof whereas Myer et al. (2006) included a warm up using agility ladders and Valovich et al. (2009) included a 5 minute warm up with jogging, side shuffles, cariocas and stretches.

The main exercises within the intervention programme could be divided into plyometric exercises (Valovich et al., 2009; Myer et al., 2006), balance exercises (Cumps et al., 2007; Emery et al., 2007; Elphinston et al., 2006; McGuine et al., 2006; Myer et al., 2006; Stasinopoulos, 2004; Verhagen et al., 2004;), eccentric loading exercises with a 25° decline board (Jonsson et al., 2005; Visnes et al., 2005; Young et al., 2005) and functional activities (Cumps et al., 2007; McGuine et al., 2006). Of the thirteen studies, three included an educational aspect for coaches into the programme (Gianotti et al., 2010; Jonsson et al., 2005; Verhagen et al., 2004;).

Two studies included functional activities as a progression to the basic exercises included in their programmes and these activities were sport specific. Both of these

studies were basketball intervention programmes, Cumps et al. (2007) included stance dribbling, aberdeen and passing. McGuine et al. (2006). Included dribbling, kicking, passing and catching. Three of the studies trialed the use of a 25° board with eccentric loading exercises and compared it to concentric loading exercises (Young et al., 2005; Visnes et al., 2005; Jonsson et al., 2005). Valovich et al. (2009) combined the use of plyometric exercises with functional strengthening and balance and stability. Myer et al. (2006) combined plyometric exercises with balance only. Plyometric exercises included maximum effort jumping and cutting exercises, wall jumps, hops, barrier jumps, box jumps and a variation of the exercises described as a progression. Agility warm up exercises were included prior to plyometrics that included jump rope, cone runs, shuttle runs with an emphasis on cutting techniques detailed in the study of Valovich et al. (2009). Six of the studies detailed purely balance and wobble board programmes conducted on bossu balls, foam rolls, balance globes and swiss balls. One of these programmes described by Emery et al. (2007) was a home-based programme.

In summary an intervention should include a warm up specific to the aim of the intervention protocol. The exercises should be relevant to the biomechanics related to the sport the protocol is designed for and should included components of the biomechanical movements that a prone to causing injury in the athlete.

5.5.4 Outcomes of the interventions

The studies mostly looked at the clinical aspects of injury prevention (n=12) with not many studies looking at the educational component with respect to the coaches and players (n=3), (Gianotti et al., 2010; Jonsson et al., 2005; Verhagen et al., 2004;).

Six of the studies employed balance training programmes or a component thereof. Cumps et al. (2007), reported a lower incidence rate of lateral ankle sprains in the intervention group compared to the control group although it was not significant

due to the low number of study subjects. They further stated that the results in their study and in the literature advocated for the use of proprioceptive balance training to prevent ankle sprains and showed positive results for the implementation of the programme. Emery et al. (2007) found that their training programme was effective in reducing the risk of acute-onset injuries in high school players with a 95% confidence interval. They also found a more clinical effect than significance related to protected effect of a wobble board in reducing injury.

McGuine et al. (2006) implemented a balance-training programme throughout the competitive season and reduced the rate of ankle sprains by 38%. In a Plyometric vs Dynamic balance-training programme Myer et al. (2006), showed that both programmes can reduce lower extremity valgus measure at the hip and ankle. The programme also reduced lower extremity valgus measures at the knee during a single limb dynamic task. The results of the study supported including a plyometric or dynamic stabilisation balance exercises in an injury prevention protocol. Stasinopoulos (2003), documented that all three preventative strategies employed in their study, specific technical training, proprioceptive balance board training and sport stirrup orthosis were effective in athletes who had suffered ankle sprains once or twice only during their career. In athletes who had suffered ankle sprains three times during their career, technical training was slightly more effective than the other two preventative methods.

Orthosis was not effective in athletes who had suffered ankle sprains more than three times during their career. In that regard technical training and proprioceptive training were equally effective in preventing sprains. Verhagen et al. (2004) concluded that a proprioceptive balance board programme was effective in preventing the recurrence of ankle sprains. It however increased the recurrence of overuse knee injuries. They recommended this for volleyball players as ankle injuries out way knee injuries in volleyball.

One study implementing a neuromuscular training programme (Valovich et al., 2009), demonstrated that a neuromuscular training programme can increase the balance and proprioceptive capabilities of female high school basketball players and clinical balance measures are sensitive to detect the differences.

Three studies used a 25° decline board for the treatment of knee tendinopathy. Johnsson et al. (2005), showed that in the short term, treatment with painful eccentric but not concentric quadriceps training while standing on a decline board significantly reduced tendon pain during activity and improved function in patient's with jumpers knee. Young et al. (2005), employed a step group performing single leg squats on a 10 cm step without tendon pain and progressed the activity with speed and load, in addition to the decline board group. Both exercise protocols improved pain and sporting function in volleyball players over 12 months. The study indicated that the decline squat protocol offered greater clinical gains during a rehab programme for patellar tendinopathy's in athletes who continue to train and play with pain. Visnes et al. (2005) indicated no change in symptoms after implementing a decline squat programme. They indicated that the eccentric programme was good for mid portion achilles but not insertional achilles tendinopathy's. They also commented that the fact that their patients continued with matches and training could have impacted on their results.

In a multi-disciplinary team approach, Elphinston et al. (2006) derived practical implications for the study conducted. These are that impacts on injury rates require an entire programme and not just sports medicine approaches. Well-designed functional profiling procedures can yield relevant information for both performance and prevention. Testing procedures reflect functional demands of the sport to the athletes and facilitate transference to the sport to be better adopted by the athletes. Functional profiling can be used to enhance player's understanding of self-awareness and self-evaluation.

In a coach's education programme, Gianotti et al. (2007), showed the integration of injury prevention messages into coach education courses and resources as a viable mechanism for the implementation and delivery of injury prevention strategies in community sport. They further advocated that organisations considering promoting injury prevention should investigate community coach education as an option to reach large numbers of community level players.

Moiler et al. (2006) illustrated that fibular repositioning tape (FRT) participants had less ankle injuries during the study period examined. These participants were also 5 times less likely to sustain an injury playing basketball and therefore advocated for its use as an injury prevention method.

When analyzing the results from the included studies and considering how the interventions impacted on the participants, it was critical to interpret the results within the context of the study within which they were conducted. Applying these interventions within a protocol specifically for netball players meant that the exclusion criteria for some of the interventions had to be considered as well as the applicability of the exercise to netball players. The impact of the interventions were also evaluated on specific populations and therefore needed to be transferable to a population of netball players. The outcomes of the intervention therefore played a crucial role in determining the applicability of the study to netball.

5.5.5 Equipment used during interventions

Equipment required to conduct the intervention programmes included the following: Balance globes (Cumps et al., 2007), wobble boards (Emery et al., 2007; McGuine et al., 2006), decline boards (Jonsson et al., 2005; Visnes et al., 2005; Young, 2005), fibular repositioning tape (Moiler et al. 2006), Bossu balls (Myer et al., 2006), swiss balls (Myer et al., 2006), plyometric boxes (Myer et al., 2006), stirrup orthosis (Stasinopoulos, 2004), jump ropes and cones (Valovich et al., 2009) and speed ladders (Myer et al. 2006). The educational component for coaches made

use of educational booklets and pocket-wallet card information sheets as well as a visual aid in the form of a dvd (Gianotti et al., 2010; Verhagen et al., 2004), the third study (Jonnson et al., 2005) educated on minimal gluteal activity and keeping the trunk upright in performing an eccentric quadriceps exercise on a 25° decline board during verbal instruction.

It is therefore essential to have or be able to reproduce the specific equipment required for the various interventions as the equipment has a direct impact on how the intervention is implemented and thus determines the success of the outcome.

5.5.6 Challenges highlighted with the implementation of the interventions

With the implementation of interventions, various challenges emerged. With regard to home-based programmes the compliance of the participants is not always guaranteed even when compliance journals are provided. Athletes training goals and management training goals sometimes differ and therefore present a barrier to the buy-in of an athlete with regard to the implementation of an injury prevention programme.

When educational aids are provided, participants prefer pocket card size concise information that is easy to access rather than video or booklet materials, (Gianotti et al., 2010). An additional intervention was taping, however, although taping methods are effective, the tape was not cost effective and the ability of training coaches and athletes to apply the tape correctly requires regular monitoring and facilitation. Exercises that were given as an additional programme and not included in the warm up had poor compliance as it was seen as additional and not something that could be incorporated into the training session.

Limited literature is available on lower limb injury prevention programmes for netball therefore the study looked to sports which included jumping and landing activities with an accelerative, decelerating nature as displayed in netball. The studies therefore provided the required information to design a protocol for netball players. Detailing the intervention duration, dosage, content, outcomes and equipment, enabled the required knowledge from the included studies to become transferable and relevant to this study by interfacing the study participants and the biomechanical aspects of the various sports with netball. The information gathered lays a good foundation to draw up a comprehensive injury prevention programme for netball players. The predisposing factors to injury such as type of injury, injury history, mechanism of injury addressed in the articles reviewed as well as the educational programmes conducted with coaches can be implemented for netball.

5.6 Limitations

Injury prevalence in netball is widely documented and presents a huge burden with regard to cost, time, duration and nature of treatment. The literature available with regard to injury prevention programmes in netball is very limited. Few studies have been conducted within the last ten years and this therefore presents a greater need to further research in the field.

5.7 Conclusion

There is limited research available on injury prevention interventions for the treatment of lower limb injuries in netball and landing sports. However these well-designed studies, with clinical trials that have been described in detail have shown positive outcomes. The results of the review of literature indicate the benefit of injury prevention intervention programmes and the need for furthering research in the field. Prevalence studies are widely documented in netball and landing sports, but if we are to truly address injury prevention then intervention programmes that

have been implemented and their outcomes need to be further researched. The benefit of conducting well-designed injury prevention programmes, which are rich in methodological detail and holistic in approach, is that they can be replicated in other settings.

5.8 Implications for practice

Within a South African context the vast majority of netball players reside within rural communities where medical staff and resources are limited. The study highlights that a few effective injury prevention measures have been tested with positive results in sports similar to and including netball with respect to the injuries sustained and the machismo of injuries identified in the needs analysis. Challenges that could exist with regard to the implementation of the interventions mentioned in the study include the purchase equipment with specific reference to decline boards, Bossu balls, wobble boards and foam rollers. In many instances trained medical staff is required to supervise the training session and therefore if implemented, the quality of the exercises performed may not always be easily monitored as the required staff may not be accessible. The intervention measures need to be modified and adapted for a South African netball audience according to the needs analysis conducted in phase one of the study.

The findings of this study, contribute to the overall development of an injury prevention programme for netball players in South Africa. Based on the needs assessment conducted in objective one this includes an injury prevention protocol, which can know be developed based on the findings of this chapter. A need for coaches' education and a centralized administrative structure that facilitates the various aspects associated with injury management were also identified in objective one. These three aspects form the foundation of the injury prevention programme for netball players in South Africa.

Objective Three: To Design an Injury Prevention Programme for Netball Players

Chapter Six:
The development of an injury prevention programme for netball: using intervention mapping as a framework

6.1 Introduction

In chapter five through a systematic review of literature it was evident that a few injury prevention programmes have been conducted both within and outside of the clinical trial realm that have been effective in preventing injury in netball and sports similar to netball. It was also highlighted that intervention measures need to be modified and adapted for a South African netball audience according to the needs analysis conducted in phase on of the study. In chapter six an injury prevention programme for netball players in South Africa is developed through a process of intervention mapping.

6.2 Literature Review

Research is aimed at promoting and publishing innovation. According to Finch (2011), unless this research culminates in practical and cost-effective interventions capable of attracting the political and social support required to allow effective implementation, it will not prevent, harm or save lives. Various frameworks have been proposed to promote the progression of sport medicine research to the application of clinical practice (Hanson, Allegrante, Sleet & Finch, 2012).

While researchers have generated considerable knowledge from surveillance, risk factor identification and efficacy and effectiveness studies, this knowledge needs to be adopted by those who can use it to improve sports medicine practice (e.g., clinicians, coaches and sporting bodies), (Sleet, 2003). This study has focused on incorporating the views, opinions and recommendations of all stakeholders in netball throughout the process. Hanson, Finch and Allagrante, (2012) present several gaps between injury prevention research and safety promotion practice. These gaps include the efficacy-to-effectiveness gap, the research-to-practice gap and the injury prevention to

safety promotion gap. These gaps stem from the contrasting approaches that researchers, policy makers, practitioners and the community take to the scientific, practical and social challenges posed by the process of implementing injury prevention programmes. The efficacy to effectiveness gap is a scientific problem dealing with applying the efficacy of an intervention's evidence from a clinically controlled trial to best practice principles for varied populations and situations. The efficacy of an intervention does not determine the success or effectiveness of an intervention. At a population level due to the fact that the community influences the intervention with multiple inter-related contextual factors the application of the intervention is impacted and is the key factor in determining the outcome. Green (2001) concluded, "Where did the field get the idea that evidence of an intervention's efficacy from carefully controlled trials could be generalized as 'best practice' for widely varied populations and situations?" Reductionist science attempts to control the effects of contextual complexity by isolating components of a problem and studying each of these factors independently. In human social science systems there is an interdependence of people, their natural, physical and social environments and therefore these factors are statistically interdependent and cannot be studied in isolation.

Researchers therefore need to be innovative in applying science to the communities. The research to practice gap deals with factors such as measures of the process of implementation, sustainability and population impact that are frequently overlooked by researchers whilst reporting on the individual impacts of interventions. This is an implementation problem and deals with the lack of information documented on how the implementation process was conducted.

The RE-AIM framework (Reach, Effectiveness, Adoption, Implementation and Maintenance) described by Glasgow, Vogt and Boles (1999) has been proposed as a reporting template to encourage sports researchers to document their research in a way that enables practitioners, policy makers and communities to use them effectively (Finch, 2011). The injury prevention to safety promotion gap deals with translating the knowledge from research

into clinical practice application including the views, opinions and policies of all stakeholders involved. It also deals with translating clinical practice application into research. This is a political problem. The widespread adoption of sports injury interventions can only be realized if they are aligned and synchronized with the goals of the community and the organizational and political processes that shape sport delivery.

Public policy is set out by those who build enough consensuses to intervene and not necessarily by proposing the principles of 'best practice' evidence (Hanson, Allegrate, Sleet & Finch, 2012). The community may not accept evidence that is pertinent to researchers if they do not fully believe and see the need for it. Intervention implementation requires partnerships, each bringing expertise that is critical to successful implementation of evidence-based practice. Integrating the expertise of all stakeholders is required to ensure that comprehensive, evidenced-based interventions are also practical and relevant to the real world application of sports medicine. Although this study does not deal with the implementation of an injury prevention programme, but rather with the feasibility of implementing such a programme, it was important to understand these philosophies and apply the principles in the design process. This would facilitate in overcoming the barriers to implementation that many researchers face and build the consensus needed to ensure effective implementation by all stakeholders in netball.

Implementation science is still an emerging and rapidly developing field, a number of its underpinning concepts have already appeared in the sports injury prevention implementation literature. These concepts include the importance of: understanding the implementation context (Donaldson & Finch, 2012; Donaldson, Leggett & Finch, 2012; Finch, 2006), and adopting a multilevel or ecological approach to implementation activities (Finch & Donaldson, 2010; Emery, Hagel & Morrongiello, 2006) and engaging intervention end users in the planning and operationalising of implementation activities, (Donaldson & Finch, 2012; Viljoen, Patricios & Boksmart, 2012; Chalmers, Simpson & Depree, 2004;). These are all requirements for successful intervention implementation in any setting and are important to

consider when designing an injury prevention programme.

6.3 Intervention Mapping

Intervention Mapping is a stepwise approach for theory and evidence based development and the implementation of interventions. It comprises six steps; each leading to a product that guides the next step (Bartholomew et al., 1998). These steps include: a needs assessment, the identification of change objectives and programme objectives, the selection of theory based methods and practical strategies, the development of a planned holistic programme, the identification of a plan for implementation and evaluation of the adopted plan.

In this study, an intervention-mapping framework was used to ensure the development of an injury prevention protocol that was grounded in theory. The Intervention Mapping protocol introduced by Bartholomew et al. (1998), suggests specific steps that can be applied to the development of injury prevention strategies. Intervention mapping proposes a systematic way to proceed from knowledge about the current problem to specific change goals, and subsequently to intervention methods and strategies based on the production of intervention matrices. In the current study a systematic approach was used to provide the authors with the content for the injury prevention protocol. This chapter provides an overview of the processes involved in this doctoral thesis, the frameworks and the tools used to assist in developing an injury prevention programme. It also describes the design and theoretical rationale for the tool developed. The aim of this chapter is to identify the processes used (step 1 – 4) and the outcomes at each stage. It finally presents the proposed injury prevention protocol.

This phase of the study was dependent on data from the previous phases, which were highlighted in chapters 3, 4 and 5. Based on the findings of these chapters objective three, which is the intervention mapping process, will be described. Figure 6.1 below shows the intervention mapping process integrated with the objectives carried out in this study.

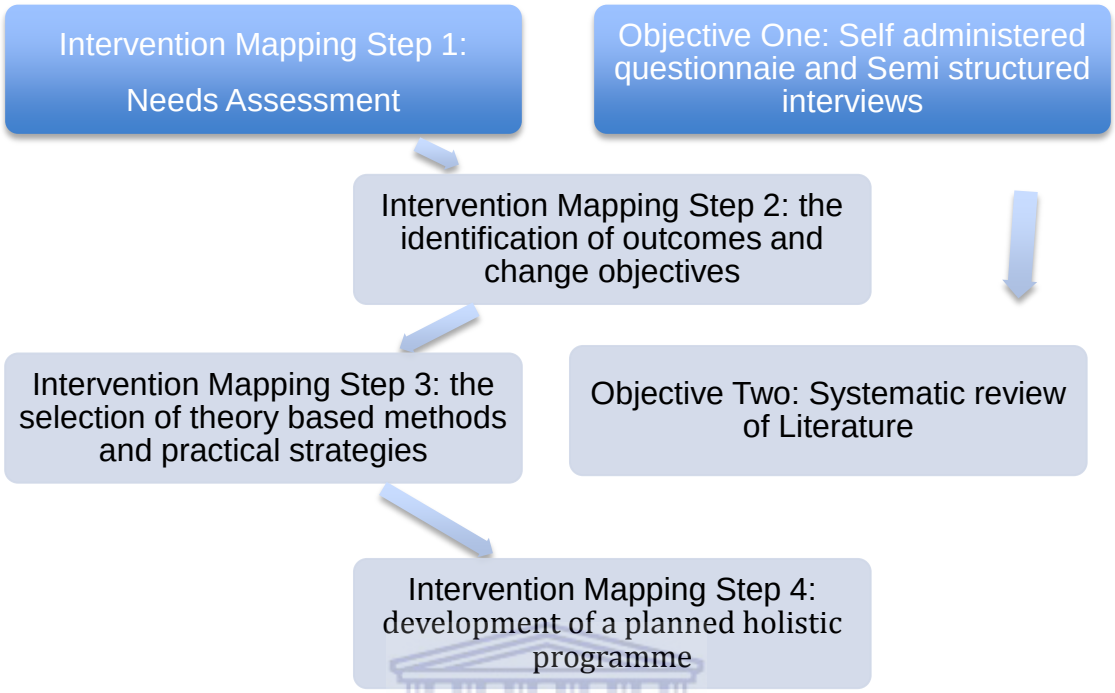


Figure 6.1: Integration of the intervention mapping process and the objectives carried out in this study

Step 1: Needs assessment

At the start of the study a survey was conducted to determine the extent of the injuries in netball. In this phase a cross-sectional quantitative research design was used to determine the injury prevalence, mechanisms and types of injuries in the sport of netball in South Africa. In addition, semi-structured interviews were used to explore the challenges experienced by players; netball sports managers, administrators and sports medicine personnel in managing injured players within the current system. To understand the barriers and facilitators associate with injury management in netball, stakeholders were interviewed on the various aspect of injury management. This included types of treatment that should be administered, current structures available to access injury management, and possible solutions from the stakeholders that could facilitate injury management. The outcome of this

needs assessment served as an evidence base for the goals of the injury prevention protocol.

Step 2: Identifying programme objectives

According to Dalum et al. (2012), during this phase, one needs to identify the goals and define the objectives, which may be referred to as 'programme objectives' (PO). The needs of the various stakeholders were identified through the analysis of the semi-structured interviews and programme objectives for each were derived. The needs assessment for this study highlighted the need for an injury prevention programme. The aspects of the injury prevention programme were three pronged and included a need for coaches' education, a centralized administrative structure that facilitates the various aspects associated with injury management and an injury prevention protocol targeting the prevention of injuries sustained in netball. Performance objectives are the expected sub behaviours that have to be accomplished by the target group to achieve the programme objectives. During this step, the target group (players, coaches, managers, health professionals) was further specified to be able to ensure that the needs of all key stakeholders are met. In addition, performance objectives were identified based on the programme objectives identified during the needs assessment. The performance objectives were formulated by answering the question: 'what do the various participants who will benefit from the injury prevention protocol need in order to effectively implement the protocol? Based on the information from the above, programme objectives were devised and are reflected in Table 6.1.

Step 3: Selecting suitable theoretical and practical methods

Intervention mapping step three is the selection of useful theory-based and evidence-based strategies that are applicable to the objectives. In this study, a systematic review was the method employed to select and specify interventions that would lead to addressing the needs identified in step 1 and the objectives outlined in step 2. Through an adaptation of the South African

Sport Medicine and Association's (SASMA) accreditation form **[Appendix 2.7],** a national physiotherapy association was formulated highlighting an administrative structure, which centralizes the approach to injury management and facilitates and co-ordinates injury management. It also guides the minimum standards and accredits the experience of physiotherapists working with national federations using netball and physiotherapy as the example.

Injury prevention is not exclusive to the discipline of physiotherapy. It is holistic in nature and encompasses the services of a multidisciplinary team. Therefore the need for a centralized administrative structure by netball stakeholders, to facilitate injury prevention implementation is neither exclusive nor limited to physiotherapy. A similar association could be drafted within other medical expert disciplines, to meet the need described by netball stakeholders to give structure to and centralize the approach to injury management.

Step 3 presents the theoretical methods selected for the development of the interventions. This describes how the theoretical methods were translated into practical strategies and how these relate to the implementation of the intervention.

Bartholomew, Parcel, Kok and Gottlieb, (2006) stated that the goal of intervention mapping step 3 is to use a conceptual model or theory to guide the identification of appropriate intervention methods and delivery strategies. These methods that are then matched to the objectives stated in Step 2. A theoretical framework or model can be thought of as a supporting technique or process that influences change in the determinants identified in the needs assessment. The components of the model are then used to operationalize the intervention components and implement the strategy. Research models are often identified and adopted based on the research setting and research participants and the applicability of the elements of the model to the study subject.

Search terms were chosen after a preliminary review of relevant literature yielded commonly used words and phrases, which were finalised after

consultation with an experienced researcher. Both researchers then conducted the search based on the guidelines previously mentioned in Step
This led to the choice of several practical intervention techniques derived from theory-based methods which were identified in the literature and translated into practical ideas based on the target groups' (players, coaches, managers and health professionals) views and opinions to ensure the input of all key stakeholders was addressed.

Step 4: Development of the injury prevention programme

In step 4 the intervention programme was then designed. The intervention programme designed for this study was based on the systematic review conducted and an adaptation of the South African Sport Medicine and Association's (SASMA) accreditation form.

Data was analysed from the data extraction form detailing the study participants, the study design and aim, controls, intervention and duration of the programme and outcomes of the individual studies. Based on these findings the intervention protocol and the coaches' educational booklet were then designed. The scope of the physiotherapy association was detailed based on an analysis of the SAMA accreditation form.

Step 5 and 6: Implementation

According to the intervention mapping, steps 5 and 6 aims to produce a plan for the adoption and implementation and evaluation. In the current study the intervention mapping process was used until the design phase in step 4.

Validity of the study was ensured by the use of mixed methods with a sound theoretical base and different sources of data collection. Piloting all the relevant tools enhanced the reliability of the study and determining sound evidence based practices for injury prevention through a well-designed systematic review. Issues of trustworthiness that demanded attention were credibility, transferability, dependability, and confirmability. Stakeholders' involved in the different aspects of netball were included to ensure information

was obtained from various sources. This provides a richer and more credible data set than if information was only obtained from one source. Member checking was also used during phase 1 of the study and participants were given the opportunity to review a summary of the data analysis procedure and a summary of the final results of the interviews. The issues of dependability and confirmability relyed on an independent audit of my research methods by competent peers, my supervisors. All information generated was thoroughly examined by my supervisor and these include the original transcripts, data analysis documents, comments from the member checking, and the text of the dissertation itself.

6.4 Results

6.4.1 Step 1: Needs assessment of intervention mapping

The needs assessment survey revealed an injury prevalence of 61.8%, (n=157/254). A total of 301 injuries were reported resulting in an injury rate of 1.9 injuries per player for one season. This injury rate is higher than that compared to the study by Hume et al., (2000) who reported an injury rate of 1.1 and lower than the study by McManus et al., (2006), who reported an injury rate of 2.6 for the same time period.

The key structures identified were as reflected in the studies of Egger (1990), where the ankle 37.5% (113) and the knee 28.6%(83) had the highest injury prevalence amongst netball players. Egger (1990) reported that netball had the highest portion of injuries (ankle 40% and knee 20%) when compared with other sporting codes such as hockey, basketball and cricket. The most common mechanism of injury for both the knee and the ankle injuries were landing with 19% and 29% respectively. Medical intervention was received by 33% of players who lost training and game time, highlighting the need for the service.

Based on the needs assessment a need for an injury prevention programme was highlighted based on:

1. The prevalence and mechanism of injuries in netball

2. The need for medical intervention at the time of injury
3. The need for prevention strategies with regard to coaches education
4. All participants regardless of whether they were coaches, players or administrators shared similar sentiments that a huge gap exists between what players at national level can access with regard to sport science and medical services and the non-existence of structures at club and provincial level.

5. Barriers to accessing these services included players' knowledge, transport and cost. There was a general consensus that a structure should be put in place to co-ordinate facilitate and monitor players.
6. There was consensus that health care is very expensive and that a more affordable solution should be sought, centralizing the approach to injury management. Participants also articulated that injuries are not managed effectively due to cost and the consequence of this was player drop out and poor team performance.
7. Participants understood each medical team member's specific area of expertise well and what they contributed to ensuring the functioning of a good multi disciplinary team and injury prevention.

It thus became evident that the needs assessment highlights injury surveillance as an integral part of developing preventative measures. The survey laid the platform for the basis of the study and identified specific focus areas to be addressed. Most of the contributing factors identified by the participants focused on extrinsic factors (n=10). The factors identified could be group into 5 main themes, which included coaches impact (influence and knowledge), injuries (existing injuries and lack of injury management), players lack of knowledge, playing surface and training techniques (warm-up, conditioning, technical skills).

6.4.2 Step 2: Identifying programme objectives

Kok, Schaalma, Robert, Ruiter, Van Empelen and Brug (2004) describe programme objectives as the specification of the general programme goals,

explicating who and what will change as a result of the intervention. They further describe performance objectives as the specific behaviours commanded of the target group or environmental agents as a result of the programme. Determinants are factors depending on the implementation by the stakeholders that will determine if the implementation is implemented. The rationale for the selection of these programme objectives were derived from the systematic review conducted and reflected in the chapters of this study. Table 6.1 summarises the programme objectives.

Table 6.1 Intervention Mapping: Specific programme objective of the injury prevention programme

Goals of the Injury Prevention Programme	**Programme Objectives**
Decrease incidence of Injuries	1. Reduce incidence of knee injuries 2. Reduce incidence of ankle injuries 3. Reduce incidence of injuries in netball on landing activities
Centralised structure for medical services	1. Improve affordability and compliance to medical care 2. Centralise a co-ordinated medical service 3. Create a platform of specialised and accredited medical staff that is accessible
Provide a knowledge based educational tool for all stakeholders to faciliate injury prevention	1. Improving knowledge on preventing contributing extrinsic factors to injuries in netball 2. Educate on best practice acute injury management 3. Educate on techniques that can facilitate injury prevention

By analyzing the needs from the questionnaire and the semi-structured interviews and cross matching them with the programme objectives, the more general programme objectives were translated into very specific intervention objectives, i.e. the performance objectives. These are the immediate targets of the injury prevention programme to be accomplished and are stated in terms of what a person exactly needs to learn to enable change. By crossing the programme objective with the determinant, the factor or process that enables the change, the performance objectives are formulated.

The list of programme and performance objectives for the injury prevention programme were then further specified and are reflected in Table 6.2.

Table 6.2 Intervention Mapping Stage 2: Programme objectives and performance objectives

Stakeholders	Aim	Programme Objectives	Performance Objectives	Determinants
Player, Coach and sport medicine personel	Decrease injuries in netball specifically whilst performing landing activities	Improve the stability and strength of the ankle and knee joints Coaches must educate and facilitate correct technique whilst players perform landing activities	Include plyometric exercises, balance excercises, eccentric loading on a 25 °decline board. Sport specific excercises incorporating all the components mentioned as a progression must be incorporated into landing activities	Coaches must included the excercises as part of the training sessions Players must be compliant with doing a home-based exercise programme Coaches and players must have access to the equipment Sport medicine personnel must be equipped with the skills to teach the programme and facilitate the correct execution thereof.

Stakeholders	Aim	Programme Objectives	Performance Objectives	Determinants
Player, Coach, Administrator and sport medicine personel	Create a platform for co-ordinated medical services that is affordable and accessible with specialised accredited professionals	Player injury management must be co-ordinated,centralised, continuous and affordable Accredited medical professionals must be accessible to players Players that have little or no affordability must be able to access medical professionals	All management of athletes must be communicated within the organogram to ensure co-ordination and continuity All injuries must be monitored and followed up to prevent non-management Medical professionals wanting to be involved in the medical structure must be graded according to the points system Identify funding or structures to remunerate service providers at affordable rates	Adoption of the policy by the Departments of Sport and Recreation South Africa, SASCOC, Federations and the HPCSA Service providers must be willing to provide medical services at an affordable rate Administrators must see this as a feasible plan for implementation Players must not default or dis-continue their treatment and must report all injuries

Stakeholders	Aim	Programme Objectives	Performance Objectives	Determinants
Player, Coach, Administrator and sport medicine personel	Improving knowledge on preventing contributing extrinsic factors to injuries in netball, best practice acute injury management and techniques that can facilitate injury prevention	Prepare the body adequately pre and post exercise Players must be conditioned according to the correct principles with specific adaptations for their sport	Warm up should include aerobic activities with dynamic stretching Cool down should include a thorough static stretching routine Strategies related to posture and the development of efficient movement patterns must be included. Strength development to increase athletic performance on court	Coaches and medical staff apply the knowledge to conduct a thorough warm up and cool down routine for every training session Coaches incorporate principles into the netball training and vary the intensity levels Combine skill with fitness training

Stakeholders	Aim	Programme Objectives	Performance Objectives	Determinants
Player, Coach, Administrator and sport medicine personel	Improving knowledge on preventing contributing extrinsic factors to injuries in netball, best practice acute injury management and techniques that can facilitate injury prevention	Injury prevention strapping techniques should be taught to and adopted by coaches and players Nutrition guidelines should be taught to and adopted by coaches and players Best practice guidelines should be taught and adopted for acute injury management	Medical personal teach coaches and players how to preventatively strap Medical personal educate coaches and players on nutrition guidelines and educate on how it facilitates fuelling and recovery Stakeholders are educated on acute injury management	Administrators and medical personel ensure strapping is accessible to players at an affordable price Players have access to good nutrition Players are disciplined Coaches create a culture of good nutrition Basic equipment available for acute injury management All stakeholders “buy in” to the acute injury management policies

6.4.3 Step 3: Selecting suitable theoretical methods and practical strategies

From the evaluation of the articles included in the systematic review, theoretical methods and practical strategies emerged and were translated into practical ideas. Studies included in the systematic review but which duplicated methods mentioned in the studies below are not listed. This is based on the views and opinions of netball stakeholders, expressed as needs and are summarised in Table 6.3. These studies formed the basis for the injury prevention programme.

6.4.3.1 Theoretical Methods

The theoretical concepts of a multi disciplinary team approach, coaches education and resources and technical training were developed from the following studies and included in the injury prevention programme:

- Elphinston et al. (2006): The effect of an integrated functional stability programme on injury rates in an international netball squad. Training compliance was increased with a multi-disciplinary team approach.
- Gianotti et al. (2010): Efficacy of injury prevention related coach education with Netball and Soccer. Integrating injury prevention content within coach education and resources reduces injury.
- Stasinopoulos (2003): Comparison of three preventative methods: in order to reduce the incidence of ankle inversion sprains among female volleyball players. Technical training on takeoff and landing techniques is slightly more effective in preventing injuries that proprioceptive training and the use of orthotics.

6.4.3.2 Practical strategies

The injury prevention protocol is a six week programme with a series of excercises extracted from the following studies that have proven, within a controlled scientific environment, to be beneficial in the prevention of injuries in or similar to netball.

- Cumps et al. (2007): Efficacy of a sports specific balance training programme on the incidence of ankle sprains in basketball. The risk for new or recurrent ankle sprains was slightly lower in the intervention group performing a balance training programme compared to the control group for the total sample.
- Emery et al. (2007): A prevention strategy to reduce the incidence of injury in high school basketball: A cluster RCT. In this study the protective effect found with respect to all injury, lower extremity injury and ankle sprain injury were not statistically significant. Compliance to a home-based intervention programme was also poor.
- Jonsson et al. (2005): Superior results with eccentric compared to concentric quadriceps training in patients with jumpers knee: a prospective randomized study. Eccentric quadriceps training while standing on a 25° decline board resulted in a decrease in the VAS and VISA scores of patients. On patient follow up the eccentric training group were still satisfied.
- Moiler et al. (2006): The role of fibular tape in the prevention of ankle injury in basketball: A pilot study. A 95 % confidence interval was shown in the results of participants who were taped with FRT, the number treated was 22.
- Myer et al. (2006): The effects of plyometric versus dynamic stabilisation and balance training on lower extremity biomechanics. Both plyometric and dynamic balance exercises should be included in injury prevention protocols.

In order to ensure that the National Sport Physiotherapy Association functions within the ambit of which sport medicine is governed in South Africa, it was important to look to the literature for guidance. The South African Sports Medicine Association (SASMA) is an a-political, non-profit, multidisciplinary professional and scientific society dedicated to the motivation, responses, adaptation and health of people involved in sport and exercise (SASMA, 2012).

SASMA is South Africa's official International Federation of Sports Medicine (FIMS) affiliated sports medicine organisation and, as such, tasked with overseeing the administration of sports medicine. Key to SASMA's ambition to uphold a high standard of clinical sports medicine practice in South Africa is the certification of medical and paramedical professionals. This ensures that clinicians offering their services to sports teams, sportspersons and exercising individuals are suitably qualified and experienced in the field of sport and exercise medicine.

- The SASMA accreditation process recognizes health professionals who are actively involved with the practice and the advancement of sports medicine. It gives a clear guideline and a system of scoring that reflects academic, clinical and sporting experience ensuring minimum standards of practice are met. The accreditation form for the development of the National Sport Physiotherapy Association has been adapted from the SASMA accreditation form 2012 **[*Appendix: 6.1].***
- The adapted forms from the SASMA accreditation form and the structure of the National Physiotherapy Association were then collated and together. The three aspects of the injury prevention protocol, the coaches' educational booklet and the National Physiotherapy Association formed the injury prevention programme.

Table 6.3 Theoretical methods and practical strategies

Determinant	**Methods from theory**	**Strategy**
Risk perception and knowledge base	Passive learning / providing information Active processing of information	Providing written information in the form of an educational booklet Evaluating and understanding the barriers facing stakeholders and have the ability to modify the programme accordingly
Skills	Guided Practice	Re-enforce best practice methods from theory and be willing to adjust according to challenges faced by stakeholders Conduct an evaluation of the implementation process of the six week exercise cycle
Self-efficacy	Positive reinforcement	Evaluation and adaptation of the programme based on feedback from the stakeholders Provide feedback to all stakeholders on implementation process and challenges and adaptations that need to be made Positively re-enforce, encourage and support implementation of the programme
Policy Adoption	Forming coalitions	Providing written and verbal information to the federations and SASCOC. Development of an organisational structure at the national level, stimulate collaboration across different agendas and facilitate strategic planning Evaluating and adapting the structure accordingly based on the feedback from SASCOC and the federations

6.4.4 Stage 4: Design of the injury prevention programme

Once all the steps had been carefully followed by the researcher and consensus reached with supervisors and experts in the field, the final design of the injury prevention programme was implemented. The final injury prevention programme aimed to be presented as an educational booklet designed for coaches, a six-week exercise protocol for netball players and a National Physiotherapy Association. In this phase the content of the programme is presented.

6.5 Coaches educational booklet

Introduction

Stage 4 of the intervention mapping process will illustrate the aim of the intervention programme together with detailing the aim and performance objectives. The change objectives are illustrated as the programme content. This educational pocket size booklet is designed for coaches. The booklet encompasses a variety of topics that serve as an easy reference tool to facilitate the process of implementing the different components that optimise training and assist with injury prevention. The aim (specific programme objectives) of the educational pocket size booklet is to:

- Decrease the incidence of injuries
- Centralise the structure for medical services
- Provide a knowledge based educational tool for all stakeholders to facilitate injury prevention

Content

A). Physical Conditioning

- **Physical conditioning aims**
- **Key netball fitness components**
- **Principles to improve athlete performance**

B). Warm up

- **Warm up aims**
- **What the ideal warm up should include**
- **Rules of stretching**

C). Cool down

- **Cool down aims**

D). Bracing, taping and shoes

E). Hydration and Nutrition Guidelines

F). Injury Management Guidelines

- **Do's and don'ts**
- **First aid bag general supplies**

6.5.1 Section A: Physical Conditioning

Aim: Improving knowledge on preventing contributing factors to injuries in netball.

Change objective: Players must be conditioned according to the correct principles with specific adaptations for their sport.

Physical Conditioning:

Various components of physical conditioning are important for success. Having a very good aerobic fitness level is an important attribute. Being quick and agile is a necessary requirement for all netball players. Player position also determines the physical conditioning disposition of the athlete. This section focuses on the key

elements of physical conditioning as well as a few guidelines to successfully implement a programme.

Physical conditioning aims:

- Prevent injuries
- Strategies related to posture and the development of efficient movement patterns
- Strength development to increase athletic performance on court
- Your programme should incorporate conditioning principles into the netball training
- Vary intensity levels
- Combine skill with fitness training

Key netball fitness components:

- Skill
- Speed
- Ball handling
- Strength
- Stamina
- Agility

Principles to improve athlete performance:

- **Specificity principle:** Train the energy systems and muscles as closely as possible to the way they are used in the sport.
- **Overload principle:** Athletes' must do more than their bodies are used to doing. When more is required the body adapts to the increase in demand.

- **Progression principle:** To steadily improve the fitness levels of your athletes you must continually increase the physical demands to overload their systems.
- **Diminishing returns principle:** As the athlete becomes fitter, the amount of improvement is less as they approach genetic limits. As fitness levels increase, more work or training is needed to make the same fitness gains.
- **Variation principle:** Use periodization to vary the volume, type and intensity of exercise and don't overstress one part of the body.
- **Reversibility principle:** When athletes stop training, hard – won fitness gains disappear. Maintaining a moderately high fitness level year round is easier than de-training at the end of season and starting again at the beginning of the new season.

6.5.2 Section B: Warm up

Aim: Improving knowledge on preventing contributing factors to injuries in netball.

Change objective: Prepare the body adequately pre exercise.

Warm up:

Prepares the body for the proceeding activity as well as helping to prevent injury to muscles, which are most susceptible to injury when cold. In young people the warm up should be 5 to 10 minutes. In adolescents and older the warm up should be 15 to 20 minutes. In cold weather the duration of the warm up should be longer.

Warm up aims:

- Prepare the body and mind for the activity
- Increase the body's core temperature
- Increase the heart rate
- Increase breathing rate

What the ideal warm up should include:

- Warm up depends on the level of competition and the age of the athlete.

- Warm up should incorporate the muscle groups and activities similar to those that are required during training or competition.
- Should include the dynamic stretching of muscle groups.
- Intensity should begin low and gradually build to the intensity required during the training or competition.
- Stretch all muscle groups involved in the activity.
- Stretch through the full range of movement required in the activity being performed.

Rules of stretching:

- Warm up prior to stretching.
- Stretch before and after exercise.
- Stretch all muscle groups that will be involved in the activity.
- Stretch gently and slowly.
- Never bounce or stretch rapidly.
- Stretch to the point of tension and not pain.
- Do not hold your breath whilst stretching. Breathing should be slow and easy.

6.5.3 Section C: Cool Down

Aim: Improving knowledge on preventing contributing factors to injuries in netball.

Change objective: Prepare the body adequately post exercise.

Cool Down:

The cool down helps the body clear lactic acid that builds up during any activity. Less lactic acid means less soreness and stiffness the next day.

Cool Down Aims:

- After vigorous exercise the body needs time to slow down
- Aids recovery

- Stretching after activity helps to maintain maximum flexibility
- Relaxes contracted muscles
- Returns muscles to resting length
- Develops long term attitude to maintaining a healthy lifestyle

6.5.4 Section D: Bracing, taping and shoes

Aim: Improving knowledge on preventing contributing factors to injuries in netball and best practice acute injury management and techniques that can facilitate injury prevention

Change objective: Injury prevention strapping techniques should be taught to and adopted by coaches and players

Bracing, taping and shoes:

- Seek professional advice on footwear.
- Consider preventive ankle taping or bracing to reduce injury risks.
- Fibular repositioning taping (FRT) is a good method to use.

FRT is applied prior to activity to maintain optimal fibula position and prevent forward fibula displacement; ankle injury prevention is the resultant effect, (Moiler, 2006).

Figure 6.2: Applying FRT

- Two 20-cm lengths of tape applied obliquely starting at the distal end of the lateral malleolus.

- A pain-free poster lateral force is applied to the distal fibula.
- The tape is applied to both ankles.
- A second reinforcing strip was applied in the same manner.

6.5.5 Section E: Hydration and Nutrition Guidelines

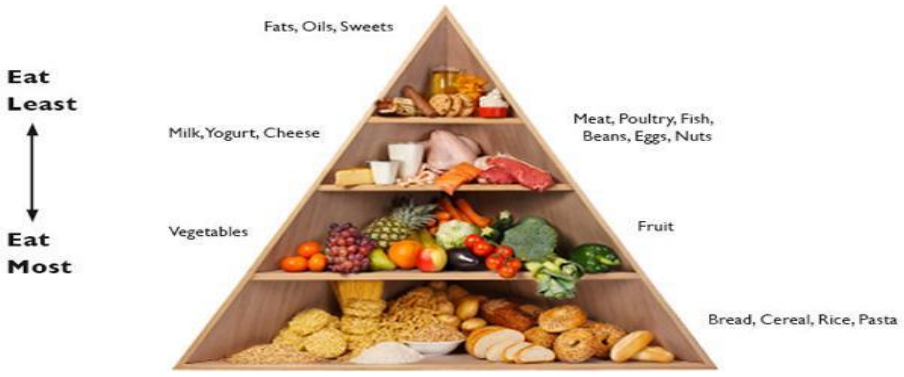
Aim: Improving knowledge on preventing contributing factors to injuries in netball and best practice acute injury management and techniques that can facilitate injury prevention

Change objective: Nutrition guidelines should be taught to and adopted by coaches and players

Hydration and Nutrition Guidelines:

You should eat a wholesome, varied diet that provides enough energy and all nutrients for a healthy active life. The basis of a good diet is the healthy food pyramid:

Figure 6.3: Hydration and Nutrition Guidelines



- Eat a varied diet. You need over 40 different nutrients daily and they come from different foods.

- Eat plenty of whole meal type foods with high carbohydrate content, which is the main fuel, required for Netball. These are foods like bread, cereal, rice, pasta, fruit, and potatoes.

- Eat a moderate amount of protein foods like these at each meal: lean red meat, chicken, fish, eggs, cheese, milk, dairy products or legumes.

- Keep fat intake low by not eating fried food and using low fat options. Food like pies, chocolate, takeaways should be eaten only occasionally.

- Avoid adding extra sugar or salt to food.

- Try to eat regularly – three times a day with snacks in between.

- Keep fluids high. The best fluid is water. Try to drink up to two liters per day and more if playing netball. Encourage players to bring a drink bottle to practices and games.

- Eat and drink before and after practice and games.

6.5.6 Section F: Injury Management Guidelines

Aim: Improving knowledge on preventing contributing factors to injuries in netball and best practice acute injury management and techniques that can facilitate injury prevention

Change objective: Best practice guidelines should be taught and adopted for acute injury management

Injury Management Guidelines: When managing an injury its always important that good decisions are made in the best interest of the athlete.

Do's and don'ts:

- RICE – always apply the principle of rest, ice, compress, elevate.
- Refer to a physio, clinic and doctor. Let a professional decide if an injury is present or not.
- Always have a qualified first aider, or medic at a match to ensure safe play.
- Do not give anti-inflammatories within the first 48 hours of an injury.

First aid bag general supplies:

- First Aid Manual or Emergency/CPR flashcards
- Strapping/bandages
- Wound care, cleaning solution and plasters
- Scissors
- CPR mouth barrier or pocket mask
- Sterile surgical gloves
- Ziploc* bags (to hold ice for ice packs)
- Cell phone

List of emergency phone numbers (paramedics, hospital and doctor)

6.6. Injury prevention protocol for netball players in South Africa

This programme has been developed through a review of literature conducted by the researcher through the process of a systematic review. Individual elements or a combination thereof was carried out through randomized controlled trials by a number of authors. The authors of these research studies were able to reduce the incidence of ankle and knee injuries successfully and the series of exercises have been chosen based upon this. Very few injury prevention exercise programmes

have been formulated therefore the programme is based on landing sports that have similar accelerative, decelerative and jumping actions present in Netball.

All exercises are to be performed 3 times weekly for ten minutes and are to be included into the warm up.

A four-week cycle of exercises is provided and must be rotated accordingly to cover the 6-week cycle. The programme should be done over a minimum number of 6 weeks. All repetitions are 3 x 30 and all positions held for 10 sec.

One leg decline squats ≥ 60° knee flexion ≤ 90° are performed on a 25° decline board. Only 15 reps are to be performed. The exercise is to be performed on both legs. In both instances the opposing leg is used to push down on the ground to go back to the start position.

The equipment required for the programme is a skipping rope and a wobble board and a 25° decline wedge.

Aim: Decrease injuries in netball specifically whilst performing landing activities

Change objective: **1.** Improve the stability and strength of the ankle and knee joints

2. Coaches must educate and facilitate correct technique whilst players perform landing activities

Purpose of each component of exercise:

Balance exercises: To improve landing technique and ankle and knee stability.

Eccentric loading: Eccentric exercises work a muscle when it is lengthening, not contracting or shortening. These exercises are often included in the rehabilitation of tendon injuries like tendinitis to help regain normal tendon function and prevent future injuries.

Plyometric exercises: Plyometric is a method of training muscle elastic strength and explosiveness to enhance athletic performance.

Aerobic exercises: Warming up will help prepare your body for aerobic activity in the prevention of muscular injury.

Table 6.4: Injury prevention protocol for netball players in South Africa

Week 1	***Day 1***	***Day 2***	***Day 3***
Balance Exercises	Single leg stance (on the floor, eyes open)	Single leg stance-swing raised leg (on the floor, eyes open)	Single leg squat (30° - 45°) (on the floor, eyes open)
Eccentric Loading	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board
Plyometric Exercises	Maximum effort two leg jump (emphasis on correct landing)	Maximum effort one leg jump (emphasis on correct landing)	Maximum effort two leg jump to receive a pass (emphasis on correct landing)
Aerobic Exercise	Rope Skipping (Double leg)	Rope Skipping (One leg)	Bounding ant and post (emphasis on proper cutting technique).

Week 2	***Day 1***	***Day 2***	***Day 3***
Balance Exercises	Single leg stance (passing and catching) (on the floor, eyes open)	Single leg stance (on the floor, eyes closed)	Single leg stance-swing raised leg (on the floor, eyes closed)
Eccentric Loading	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board
Plyometric Exercises	Maximum effort one leg jump to receive a pass (emphasis on correct landing)	Squat jumps. Perform a deep squat and then maximum effort jump into the air (emphasis on correct landing)	Squat split jumps. Perform a deep lunge and then maximum effort jump into the air (emphasis on correct landing)
Aerobic Exercise	Bounding lateral and medial (emphasis on proper cutting technique).	Shuttle runs repeated from baseline to each line back to the baseline (Full court). Each line counts as one rep.	Double leg hops (performed in pairs, small rhythmic hops jump, throw/catch a ball)

Week 3	***Day 1***	***Day 2***	***Day 3***
Balance Exercises	Single leg squat (30° - 45°) (on the floor, eyes closed)	Single leg stance (on the wobble board, eyes open)	Single leg stance-swing raised leg (on the wobble board, eyes open)
Eccentric Loading	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board
Plyometric Exercises	Tuck jumps. Place feet parallel and shoulder-width apart. Spring upward and tuck both knees toward chest before landing with feet in their original position.	Lateral tuck jumps. Performed the same as tuck jumps but side to side over an object. Start with a cone and progress the height of the object. Repeat.	Double leg hops Place feet together, jump up and forward as far as possible. Repeat.
Aerobic Exercise	Single leg hops (performed in pairs, small rhythmic hops jump, throw/catch a ball)	4 point double leg hops forward, backward, left and right (repeat every alternative one in the opposite direction)	4 point single leg hops forward, backward, left and right (repeat every alternative one in the opposite direction)

Week 4	***Day 1***	***Day 2***	***Day 3***
Balance Exercises	Single leg squat (30° - 45°) (on the wobble board, eyes open)	Double leg stance rotate the board (on the wobble board, eyes open)	Single leg stance (on the wobble board, eyes closed)
Eccentric Loading	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board
Plyometric Exercises	Single leg hops Standing on one leg, jump up and forward as far as possible. Alternate and repeat	Squat jumps to receive a pass. Perform a deep squat and then maximum effort jump into the air receive a pass. (Emphasis on correct landing)	Squat split jumps to receive a pass. Perform a deep lunge and then maximum effort jump into the air to receive a pass. (Emphasis on correct landing)
Aerobic Exercise	4 point double leg hops (performed in pairs, small rhythmic hops jump, throw/catch a ball)	4 point single leg hops (performed in pairs, small rhythmic hops jump, throw/catch a ball)	Jogging with a partner throw/catch a ball with a jump and single leg land

6.7. National Sport Physiotherapy Association

The National Physiotherapy Association is an example of how a centralized approach to injury management can be created within a body such as SASMA to guide and implement injury prevention strategies. Injury prevention is not limited to physiotherapy but rather encompasses a multidisciplinary team approach. This structure is therefore not limited to physiotherapy and physiotherapy is used as an example for this study. Therefore the structure can apply to other disciplines within the multidisciplinary team approach such as biokineticists. Within this infrastructure the co-ordination of multidisciplinary services can then be better facilitated and coordinated.

Aim: Create a platform for coordinated physiotherapy services that is affordable and accessible with specialized accredited professionals

Change objective:

1. Player injury management must be coordinated, centralized, continuous and affordable
2. Accredited physiotherapists must be accessible to players
3. Players that have little or no affordability must be able to access physiotherapy

To emphasize the importance of injury prevention and the comprehensive physiotherapy care of all athletes in South Africa. A forum of sport physiotherapists involved in provincial and national sport need to collectively assist in optimising physiotherapy care and injury prevention as well as improving communication and continued physiotherapy education. This sport physiotherapy association of physiotherapists should be the official forum for provincial and national physiotherapists in South Africa and should conduct its business in co-operation with the Director of Physiotherapy.

The main objectives of this sport physiotherapy sport association are:

1. To create and maintain a scientific communication forum for national and provincial physiotherapists dealing with athletes.
2. To communicate with and advise the federations through it's Director of Physiotherapy and other relevant organizations on strategies to prevent and manage injuries in South African sport. The director will have an appointed assistant.
3. To assist in the development, implementation and operation of comprehensive emergency and physiotherapy care structure for sport at all levels in South Africa,
4. To liaise with the Director of Physiotherapy and tertiary institutions on sport - related research matters.
5. To establish and maintain a structure for continuous sport physiotherapy education for physiotherapists in sport in South Africa.
6. To formulate and maintain an ethical code of conduct for members, and
7. To assist with the formulation of minimum qualifications and guidelines for the appointment of physiotherapy staff for representative South African sport teams national, regional, and provincial teams.

This sport physiotherapy association of physiotherapists consists of the Director and the Head national physiotherapist for the different codes, which are an academic and clinical group, and will address the scientific and operational aspects of its objectives to maintain and improve the physiotherapy care of the athletes in consultation with South Africa's sport science and medical institutions.

Membership of the sport physiotherapy is compulsory, if the physiotherapist is part of the programme or voluntary:

1. Compulsory membership: Membership of the Sport physiotherapy association should be compulsory for all physiotherapists representing South African teams, regional franchises, and provincial representative teams.

2. Voluntary membership: Voluntary membership of the Sport physiotherapy association should be available for all physiotherapy professionals registered with the Health Professions Council of South Africa or equivalent body, who are interested in the care of athletes. All sport physiotherapists involved in medical care of sport teams in South Africa should be encouraged to acquire membership of the Sport physiotherapy association.

6.7.1 Sport Physiotherapy Association Structure

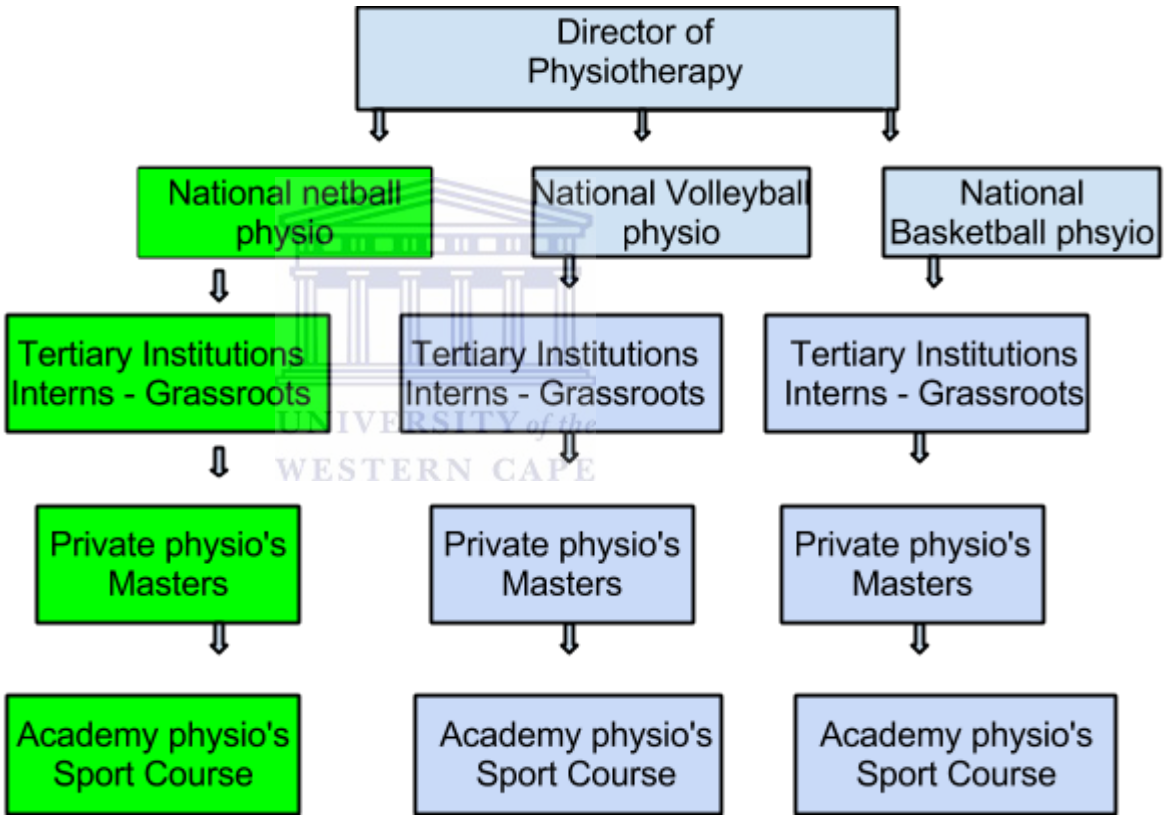


Figure 6.4: Organogram of the Sport Physiotherapy Association

Director of Physiotherapy:

Job Description:

- Communicate and liaise with the sporting federations
- Standardise assessment protocols for national teams
- Collate data of injury stats and co-ordinate research together with tertiary institutions with regard to interventions protocols for national teams
- Ensure best practice principles
- Assist federations with appointing National team physiotherapists
- Create and establish a forum for physiotherapist in accordance with the South African Society of Physiotherapist that co-ordinates the National and Provincial sport programme.
- Develop continuing education programs to improve physiotherapy nationally in care of the athletes
- Update and improve Sports Emergency Supervision through educating officials and management at all events.
- The forum should be inclusive and promote physiotherapy practice at an academic level as well as at a practice level.

6.7.2 National Team Physiotherapist Job Description

- Liaise with the coaches and the Federations
- Plan and co-ordinate musculoskeletal assessments of teams pre and post season
- Monitor injury stats
- Provide physiotherapy services at national camps and competitions:
- Assessment of new injuries
- Treatment
- Recovery
- Strapping
- General first aid
- Referral to other medical professionals
- Drawing up of rehabilitation programmes for athletes returning to provinces

- Liaise with tertiary institutions, provincial physios and academy physios
- Monitor treatment being delivered at provincial level

Tertiary Institutions:

- Formalise and structure a sport physiotherapy block for students
- Ensure that students are equipped with the necessary skills to be able to assist at sporting events and carry them out as practical blocks at Grass Roots.
- To ensure adequate output of research within the field of sport physiotherapy

Private Physio's:

- To assess and treat provincial and national athletes within their area of expertise.
- To provide regular feedback to the national physio with regard to the treatment progress of the athlete
- To be involved within the federation at a provincial level and club area assisting with camps and competitions
- To be available to supervise students offering services at camps and competition.

Academy Physio's:

- To assess and treat provincial and national athletes within their area of expertise.
- To provide regular feedback to the National physio with regard to the treatment progress of the athlete
- To be involved within the federation at a provincial level and club area assisting with camps and competitions
- To be available to supervise students offering services at camps and competitions

Team represented	
Title:	
Name: *	
Surname: *	
Date of Birth:	
Highest Qualification:	
Year Qualification:	
Other Qualification:	
Year Qualification:	
Area of Specialisation:	
Years of experience in sport Physiotherapy	
Provincial Sport Team	
Postal Address:	
Postal code:	
Physical Address:	
Tel:	
Fax:	
Cell:	
Email: *	
HPCSA no	
Member Type: (compulsory/voluntary)	

Figure 6.5: **Department of Sport and Recreation National and Provincial Sport Physiotherapy Registration form**

6.7.3 South African Sport Physiotherapy Accreditation of Professionals to National Teams

The Sport physiotherapy Association will implement a grading system for professionals wishing to work with one of our National Teams. Future appointments should be decided upon by the grade obtained by the respective professionals.

A scoring system is proposed where professionals will be ranked according to work experience, in particular sport-related experience, academic qualifications in the field of Sports Medicine and Sports Science, and registration with National Professional bodies.

The appropriate references as well as copies of degrees and course certification need to be included in the application. **Grading will be reviewed on an annual basis**.

INSTRUCTIONS FOR COMPLETING THE APPLICATION:

Work Experience

1. Years since qualification

Please make an X against the appropriate number of years since qualification as a physiotherapist. Enter the value of the points in the SCORE [ ]. A copy of your graduation and current registration certificates may be asked for. Only working years apply.

2. Sport Related Experience

Only the highest level attained must be used for allocating points in this section so enter the value for the **only one level**. A letter from the relevant team confirming your appointment must be included in this application.

3. Academic

3.1 Post Graduate Qualifications

Only the highest level attained must be used for allocating points in this section.

Proof of qualification is required.

3.2 Specialized Training / Courses

Each course counts for 1 point. Course must have been done in the past 5 years. Proof of certification and date completed must accompany this application; once course accreditation has been approved and only accredited courses will be accepted. If you have presented a course you can also receive a point. However, you cannot receive a point for attending as well as a point for presenting a specific topic / course. You cannot receive points for courses offered as part of post grad qualification (section 2.1 above)

3.3 Publications

Points are also awarded for publications but only in recognized Scientific Journals. If you were a co-author you will receive fewer points than if you were the first author. Proof of publication is required. **Publications must also be applicable to sport or the management of injuries that may occur in athletes**.

4. Registrations

Proof of current registration must accompany this application

Circle the correct numbers as it applies to you on Form 2. Then total the scores. The rating would be as follows:

▪ National ▪ Provincial ▪ School/Club/ University	25 – 31 points 20 – 24 points 10 – 19 points

Minimum Qualifications
Experience > 5 years Sport experience > 3 years
Recommended Qualifications
Academic involvement

Figure 6.6: Grading of professionals

Date: _____

Demographic Data:

Name: _____

Surname: _____

Date of Birth: _____

Place of Birth: _____

Province: _____

Age: _____

Gender: **M** **F**

Profession: PHYSIOTHERAPY

Contact Details:

Home: _____

Address: _____

Code: _____

Telephone: **Work:** _____

Home: _____

Fax: _____

Cell: _____

Email: _____

Figure 6.7: Physiotherapy association rating of Sport Physiotherapists

Years of experience as a Physiotherapist	0-4 years 5-10 years >10 years	2 3 4
Post graduate qualifications	OMT I/SPTI Masters degree Masters (course work only) Doctoral degree	3 5 2 5
Additional Qualifications	Manual therapy Dry needling/Acupuncture Strapping Other	1 1 1 1
Sports related experience **(Cumulative: at least one season)**	School Club Provincial National Schools National U/19 National U/21 National U/23 Development National Team	2 3 5 7 5 5 6 6 7
Personal playing experience in sport	Schools Club Provincial National	1 1 2 3
Academic Involvement	Teaching undergraduates Teaching graduates CME Lectures/Conference/ Presentations Academic Publications < 2 Academic Publications > 2	2 3 3 1 2
Involvement in other sporting codes (Sports Medicine)	Club Provincial National	1 2 3
Member of Professional Sport physiotherapy association **(Add one point if serving/served in Executive capacity)**	SASMA SIG	1 1
TOTAL SCORE		

Figure 6.8: Physiotherapist Rating System

6.8 Discussion.

Applying the intervention mapping process to develop the injury prevention programme helped facilitate the researchers to fully consider each decision concerning the intervention inclusion, in the development, the implementation and the evaluation phase. Intervention mapping was found to be a useful tool. The process of intervention mapping enabled the researcher to consider the factors for required facilitating the feasibility to implementation process.

The first step of the intervention mapping process focused on a needs assessment incorporating all stakeholders into the process. Through the semi-structured interviews the researcher was able to gauge what types of solutions and recommendations the stakeholders viewed pertinent to addressing injury prevention in netball players in South Africa. By incorporating the stakeholders in semi-structured interviews important factors compounding injury prevention were identified.

Tools they thought might be successful in aiding injury prevention were considered and compatibility with daily practice as a deliberation created another opportunity for combined input. This created an inclusive process facilitating easier adoption for the success of future implementation. The literature review outlined and described best practice guidelines and programmes for injury prevention implementation.

The intervention mapping process is the key to merging research with clinical practice application. According to Hanson et al. (2012), sports injuries are largely preventable but discrepancies among researcher; practitioner and community perceptions of injury causation and the potentially feasible solutions for prevention are important barriers to mounting an effective response. It is not enough to understand what should be done but rather to understand what can be done and how it needs to be done. As a result the researcher was able to develop a protocol taking into account the following: a theoretical framework, input from all stakeholders in netball, a needs assessment and best practice guidelines from the literature.

To date intervention mapping has mainly been used as a tool for the planning and development of health promotion interventions (Bartholomew et al., 1998). This study shows that intervention mapping can also be useful for the development of injury prevention programmes merging research and clinical practice. Although studies such as MacGrath et al. (1998) describe the measures and countermeasures, which have been effective in preventing injury in netball, not many studies have examined the processes involved in applying the interventions.

This study contributes greatly in that it allows other researchers to examine, through the process of intervention mapping, how to develop a programme that is relevant to stakeholders which will be involved in the implementation and adoption stage.

It is clear that limited research attention has focused to date on understanding intervention implementation contexts and processes, including barriers and facilitators to sustainable programmes that need to be delivered and adopted within the complex and multi-faceted setting of sports delivery. To address this challenge, future injury prevention research aimed at demonstrating the uptake of interventions will need to:

- Draw on the available evidence for the efficacy/effectiveness of interventions in terms of desired injury and injury risk reductions as well as impact measures.
- Engage relevant stakeholders in implementation and injury prevention research from the outset.
- Continue to partner with these stakeholder groups in further intervention and intervention delivery developments, and even to modify research approaches to accommodate them.
- Develop multifaceted strategic approaches towards injury prevention in relevant real-world culturally relevant settings.
- Develop and evaluate strategic implementation plans designed to address key barriers and facilitators towards intervention uptake across all ecological sports delivery levels.

- Adopt a multidisciplinary approach that embraces both qualitative and quantitative research methodologies, both hard science and social science.

While research about prevention is a necessary to facilitate widespread safety and population level injury prevention, this evidence alone is not sufficient. Researchers need to accept that intervention mapping and the evaluation phase is a time consuming process, but that there is also a major opportunity to become involved in documenting and evaluating this process from a research inquiry point of view. Collation of this new type of sports injury implementation evidence, when coupled with new research partnerships within the target sector, will ensure that injury prevention goals are successful.

6.9 Conclusion

This chapter demonstrates the effectiveness of collaborating intervention mapping as a tool with the development of an injury prevention programme. This study shows that intervention mapping can also be useful for the development of injury prevention programmes merging research and clinical practice. It is recommended that researchers wishing to engage in injury prevention implementation science should engage themselves in understanding the processes that under pin intervention mapping. Whilst developing an injury prevention programme it is critical to bear in mind the impact of the programme on stakeholders involved in the implementation phase. Merging research and clinical practice facilitates the execution of implementing the programme in the 'real world scenario'. This holistic approach to injury prevention encompasses diversity and directs towards developing a programme that is feasible for implementation.

6.10 Implications for the current study

The study lends itself a step further toward implementation by allowing a process for evaluation and comment through means of a Delphi Study. In this final step stakeholders will have an opportunity to review the injury prevention programme and to reach consensus on the content.

Objective Four: To evaluate the feasibility of the proposed protocol

Chapter Seven: A process of reaching consensus on an injury programme for netball players in South Africa

7.1 Introduction

In Chapter Six, an injury-prevention programme for netball players in South Africa was developed. It was important to verify that the injury-prevention programme met the needs of the stakeholders established in chapters Three and Four and that the evidence-based methods, derived from the literature in Chapter Five, were presented in a format that was practical and relevant for implementation by the stakeholders. Chapter Seven presents the views and opinions of an expert panel based on their evaluation of the injury-prevention protocol. The Delphi study also facilitates the process of reaching consensus on the content that should be included in the programme. This chapter evaluates the feasibility for the implementation of an injury-prevention programme for netball players in South Africa from the perspective of the stakeholders involved via a Delphi study.

7.2 Literature review

The theoretical framework of the study is based on Van Mechelen's prevention model, as described by Van Mechelen et al. (1992) and the steps in an adapted operational feasibility study as described by Castro et al. (2002). Both these theoretical models conclude the theoretical steps in their models by designing an intervention programme and conducting an evaluation process.

Bryce (2008) makes the following statement about feasibility studies as stated in chapter one:

> [A] feasibility study should provide management with enough information to decide the following: can the project be done; is the final product beneficial to its intended users; are there alternatives among which a solution can be chosen and is there is a preferred alternative.

In an operational feasibility study, an attempt is made to define the problem and the acceptability of proposed solutions to the problem. It also aims to evaluate whether all stakeholders will utilise the proposed system if it is indeed developed. This type of framework allows for the inclusion of people-oriented and social issues.

In the current study the researcher used the Delphi method, defined as “a multiple iteration technique usually meant to be anonymous with the purpose of refining the expert opinion and ultimately arriving at a combined or consensual position” (Helmer & Rescher, 1959). The Rand Corporation developed the original Delphi method in the 1950s. Over time, the method has been modified and improved, especially with new technology. However, the basic process has remained consistent. The method enables equal input from each panel member and reduces the undue influence of a single viewpoint. Through critical appraisal of the research, health science educators, researchers and clinicians seek to support their craft with the best available evidence (Falzarano & Zipp, 2013).

The Delphi technique is a methodology used in health science literature to provide practical guidelines and to establish consensus via expert opinion on a recommended approach. Keeney, Hasson and McKenna (2006) define the technique as a method to reach consensus on something that is not known or to obtain judgement about a subject. Traditionally, the Delphi technique uses a series of questions in an effort to obtain controlled feedback in order to reach the most reliable consensus among a group of experts in a specified area (Linstone & Turoff, 1975). These researchers developed individual questions that address the overall goals of the questionnaire. Experts individually respond to the questions posed for each section of the questionnaire. The researcher then reviews all the expert responses and modifies the tool accordingly. The modified tool is then resent to the panel until consensus is reached. Consensus is usually set at a predetermined rate and can be measured by the use of a scale such as the Likert

scale. The Delphi process used in this study is represented Figure 7.1.

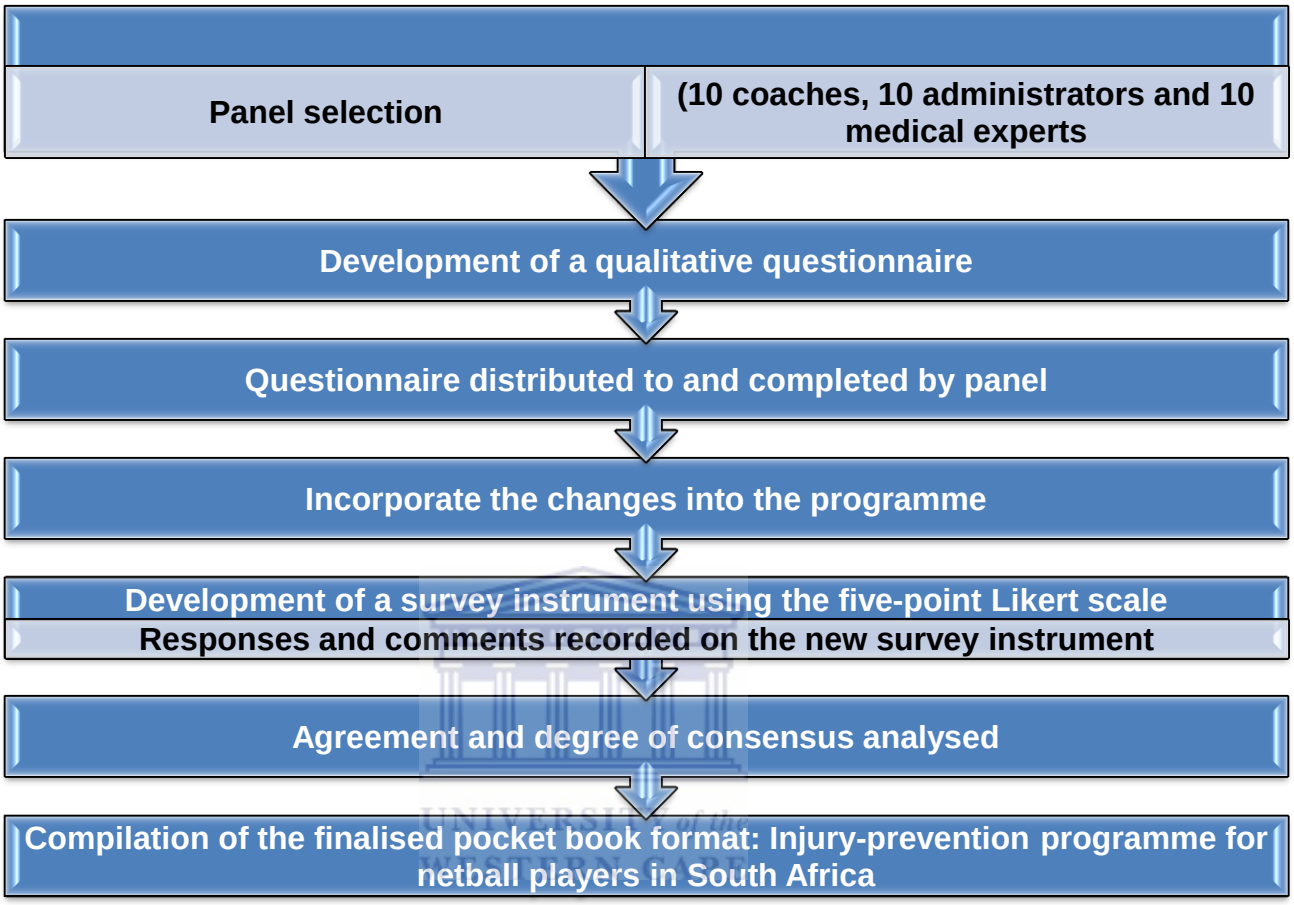


Figure 7.1: The Delphi process

7.2.1 Reaching consensus using the Likert scale

In the Delphi process, data analysis can involve both qualitative and quantitative data. The major statistics used in Delphi studies are measures of central tendency (means, median and mode) and level of dispersion (standard deviation and interquartile range) in order to present information concerning the collective judgements of the respondents (Hasson, Keeney & McKenna, 2000). In the literature, the use of a median score based on the Likert scale is strongly favoured (Jacobs, 1996; Eckman, 1983; Hill & Fowles, 1975). According to Ludwig (1994), "the Delphi process has a tendency to create convergence, and though this was usually to a single point, there was the possibility of polarization or clustering of the

results around two or more points."

The Likert scale was named after its developer, Rensis Likert. The end points of a Likert scale are typically "strongly disagree" and "strongly agree". The participants are asked to indicate their degree of agreement by checking one of five to nine response categories. The Likert scale has several advantages. It is easy for the researcher to construct and administer this scale, and it is easily understood by the respondents (Malik, Mushtaq, Khalid, Khalil & Malik, 2009). Therefore, it is suitable for mail, telephone, personal, or electronic interviews. Several variants of the Likert scale are commonly used in marketing that vary the number of scale points (for example five or seven points); however, longer editions of the scale often leave participants unsure of where to allocate their agreement or non-agreement with the statement. According to Colman, Noris and Preston (1997) in a review article,

> Miller (1956) argued that the human mind has a span of absolute judgment that can distinguish about seven distinct categories, a span of immediate memory for about seven items, and a span of attention that can encompass about six objects at a time, which suggested that any increase in number of response categories beyond six or seven might be futile.

The major disadvantage of the Likert scale is that it takes longer to complete than other itemised rating scales. Respondents have to read the entire statement, rather than a short phrase. The researcher must make four major decisions when constructing Likert type of scales:

1. The number of scale categories to use
2. Balanced versus unbalanced scale
3. Odd or even number of categories
4. Forced versus non-forced choice.

Number of scale categories

With a large scale with a number of categories, the discrimination of choosing a scale category becomes difficult. Participants find it difficult to allocate an answer to varying degerees of aggreability when they exceed the guidlines. Traditional guidelines suggest that the appropriate number of categories should be seven plus or minus two, in other words between five and nine.

Balanced versus unbalanced scale

In a balanced scale, the number of favourable and unfavourable categories is equal. In an unbalanced scale, the number is unequal. In general, the scale should be balanced in order to obtain objective data.

Odd or even number of categories

With an odd number of categories, the middle-scale position is generally designated as neutral or impartial. The presence, position, and labelling of a neutral category can have a significant influence on the response. The Likert scale is a balanced rating scale with an odd number of categories and a neutral point.

Forced versus non-forced choice

On forced rating scales, respondents are forced to express an opinion, because a “no opinion” option is not provided. In such a case, respondents without an opinion may mark the middle-scale position. If a sufficient proportion of the respondents do not have opinions on the topic, marking the middle position will distort measures of central tendency and variance.

The five-point Likert scale was chosen for this study, representing an odd number of categories with a neutral point on a balanced scale. The choice of scale was a forced rating scale .

7.3 Methods

This study utilised both quantitative and qualitative methods to reach consensus on the content of an injury-prevention programme for netball players in South Africa.

7.3.1. Development of a qualitative questionnaire

The qualitative questionnaire was developed to cover 'the elements of a good feasibility study', as described by Bryce (2008). These include the project scope, strengths and weaknesses, requirements, the approach, the evaluation and the review. The scope establishes whether the goals of the programme are definitive and concise. The strengths and weaknesses are associated with identifying the strong attributes of the programme as well as those that require improvement. The approach deals with evaluating the method chosen to address an aspect within the injury-prevention programme. With evaluation, the cost-effectiveness of the approach selected is examined. In terms of review, all the above aspects are considered, after which the feasibility of the injury-prevention programme is ultimately determined. In this questionnaire a qualitative structure was used, with free-text responses to open-ended questions that covered aspects described above. To avoid bias, questions were worded in neutral terms. Items were reviewed with the study supervisor in terms of content, clarity and neutrality, and were refined as needed.

7.3.2 Development of a Likert scale survey

The survey instrument included statements based on the responses, which the panel members responded to according to their level of agreement on a Likert scale. The five-point Likert scale ranged from one, representing "strongly disagree", to five, representing "strongly agree," and three was defined as "neutral". The statements were derived from the themes that emerged from the qualitative questionnaire.

7.3.3 Expert panel

Ten coaches, ten medical administrators and ten medical experts were selected for their work in related fields and their valued expert opinion. Coaches were limited to netball coaches; however, the medical administrators and medical experts included a wide cross-section of subject matter experts representing national federations. A qualitative questionnaire was initially conducted. The participants were asked to review the area of the injury-prevention programme that was of relevance to them. After the selection process was completed, the panel was emailed informing them of the study and of their requested participation. The email also contained a link to the section of the programme they were required to review as well as a link to the qualitative questionnaire. The questionnaire concentrated on obtaining the experts' views and comments on the following:

- The project scope: Programme content
- Strengths and weaknesses of the programme
- Requirements: Proposed modifications of the programme
- The approach: Possible challenges with implementation
- Evaluation: Cost and affordability
- Review: Is this a feasible programme for implementation for netball players in South Africa?

7.3.4 Panel survey

The panel was surveyed twice with the use of the web-based software Google Docs to protect confidentiality and to limit the possibility of bias. Email addresses were collected strictly for administrative purposes. The first qualitative questionnaire was sent to the coaches, administrators and medics together with the section of the injury-prevention programme relevant to their area of expertise. Once the responses were received, the researcher tabled the responses and drew themes from the recommended changes. The recommendations were then constructed into statements on a five-point Likert scale. The second Likert scale

survey was then sent to the participants with the changes posed as statements and the participants were asked to score their level of agreement on the five-point Likert scale. Consensus was then evaluated and the amended changes highlighted on the programme. All participants, coaches, medical experts and administrators scored the same five-point Likert scale survey and received all three aspects of the injury-prevention programme with the highlighted changes. This ensured that all the experts had a holistic view of the injury-prevention programme and facilitated synthesis and consensus on the combined approach to injury prevention for netball players in South Africa. These results were then analysed and applied to the injury prevention programme.

7.3.5 Analysis and interpretation

The responses on the qualitative questionnaire were summarised in a data-capturing form and the individual items were grouped by themes that emerged from the responses. Statistical analyses were performed for each survey question using SAS V.9. (SAS Inc., Cary, USA). Likert scales were reported with the mean, mode, median and full range. Using the Likert scales, consensus was defined as responses clustered within two Likert rating points of the mean response with no more than one outlier. Near consensus occurred when there was a cluster around the mean response with two outliers. No consensus occurred when the consensus or near consensus criteria were not met. These definitions were used as per Rhee et al. (2010).

7.4 Results:

Delphi study Round 1

Ten coaches, ten medical experts and ten administrators were invited to participate in the study. Of the 30 qualitative surveys sent out, six coaches, six medical experts and five administrators replied, yielding a response rate of 57%. All medical experts had less than five years' experience and all administrators had

more than five years' experience in their current position within the federation. The coaches' experience varied with a 50:50 ratio. Female experts dominated the panel, comprising 76.5% (n=13/17) of the panel. Coaches and administrators were the only portfolio that was reflected as being interchangeable. All participants were representative in their capacity either as part of the national netball federation or working at a national level as part of another federation. Table 7.1 represents the demographic information of the participants.

Following the demographic information, the results are summarised as tables and the responses of the coaches, medical experts and administrators are categorised under the headings of themes, highlighting the comments on the coaches' booklet, the injury-prevention protocol and the national physiotherapy association, with substantiating quotes from the open-ended Delphi questions. The results are then discussed under the themes recommended by Bryce (2008).

Table 7.1 Profile of participants

Demographic information: Medical experts	**Years of experience in current position**	**Current position within a federation**	**Other portfolios**
Male	< 5 years	Doctor/Physiotherapist	Doctor/Physiotherapist
Male	< 5 years	Doctor/Physiotherapist	Doctor/Physiotherapist
Female	> 5 years	Doctor/Physiotherapist	Doctor/Physiotherapist
Male	< 5 years	Doctor/Physiotherapist	Doctor/Physiotherapist
Male	< 5 years	Doctor/Physiotherapist	Doctor/Physiotherapist
Female	< 5 years	Doctor/Physiotherapist	Doctor/Physiotherapist
Demographic information: Administrators	**Years of experience in current position**	**Current position within a federation**	**Other portfolios**
Female	> 5 years	Executive Committee	Manager
Female	> 5 years	Executive Committee	Coach
Female	> 5 years	Manager	Coach
Female	> 5 years	Manager	Manager
Female	> 5 years	Executive Committee	Manager

Demographic information: Coaches	**Years of experience in current position**	**Current position within a federation**	**Other portfolios**
Female	> 5 years	Coach	Manager
Female	< 5 years	Coach	None
Female	< 5 years	Coach	Manager
Female	> 5 years	Coach	Manager, Executive Committee
Female	< 5 years	Coach	None
Female	> 5 years	Coach	Manager

7.4.1 Summary of responses by coaches

Table 7.2 Participants: Coaches

Theme	Subcategory	Participants' experience	Quote
The project scope	Definitive goals of the injury-prevention programme	Applicable to injury prevention	"Able to see how the different sections deal with injury prevention"
		Limited resource-implementation guidelines	"adding some of the guidelines how to use the programme will be beneficial"
		Add technical skill correction	"Performing the skill correctly prevents injury"
		Add core training	"Should be inclusive of core training"
		Accessibility of the tool	"Consider translating into another language
	Areas of the programme that should be clarified	Theoretical background and the application of injury-prevention principles	"… coaches and players need theoretical background and practical application … how to apply the programme"

Theme	Subcategory	Participants' experience	Quote
The project scope	Contributing factors to injuries that need to be considered	Training of coaches	"Coaches' courses should include injury prevention … a tool as part of their training
		Technical skills correction	"more technique correction guidelines ... this can cause injury … difficult to change bad technique"
		Compliance	"Responsibility of the players … they default a lot and don't comply"
	Facilitation of the injury-management process	Clear injury-referral route	"… there will be a clear referral route"
		Player education	"… Players need to be taught … they need to know what is expected"

Theme	Subcategory	Participants' experience	Quote
Strengths	Applicability	Player-focused approach	"… stronger, more educated players"
		Sport-specific	"… focused on netball and not a general programme"
	Efficiency	Practical format	"… can be built into a warm-up session … easy access pocket book"
		Empowerment	" … providing a tool giving us the knowledge"
		User-friendly	"… simple and this means more people will use it"
Weaknesses	Applicability	Visual aids	"Try to use more images … facilitates understanding"
	Efficiency	Coach and player behaviour-dependent	"Getting buy-in"
		Time	"Very detailed … might take some time to get all role players involved"

Theme	Subcategory	Participants' experience	Quote
Requirements	Suggested modifications	Content modification	"Focus on technical execution" "More dynamic warm-up" "In the cool-down include core and more static exercises"
		Facilitation of shift in mindset	"Include motivation to help them make the shift to thinking about preventing injury"
		Overview	"Show how the three aspects are linked and how this contributes to making injury prevention easy"
	Challenges with implementation	Funding	"Cost is a big factor"
		Facilitation of the implementation process	"Workshops for the coaches to inform and facilitate the process … they need a process to implement this"
		Printing costs	"The booklets would have to be made available … we won't be able to print it"
		Time	"Change will be time-consuming"

Theme	Subcategory	Participants' experience	Quote
Requirements	Suggested modifications	Removal of barriers to implementation	"… a funding source would have to be found"
		Endorsement of the programme	"… come from a level of authority … buy in when they see media campaigns"
		Adoption of the programme	""It's sport-specific … they would love that they didn't have to invest in the development phase"
		Coaches' booklets	"Printed booklets would have to be made available"
	Challenges with implementation	Co-ordinator	"The co-ordinator can facilitate the coaches"
		Personnel	"… personnel to get us started and to supervise the implementation"

Theme	Subcategory	Participants' experience	Quote
Cost evaluation	Cost-effective	Medical aspect	"The medical part might be expensive … the equipment"
		Initial cost	"… would have to fundraise but it is a feasible once-off investment"
		Relative cost	"Looking at medical treatment in comparison, this is a good way to deal with it"
	Affordability	Player commitment	"No, players don't even pay their club fees … anything involving cost becomes a problem"
		Federation assistance	"If the federations helps, then yes"
		Focus-driven	"… fundraise … focus on getting it … then they would be able to do it"
Review of feasibility	Holistic approach	Stakeholder involvement	"Yes, it addresses all role players and stakeholders"
			"Involves everyone … to contribute"
		Focused approach	"Yes, it covers most injury-prone parts"

Theme	Subcategory	Participants' experience	Quote
Review of feasibility	Appropriate implementation method	Encompassing	"Yes, it looks at all the aspects. Medical, management and the coach and the player"
		Tool	"The coaches always use handbooks … so this is good"
		Accessibility	"Coaches in rural areas don't necessarily have access to technology"
	Feasibility for implementation in SA Netball	Transfer of knowledge	"We may not have access to the knowledge but this gives us the knowledge" "Yes, the work has been done for us … the federation must take ownership"
		Federation input	"… effective way to implement a strategy that has a definite product … that has a once-off cost that could be shared by many"
		Efficiency	

7.4.2 Discussion: Responses by coaches

Responses from the coaches were positive however they did make a few recommendations.

7.4.2.1 The project scope

The coaches described the project scope as applicable to injury prevention. The goals of the injury-prevention programme were agreed to be definitive, although a guideline should be included as to how to use the programme. They also commented that technical skills training correction and core training should be included as goals of the injury-prevention programme. In addiiton, the coaches expressed a need for a practical application guide against the theoretical background provided to facilitate the implementation process. Contributing factors to injuries that need to be considered included coach training. It was expressed that the empowerment of coaches with knowledge at the outset, as part of their training, would facilitate injury prevention. The coaches emphasised that the incorrect execution of technique contributed to injury and that bad habits are difficult to change later. Compliance of the player was also mentioned, and also that injuries were recurrent as the players defaulted and did not comply with prescriptions. A clear injury-referral route was described as facilitating the injury-management process and player education was regarded as critical to facilitate this process.

7.4.2.2 Strengths and Weakness

From the view of the coaches, strengths and weaknesses linked to the programme were highlighted. The strengths highglighted by the coaches included:

- The programme was viewed as being applicable, with a player-focused approach.
- The major strength of the programme was that it was sport-specific and presented in a practical format.

- They agreed that the efficiency of the programme was that it empowered them by providing them with an educational tool in a user-friendly manner.

Weakness or challenges identified that may be experienced with the implementation of this programme included the following:

- The programme was dependent on buy-in from the coaches and players, and this was seen as a weakness greatly influencing the success of the implementation.
- Time was also regarded as a deterrent, as the programme was very detailed, and it was stated that it could take some time to get all the role players involved.
- Another challenge was the limited number of visual aids and thus the recommendation that more visual aids be included.

In addition to strengths and weaknesses, the coaches also made recommendations and these inluded the following suggestions:

- Modifications of content were recommended with a focus on the correction of technical execution, the emphasis on the warm-up to be a dynamic one and the inclusion of core and more static exercises in the cool-down.
- The use of a motivational introduction to facilitate the mind shift required to change the focus to preventing injury was also mentioned.
- Cost was raised as a factor that should be reviewed.

7.4.2.3 Requirements for implementation

To facilitate the implementation of the programme that had been raised as a challenge, workshops were seen as a need to inform coaches of how to use the programme. The coaches requested that the booklets needed to be made available, as printing would not be an option. Making the mind shift to preventing injuries and the time required to implement the programme were also raised as implementation challenges and the strategy for change management needed some thought.

7.4.2.4 Cost Evaluation

The federation's buy-in was considered dependent on a funding source as well as the endorsement of the programme from a level of authority. The coaches also mentioned a campaign and media as tools that would facilitate federation buy-in. They felt that one major advantage why the programme would be embraced, was that no investment had to made in the developmental phase. The coaches highlighted that infrastructural requirements to implement the programme would include the printed booklets, a coordinator to facilitate the coaches and personnel to initiate and supervise the process. The participants regarded the issue of purchasing the injury-prevention programme as a feasible once-off investment for which they would be able to raise funds. They compared the programme to the relative cost of medical treatment and agreed that it was a good way to overcome excesive treatment costs by preventing injury. However, they still found the equipment mentioned in the protocol expensive. Federation support would have to be obtained, as the coaches stated that players do not even commit to paying their club fees. The process therefore has to be focus-driven and funds should be raised for it.

7.4.2.5 Review of Feasibility

Their opinion was that the programme would be feasible for implementation, as it was holistic, with stakeholder involvement as a focused approach and consideration of all aspects of injury prevention. The tool was found to be appropriate for and accessible to people without technology transferring the required knowledge. The overall efficiency was described as an effective way to implement a strategy that has a definite product, with a once-off cost that could be shared by many.

7.4.3 Summary of responses by medical experts

Table 7.3 Participants: Medical experts

Theme	Subcategory	Participants' experience	Quote
The project scope	Definitive goals of the injury-prevention programme	Goals of the association	"The goals of the physiotherapy association in terms of injury prevention is unclear"
		Federation focus	"…does the structure pertain to netball as a federation or is it a national physiotherapy association?"
		Involvement of other sport medicine staff	"…collaborate with biokineticists and sport physicians for depth"
	Areas of the programme that should be clarified	Clarification of the aims of each component	"The content of the first two aspects is unclear, e.g. what information is contained … need an overview"
	Contributing factors to injuries that need to be considered	Screening	"Pre-season screening is not included"
		Supervision	"Qualified supervision for technique errors"

Theme	Subcategory	Participants' experience	Quote
The project scope	Contributing factors to injuries that need to be considered	Rehabilitation	"… return-to-play protocols"
		Contact sport	"Programme fails to address the added impact of contact … include exercises where the athlete has to push off a surface"
		Content to be added	"footwear, playing surface, flexibility, dynamic core and dynamic stabilisation, exercises for movement control when changing direction"
		Revision of the suggested programme	"If the changes are applied, yes"
		Holistic view of the programme	"If we understand how this component will be integrated with the others, then yes"
	The facilitation of the injury-management process	Integrated approach	"… holistic approach, distinguishes the roles to be addressed"

Theme	Subcategory	Participants' experience	Quote
Strengths	Applicability	Practical	"Not time-consuming … can be included in the warm-up"
		Relevant content	"Eccentric programme are good exercises for proprioception"
		Variance	"Modify exercises weekly, give the programme variety … more appealing to players"
	Efficiency	Time	"Not time-consuming in terms of an additional activity at training … included in the warm-up"
Weaknesses	Applicability	Duration of the programme	"Six weeks is a bit long, try to shorten to four weeks. like the FMARC"
	Efficiency	Content	"Lacks mention of dynamic flexibility and core and dynamic stabilisation"
		Implementability	"Over a broad spectrum this might be difficult to implement"
		Supervision	"Compliance … supervision of the programme is required"

Theme	Subcategory	Participants' experience	Quote
Requirements	Federation buy-in	Fitness guidelines	"Add minimum fitness requirements for different levels of play"
		Physiotherapy association goals	"Injury surveillance should be included as a goal of the association"
		Programme modifications	"Add return-to-play protocols"
			"Programme should be shortened to four weeks"
			"Progression of exercises should be in intensity and not change of activity"
			"Include change of direction training and contact training"
		Screening	"Include test-retest or a screening form"
			"Buy-in of the coaches"
		Adoption of the programme	"Implementation of the programme and sustainability"
		Programme facilitation	

Theme	Subcategory	Participants' experience	Quote
Requirements	Infrastructure requirements	Dedicated staff	"Need someone committed to the programme to ensure it is carried out per specification"
		Assistance with the implementation process	"Facilitation to workshop this with the coaches"
		Change of mindset required	"If the coaches can be convinced"
		Motivation of clinical evidence	"If compelling clinical evidence, yes"
		Platform for implementation	"Roll-out plan from the national federation"
		Staff	"Strength and conditioning coach or a physio to monitor"

Theme	Subcategory	Participants' experience	Quote
Cost evaluation	Cost-effective	Longevity of the programme	"Yes, depending on the successful implementation and sustainability thereof"
		Focus-driven approach	"Yes, if they focus on implementing it"
	Affordability	Comparative effect	"Most, if you consider costs this would save compared to physio consultations in the case of injuries"
Review of feasibility	Holistic approach	Modifications need to be considered	"It is practical to implement and can be considered holistic with the amended changes"
	Appropriate implementation method	Modifications need to be considered	"Yes, if shortened"
			"Yes, if modifications are made"
	Feasibility for implementation in SA netball	Modifications would enable feasibility of the programme	"A few improvements would need to be made; in principle yes, such a programme would go a long way in preventing lower-limb injuries"

7.4.4 Discussion: Responses by medical experts

7.4.4.1 The project scope

There were mixed responses from the medical experts to the goals of the injury-prevention programme, with some responses indicating that the goals of the injury-prevention programme were unclear. The medical experts also sought clarity on the physiotherapy association and whether it pertained to netball as a federation or whether it was a national physiotherapy association for all sports. Collaboration with a biokineticist and a sport physician was recommended for depth. An overview of the injury-prevention programme was requested with the clarification of the aims of each component of the programme and the manner in which they would be integrated. Contributing factors to injury that need to be considered include pre-season screening, the qualified supervision of techniques errors with the implementation of the protocol and a rehabilitation guideline for return-to-play protocols. It was also stated that netball is a contact sport and that the programme fails to address the added impact of contact. Content to be added included recommendations on footwear, risks associated with playing surface, flexibility, dynamic core and dynamic stabilisation and exercises for movement control when changing direction. The participants felt that the application of these suggested revisions would facilitate the injury-management process.

7.4.4.2 Strengths and Weakness

The experts wanted to have a good understanding of how the protocol would be integrated with the coaches' booklet and the national physiotherapy association in order to understand its holistic nature. The considered strengths of the programme included that it was practical to implement as well as time-efficient, as it could be included in the warm-up. The choices of exercises were regarded applicable and the variance with a weekly modification of exercises meant that the programme would be more appealing to players. However, the experts felt that a six-week

programme was a bit long and that it should be shortened to four weeks. They also pointed out that the content lacked mention of dynamic flexibility and core and dynamic stabilisation exercises.

7.4.4.3 Requirements for implementation

The medical experts mentioned the folowing as considerations to bear in mind and this included that the programme might be difficult to implement over a broad spectrum, that the compliance might also be an issue and that supervision would be required for a programme of this nature. Suggested modifications included adding minimum fitness requirements for different levels of play, and including injury surveillance as a goal of the physiotherapy association. They suggested that progression of the programme should be in terms of intensity, not a change in the type of activity, and that change of direction and contact training as well as a test-retest or a pre-season screening form be included.

Buy-in from coaches was mentioned as a challenge in terms of implementation as well as facilitation of the programme by qualified staff. Dedicated staff would be required to ensure implementation as per the specification. Workshops were named as a process to implementation. The medical experts stated that a change of mindset and motivational evidence in the form of convincing clinical evidence were required to ensure federation buy-in. There would also need to be a platform for implementation with a roll-out plan from the national federation. Staff required could include a strength and conditioning coach to monitor the application of the programme.

7.4.4.4 Cost Evaluation

The experts felt that the programme would be cost-effective if it was successfully implemented and sustainable. The stakeholders were regarded as able to afford the programme if they focus on attaining it. The comparative effect was also

mentioned, referring to the saving compared to paying for physiotherapy consultations.

7.4.4.5 Review of Feasibility

The experts stated that the programme would be considered holistic if the modifications were applied, and that the implementation method would also be appropriate if the programme was shortened. In their opinion, the suggested modifications would also enhance the feasibility of implementation.

7.4.5 Summary of responses by administrators

Table 7.4 Participants: Administrators

Theme	Subcategory	Participants' experience	Quote
The project scope	Definitive goals of the injury-prevention programme	Policy framework and procedure	"… gives a clear guideline as to the entities within the federation that would be responsible for the different components"
		Integration of the three aspects	"… can clearly see how the three aspects would be implemented"
		Player involvement	"The responsibility and the involvement of the player should be mentioned"
	Areas of the programme that should be clarified	Personnel	"Perhaps identify personnel that would need to be employed to implement this programme"
		Federation-focused approach	"The programme seems to be detailed for all federations, will it be rolled out as such, although the focus is on netball?"

Theme	Subcategory	Participants' experience	Quote
The project scope	Contributing factors to injuries that need to be considered	Technical skills correction	"Coaches must [place] emphasis on correct technical execution"
	The facilitation of the injury-management process	Clarification of roles	"From a management structure point of view it clarifies the roles"
		Guidelines	"… gives clear guidelines as to how to implement an operational structure to keep players healthy"
Strengths	Applicability	Stakeholder involvement	"It involves all the role players, so everyone is involved"

Theme	Subcategory	Participants' experience	Quote
Strengths	Efficiency	Comprehendible	"It's simple to understand … simple language"
		Implementability	"The design is easy to implement. It speaks to structure of the injury prevention programme …"
			"It's easy to understand.."
Weaknesses	Efficiency	Time-consuming	"It could be a time-consuming process to get everyone involved and implement the different aspects … it could be shorter"
		Elitist	"The programme does ask for specific qualifications ... it could exclude some physios but then I guess they could volunteer"
Requirements	Suggested modifications	Time efficient	"Consider making it as time-efficient as possible to implement … shorten the programme"
		Integration of all medical staff	"Include how other medical staff would function within the structure"

Theme	Subcategory	Participants' experience	Quote
Requirements	Challenges with implementation	Staff to facilitate the programme	"Challenges would be less if the process was facilitated by the researcher"
		Time and funding	"Time and funding to facilitate the implementation would have to be sought"
		Discipline	"We may not have the discipline from the coaches and players to comply with the programme"
		Personnel	"Personnel and time to workshop and plan how to roll out the programme"
	Federation buy-in	Cost-efficiency motivating	"Yes, when they see the saving to the federation they will"
		Consensus	"If this was discussed and agreed upon by the Exco"
	Infrastructure requirements	Finance	"Funding … support in the form of sponsorship"

Theme	Subcategory	Participants' experience	Quote
Requirements	Infrastructure requirements	Skilled staff	"Personnel to implement the programmes"
		Invested mindset	"Mindset change from injury management to prevention"
Cost evaluation	Cost-effective	Comparative cost	"When we look at the budget we have to lay out for medical staff and injuries, yes"
		Avoids unnecessary cost	" The Physiotehrapy Association streamlines the management and therefore the approach to the injuries besides preventing also standardises what is done"
		Simple approach	"Yes, it simplifies the approach to injury management and that is what makes it cost-effective"
	Affordability	Sharing of cost	"Maybe the clubs and players could jointly pay for it"

Theme	Subcategory	Participants' experience	Quote
Cost evaluation	Affordability	Sponsorship	"… attainable to get a sponsor and roll out the programme under the auspices of netball"
		Focus-driven approach	"It's all about mind shift. If you see the value in something, it is attainable"
		Compulsory implementation approach	"… possible if it was rolled out from an official capacity and made a directorate, they could fundraise if they knew they had to get it"
Review of feasibility	Holistic approach	Role players	"It incorporates all role players"
		Involvement of structures	"It includes all the structures in the federation"
	Appropriate implementation method	Accreditation	"This should be motivated to a higher body like SASCOC. The structure will facilitate injury prevention from an accredited platform"
		Policy framework and structure	The organogram and the proposed structure will be easy to implement within the current structure and Exco"

Theme	Subcategory	Participants' experience	Quote
Review of feasibility	Appropriate implementation method	Foundation for sustainability	"The component will create a foundation to build on and facilitate keeping our players on the court"
		Monitoring	"… and puts control measures in place"
		Value for investment made	"… ensures the correct staff are put in place and we get value for our investment"
	Feasibility for implementation in SA netball	Realistic aim	"Yes, it is a great initiative and considering all the aspects, it is doable"
		Vision and focus	"The clear vision and focus of the Physiotherapy Association as it is detailed make it feasible for implementation"
		Goal-orientated	"It has a specific goal and it is easy to understand"

7.4.6 Discussion: Responses by administrators

7.4.6.1 The project scope

The administrators agree that the policy framework and procedure give clear guidelines as to the entities within the federation that would be responsible for the different components of the injury-prevention programme. They agreed that they could clearly see how the three aspects of the injury-prevention programme would be integrated. They felt that the role of the players' involvement should be mentioned and clarified as well as the personnel that would need to be employed to implement the programme. They commented that the programme seemed to be detailed for all federations from a policy aspect and clarity was sought on the federation focus.

A contributing factor to injury that the administrators felt need to be considered was technical skills correction. They also emphasised that clarification of the roles of the various stakeholders from a management structure point of view facilitated injury management. The programme also gave the administrators guidelines as to how to implement an operational structure to keep players healthy. They regarded the programme as applicable, as it involved all the role players, and efficient due to it being comprehendible. The design of the National Physiotehrapy Association spoke to structure and it was in simple language that was easy to understand.

7.4.6.2 Strengths and Weakness

Time efficiency was noted as a weakness, as the administrators felt that it could be a time-consuming process to get everyone on board and to implement the different aspects of the injury-prevention programme. They also thought that programme may be seen as elitist, as it requires specific qualifications in physiotherapists for the different playing levels, but this was further substantiated by the fact that it presents opportunities for volunteers, thereby contributing to its inclusivity.

7.4.6.3 Requirements for implementation

Suggested modifications included shortening the protocol to make it time-efficient and integrating all medical staff disciplines to see how they would function within the structure. It was noted that challenges to implementation would be less if the researcher facilitated the process. The administrators noted that time and funding to facilitate the implementation process would have to be sought. The administrators furthermore felt that the required time and discipline might not be obtained from the coaches and players to comply with the programme. Personnel and time to workshop and plan and the roll-out of the programme were also regarded as a challenge with regard to implementation. Cost-efficiency was seen as a motivating factor to attract federation buy-in. They stated that they would adopt the programme if it was discussed and agreed upon by the executive committee.

7.4.6.4 Cost Evaluation

Infrastructure requirements mentioned included finance in the form of sponsorship, personnel to implement the programme and a mindset change from injury management to injury prevention. The programme was regarded as cost-effective when considering the comparative cost of the budget they would have to lay out for medical staff and injuries. It also streamlined the management of injuries, thereby avoiding unnecessary cost. Affordability was expressed as a sharing of cost and it was suggested that clubs and players could perhaps jointly afford the injury prevention programme. Attaining a sponsor and roll-out of the programme under the auspices of NSA were other possibilities mentioned. Affordability was also viewed as a mindset: “If you see the value in something, it is attainable”. The administrators argued that compulsory implementation would also change the view of affordability, and the affordibilty thereafter could be enahanced enabled by fundraising.

7.4.6.5 Review of Feasibility

The administrators were of the opinion that the advocacy for the injury prevention programme by a higher authority would strengthen the credibility of the programme highlighting the importance of implementation. The

administrators also reported that the programme incorporated all role players and involved all structures within the federation. The method for implementation was considered appropriate within a policy framework and structure, and they also felt that it provided a foundation for sustainability, thereby assisting with a process for monitoring and evaluation. This in turn would ensure the appointment of the correct staff and a return on investment. The programme was deemed feasible for implementation based on the realistic aim of the programme, and on it having a clear vision and focus and an outcome that is goal-orientated and easy to understand.

7.5 Formation of the statements for the Likert scale survey

Table 7.5 collates all the changes and recommendations made by the Delphi panel. These changes were then converted into Likert scale statements on a scale rating from 1 to 5. Round 2 of the Delphi study was conducted via the five-point Likert scale survey.

Table 7.5 Formation of the Likert scale survey

Participants	Recommendation	Likert scale statement
Coaches	Add guidelines on how to use the coaches' booklet	Use of the coaches' booklet would be facilitated by: Guidelines
Coaches and medical experts	Add a core training programme	Exercises in the coaches' booklet should include: Core training
Coaches and administrators	Add technical skills correction	Exercises in the coaches' booklet should include: Technical skills correction
Coaches	The coaches' booklet should be translated	Use of the coaches' booklet would be facilitated by: Translating the booklet
Coaches	More visual aids need to be added to the programme	Use of the coaches' booklet would be facilitated by: Adding visual aids
Coaches	The warm-up should include more dynamic activities	Exercises in the coaches' booklet should include: A dynamic warm-up
Coaches	Include core and more static exercises in the cool-down	Exercises in the coaches' booklet should include: A static cool-down with core exercises
Coaches and administrators	Include motivational quotes	Use of the coaches' booklet would be facilitated by: Motivational quotes

Participants	Recommendation	Likert scale statement
Coaches	The programme needs an overview showing the integration of the three aspects of the injury-prevention programme	Use of the coaches' booklet would be facilitated by: An integrated overview of the three components of the programme
Medical experts	Goals for the physiotherapy association need be included	The framework of the physiotherapy association would be facilitated by: Adding goals
Medical experts and administrators	Clarification on the federation focus of the national physiotherapy association	The framework of the physiotherapy association would be facilitated by: Clarifying the federation focus
Medical experts and administrators	Add the role of the biokineticist and the sport physician in the national physiotherapy association	The framework of the physiotherapy association would be facilitated by: The role of the bio and sports physician
Medical experts	Pre-season screening should be added to the protocol	The exercise protocol should be modified by: Including pre-season screening
Medical experts	Return-to-play protocols should be added	The exercise protocol should be modified by: Including return-to-play protocols

Participants	Recommendation	Likert scale statement
Medical experts	Exercises to prevent contact injuries should be included, e.g. pushing off a surface	The exercise protocol should be modified by: Including exercises to prevent contact injuries
Medical experts	Guidelines on footwear and playing surface	The exercise protocol should be modified by: Including guidelines on footwear and playing surface
Medical experts	Exercises on dynamic stabilisation	The exercise protocol should be modified by: Including dynamic stabilisation exercises
Medical experts	Exercises on flexibility	The exercise protocol should be modified by: Including flexibility exercises
Medical experts	Exercises for changing movement control when changing direction	The exercise protocol should be modified by: Including exercises for changing movement control when changing direction
Medical experts and administrators	The programme should be shortened to a four-week cycle	The exercise protocol should be modified by: Shortening the duration to four weeks

Participants	Recommendation	Likert scale statement
Medical experts	Minimum fitness requirements should be added for the different levels of play	The exercise protocol should be modified by: Adding the minimum fitness requirements for the different levels of play
Medical experts	Injury surveillance should be added as a goal of the physiotherapy association	The framework of the physiotherapy association would be facilitated by: Adding injury surveillance as a goal
Medical experts	Progression of the protocol should be via change of intensity and not a change in activity	The exercise protocol should be modified by: Progressing the intensity of activities and not changing the activity
Administrators	The responsibility and the involvement of the player should be mentioned	The framework of the physiotherapy association would be facilitated by: Mentioning the responsibility and involvement of the player
Administrators	Identify personnel that would need to be employed to implement the programme	The framework of the physiotherapy association would be facilitated by: Identifying the required personnel

7.6 Results round 2: Likert scale survey

Ten coaches, ten medical experts and ten administrators were initially invited to participate in the first round of the Delphi study. Of the 30 qualitative surveys sent out, six coaches, six medical experts and five administrators replied, yielding a response rate of 57%. In Round 2, the Likert scale survey was sent out to all 30 of the original participants; however, only participants that responded in Round 1 responded in Round 2. Therefore, the response rate for the Likert scale survey was also 57%.

7.6.1 Likert scale statements and agreeability scale coding analysis

In the analysis phase of the Likert scale, statements were numbered in the order of their appearance on the survey, and the five options of the level of agreeability scale were also numbered from 1 to 5. Data were entered into an Excel data sheet and manually re-entered a second time to ensure that no human errors were made in the data-entry process. Table 7.6 shows the Likert scale and Table 7.7 shows the level of agreeability coding system.

Table 7.6 Likert scale statement coding

Likert scale statement	**Code:**
Use of the coaches' booklet would be facilitated by: Guidelines	Q1
Exercises in the coaches' booklet should include: Core training	Q2
Exercises in the coaches' booklet should include: Technical skills correction	Q3
Use of the coaches' booklet would be facilitated by: Translating the booklet	Q4
Use of the coaches' booklet would be facilitated by: Adding visual aids	Q5
Exercises in the coaches' booklet should include: A dynamic warm-up	Q6
Exercises in the coaches' booklet should include: A static-cool down with core exercises	Q7
Use of the coaches' booklet would be facilitated by: Motivational quotes	Q8
Use of the coaches' booklet would be facilitated by: An integrated overview of the three components of the programme	Q9
The framework of the physiotherapy association would be facilitated by: Adding goals	Q10
The framework of the physiotherapy association would be facilitated by: Clarifying the federation focus	Q11
The framework of the physiotherapy association would be facilitated by: The role of the bio and sports physician	Q12
The exercise protocol should be modified by: Including pre-season screening	Q13
The exercise protocol should be modified by: including return-to-play protocols	Q14
The exercise protocol should be modified by: Including exercises to prevent contact injuries	Q15

Likert scale statement	Code:
The exercise protocol should be modified by: Including guidelines on footwear and playing surface	Q16
The exercise protocol should be modified by: Including dynamic stabilisation exercises	Q17
The exercise protocol should be modified by: Including flexibility exercises	Q18
The exercise protocol should be modified by: Including exercises for changing movement control when changing direction	Q19
The exercise protocol should be modified by: Shortening the duration to four weeks	Q20
The exercise protocol should be modified by: Adding the minimum fitness requirements for the different levels of play	Q21
The framework of the physiotherapy association would be facilitated by: Adding injury surveillance as a goal	Q22
The exercise protocol should be modified by: Progressing the intensity of activities and not changing the activity	Q23
The framework of the physiotherapy association would be facilitated by: Mentioning the responsibility and involvement of the player	Q24
The framework of the physiotherapy association would be facilitated by: Identifying the required personnel	Q25

Table 7.7: Likert scale level of agreeability coding system

Likert Scale Agreeability Level	Code
Strongly agree	1
Agree	2
Neutral	3
Disagree	4
Strongly disagree	5

7.6.2 Statistical meaning

The mean, mode, median and full range for the coded responses are presented in Table 7.8

Table 7.8 Mean, Mode, Median and Full range for coded responses

Question no.	Mean	Mode	Median	Full range
Q1	2.18	2	2	[1:3]
Q2	2.18	2	2	[2:3]
Q3	1.88	2	2	[1:3]
Q4	2.12	2	2	[1:3]
Q5	2.06	2	2	[1:3]
Q6	1.94	2	2	[1:3]
Q7	1.94	2	2	[1:3]
Q8	1.76	2	2	[1:2]
Q9	1.82	2	2	[1:2]
Q10	1.94	2	2	[1:2]
Q11	1.88	2	2	[1:3]
Q12	1.59	1	2	[1:3]
Q13	1.82	2	2	[1:2]
Q14	1.71	2	2	[1:3]
Q15	1.82	2	2	[1:3]
Q16	2.00	2	2	[1:3]
Q17	2.88	2	3	[2:4]
Q18	2.12	2	2	[2:3]
Q19	2.12	2	2	[2:3]
Q20	2.53	2	3	[2:4]
Q21	2.06	2	2	[1:3]
Q22	2.18	2	2	[2:3]
Q23	2.12	2	2	[2:3]
Q24	2.00	2	2	[2:2]
Q25	2.12	2	2	[2:3]

Table 7.8 shows that on all statements, the mode score is between 1 and 2, showing that all the statements, which are recommended changes derived from the qualitative questionnaire, were strongly agreed upon or agreed upon by the majority of the participants as changes that should be included. There was strong advocacy for Statement 12, *The framework of the physiotherapy association would be facilitated by: The role of the biokineticist and sport physician*, with a mode of 1. For Statement 17, *The exercise protocol should be modified by: Including dynamic stabilisation exercises*, and Statement 20, *The exercise protocol should be modified by: Shortening the duration to four weeks*, the median response was 3, indicating that there were participants who marked 4 on this statement and therefore disagreed with it.

7.6.3 Reaching consensus

Using the Likert scales, consensus was defined as responses clustered within two Likert rating points of the mean response with no more than one outlier. Near consensus occurred when there was a cluster around the mean response with two outliers. No consensus occurred when the consensus or near consensus criteria were not met. Table 7.9 shows the number of outliers for each statement numbered 1 to 25.

Table 7.9 Number of outliers per statement

Question no.	Number of outliers from the mean
Q1	1
Q2	0
Q3	1
Q4	3
Q5	4
Q6	1
Q7	1
Q8	0
Q9	0
Q10	0
Q11	2
Q12	1
Q13	0

Question no.	Number of outliers from the mean
Q14	1
Q15	1
Q16	0
Q17	5
Q18	0
Q19	0
Q20	3
Q21	1
Q22	0
Q23	0
Q24	0
Q25	0

Consensus was reached on 12 statements, and 9 statements had near consensus. There was no consensus on (n=4) statements. Statements 4 and 5 had three and four outliers respectively. The full range for both these statements is [1:3]. Although there was no consensus on these statements, no participants disagreed that the statement should be included and in this instance, it implies that there were more than two participants who either strongly agreed or were neutral to the statement. The non-consensus in this instance had no effect on the inclusion of the statement in the injury-prevention programme. Statements 17 and 20 had five and three outliers respectively. The full range for Statement 17 was [2:4], indicating that some participants disagreed with the inclusion of this statement. The mean score for this statement was 2.88, however, which meant that the majority of the participants agreed with the inclusion of the statement. The full range for Statement 20 was [2:4], indicating that some participants also disagreed with the inclusion of this statement. The mean score for this statement was 2.53, translating into the majority of the participants agreeing with the inclusion of the statement. These two statements were therefore not excluded from the list of recommended changes made by the stakeholders in the qualitative questionnaire.

7.7 Discussion

The aim of Delphi the study was to evaluate the relevance and feasibility of the proposed protocol among netball stakeholders. The content of the injury-prevention programme can provide a starting point for further research and implementation. With adequate resources, this could be adapted to be incorporated into a national framework for sports-injury prevention, targeting national federations in South Africa. The panellists were chosen with a view to representation of a large number of viewpoints reflective of netball stakeholders and the use of the Delphi technique allowed the panel to express their views anonymously. It also facilitated the evaluation of the consistency of the recommendations made by the panellists. In this way, consensus on the included content for the injury-prevention programme could be sought without introducing the bias of interpersonal relationships and prejudice.

According to Carley, Mackway-Jones and Donnan (1999), the Delphi process has some limitations, as the selection of the panel depends on the subjective opinion of the researcher and the availability of the experts within the allocated time period. In Round 1 of the Delphi study, coaches, medical experts and administrators were able to categorically make definitive recommendations on the proposed injury-prevention programme.

In the qualitative aspect of the study, the coaches argued that the approach of the injury-prevention programme was holistic in nature, involving all stakeholders in netball. The coaches viewed the booklet as having a focused approach with specific outcomes, empowering them with knowledge and providing ownership of this aspect of the injury-prevention programme. The programme was also said to be efficient, as it provided a cost-effective tool that was accessible if implemented among a wider community. This is important, as it illustrates a willingness to embrace the injury-prevention programme and illustrates that if it is implemented, there will be stakeholder buy-in.

The medical experts advocated for a variety of changes to the injury-prevention exercise protocol. The injury-prevention protocol was derived from the literature conducted in the systematic review in Chapter Five of this study. All exercises included in the protocol were conducted in the environment of clinical trials and showed positive outcomes for the various interventions due to the type of activity performed and the exercise dosage. The modifications advocated by the medical experts were included in the Likert scale survey to validate the consensus of these changes. Two statements from the Likert scale survey reached no consensus, with reference to shortening the duration of the protocol from six weeks to four weeks and including dynamic stabilisation exercises. However, the mean scores on these statements of 2.88 and 2.53 respectively still reflected that the majority of the participants agreed with the inclusion of the change in the protocol.

The medical experts agreed that the injury-prevention protocol would be feasible for implementation if the modifications to the protocol were made. It was important to establish the medical experts' views on the protocol, as it highlighted what they perceive as being pertinent to preventing injuries in netball. Medical experts practice within a variety of sports and are able to draw from these experiences and apply the knowledge clinically. However, within the scope of this study, the researcher developed an injury-prevention protocol that was grounded in theory and evidence from studies previously conducted. The interventions from these studies were then combined to form the injury-prevention protocol for this study. In the absence of a clinical trial for the proposed protocol with and without the recommended changes, the researcher would have to advocate that the protocol designed for this study be tested in a clinical trial setting using the recommended changes as a control. This would provide an evidence-based platform to advocate for or negate the recommendations. In its current format, the injury-prevention protocol would be feasible for implementation once a clinical trial was conducted.

The administrators reviewed the national physiotherapy association aspect of the injury-prevention programme. They commented that the association was

structured and would create a foundation to build on and facilitate keeping netball players on the court by ensuring control and monitoring measures for injury prevention. It was recommended that the association be motivated to a higher body such as SASCOC to facilitate injury prevention from an accredited platform. It was also viewed as being easy to implement within the current structures of netball in South Africa. The National Physiotherapy Association is feasible for implementation as part of the injury prevention programme; however, the administrators commented that this would require a mindshift from injury management to injury prevention.

7.8 Conclusion

The coaches viewed the booklet as having a focused approach with specific outcomes, empowering them with knowledge and providing ownership of this aspect of the injury-prevention programme. The programme was also regarded as efficient, as it provided a cost-effective tool that was accessible if implemented to a wider community. The emdical experts advocated for a number of changes for the injury prevention protocol. In the absence of a clinical trial for the proposed injury prevention protocol, the researcher would have to advocate that the protocol designed for this study be tested in a clinical trial setting using the recommended changes as a control. The national physiotherapy association is feasible for implementation; however, the administrators commented that this would require a mindshift from injury management to injury prevention.

7.9 Implications for the current study

The content of the injury-prevention programme can provide a starting point for further research and implementation. With adequate resources, this could be adapted to be incorporated into a national framework for sports injury prevention, targeting national federations in South Africa.

Chapter Eight:
Discussion, conclusion and implications for clinical practice

8.1. Introduction

This thesis consisted of four objectives, which were discussed, in chapters three to seven. Chapter eight presents the discussion chapter where the cohesion of the study is brought together and discussed. It also highlights this study's implications for clinical practice.

8.2. The theoretical framework of this study

The aim of this study was to determine the feasibility of an injury prevention protocol for netball players in South Africa. The theoretical framework of the study was based on van Mechelen's sequence of prevention model and the steps in an adapted operational feasibility study as described by Castro et al. (2002). Van Mechelen et al. (1992) presents a "sequence of prevention" that was incorporated for netball in South Africa and upon which an injury prevention programme for netball player in South Africa was based. In this model, Van Mechelen attempts to identify the problem, design and implement an intervention and evaluate the intervention. Throughout this model, all key stakeholders are included at every stage of the process. In this study, this was done through the four objectives described in chapters three to seven of this thesis.

The four-stage model of sports injury prevention has been a valuable tool to guide injury research over the past decade and was therefore chosen as the theoretical framework for this study. The model guided this study from a development aspect by clearly outlining the required evidence needed to build an evidence base about sport injuries in netball and the steps that needed to be taken in order to develop an intervention strategy.

A feasibility study represents a definition of a problem or opportunity to be studied, an analysis of the current mode of operation, a definition of requirements, an evaluation of alternatives, and an agreed upon course of action. The author highlights that “a feasibility study should provide management with enough information to decide the following: whether the project can be done; whether the final product will benefit its intended users; what are the alternatives among which a solution will be chosen and if there is a preferred alternative to the proposal”.

In this study the four objectives of the study and the engagement of stakeholders through every process as well as the evaluation phase of the study conducted through the Delphi method assimilates the research with the steps conducted in a feasibility study. **Table 1.2** below summarises the commonalities of the theoretical approaches on which this study is based

Table 8.1: Theoretical approaches upon which the study is based

	Van Mechelen’s model	**Feasibility Study**
What is the problem?	Establish the extent of the problem	What is the current mode of operation
Why is there a problem?	Risk factors and possible causes of the problem	Effects of the current mode of operation on key stakeholders
How can it be resolved	Design an intervention based on the problem	Designing of a new system
Evaluation	Evaluate the effects of the intervention	Evaluate the feasibility of the new system by evaluating how key stakeholders will use it

Based on the outcomes of this study the following questions will be answered relative to the feasibility of the proposed injury prevention programme for netball.

8.3 What is the current need within netball?

The first phase of the needs assessment was to determine the prevalence and type of injuries as well as risk factors and mechanisms of injuries sustained among South African school, provincial and national netball players and thereby highlighting the need in netball regarding injury surveillance. Limited literature exists on the prevalence of injuries among netball players in South Africa. This study highlighted an injury prevalence and injury distribution concurrent with findings both within South Africa and internationally (Ferreira et al., 2010; Hopper et al., 1995). It was evident that the ankle and knee were the most common joints injured in netball and therefore effective injury prevention strategies are needed as these structures are subjected to increased physical stress during the sport.

The primary mechanisms of injury were tripping and landing for both the ankle and knee injuries, which are similar to the findings in other studies (Van Mechelen et al., 2005). Provincial players were determined to be the group with the highest incidence of injury. There was also an even distribution of mild and severe injuries. A shortcoming of this study is that the diagnosis of an injury cannot be confirmed, as injuries were self-reported. Only half of the sample reported that they were able to access professional health care. 31% of netball players attended a consultation with a physiotherapist. This could possibly be due to the mild injuries reported. However, if left untreated or inadequately managed, the ramifications of minor injuries at club level could impact severely at a national tier by predisposing to further injury.

The findings of the study are significant to the researcher as it lays the foundation upon which the injury prevention programme could be developed. For the netball stakeholders it objectifies the real world scenario of the plight of injuries that exist within the federation and gives insight as to the cause of these injuries.

On examination of the literature, preventative sports medicine has largely ignored the issue of how best to translate research evidence into effective interventions

that have high adoption levels. Involving the key stakeholders in the development of an injury prevention programme was considered essential in order to ensure that all stakeholders are represented.

8.4 What is the current mode of practice?

The second phase of the needs assessment was conducted via semi – structured interviews. The interviews also highlighted the current mode of practice within netball with regard to injury management and the challenges faced by stakeholders with the implementation of this.

Stakeholders demonstrated that they had a good understanding of defining injuries and also the role the medical team played in the management of these injuries. Participants understood the role as complementing the technical aspect of the game and the importance of making accurate injury assessment during matches relevant to the future of the athlete.

Sport science and medical staff are faced on a daily basis with making crucial decisions for athletes. These decisions often come with limitations and restrictions placed on the athletes in terms of activity load, diet, playing time etc. In order for interventions to be successful you need the 'buy in' from stakeholders. Parents, coaches, and athletes expect medical providers to be competent in injury management and return to play decision-making (Mitten et al., 1995). The understanding of the role of sports science and medical staff facilitates stakeholder 'buy in' in the implementation of injury prevention or injury management strategies.

The study participants also highlighted the importance of ensuring that coaches had adequate knowledge as they were reported to be able to impact the incidence of sport injuries by over-training athletes and not correcting the technical execution of techniques. In addition the need to educate players was also identified as a

current need. The participants were clear about what knowledge they had and what they lacked in order to prevent injury. In addition, participants described a lack of accessibility to sports science and medical staff. The availability of funded sport science and medical facilities, transport, resources and time were the barriers identified to accessing these services. Some clubs have access through affiliation with universities. Players also don't have their own transport. There is currently no designated leader in this area, no existing partnership in place to develop a nationwide sports injury prevention policy, and no immediate funding source available to support sports safety and injury prevention.

The research question asked in objective two was: What do we know about current effective evidence based injury prevention programmes for netball players? The objective was to determine what the most effective evidence based injury prevention programmes for netball are. The method used in this aspect of the study was a systematic review of literature. The systematic review of literature highlights the current mode of practice for intervention studies. Few studies existed with evidence for interventions in netball and therefore the researcher looked to studies, which emulated the jump, stop, start, accelerative and decelerate nature of netball.

The duration of the intervention studies varied considerably depending on the type of programme. Eight of the studies included a balance-training programme or a component thereof. Exercise dosage varied but overall consisted of 30-minute sessions, three times weekly, over a five-week period. The duration and dosage of exercise was not altered as these studies were conducted within a clinical setting and this could alter the effect of the intervention.

The injury prevention protocol was compiled through the evaluation of a number of interventions that were successful in managing injuries established in the needs

analysis for this thesis. The main exercises within the intervention programme could be divided into plyometric exercises (Valovich et al., 2009; Myer et al., 2006), balance exercises (Cumps et al., 2007; Emery et al., 2007; Elphinston et al., 2006; McGuine et al., 2006; Myer et al., 2006; Stasinopoulos, 2003; Verhagen et al., 2004), eccentric loading exercises with a 25° decline board (Jonsson et al., 2005; Visnes et al., 2005; Young et al., 2005) and functional activities (Cumps et al., 2007; McGuine et al., 2006). Of the thirteen studies, three included an educational aspect for coaches into the programme (Gianotti et al., 2010; Jonsson et al., 2005; Verhagen et al., 2004).

Two studies included functional activities as a progression to the basic excercises included in their programmes and these activities were sport specific. Three of the studies trialed the use of a 25° board with eccentric loading excercises and compared it to concentric loading excercises, Young et al. (2005), Visnes et al. (2005) and Jonsson et al. (2005). Valovich et al. (2009) combined the use of plyometric excercises with functional strengthening and balance and stability. Myer et al. (2006) combined plyometric excercises with balance only. Plyometric excercises included maximum effort jumping. Netball is a sport comprising a multitude of movements and with varied lower limb injuries. It was therefore important to incorporate interventions that could be compiled within an injury prevention protocol that was varied and sport specific.

The studies mostly looked at the clinical aspects of injury prevention (n=12) with not many studies looking at the educational component with respect to the coaches (n=3), (Gianotti et al., 2010; Jonsson et al., 2005 & Verhagen et al., 2004), and players. The studies were chosen on the basis of meeting the inclusion criteria for the systematic review. They were included predominantly on the basis of their generalizability and detailed methodology. All the studies did not have positive outcomes but were included due to their applicability for netball and based on the fact that in instances where the outcome were not positive the study advocated

recommendations that could have a positive impact. Therefore in developing intervention studies it is important to look to the literature for studies with detailed methodologies that are generalizable.

Challenges with regard to implementation include equipment with specific reference to decline boards, Bossu balls, wobble boards and foam rollers. In many instances trained medical staff is required and therefore the quality of excercises performed is not always easily monitored. Within a South African context this may prove to be challenge as the vast majority of netball players reside within rural communities where medical staff and resources are limited. For this study basic equipment was evaluated for cost and the educational tool provided developed on the basis that it could easily be printed and accessible. This was evaluated in the Delphi study evaluation phase of the study and proved that cost effective measures can be adapted for a wider community.

The studies included in the literature highlighted that with regard to home-based programmes compliance of the participants is not always guaranteed even when compliance journals are provided. Athletes training goals and management training goals sometimes differ and therefore present a barrier to the buy in of an athlete with regard to the implementation of an injury prevention programme. When educational aids are provided, participants prefer pocket card size concise information that is easy to access rather than video or booklet materials, (Gianotti et al. 2010). Eccentric load training was reviewed as effective however it is not suitable for patients with insertion achilles tendinopathy. Taping methods are also effective however the tape is not cost effective and training coaches and athletes to apply the tape correctly requires regular monitoring and facilitation. Exercises that were given as an additional programme and not included in the warm up had poor compliance as it was seen as additional and not something that could be incorporated into the training session. These considerations are important in the development of an injury prevention programme as they illustrate methods that

work well and those that maybe good in theory but prove to be challenging in the implementation phase.

8.5 Designing of a new system

The intervention mapping process is an effective method that is key to merging research with clinical practice application. As a result the researcher was able to develop a protocol taking into account the following: a theoretical framework, input from all stakeholders in netball, a needs assessment and best practice guidelines from the literature.

The injury prevention programme was designed with a clear injury prevention protocol, coach's educational booklet and an administrative structure known as the National Physiotherapy Association. The intervention mapping process facilitates the design of outcomes and indicators relevant for each stage of the programme. In the current study, the process of intervention mapping enabled the researcher to consider the factors for feasibility to implementation.

The identification of the problem focused on a needs assessment incorporating all stakeholders into the process. Through the semi-structured interviews the researcher was able to gauge what types of solutions and recommendations the stakeholders viewed pertinent to addressing injury prevention in netball players in South Africa and what the current mode of practice was. By incorporating the stakeholders in semi-structured interviews important factors compounding injury prevention were identified. Tools they thought might be successful in aiding injury prevention were considered and compatibility with daily practice as a deliberation created another opportunity for combined input. This created an inclusive process facilitating easier adoption for the success of future implementation. The literature

review outlined and described best practice guidelines and programmes for injury prevention implementation.

The mode of practice with regard to injury management, as initially described by stakeholders in the semi-structured interviews, lacked tangible tools to facilitate the process. Many of the barriers mentioned could have been overcome if definitive structures were in place with a focus on preventing injury. The injury prevention programme that has been designed offers the educational resources required to prevent injury, an exercise protocol to prevent injury and a management structured that can be aligned to netball and other sporting codes as well as various sport medicine disciplines which will streamline the injury management process.

This study contributes greatly in that it allows other researchers to examine, through the process of intervention mapping, how to develop a programme that is relevant to stakeholders which will be involved in the implementation and adoption stage. Collation of this new type of sports injury implementation evidence, when coupled with new research partnerships within the target sector, will ensure that injury prevention goals are successful.

8.6 What is the feasibility of the proposed injury prevention programme for implementation?

The last element of the study was concluded via the Delphi method and forms the evaluation of feasibility for the proposed injury prevention programme for netball players in South Africa. The objectives were:

- To evaluate the relevance of the proposed tool among netball stakeholders
- To evaluate responses of key stakeholders to the feasibility of implementing the proposed protocol

In an operational feasibility study, an attempt is made to define the problem and the acceptability of proposed solutions to the problem. It also aims to evaluate whether all stakeholders if it is developed, will utilize the proposed system. This type of framework allows for the inclusion of people-oriented and social issues.

The PIECES Framework is commonly used in operational feasibility studies as it can assist in identifying the problems, current challenges, identifying possible solutions and the evaluation of the solution. Castro et al. (2002) highlighted the PIECES framework that can help in identifying problems to be solved during a feasibility study.

Performance:

In round one of the Delphi study coaches, medical experts and administrators were able to categorically make definitive recommendations on the proposed injury prevention programme. In the qualitative aspect of the study coaches expressed that the approach of the injury prevention programme was holistic in nature involving all stakeholders in netball. The coaches viewed the booklet as having a focused approach with specific outcomes, empowering them with knowledge and providing ownership of this aspect of the injury prevention programme.

Information:

The coaches viewed the booklet as having a focused approach with specific outcomes, empowering them with knowledge and providing ownership of this aspect of the injury prevention programme.

Economy:

The programme was also said to be efficient as it provided a cost effective tool that was accessible if implemented to a wider community. This is important as it illustrates a positive willingness to embrace the injury prevention programme and illustrates that if it is implemented there will be stakeholder ‘buy in’.

Control:

The content of the injury prevention programme can provide a starting point for further research and implementation. It provides a control and monitoring system for injury surveillance, injury management and a centralized system for coordinated physiotherapy services. With adequate resources this could be adapted and incorporated into a national framework for sport injury prevention targeting national federations in South Africa. The national physiotherapy association is feasible for implementation however administrators commented that this would require a mind shift from injury management to injury prevention.

Efficiency: Administrators reviewed the national physiotherapy association aspect of the injury prevention programme. They commented that the association was structured and would create a foundation to build on and facilitate keeping netball players on the court by ensuring control and monitoring measures for injury prevention. It is recommended that the association be motivated to a higher body like SASCOC to facilitate injury prevention from an accredited platform. It also viewed as being easy to implement within the current structures of netball in South Africa. The national physiotherapy association is feasible for implementation however administrators commented that this would require a mind shift from injury management to injury prevention.

Services:

Medical experts advocated for a variety of changes to the injury prevention exercise protocol. The injury prevention protocol was derived from the literature conducted in the systematic review in chapter five of this study. All exercises included were conducted in the environment of clinical trials and showed positive outcomes for the various interventions due to the type of activity performed and the exercise dosage. The modifications advocated by the medical experts were included in the Likert scale survey to validate the consensus of these changes. Two statements from the Likert scale survey reached no consensus with reference

to shortening the duration of the protocol from six weeks to four week and the inclusion of dynamic stabilization exercises. However the mean score 2.88 and 2.53 respectively still reflected that the majority of participants agreed with the inclusion of the change into the protocol. In the absence of a clinical trial for the proposed protocol with and without the recommended changes the researcher would have to advocate that the protocol designed for this study be tested in a clinical trial setting using the recommended changes as a control. This would provide an evidence-based platform to advocate for or negate the recommendations. Medical experts expressed that the injury prevention protocol would be feasible for implementation if the modifications to the protocol were made. In its current format the injury prevention protocol would be feasible for implementation once a clinical trial was conducted.

8.7 Conclusion

Within a South African context it was highlighted at the 14th Biennial South African Sports Medicine Congress in Johannesburg (18 - 20 October 2011 meeting), that health professionals focus most primary health promotion efforts on the prevention of degenerative diseases because these are the leading causes of death amenable to risk factor modification, and in the case of Sport Medicine focus on the prevention of injuries. The content of the injury prevention programme can provide a starting point for further research and implementation. With adequate resources this could be adapted could be incorporated into a national framework for sport injury prevention targeting national federations in South Africa. However, not enough is being done to prevent the overall burden of injuries. Stafford (2001) reported that it advocated a greater public health injury prevention role for sports medicine and related allied health practitioners. This highlights the need for injury prevention strategies to become a major public health goal.

Netball is the most widely played sport amongst women in South Africa and has been identified as a priority code. Currently the structures for injury prevention at all levels of netball in South Africa are being challenged and questioned. The study aimed to design a structure that will meet the needs of Netball South Africa and therefore contribute to assisting the key stakeholders in Netball South Africa in meeting their obligations as a priority code in South Africa. The success of this study will greatly assist in moving the code of netball forward in South Africa. Smaller federations will be more willing to buy into a proposal when they are able to see the viability for implementation from all angles. Promotion of the project to bigger stake holders such as SASCOC and LOTTO may also be simplified. The prehabilitation protocol will also then be of a wholistic nature as input from all stakeholders would have been sought which will lay a good foundation for implementation.

8.8 Implications for clinical practice

Finally, if the field of sports injury prevention is to advance, multidisciplinary collaboration will be required, along with the involvement of the sports community. Chalmers (2002), further stated that “injury prevention should become part of the game” contrary to the saying that “injury is just part of the game.” However, designing and implementing strategies that are not evidence informed will not be useful and thus the following implications for practice from this study contribute to the development strategies for injury prevention interventions:

- Although preventative solutions are known to be multifaceted, there is a need for a concerted and coordinated intra-and inter-sectorial approach to reducing the magnitude and frequency of the burden of injury in netball.
- A motivation for this is to ensure that sports medicine adopts best practice principles to dealing with injury prevention.

- The management of sport injuries requires both the education of the athlete and coaching staff as well as the application of best practice principles of injury management.
- It is only when the stakeholders understand and respect the role of sport science and medical staff that 'buy in' becomes viable.
- Contributing factors to injury in netball need to be constantly highlighted by sport science and medicine staff in order to facilitate the mind shift from management to prevention.
- Understanding the contributing factors to injury as experienced by stakeholder allows for the inclusion of relevant intervention techniques that address challenges that are central to the current injury prevalence.
- It is important to incorporate interventions that could be compiled within a protocol that is varied and sport specific.
- In developing intervention studies it is important to look to the literature for studies with detailed methodologies that are generalizable.
- Cost effective measures can be adapted for injury prevention interventions from clinical trials accessing a wider community.
- The holistic approach to injury prevention programmes needs further research to develop best practice guidelines and practices for the treatment of lower limb injuries in landing sports.
- In the development of an injury prevention programme it is important to consider methods that are grounded in theory but that are also practical in the implementation phase.
- Draw on the available evidence for the efficacy/effectiveness of interventions in terms of desired injury and injury risk reductions as well as impact measures.
- Engage relevant stakeholders in implementation and injury prevention research from the outset.
- Continue to partner with stakeholder groups in further intervention and

intervention delivery developments, and even to modify research approaches to accommodate them.

- Develop multifaceted strategic approaches towards injury prevention in relevant real-world culturally relevant settings.
- Develop and evaluate strategic implementation plans designed to address key barriers and facilitators towards intervention uptake across all ecological sports delivery levels.

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Appendix 2.1: Netball South Africa Research Questionnaire

Personal Information

Name: _____ **Surname: _____**

Age: _____ **Gender: _____**

Handedness	**Starting age of playing netball:**	**Highest current playing level:**
Right Handed:	Age:	Club: □
Left Handed:		Provincial: □
		National: □

Frequency of play

Record the number of:

Playing/Training court sessions per week:	Number of gym sessions per week:	Number of match days per week, (Including training matches):

Playing Position

Circle your number one playing position as 1 and your alternative position as

2.

Centre: 1 2	Wing Defence:1 2	Goal Defence: 1 2	Goal Keeper: 1 2
Wing Attack: 1 2	Goal Attack: 1 2	Goal Shooter: 1 2	

Protective Clothing

Do you wear protective gear?

Yes: □

No: □

If yes, state what type: _____

Warm up and cool down

Do you warm up and cool down before training session?

Yes:□

No: □

Is your warm up or cool down any of the following:

Less than 15 min: □	About 15 min: □	More than 15 min: □

Does your warm up include any of the following activities; you may choose more than one option:

Jogging: □	Dynamic stretching: □	Soccer: □
Walking: □	Static stretching: □	Frisby: □
Running: □	Netball specific drills □	Other: □

Recovery

Do you make use of one or more of the following routinely as part of your daily recovery routine:

Ice baths: □	Active stretching: □	Massage: □
Skins: □	Glutamine: □	Other: □

Sports

Do you participate in any other sporting codes competitively or recreationally?

Mark 1 as competitively and mark 2 as recreational

Hockey: 1 2	Athletics: 1 2	Softball:1 2	Soccer: 1 2	Action netball: 1 2
Swimming: 1 2	Baseball:1 2	Volleyball:1 2	Rugby:1 2	Other:

Surface

Mark the surface that you most train on as 1, sometimes train on as 2, rarely train on as 3.

Outdoor concrete: 1 2 3	Outdoor Tar: 1 2 3	Wooden sprung floor: 1 2 3	Indoor wooden hall floor: 1 2 3
Indoor concrete: 1 2 3	Grass: 1 2 3	Action netball court: 1 2 3	Other: 1 2 3

Injury History

Have you ever been injured?

Yes: □

No: □

General injuries sustained

Tick which, if any, body part areas have been injured over the last two years.

You may tick more than one box:

Chest:□	Shoulder: □	Elbow:□	Back: □	Ankle: □
Neck:□	Lower leg:□	Calf:□	Hand:□	Knees: □
Head: □	Thigh: □	Arm: □	Wrist: □	Other: □

Answer the next question if you have ever had a knee injury. Proceed to ankle injuries if it does not apply to you.

Knee injuries

Which knee did you injure in the last two years?

R □

L □

Did you injure both knees?

Yes □

No □

Have you injured the same knee more than once?

Yes: □

No: □

How many times have you injured your knees over the last two years?

Once: □	Twice: □	Three times or more: □	Cannot recall: □

Which of area of your knee, as identified by yourself, did you injure?

Anterior (In front): □	Lateral (Outside): □	Infra patella (Below the knee): □	Intra-articular (Inside the knee joint): □	Hamstring: □
Posterior (At the back): □	Medial (Inside): □	Supra patella (Above the knee): □	Quad: □	Other: □

Answer the next question if you have injured your ankles. Please go to the next question if this does not apply to you.

Ankle Injuries

Which ankle did you injure in the last two years?

R □

L □

Did you injure both ankles?

Yes □

No □

Have you injured the same ankle more than once?

Yes: □

No: □

How many times have you injured your ankles over the last two years?

Once: □	Twice: □	Three times or more: □	Cannot recall: □

Injury Mechanism

Did you injure yourself by:

Bumping into a player: □	Tripping: □	Overuse: □
Landing: □	Falling: □	Other: □

On which surface were you playing when you got injured? If it is a knee injury mark 1, if it is an ankle injury injury mark 2, for all other injuries mark 3.

Outdoor concrete: 1 2 3	Outdoor Tar: 1 2 3	Wooden sprung floor: 1 2 3	Indoor wooden hall floor: 1 2 3
Indoor concrete: 1 2 3	Grass: 1 2 3	Action netball court: 1 2 3	Other: 1 2 3

Injury Characteristics

When you got injured, did you see, hear or experience any of the following:

Swelling: □	Unable to weight bear through the injured site: □	Crackling/popping sounds: □	Visible internal bruising: □
Pain: □	Unable to move the injured part: □	Knee locking: □	Other: □

Injury Severity

After the injury you:

1. Were able to continue with the game. □
2. The injury-required first aid before you could continue with the game. □
3. The injury resulted in you requiring a medical consultation immediately after the injury and not returning to the game. □
4. Injury resulted in you losing practice and game time for a while after that match/practice. □

Injury Management

Did you receive professional management of your injury?

Yes: □

No: □

If yes, tick the appropriate box below; you may tick more than one box.

Physiotherapy: □	Post op rehab: □	Medication: □
Doctors Consultation: □	Operation: □	Bracing: □

Where you medically cleared to return to play?

Yes: □

No:□

Thank you for your assistance in completing this questionnaire.

Appendix 2.2 Information sheet and consent form - Semi Structured interviews

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Private Bag X 17, Bellville 7535, South Africa
Tel: +27 21-959, Fax: 27 21-959
E-mail:

Project Title: Determining the feasibility of a prehabilitative injury prevention protocol for netball players in South Africa

What is this study about?

This is a research project being conducted by Tanushree Pillay at the University of the Western Cape. We are inviting you to participate in this research project because you are a stakeholder in South African Netball as school-going, provincial or national netball players, or as a coach or administrators in Netball South Africa. The purpose of this research project is to develop a prehabilitative injury prevention protocol for netball players in South Africa. Netball is a sport that is rife with injury posing a burden on both individuals and society. The protocol will be developed from a self-administered questionnaire, semi structured interviews, a literature review, document analysis of current policies and a delphi study. Viability of the protocol will be determined by a follow up delphi study, a focused group discussion and implementation of the protocol.

What will I be asked to do if I agree to participate?

- Netball Players – Self-administered questionnaire – You will be asked to fill out a questionnaire that should take no longer than 30 min to do so.

- Semi-structured interviews - You will be asked to sit in on an interview at a time that is convenient to you to discuss explore the challenges experienced by players, netball sports managers, administrators and sports medicine personnel. The duration of this interview should be no longer than 30 min per interview session.

- Delphi Study 1 – You will form part of a panel to review information that has been collected from document analysis of current medical policies and injury surveillance systems as well as literature with information relevant to the best practices for injury prevention. This information will

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E-mail:

- be emailed to you for you to review and comment on through a series of emails. Sufficient time will be given for the completion of review of information. Once consensus has been reached you will be notified in writing and the final comments sent to you for review.

- Delphi Study 2 – You will form part of a panel who will review the relevance and viability of an injury prevention protocol for netball players in South Africa. All comments will be collated and reviewed by a panel of experts. Recommendations will then be made and circulated back to you for comment. This will all be done via email with adequate time for completion. The aim is to get consensus and formulate a final document for the feasible implementation of the programme.

- Evaluation of the protocol (focused group discussions) – After a season of the intervention protocol having been implemented, you as a stakeholder in netball will be invited to sit in on a discussion to describe your views on the protocol that was implemented. It will be done at a time that is convenient to you. These group discussions will be tape recorded and confidentiality will be maintained throughout.

Would my participation in this study be kept confidential?

We will do our best to keep your personal information confidential. To help protect your confidentiality the following steps will be taken:

- Netball Players – Self administered questionnaire

- Semi-structured interviews - surveys are anonymous and will not contain information that may personally identify you". Your name will not be included on the surveys and other collected data. A code will be placed on the survey and other collected data. Through the use of an identification key, the researcher will be able to link your survey to your identity only the researcher will have access to the identification key.

- Delphi Study 1 – A code will be attached to each member of the panel. The researcher will receive emails only. Once a code is attached to your comments it will then be sent on to the panel of experts. Your identity will be kept confidential at all times.

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Tel: +27 21-959, Fax: 27 21-959
E-mail:

- Delphi Study 2 – A code will be attached to each member of the panel. The researcher will receive emails only. Once a code is attached to your comments it will then be sent on to the panel of experts. Your identity will be kept confidential at all times.

- Evaluation of the protocol (focused group discussions) – The focused group discussion will be tape recorded. All tapes will be destroyed once they have been transcribed. Permission to tape record the session will be obtained from you. It will then be transcribed and documented according to themes.

If we write a report or article about this research project, your identity will be protected to the maximum extent possible.

What are the risks of this research?

There are no known risks associated with participating in this research project.

What are the benefits of this research?

This research is not designed to help you personally, but the results may help the investigator learn more about the types of injuries found in Netball and what can be done to prevent it.. We hope that, in the future, other people might benefit from this study through improved understanding of injury prevention and that a system can be put in place to better manage, document and prevent injuries in South African netball.

Do I have to be in this research and may I stop participating at any time?

Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify.

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E-mail:

Is any assistance available if I am negatively affected by participating in this study?
The researcher will be available for you to contact should you be negatively affected by any aspect of this research at any time and an appropriate course of action will be followed with the support of the researcher.

What if I have questions?
Tanushree Pillay and the Department of Physiotherapy at the University of the Western Cape are conducting this research. If you have any questions about the research study itself, please contact Tanushree Pillay at: 0824949561, email: tanushreeza@yahoo.com
Should you have any questions regarding this study and your rights as a research participant or if you wish to report any problems you have experienced related to the study, please contact:
Head of Department: Ms. J Phillips
Dean of the Faculty of Community and Health Sciences:
University of the Western Cape
Private Bag X17
Bellville 7535
The University of the Western Cape's Senate Research Committee and Ethics Committee has approved this research.

I _____ have understood the content of the information sheet and the aspects of confidentiality mentioned. I hereby given consent for my views and opinions to be captured as data, and used for the purposes of this study.

Date: _____ Signature: _____

Appendix 2.3: Explore Challenges experienced by players, managers, sport medicine practioners, coaches and administrators with regard to Injuries in Netball and the management thereof.

This is a research project being conducted by Tanushree Pillay at the University of the Western Cape. We are inviting you to participate in this research project because you are a stakeholder in South African Netball as a school-going, provincial or national netball player, or as a coach or administrators in Netball South Africa.The purpose of this research project is to develop a prehabilitative injury prevention protocol for netball players in South Africa. Netball is a sport that is rife with injury posing a burden on both individuals and society. The protocol will be developed from a self - administeredquestionnaire, semi structured interviews, a literature review, document analysis of current policies and the viability of the protocol will be determined by a follow up delphi study.

- Semi-structured interviews - You have been asked to sit in on an interview at a time that is convenient to you to discuss and explore the challenges experienced by players, netball sports managers, administrators and sports medicine personnel. The duration of this interview should be no longer than 30 min per interview session.

Questions:

1. What is your understanding of a sport injury
2. What do you understand about how an injury should be managed?
3. What is your understanding of the role the medical team is to play as part of the team management?
4. What do you think are the major contributing factors to injuries in netball?
5. What are the current structures available that netball players can access with regard to injury management?
6. Do you think player's injuries are managed adequately within the current injury management structure?

7. What is your understanding of the structures in place to manage player's injuries at: a) club level, b) provincial level and c) national level?
8. Do you think that there is gap between how players are managed at club and provincial level in comparison with the national team setup?
9. Do you think that medical and sport science interventions are accessible to netball players at large?
10. What are the major challenges in accessing sport scientists, physiotherapists and sport physicians?
11. What do you think can be done to assist players with regard to injury management?
12. Do you think there is a component of injuries that are not managed?
13. How does the non-management of an injured player affect team performance?
14. What can be done by the provincial and national federations, to assist players with regard to injury management?

Appendix 2.4: Systematic Review Protocol

Best practice principles and guidelines for the treatment of lower limb injuries in landing sports.

BACKGROUND AND RATIONALE FOR ASSESSMENT

Sport injuries are a cost burden on both individuals and society with respect to the duration and nature of treatment, the amount of sport and working time lost, permanent damage and disability, reduced quality of life and monetary costs (Parkkari, Kujuala and Kannus, 2001). It is therefore evident that preventative measures with regard to injury prevention strategies within South African sport are needed. Netball has been identified as one of the priority female codes of sport in South Africa and against its relevance as a transformative sport there is a need to focus on implementing effective injury prevention and monitoring strategies. Netball is played on a daily basis in schools, clubs and at regional level.

Netball is a physically demanding game that requires high levels of endurance, strength, speed, power, agility and flexibility (Murphy 1998). It has a high impact on joints due to the stop-start nature of the sport and the aerial requirements further predispose joints to injuries. Forces associated with landing in netball have shown to be considerable. Steele and Milburn (1989) noted vertical ground reaction forces up to 6.8 x the body weight during landing. Joint motion and muscle activity are important in decreasing the impact forces associated with landing (McNitt-Gray 1991). The body part most affected by injury among netball players are the ankle joints (39.13%), with the most common mechanism of injury being incorrect landing techniques (52.17%) (Ferreira & Spamer, 2010).

The theoretical framework of the study is based on van Mechelen's sequence of prevention model. van Mechelen et al (1992) presents a “sequence of prevention” model that can be incorporated by sporting codes on which successful intervention strategies can be based. In this model, Van Mechelen attempts to identify the problem, design and implement an intervention and evaluate the intervention. However, there exists a gap for the evaluation of evidence based interventions to inform practice. Interventions can occur in

various settings but should have a similar approach to the management of lower limb injuries in landing sports that can be implemented as home based programmes. South African netball players are representative of the diverse country we live in. With little medical support at club level to fully fledged medical teams at national level, players tend to carry injuries from the club setup to the national setup. This proves to make the management of injuries vey challenging at national level. Players are required to traiin and play matches with the national team, making rehabilitation during competition very difficult. This highlights the need for evidence based injury prevention programmes to be implemented at grass root level. The purpose of this review was to identify the strategies used in the treatment and prevention of lower limb injuries in landing sports. This review will assist therapists and trainers at all competitive levels of netball from amateur to elite with the prevention of lower limb injuries in netball.

AIM OF THE REVIEW

The aim of this literature review was to review literature relating to injury prevention models and interventions with regard to the prevention and treatment of lower limb injuries in landing sports.

Research question

What are the injury prevention and mangement strategies used to prevent lower limb injuries in landing sports?

OBJECTIVES OF THE REVIEW

The objectives was to highlight the:

(i) Types of preventative and treatment interventions used to address lower limb injuries in landing sports

(ii) outcomes of injury prevention models and interventions implemented as best practice for the treatment of lower limb injuries in landing sports

(iii) formulate an evidence base for best practice methods in the prevention of lower limb injuries in landing sports.

CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW

Search terms:

Injury prevention/health education

Injury management/treatment/rehabilitation

Lower limb/ankle/knee

Sport/netball/basketball/volleyball/

Proprioception/ROM/ strength /balance/ joint stability

Type of studies

All published randomized controlled trials (RCTs) will be assessed for inclusion in the review. However, in the absence of RCTs, controlled trials, quasi-randomized controlled trials, cohort studies, experimental and non-experimental studies, prospective studies, descriptive studies, before-and-after studies will be considered. Other research designs, such as systematic reviews and observational studies will be excluded.

Type of participants

This review will consider studies that examine female athletes, who participate in sports which emulate the excellerative, decllerative, jumping and landing actions of netball players.

Inclusion/Exclusion:

The search parameters will include full-text articles published in English between 2001 and 2011, and studies with both positive and negative outcomes to reduce publication bias. A systematic approach to the review will be adopted and reported in a narrative form. All published randomized controlled trials (RCTs) will be assessed for inclusion in the review. However, in the absence of RCTs, controlled trials, quasi-randomized controlled trials, cohort studies, experimental and non-experimental studies, prospective studies, descriptive studies, before-and-after studies were considered. Other research designs, such as systematic reviews and observational studies will

be reviewed and articles referenced in the articles that fit the inclusion criteria of this study will be included in this study.

Search terms will be chosen after a preliminary review of relevant literature yields commonly used words and phrases, which will be finalised after consultation with an experienced researcher.

Types of interventions

The interventions most commonly administered in addressing the treatment and prevention of lower limb injuries in landing sports will be included. These should be exercise and rehab based interventions that can be implemented as a home based programmes.

Types of Comparison

No comparison will be included

Types of outcome measures

The outcomes of interest will include, but will not be confined to the effects on:

Range of movement

Strength

Proprioception

Balance

Stability of the joint

Search strategy for the identification of articles for inclusion

Data bases such as Medline, CINAHL, Ebscohost will be searched for the period of 1996-2008. The criteria for inclusion into the study will be:

(i) publication in the English language;

(ii) publication data between 1996 and 2008;

(iii) target population in school settings;

(iv) school based interventions addressing risk factors for chronic diseases of lifestyle.

Manual searching of reference lists will also be undertaken and articles referred to author by experts in the field will also be included. Search terms will be constructed after some review of relevant literature and included risk factors for chronic diseases, school based intervention

programmes, nutrition, physical activity, smoking, alcohol, youth/adolescents, prevention.

METHODS OF THE REVIEW

1. Validity assessment: level of evidence

Table 1: JBI scale of level of evidence: Effectiveness

Levels of evidence	**Effectiveness E (1-4)**
Level I	Systematic review (with homogeneity) of experimental studies (e.g. RCT with concealed allocation)
Level II	Quasi-experimental studies (e.g. without randomization)
Level III	3a Cohort studies (with control group) 3b Case controlled 3c Observational studies without control groups
Level IV	Expert opinion without explicit critical appraisal, or based on physiology, bench research or consensus

2. Methodological quality assessment

Data storage

For tracking purposes, all articles obtained for the review will be recorded on a data storage form (Appendix 2), which will provide details about the article's authors, title and source, which database the article was retrieved from, and the location where the article is being stored.

Data extraction

Data will be extracted independently by two reviewers using the 'JBI data extraction tool' (Appendix 3). A third reviewer will be asked to adjudicate if the initial reviewers disagree. Data to be collected will include type of design; details of randomization (if used), study population, intervention, control, outcomes, and quality and result of study analysis. When necessary, we will attempt to contact the researchers of a study to obtain missing information.

Data synthesis

Data will be summarized statistically if they are sufficiently similar and if they are of adequate quality. If the statistical pooling of results is inappropriate, the findings will be summarized in narrative form.

Appendix 2.5: Letter of request Merit Tournament

NETBALL SOUTH AFRICA

P O Box 12474 Hatfield 0083 / 846 Park Street Arcadia 0028
Tel: +27 (0) 12 3445971 Fax: +27 (0) 12 3435285
Url; www.netballsa.org.za

President
A B Mthethwa
+27 (0) 72 2353100
amthethwa@hlabisa.org.za

Vice-President
Blanche de la Guerre
+ 27 (0) 834471774
blanche@netball-sa.co.za

To Whom it may concern

As the head physiotherapist of netball South Africa and through my clinical experience of 3 years working with netball players, I have noticed a high prevalence in knee injuries amongst players. Some players have received interventions, some not and some continue to play without the correct knowledge as to the further damage they could be causing to their knees.

Little or few publication exists in South Africa with regard to the injury prevalence that faces our sport. Girls are selected into national teams and for many of them it is the first time experience of a thorough medical screening.

The upcoming merit tournament is going to present an opportunity to have representation of all regions and ethic groups that comprise the netball playing demographics of our country.

I would like to use this opportunity to present the players with an injury surveillance questionnaire. The information would be available to Netball South Africa once completed, and could be further ultilised to motivate funds for quality netball facilities in the regions.

I hypothesise that the greatest cause of injury is the surface as well as that there is a large population playing action netball in addition to outdoor.

My end goal is to develop a model that will profile the player that will pre-dispose to knee injury as well as to develop a rehab manual for netball players of the country under the auspices of netball South Africa.

Regards
Tanu Pillay

Appendix 2.6: Player consent Letter

NETBALL SOUTH AFRICA

P O Box 12474 Hatfield 0083 / 846 Park Street Arcadia 0028
Tel: +27 (0) 12 3445971 Fax: +27 (0) 12 3435285
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To Whom it may concern

As the head physiotherapist of netball South Africa and through my clinical experience of 3 years working with netball players, I have noticed a high prevalence in knee injuries amongst players. Some players have received interventions, some not and some continue to play without the correct knowledge as to the further damage they could be causing to their knees.

Little or few publication exists in South Africa with regard to the injury prevalence that faces our sport. Girls are selected into national teams and for many of them it is the first time experience of a thorough medical screening. I would like to use this opportunity to present the players with an injury surveillance questionnaire. The information would be available to Netball South Africa once completed, and could be further ultilised to motivate funds for quality netball facilities in the regions.
I hypothesise that the greatest cause of injury is the surface as well as that there is a large population playing action netball in addition to outdoor.
My end goal is to develop a model that will profile the player that will pre-dispose to knee injury as well as to develop a rehab manual for netball players of the country under the auspices of netball South Africa.
Please would you_____ (player name) give consent for your data to be used anonymously as part of a PHd study, in support of this letter.

Player Signature: _____

Regards

Tanu Pillay

Appendix 2.7: SASMA Accreditation Form 2012

South African Sports Medicine Association

Sports Medicine Clinic, Mabaleng A, University of the Free State, Bloemfontein,
P O Box 31316 Fichartpark Bloemfontein South Africa 9300

National Office:tel: (+2751) 4013325 **e-mail: gesal@ufs.ac.za**
fax: (+2751) 4442969 **website: www.sasma.org.za**

APPLICATION FOR ACCREDITATION AS A SASMA-RECOGNISED SPORTS MEDICINE PRACTITIONER

The South African Sports Medicine Association (SASMA) is a multi-disciplinary organization of clinicians whose members are dedicated to education, research, collaboration and fellowship within the field of sports medicine. SASMA is South Africa's official International Federation of Sports Medicine (FIMS) affiliated sports medicine organisation and, as such, tasked with overseeing the administration of sports medicine in the region. Central to SASMA's ambition to uphold a high standard of clinical sports medicine practice in South Africa, is the certification of medical and paramedical professionals to ensure that clinicians offering their services to sports teams, sportspersons and exercising individuals are suitably qualified and experienced in the field of sport and exercise medicine.

The SASMA accreditation is deliberately exclusive but not restrictive and aims to recognize individuals and practices that are significantly involved in the practice and advancement of sports medicine as opposed to those who are "just interested". By nature of their training and experience, these clinicians should be ideally suited to provide comprehensive medical care for athletes, sports teams, or active individuals who are simply looking to maintain a healthy lifestyle. Those who fall short of the accreditation criteria are encouraged to participate in SASMA and other sports medicine educational meetings to develop greater experience and a stronger involvement in sports medicine.

Professionals who wish to be acknowledged for their experience and work in the field of sports medicine and receive the appropriate certification are required to complete the following application form. You will then be entered onto the SASMA database.

The appropriate references as well as copies of degrees and course certification need to be included with your application.

Please let us know when we need to change your current status so we can make the necessary adjustments on the database.

ACCREDITATION OF SPORTS MEDICINE PROFESSIONALS & PRACTICES

Approval as an individual accredited by the South African Sports Medicine Association and recognised as qualified and experienced in the field of sports medicine will be confirmed by the issuing of a certificate to be renewed every 3 years using the following parameters:

1

Appropriate professional registration, medical indemnity insurance & SASMA/FIMS membership are prerequisites

Accreditation Status	Required Score
Fully Accredited Professional	≥ 25 points
Associate Sports Medicine Professional	15 – 24 points
Sports Medicine Professional in Training	10 – 15 points

Certification of practices, partnerships and associations as Sports Medicine Units accredited by SASMA will be on the following basis:

1. At least 50% of the partners or associates are Fully Accredited SASMA professionals
2. At least 50% of professional employees are Associate or Fully Accredited.
3. At least 25% of professional employees are Sports Medicine Professionals in Training

COST OF APPLICATION FOR ACCREDITATION: R100

Please indicate what you like to order when your application is successful

Cost	Description	Mark with X
R100 (Includes)	Application and certificate	
R 60	Name Badge	
R300	Plaque	

SASMA accredited status provides:

- Active marketing of the SASMA accredited status
- Listing as accredited member on the SASMA website

- Annual registration and membership fees include:

SASMA Membership

- FIMS membership including
  - Access to the online International Sports Medicine Journal
  - Access to member sections of the FIMS website
  - Sportsmed Update summaries of 5 scientific articles e-mailed weekly
- Individual and practice certification for 3 years from date of application
- Subscription to the quarterly South African Journal of Sports Medicine
- Discounted registration fees for Biennial SASMA Congress
- Retail, car hire, flight and hotel discounts

NSTRUCTIONS FOR COMPLETING THE APPLICATION:

1. Complete form.

2. Circle the correct numbers as it applies to you on and then total the scores.

3. **Send the forms with relevant documents and proof of payment to:**

   For attention: Dr Glen Hagemann
   Fax 086 515 7515
   Postal address: P O 20033, DURBAN NORTH , 7515
   Or E-Mail: Ghagemann@sharksmedical.co.za

   Bank Account details: ABSA
   Account name: SASMA
   Account no: 2870149258
   Branch code: 631205
   Account type: Cheque

APPLICATION FOR SASMA ACCREDITATION

PROFESSIONAL DETAILS

DATE: _____

1. DEMOGRAPHIC DATA

NAME: _____
SURNAME: _____

DATE OF BIRTH: _____
PLACE OF BIRTH: _____

PROVINCE: _____
AGE: _____

I.D. Number: _____

Passport Number: _____

Passport Type: _____

GENDER: M F

2. PROFESSION

MEDICAL PRACTITIONER

PHYSIOTHERAPY

BIOKINETICIST

CHIROPRACTOR

PODIATRIST

DIETICIAN

OTHER: (Specify_____)

3. CONTACT DETAILS

HOME ADDRESS: _____
_____
_____
POSTAL CODE: _____

POSTAL ADDRESS:
_____
_____
_____ POSTAL CODE:
_____

WORK: _____
HOME: _____
FAX: _____
CELL: _____
EMAIL: _____

4. REGISTRATION WITH OTHER PROFESSIONAL BODY

HPCSA: _____

SASMA: _____

PROFESSIONAL BODY (e.g. Physiotherapy Society): _____

OTHER: _____

Proof of current registration must accompany this application

PROFESSIONAL SPORTS MEDICINE RECORD

Years of experience in your profession (General Practitioner, Sports Physician, Orthopaedic surgeon, Physiotherapist, Chiropractor, Biokineticist, Podiatrist, Dietician)	0-4 years 5-10 years >10 years	2 4 6
Proportion of practice dedicated to sports medicine	0-10% 10-30% 30-50% 50-75% 75%+	0 1 2 3 4
Post graduate qualifications related to Sport and Exercise Medicine (SEM): List: _____ _____ _____ _____	OMTI/SPTI Masters in SEM (by course work and dissertation) Masters SEM (dissertation only) Masters SEM (course work only) MMed or FCS (ortho) Sports Medicine Fellowship Doctoral degree	3 5 3 3 5 5
Additional Qualifications List: _____ _____ _____ _____	Manual therapy Dry needling/Acupuncture Strapping Diving medicine Other	1 1 1 1 1
Sports-related medical experience (highest level only; cumulative experience at least one season) Please list relevant teams & provide a contact number for a reference (e.g. coach, manager) _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	School Club Provincial Super 14 National Schools National U/19 National U/20 National U/21 National U/23 Womens National Development SA “A” National	2 3 5 7 3 5 6 6 6 6 6 6 7
Personal playing experience in sport List detail: _____	Schools Club Provincial	1 1 2

_____ _____ _____ _____ _____ _____ _____ _____	National (School,u19,u20 etc)	3
Academic Involvement in Sports Medicine List detail: _____ _____ _____ _____ _____	Teaching undergraduates Teaching graduates Academic Publications < 2 Academic Publications 2 or more Book chapter	2 3 1 2 2
Involvement in SASMA & Related Administrative & Academic Activities in last 5 years (List): _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	Attendance at regional meetings in last year Attendance at Biennial Meetings Presentations at Regional Meetings Presentations at Biennial Meeting Attendance at International Sports Medicine Meetings Presentations at International Meetings Sports Medicine Committee EXCO member	1 each 2 each 2 each 2 each 2 each 2 each 1 each
TOTAL SCORE		

Appendix 2.8: Coaches Questionnaire - Netball injury prevention programme

Please answer all the questions on this form. Please include as much details as possible. Please do not give yes and no answers but substantiate in as much detail as possible. Your input is valued and will contribute to enhancing the Injury prevention programme for netball players in South Africa.

Demographic Information *

Please check the appropriate box

□ Male

□ Female

What is your current position within a federation *

You may only check one box

- □ Coach
- □ Player
- □ Manager
- □ Executive Committee
- □ Doctor/Physio

How many years have you held your current position *

You may only check one box

□ > than 2 years

□ < than 2 years

□ > than 5 years

□ < than 5 years

What other portfolio positions have you held within the federation *

You may check more than one box

- □ Coach
- □ Player
- □ Manager
- □ Executive Committee
- □ Doctor/Physio

Please leave this page open and copy and paste the url below into a new web browser to view the Injury prevention programme below. Once you have reviewed the document, please continue to answer the questions on this form.

http://goo.gl/qLQNA

Ethical Consideration *

This study has received ethical clearance from the University of the Western Cape Ethics Committee (project registration number: 11/1/22). You are not required to participate in this research project and non-participation will have no negative effects on you. Should you decide not to continue, all you need to do is close this page. All of your responses will be anonymous. You may decide to withdraw from the project at any stage, and have your responses removed from the database. If you do choose to participate in the first round, you are under no obligation to participate in subsequent rounds. Please check the box below before you proceed to the next page.

□ I confirm I have read and understood the netball injury prevention programme

□ I am willing to participate in the research project

After page 1 Continue to next page

Evaluation

After reviewing the provided Injury prevention programme for netball players in South Africa, please answer the following questions:

Do you think the three aspects of the injury prevention programme outlined are definitive and concise? Please quantify your answer. *

What aspects of the injury prevention programme need further explanation and clarification? *

What contributing factors to injury in netball players does the programme fail to address? *

In your opinion does the proposed injury prevention programme address the various predisposing factors related to players sustaining injuries in netball and facilitate the injury management process? *

What are the strengths of the injury prevention programme ? *

What are the weaknesses of the injury prevention programme? *

What modification could be made to the injury prevention programme? *

What possible challenges would your federation face with implementing the injury prevention programme? *

Would there be sufficient "buy in" from the federation for the proposed injury prevention programme? *

What infrastructure would your federation require in order to implement the injury prevention programme? *

Do you think the injury prevention programme is a holistic approach to injury prevention for netball players in South Africa? *

You reviewed one component of the injury prevention programme. Do you think that the tool you reviewed was an appropriate method chosen for the implementation of that aspect of the injury prevention programme? *

Evaluation

The cost of a wobble board is in the region of R200. A decline board kit that you can assemble at home costs R150. A skipping rope costs R60. The total cost of purchasing an injury prevention programme package would be R500. One session of physiotherapy costs on average R300.

Do you think the injury prevention programme is a cost effective intervention for netball players in South Africa? *

Would local netball clubs be able to afford purchasing the injury prevention programme? *

Review

Considering all the responses you have provided, do you think the injury prevention programme is a feasible intervention programme that can be implemented for netball players in South Africa? *

Appendix 2.9: Administrators Questionnaire - Netball injury prevention programme

Please answer all the questions on this form. Please include as much details as possible. Please do not give yes and no answers but substantiate in as much detail as possible. Your input is valued and will contribute to enhancing the Injury prevention programme for netball players in South Africa.

Demographic Information *

Please check the appropriate box

□ Male

□ Female

What is your current position within a federation *

You may only check one box

- □ Coach
- □ Player
- □ Manager
- □ Executive Committee
- □ Doctor/Physio

How many years have you held your current position *

You may only check one box

□ > than 2 years

□ < than 2 years

□ > than 5 years

□ < than 5 years

What other portfolio positions have you held within the federation *

You may check more than one box

- □ Coach
- □ Player
- □ Manager
- □ Executive Committee
- □ Doctor/Physio

Please leave this page open and copy and paste the url below into a new web browser to view the Injury prevention programme below. Once you have reviewed the document, please continue to answer the questions on this form.

http://goo.gl/qLQNA

Ethical Consideration *

This study has received ethical clearance from the University of the Western Cape Ethics Committee (project registration number: 11/1/22). You are not required to participate in this research project and non-participation will have no negative effects on you. Should you decide not to continue, all you need to do is close this page. All of your responses will be anonymous. You may decide to withdraw from the project at any stage, and have your responses removed from the database. If you do choose to participate in the first round, you are under no obligation to participate in subsequent rounds.Please check the box below before you proceed to the next page.

- □ I confirm I have read and understood the netball injury prevention programme
- □ I am willing to participate in the research project

After page 1 Continue to next page

Evaluation

After reviewing the provided Injury prevention programme for netball players in South Africa, please answer the following questions:

Do you think the three aspects of the injury prevention programme outlined are definitive and concise? Please quantify your answer. *

What aspects of the injury prevention programme need further explanation and clarification? *

What contributing factors to injury in netball players does the programme fail to address? *

In your opinion does the proposed injury prevention programme address the various predisposing factors related to players sustaining injuries in netball and facilitate the injury management process? *

What are the strengths of the injury prevention programme? *

What are the weaknesses of the injury prevention programme? *

What modification could be made to the injury prevention programme? *

What possible challenges would your federation face with implementing the injury prevention programme? *

Would there be sufficient "buy in" from the federation for the proposed injury prevention programme? *

What infrastructure would your federation require in order to implement the injury prevention programme? *

Do you think the injury prevention programme is a holistic approach to injury prevention for netball players in South Africa? *

You reviewed one component of the injury prevention programme. Do you think that the tool you reviewed was an appropriate method chosen for the implementation of that aspect of the injury prevention programme? *

Evaluation

The cost of a wobble board is in the region of R200. A decline board kit that you can assemble at home costs R150. A skipping rope costs R60. The total cost of purchasing an injury prevention programme package would be R500. One session of physiotherapy costs on average R300.

Do you think the injury prevention programme is a cost effective intervention for netball players in South Africa? *

Would local netball clubs be able to afford purchasing the injury prevention programme? *

Review

Considering all the responses you have provided, do you think the injury prevention programme is a feasible intervention programme that can be implemented for netball players in South Africa? *

Appendix 2.10: Medical Experts Questionnaire - Netball injury prevention programme

Please answer all the questions on this form. Please include as much details as possible. Please do not give yes and no answers but substantiate in as much detail as possible. Your input is valued and will contribute to enhancing the Injury prevention programme for netball players in South Africa.

Demographic Information *

Please check the appropriate box

□ Male

□ Female

What is your current position within a federation *

You may only check one box

- □ Coach
- □ Player
- □ Manager
- □ Executive Committee
- □ Doctor/Physio

How many years have you held your current position *

You may only check one box

□ > than 2 years

□ < than 2 years

□ > than 5 years

□ < than 5 years

What other portfolio positions have you held within the federation *

You may check more than one box

- □ Coach
- □ Player
- □ Manager
- □ Executive Committee
- □ Doctor/Physio

Please leave this page open and copy and paste the url below into a new web browser to view the Injury prevention programme below. Once you have reviewed the document, please continue to answer the questions on this form.

http://goo.gl/qLQNA

Ethical Consideration *

This study has received ethical clearance from the University of the Western Cape Ethics Committee (project registration number: 11/1/22). You are not required to participate in this research project and non-participation will have no negative effects on you. Should you decide not to continue, all you need to do is close this page. All of your responses will be anonymous. You may decide to withdraw from the project at any stage, and have your responses removed from the database. If you do choose to participate in the first round, you are under no obligation to participate in subsequent rounds.Please check the box below before you proceed to the next page.

□ I confirm I have read and understood the netball injury prevention programme

□ I am willing to participate in the research project

After page 1 Continue to next page

Evaluation

After reviewing the provided Injury prevention programme for netball players in South Africa, please answer the following questions:

Do you think the three aspects of the injury prevention programme outlined are definitive and concise? Please quantify your answer. *

What aspects of the injury prevention programme need further explanation and clarification? *

What contributing factors to injury in netball players does the programme fail to address ? *

In your opinion does the proposed injury prevention programme address the various predisposing factors related to players sustaining injuries in netball and facilitate the injury management process? *

What are the strengths of the injury prevention programme? *

What are the weaknesses of the injury prevention programme? *

What modification could be made to the injury prevention programme? *

What possible challenges would your federation face with implementing the injury prevention programme? *

Would there be sufficient "buy in" from the federation for the proposed injury prevention programme? *

What infrastructure would your federation require in order to implement the injury prevention programme? *

Do you think the injury prevention programme is a holistic approach to injury prevention for netball players in South Africa? *

You reviewed one component of the injury prevention programme. Do you think that the tool you reviewed was an appropriate method chosen for the implementation of that aspect of the injury prevention programme? *

Evaluation

The cost of a wobble board is in the region of R200. A decline board kit that you can assemble at home costs R150. A skipping rope costs R60. The total cost of purchasing an injury prevention programme package would be R500. One session of physiotherapy costs on average R300.

Do you think the injury prevention programme is a cost effective intervention for netball players in South Africa? *

Would local netball clubs be able to afford purchasing the injury prevention programme? *

Review

Considering all the responses you have provided, do you think the injury prevention programme is a feasible intervention programme that can be implemented for netball players in South Africa? *

Appendix 2.11: 5 - Point Likert Scale Survey

You have now viewed the 3 components of the injury prevention programme with the amended changes. In round 1 of the Delphi study you answered open-ended question on one aspect of the injury prevention programme. In this 5 Point Likert Scale survey select the answer most appropriate to you on the proposed recommended change.

- Required field*

Designation * Please select your area of expertise

Mark only one box.

- □ Coach
- □ Medical Expert
- □ Administrator

Ethical Considerations *

This study has received ethical clearance from the University of the Western Cape Ethics Committee (project registration number: 11/1/22). You are not required to participate in this research project and non-participation will have no negative effects on you. Should you decide not to continue, all you need to do is close this page. All of your responses will be anonymous. You may decide to withdraw from the project at any stage, and have your responses removed from the database. If you do choose to participate in the first round, you are under no obligation to participate in subsequent rounds. Please check the boxes below before you proceed to the next page.

Check all boxes that apply.

- □ I confirm I have read and understood the netball injury prevention programme
- □ I am willing to participate in the research project

For the Likert Scale question you may mark only one box

1. **Use of the coaches booklet would be facilitated by:** *

An integrated overview of the three components of the programme

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

2. Use of the coaches booklet would be facilitated by: *

Guidelines on how to use the booklet

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

3. **Use of the coaches booklet would be facilitated by:** *

Translating it

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

4. **Use of the coaches booklet would be facilitated by:** *

Adding visual aids

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

5. Use of the coaches booklet would be facilitated by: *

Motivational Quotes

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

6. Exercises in the coaches booklet should include: *

Technical skill correction

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

7. Exercises in the coaches booklet should include: *

Core training

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

8. Exercises in the coaches booklet should include: *

A dynamic warm up.

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

9. Exercises in the coaches booklet should include: *

A static cool down with core exercises

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

10. The framework of the physiotherapy association would be facilitated by: *

Clarification of the federation focus

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

11. The framework of the physiotherapy association would be facilitated by: *

Adding Goals

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

12. The framework of the physiotherapy association would be facilitated by: *

Adding the role of the bio and sport physician

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

13. The framework of the physiotherapy association would be facilitated by: *

Adding injury surveillance as a goal

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

14. The framework of the physiotherapy association would be facilitated by: *

Mentioning the responsibility and involvement of the player

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

15. The framework of the physiotherapy association would be facilitated by: *

Identifying the required personnel for implementation

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

16. The exercise protocol should be modified by: *

Progressing the intensity of the activity and not by changing the activity

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

17. The exercise protocol should be modified by: *

Including pre-season screening

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

18. The exercise protocol should be modified by: *

Including return to play protocols

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

19. The exercise protocol should be modified by: *

Including exercises to prevent contact injuries

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

20. The exercise protocol should be modified by: *

Including guidelines on footwear and playing surface

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

21. The exercise protocol should be modified by: *

Including dynamic stabilisation execises

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

22. The exercise protocol should be modified by: *

Including flexibility exercises

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

23. The exercise protocol should be modified by: *

Exercises for changing movement control when changing direction

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

24. The exercise protocol should be modified by: *

Shortening the duration to a four-week cycle

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

25. The exercise protocol should be modified by: *

Adding the minimum fitness requirements for the different levels of play

- □ Strongly Agree
- □ Agree
- □ Neutral
- □ Disagree
- □ Strongly Disagree

Thank you for taking the time to complete the questionnaire. Your response has been recorded. Please feel free to contact me should you have any further queries.

Tanushree Pillay
0824949561
tanushreeza@yahoo.com

Appendix 2.12: Injury prevention programme with recommended changes highlighted

A feasibility study represents a definition of a problem and evaluating responses with regard to the implementation of the proposed solution. In this study the researcher aims to establish the feasibility of the proposed injury prevention programme and its viability for implementation. As a build up to this programme, the current injury prevalence among netball players was determined; experiences relating to the current mode of operation were explored with various stakeholders and an evaluation of current practices relating to injury prevention was conducted by means of a systematic review. Based on the findings of the three previous steps highlighted, an injury prevention programme was designed. As an expert in your field either as a coach, medical expert or administrator you viewed one aspect of the injury prevention programme. The responses to the questionnaire you were initially sent have been collated and the recommended changes to the injury prevention programme have been applied for your perusal. The survey you have received aims to reach consensus amongst you, the expert panel, on the recommended changes. Please find attached below the three components of the injury prevention programme with the recommended changes. All the recommended changes are written in the coloured text.

Injury Prevention programme for netball players in South Africa: Overview

The injury prevention programme is a multi-faceted, player centred programme targeting injury prevention in netball through the involvement of all stakeholders: coaches, medical experts and administrators targeting how they impact the player through their specific roles. Although the approach is player centred the responsibility is still the players to comply with what is advised Through the creation of a scientific forum, the Sport Physiotherapy association, the association aims to streamline injury management and strategies to injuries. It also aims to coordinate research related matters, ethical code of conduct for members, and to assist with the formulation of minimum qualifications and guidelines for the appointment of physiotherapy staff for representative South African sport teams national, regional, and provincial teams. This would encompass managing injury prevention from an administrative perspective. The coaches educational pocket size booklet is designed for coaches. The booklet encompasses a variety of topics that serve as an easy reference tool to facilitate the process of implementing the different components that optimise training and assist with injury prevention. This targets injury prevention from the coaches aspect and serves to educate both the coach and the player. The injury prevention protocol has been developed through a review of literature. The authors of these research studies were able to reduce the incidence of ankle and knee injuries successfully and the series of exercises have been chosen based upon this. By including these excercises into the warm up and complying with the routine, the protocol aims to prevent injuries in netball players.

National Sport Physiotherapy Policy

Aim:

To emphasise the importance of injury prevention and the comprehensive physiotherapy care of all athletes in South Africa. A forum of sport physiotherapists involved in provincial and national sport need to collectively assist in optimising physiotherapy care and injury prevention as well as improving communication and continued physiotherapy education. This sport physiotherapy association of physiotherapists should be the official forum for provincial and national physiotherapists in South Africa and should conduct its business in co-operation with the Director of Physiotherapy. The focus of the association is all national federations. For this study netball is being used as the focus code illustrating how the association would impact injury prevention through an integrated approach

The goals of this sport physiotherapy sport association are:

1. To create and maintain a scientific communication forum for national and provincial physiotherapists dealing with athletes.
2. To create a platform for the monitoring of injury surveillance within national sporting codes
3. To communicate with and advise the federations through it's Director of Physiotherapy and other relevant organisations on strategies to prevent and manage injuries in South African sport. The director will have an appointed assistant.
4. To assist in the development, implementation and operation of comprehensive emergency and physiotherapy care structure for sport at all levels in South Africa,

5. To liaise with the Director of Physiotherapy and tertiary institutions on sport - related research matters.
6. To formulate and maintain an ethical code of conduct for members, and
7. To assist with the formulation of minimum qualifications and guidelines for the appointment of physiotherapy staff for representative South African sport teams national, regional, and provincial teams.

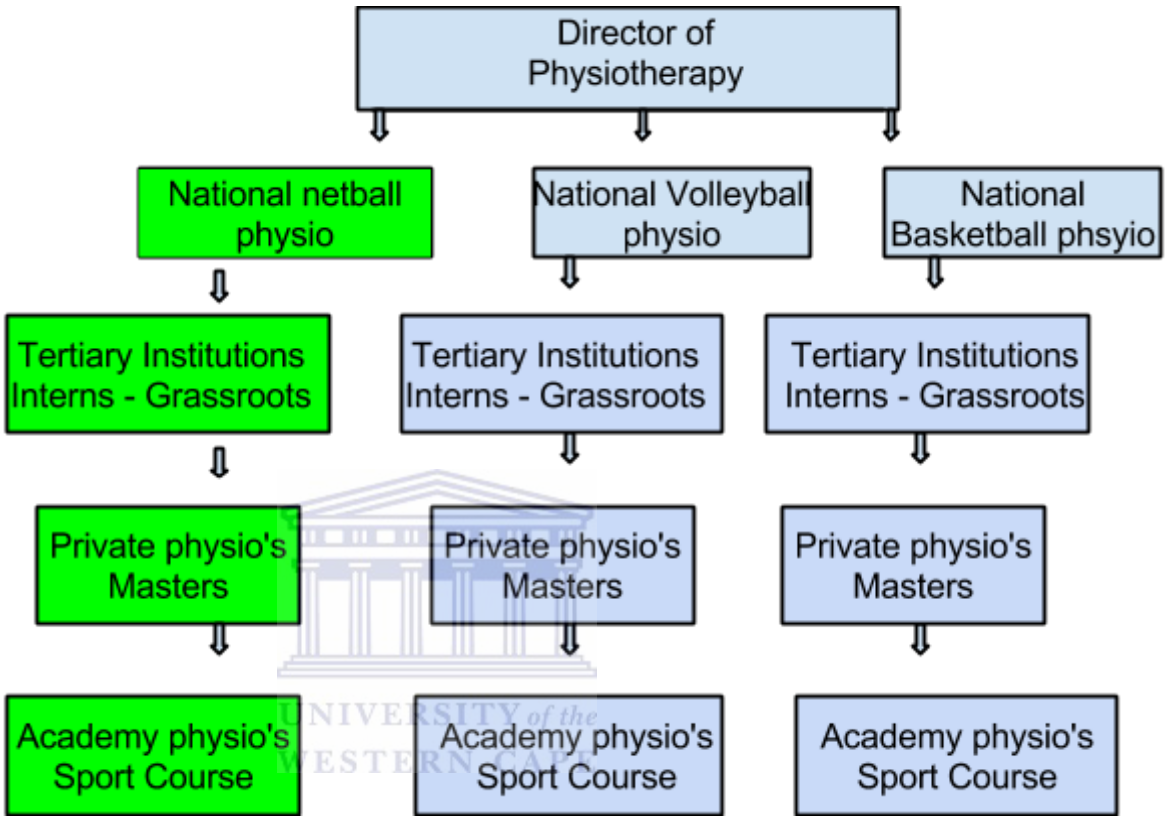
This sport physiotherapy association of physiotherapists consists of the Director and the Head national physiotherapist for the different codes, which are an academic and clinical group, and will address the scientific and operational aspects of its objectives to maintain and improve the physiotherapy care of the athletes in consultation with South Africa's sport science and medical institutions.

The sport physiotherapy associations affiliations will have both compulsory and voluntary membership:

1. Compulsory membership: Membership of the Sport physiotherapy association should be compulsory for all physiotherapists representing South African teams, regional franchises, and provincial representative teams.
2. Voluntary membership: Voluntary membership of the Sport physiotherapy association should be available for all physiotherapy professionals registered with the Health Professions Council of South Africa or equivalent body, who are interested in medical care of athletes. All sport physiotherapists involved in medical care of sport

teams in South Africa should be encouraged to acquire membership of the Sport physiotherapy association.

Sport Physiotherapy Association



Director of Physiotherapy:

Job Description:

- Communicate and liaise with the sporting federations
- Standardise assessment protocols for national teams
- Collate data of injury stats and co-ordinate research together with tertiary institutions with regard to interventions protocols for national teams
- Ensure best practice principles
- Assist federations with appointing National team physiotherapists

- Create and establish a forum for physiotherapist in accordance with the South African Society of Physiotherapy that coordinates the National and Provincial sport programme.
- Update and improve Sports Emergency Supervision through educating officials and management at all events.
- The forum should be inclusive and promote physiotherapy practice at an academic level as well as at a practice level.

National Team Physiotherapist:

Job Description:

- Liaise with the coaches and the Federations
- Plan and co-ordinate musculoskeletal assessments of teams pre and post season
- Monitor injury stats
- Provide physiotherapy services at national camps and competitions:
    - Assessment of new injuries
    - Treatment
    - Recovery
    - Strapping
    - Prescribing and administering return to play protocols
    - General first aid
    - Referral to other medical professionals
- Drawing up of rehabilitation programmes for athletes returning to provinces
- Liaise with tertiary institutions, provincial physios and academy physios
- Monitor treatment being delivered at provincial level

Tertiary Institutions:

- Formalise and structure a sport physiotherapy block for students
- Ensure that students are equipped with the necessary skills to be able to assist at sporting events and carry them out as practical blocks at Grass Roots.
- To ensure adequate output of research within the field of sport physiotherapy

Private Physio's:

- To assess and treat provincial and national athletes within their area of expertise.
- To provide regular feedback to the National physio with regard to the treatment progress of the athlete
- To be involved within the federation at a provincial level and club area assisting with camps and competitions
- To be available to supervise students offering services at camps and competition.

Academy Physio's:

- To assess and treat provincial and national athletes within their area of expertise.
- To provide regular feedback to the National physio with regard to the treatment progress of the athlete
- To be involved within the federation at a provincial level and club area assisting with camps and competitions
- To be available to supervise students offering services at camps and competitions

The Referral Network

The physiotherapy association will work within an established and affiliated referral network of other health care providers. This ensures the involvement of a multi-disciplinary medical team approach and will ensure the streamlining of medical information and timeous referrals.

National and Provincial Sport Physiotherapy

Registration form

Team represented	
Title:	
Name: *	
Surname: *	
Date of Birth:	
Highest Qualification:	
Year Qualification:	
Other Qualification:	
Year Qualification:	
Area of Specialisation:	
Years of experience in sport Physiotherapy	
Provincial Sport Team	
Postal Address:	
Postal code:	
Physical Address:	
Tel:	
Fax:	
Cell:	
Email: *	
HPCSA no	
Member Type: (compulsory/voluntary)	

South African Sport Physiotherapy Accreditation of Professionals to National Teams

The Sport physiotherapy Association will implement a grading system for professionals wishing to work with one of our National Teams. Future appointments should be decided upon by the grade obtained by the respective professionals.

A scoring system is proposed where professionals will be ranked according to work experience, in particular sport-related experience, academic qualifications in the field of Sports Medicine and Sports Science, and registration with National Professional bodies.

The appropriate references as well as copies of degrees and course certification need to be included in the application. **Grading will be reviewed on an annual basis**.

INSTRUCTIONS FOR COMPLETING THE APPLICATION:

Work Experience

1. Years since qualification

Please make a X against the appropriate number of years since qualification as a physiotherapist. Enter the value of the points in the SCORE [ ]. A copy of your graduation and current registration certificates may be asked for. Only working years apply.

2. Sport Related Experience

Only the highest level attained must be used for allocating points in this section so enter the value for the **only one level**. A letter from the relevant team confirming your appointment must be included in this application.

3. Academic

3.1 Post Graduate Qualifications

Only the highest level attained must be used for allocating points in this section.

Proof of qualification is required.

3.2 Specialized Training / Courses

Each course counts for 1 point. Course must have been done in the past 5 years. Proof of certification and date completed must accompany this application. Once course accreditation has been approved only accredited courses will be accepted. If you have presented a course you can also receive a point. However, you cannot receive a point for attending as well as a point for presenting a specific topic / course. You cannot receive points for courses offered as part of post grad qualification [section 2.1 above]

3.3 Publications

Points are also awarded for publications but only in recognized Scientific Journals. If you were a co-author you will receive fewer points than if you were the first author. Proof of publication is required. **Publications must also be applicable to sport or the management of injuries that may occur in athletes**.

4. Registrations

Proof of current registration must accompany this application

Circle the correct numbers as it applies to you on Form 2. Then total the scores. The rating would be as follows:

GRADING OF PROFESSIONALS

■ National	25 – 31 points
■ Provincial	20 – 24 points
■ School/Club/ University	10 – 19 points

Minimum Qualifications
Experience > 5 years Sport experience > 3 years
Recommended Qualifications
Academic involvement

FORM 1

DEPARTMENT OF SPORT AND RECREATION RATING OF SPORT PHYSIOTHERAPISTS

DATE: _____

1. DEMOGRAPHIC DATA:

NAME: _____

SURNAME: _____

DATE OF BIRTH: _____

PLACE OF BIRTH: _____

PROVINCE: _____

AGE: _____

GENDER: M F

2. PROFESSION: PHYSIOTHERAPY

CONTACT DETAILS:

HOME: _____

ADDRESS:_____

CODE: _____

POSTAL ADDRESS:_____

CODE: _____

TELEPHONE: WORK: _____

HOME: _____

FAX: _____

CELL: _____

EMAIL: _____

FORM 2

PHYSIOTHERAPIST RATING SYSTEM		
Years of experience as a Physiotherapist	0-4 years 5-10 years >10 years	2 3 4
Post graduate qualifications	OMTI/SPTI Masters degree Masters (coursework only) Doctoral degree	3 5 2 5
Additional Qualifications	Manual therapy Dry needling/Acupuncture Strapping Other	1 1 1 1
Sports related experience (Cumulative experience at least one season)	School Club Provincial National Schools National U/19 National U/21 National U/23 Development National Team	2 3 5 7 5 5 6 6 7
Personal playing experience in sport	Schools Club Provincial National	1 1 2 3
Academic Involvement	Teaching undergraduates Teaching graduates CME Lectures/Conference/ Presentations Academic Publications < 2 Academic Publications > 2	2 3 3 1 2
Involvement in other sporting codes (Sports Medicine)	Club Provincial National	1 2 3
Member of Professional Sport physiotherapy association (Add one point if serving/served in Executive capacity)	SASMA SIG	1 1
TOTAL SCORE		

Educational pamphlet/Pocket size booklet content

Introduction[1]

This educational pocket size booklet is designed for coaches. The booklet encompasses a variety of topics that serve as an easy reference tool to facilitate the process of implementing the different components that optimise training and assist with injury prevention. This tool aims to service coaches that don't have access to sport science and medical staff, as well as contribute to the wealth of knowledge that coaches may already have.

Guidelines on how to use the coaches' booklet:

Sections A-F cover specific topics that facilitate preventing injury in netball. As a coach you implement these elements on a daily basis. Browse through booklet so that you have a good idea of the content. In planning your coaching session refer to the relevant sections and follow the guidelines detailed. This has been designed to empower you the coach with the correct knowledge to facilitate preventing injury in netball.

1

[1] *"The only way to prove that you're a good sport is to lose."– Ernie Banks*

Contents

[2] "I always felt that my greatest asset was not my physical ability, it was my mental ability."– Bruce Jenner

SECTION A:

Physical Conditioning:

Various components of physical conditioning are important for success. Having a very good aerobic fitness level is an important attribute. Being quick and agile is a necessary requirement for all netball players. Player position also determines the physical conditioning disposition of the athlete. This section focuses on the key elements of physical conditioning as well as a few guidelines to successfully implement a programme.

Physical conditioning aims:

3. Prevent injuries
4. Strategies related to posture and the development of efficient movement patterns
5. Strength development to increase athletic performance on court
6. Your programme should incorporate conditioning principles into the netball training

- Vary intensity levels
- Combine skill with fitness training

[3]Key netball fitness components:

1. Skill	**5. Stamina**
2. Speed	**6. Agility**
3. Ball Handling	**7. Core strength**
4. Strength	**8. Technical skill correction**

[3] "Most people give up just when they're about to achieve success. They quit on the one yard line. They give up at the last minute of the game one foot from a winning touchdown."– Ross Perot

Minimum fitness requirements for the different levels of play

It is essential that baseline data is captured and that continuous fitness testing is carried out at the various levels of play. Minimum fitness requirements for each level of play should be established and athletes encouraged to reach these goals.

[4]SECTION B

Warm up:

Prepares the body for the proceeding activity as well as helping to prevent injury to muscles, which are most susceptible to injury when cold. In young people the warm up should be 5 to 10 minutes. In adolescents and older the warm up should be 15 to 20 minutes. In cold weather the duration of the warm up should be longer.

Warm up aims:

- Prepare the body and mind for the activity
- Increase the body's core temperature
- Increase the heart rate
- Increase breathing rate

What the ideal warm up should include:

- Warm up depends on the level of competition and the age of the athlete.
- Warm up should incorporate the muscle groups and activities similar to those that are required during training or competition.

Principles to improve athlete performance:

- **Specificity principle:** Train the energy systems and muscles as closely as possible to the way they are used in the sport.
- **Overload principle:** Athletes' must do more than their bodies are used to doing. When more is required the body adapts to the increase in demand.

[4] "The five S's of sports training are: stamina, speed, strength, skill, and spirit; but the greatest of these is spirit."– Ken Doherty

- **[5]Progression principle:** To steadily improve the fitness levels of your athletes you must continually increase the physical demands to overload their systems.
- **Diminishing returns principle:** As the athlete becomes fitter, the amount of improvement is less as they approach genetic limits. As fitness levels increase, more work or training is needed to make the same fitness gains.
- **Variation principle:** Use periodization to vary the volume, type and intensity of exercise and don't overstress one part of the body.
- **Reversibility principle:** When athletes stop training, hard – won fitness gains disappear. Maintaining a moderately high fitness level year round is easier than de-training at the end of season and starting again at the beginning of the new season.

- Should include the dynamic stretching of muscle groups integrated with dynamic sport specific drills.
- Intensity should begin low and gradually build to the intensity required during the training or competition.
- Stretch all muscle groups involved in the activity.
- Stretch through the full range of movement required in the activity being performed.

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[5] "Somewhere behind the athlete you've become and the hours of practice and the coaches who have pushed you is a little girl who fell in love with the game and never looked back… play for her."– Mia Hamm

- [6]**Rules of stretching:**
- Warm up prior to stretching.
- Stretch before and after exercise.
- Stretch all muscle groups that will be involved in the activity.
- Stretch gently and slowly.
- Never bounce or stretch rapidly.
- Stretch to the point of tension and not pain.
- Do not hold your breath whilst stretching breath whilst stretching. Breathing should be slow and easy.

[6] "It's not the will to win that matters—everyone has that. It's the will to prepare to win that matters."– Paul "Bear" Bryant

[7]SECTION C

Cool Down:

The cool down helps the body clear lactic acid that builds up during any activity. Less lactic acid means less soreness and stiffness the next day.

Cool Down Aims:

- After vigorous exercise the body needs time to slow down
- Aids recovery
- Stretching after activity helps to maintain maximum flexibility
- Relaxes contracted muscles
- Returns muscles to resting length
- Develops long term attitude to maintaining a healthy lifestyle
- Core training can be included in the cool down as a static excercise

[7] "Make sure your worst enemy doesn't live between your own two ears."– Laird Hamilton

[8]SECTION D

Bracing, taping and shoes:

- Seek professional advice on footwear.
- Consider preventive ankle taping or bracing to reduce injury risks.
- Fibular repositioning taping (FRT) is a good method to use.

FRT is applied prior to activity to maintain optimal fibula position and prevent forward fibula displacement; ankle injury prevention is the resultant effect, (Moiler 2006).

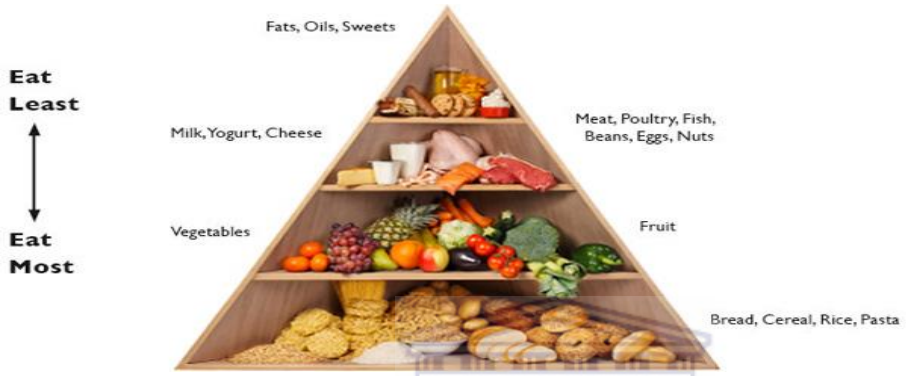
- Two 20-cm lengths of tape applied obliquely starting at the distal end of the lateral malleolus.
- A pain-free poster lateral force is applied to the distal fibula.
- The tape is applied to both ankles.
- A second reinforcing strip was applied in the same manner.

[8] "If you fail to prepare, you're prepared to fail."– Mark Spitz

[9]SECTION E

Hydration and Nutrition Guidelines:

You should eat a wholesome, varied diet that provides enough energy and all nutrients for a healthy active life. The basis of a good diet is the healthy food pyramid:



- Eat a varied diet. You need over 40 different nutrients daily and they come from different foods.
- Eat plenty of whole meal type foods with high carbohydrate content, which is the main fuel, required for Netball. These are foods like bread, cereal, rice, pasta, fruit, and potatoes.
- Eat a moderate amount of protein foods like these at each meal: lean red meat, chicken, fish, eggs, cheese, milk, dairy products or legumes.
- Keep fat intake low by not eating fried food and using low fat options. Food like pies, chocolate, takeaways should be eaten only occasionally.
- Avoid adding extra sugar or salt to food.
- Try to eat regularly – three times a day with snacks in between.

[9] "Persistence can change failure into extraordinary achievement."– Matt Biondi

- Keep fluids high. The best fluid is water. Try to drink up to two litres per day and more if playing netball. Encourage players to bring a drink bottle to practices and games.
- [10]Eat and drink before and after practice and games.

[10] "The hardest skill to acquire in this sport is the one where you compete all out, give it all you have, and you are still getting beat no matter what you do. When you have the killer instinct to fight through that, it is very special."– Eddie Reese

[11]SECTION F

Injury Management Guidelines:

When managing an injury it's always important that good decisions are made in the best interest of the athlete.

Do's and don'ts:

- RICE – always apply the principle of rest, ice, compress, elevate.
- Refer to a physio, clinic and doctor. Let a professional decide if an injury is present or not.
- Always have a qualified first aider, or medic at a match to ensure safe play.
- Do not give anti-inflammatories within the first 48 hours of an injury.

First aid bag general supplies:

1. First Aid Manual or Emergency/CPR flashcards
2. Strapping/bandages
3. Wound care, cleaning solution and plasters
4. Scissors
5. CPR mouth barrier or pocket mask
6. Sterile surgical gloves
7. Ziploc* bags (to hold ice for ice packs)
8. Cell phone and a list of numbers (paramedics and hospital)

[11] "Without self-discipline, success is impossible, period."– Lou Holtz

[12]SECTION G

Playing Surface Guidelines

Netball is played on a variety of surfaces ranging from natural turf to concrete, synthetic grass and wooden sprung floors. Ensure a netball surface remains free of potholes and stones. All grounds, particularly the surfaces, should be checked for dangerous items such as glass and rubbish, prior to each event. There are specifications for netball facilities. Within these specifications they indicate that:

· The minimum space between the side and base line and any obstacle shall be 10 feet.

· The minimum space between the courts shall be 20 feet

· There is however some flexibility within these regulations

All outside surfaces should be of a permanently firm nature and should be: smooth and level, slip resistant both dry or wet (including paint used for marking lines), well drained and preferably with a degree of shock absorbency (IFNA, 1997).

[12] "Pain is temporary. It may last a minute, or an hour, or a day, or a year, but eventually it will subside and something else will take its place. If I quit, however, it lasts forever."– Lance Armstrong

[13]SECTION H

Footwear Guidelines

Evidence has indicated that most netball injuries are located from the knee and ankles. One approach to prevent these injuries would, therefore, be to reduce the impact forces and provide a stable foot position by using specifically designed netball shoes. This is not always affordable so here are some basic guidelines:

- Athlete's footwear must be able to absorb shock, while maintaining enough stability to prevent excessive rolling in of the foot.
- The material of the midsole cannot be too heavy or too inflexible, but must still provide much of the shock absorption.
- It also should not be too thick as this makes the shoe unstable and a player has an increased risk of ankle sprain .
- As a result of these factors, shoes are now designed with gel or air inserts in the midsole in order to provide lighter, yet efficient, shock absorption qualities.
- Because netball is played on a hard abrasive surface a hard wearing outsole that is not too grippy is in wet and slippery conditions requires a good tread pattern on the outer sole of the shoe.
- The inner sole should be comfortable, cupping the normal heel contour during landing and supporting the arch of the foot.

[13] "Obstacles don't have to stop you. If you run into a wall, don't turn around and give up. Figure out how to climb it, go through it, or work around it."– Michael Jordan

- [14] The toe box of the shoe should leave sufficient room for foot movement, particularly when braking.
- Blisters, corns, loss of toenails, and so on, can be the result of a too tight fit.
- It is also important that the material used in manufacturing sports shoes allows the feet to breathe, thus reducing moisture and helping prevent blisters.
- For the serious athlete, this requires a regular update of shoes (every 6-12 months) as supportive features deteriorate with usage
- An understanding that poor shoes may contribute to netball-related injuries has lead manufacturers to design shoes with added stability and motion control, through the use of various components.
- Fit is especially important and netball shoes should always be fitted by an experienced shoe fitter
- It is often speculated that high-top shoes will aid the prevention of ankle sprains in multidirectional sports. High-top shoes theoretically provide external mechanical support to the ankle by preventing extremes in range of motion, thereby reducing the risks of injury

[14] "Some people say I have attitude – maybe I do…but I think you have to. You have to believe in yourself when no one else does – that makes you a winner right there. "– Venus Williams

Injury prevention protocol for netball players in South Africa

This protocol has been developed through a review of literature conducted by the researcher through the process of a systematic review. Individual elements or a combination thereof was carried out through randomized controlled trials by a number of authors. The authors of these research studies were able to reduce the incidence of ankle and knee injuries successfully and the series of exercises have been chosen based upon this. Very few injury prevention exercise programmes have been formulated therefore the programme is based on landing sports that have similar accelerative, decelerative and jumping actions present in Netball.

All exercises are to be performed 3 times weekly for ten minutes and are to be included into the warm up.

A four-week cycle of exercises is provided and must be rotated accordingly to cover the 6 week cycle. The programme should be done over a minimum number of 6 weeks. All repetitions are 3 x 30 and all positions held for 10 sec.

One leg decline squats ≥ 60° knee flexion ≤ 90° are performed on a 25° decline board. Only 15 reps are to be performed. The exercise is to be performed on both legs. In both instances the opposing leg is used to push down on the ground to go back to the start position. The equipment required for the programme is a skipping rope and a wobble board and a 25° decline wedge.

Purpose of each component of exercise:

Balance exercises: To improve landing technique as well as ankle and knee stability.

Eccentric loading: Eccentric exercises work a muscle when it is lengthening, not contracting or shortening. These exercises are often included in the rehabilitation of tendon injuries like tendinitis to help regain normal tendon function and prevent future injuries.

Plyometric exercises: Plyometric is a method of training muscle elastic strength and explosiveness to enhance athletic performance.

Aerobic exercises: Warming up will help prepare your body for aerobic activity in the prevention of muscular injury.

Week 1	***Day 1***	***Day 2***	***Day 3***
Balance Exercises	Single leg stance (on the floor, eyes open)	Single leg stance-swing raised leg (on the floor, eyes open)	Single leg squat (30° - 45°) (on the floor, eyes open)
Eccentric Loading	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board
Plyometric Exercises	Maximum effort two leg jump (emphasis on correct landing)	Maximum effort one leg jump (emphasis on correct landing)	Maximum effort two leg jump to receive a pass (emphasis on correct landing)
Aerobic Exercise	Rope Skipping (Double leg)	Rope Skipping (One leg)	Bounding ant and post (emphasis on proper cutting technique).

Week 2	***Day 1***	***Day 2***	***Day 3***
Balance Exercises	Single leg stance (passing and catching) (on the floor, eyes open)	Single leg stance (on the floor, eyes closed)	Single leg stance-swing raised leg (on the floor, eyes closed)
Eccentric Loading	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board
Plyometric Exercises	Maximum effort one leg jump to receive a pass (emphasis on correct landing)	Squat jumps. Perform a deep squat and then maximum effort jump into the air (emphasis on correct landing)	Squat split jumps. Perform a deep lunge and then maximum effort jump into the air (emphasis on correct landing)
Aerobic Exercise	Bounding lateral and medial (emphasis on proper cutting technique).	Shuttle runs repeated from baseline to each line back to the baseline (Full court). Each line counts as one rep.	Double leg hops (performed in pairs, small rhythmic hops jump, throw/catch a ball)

Week 3	***Day 1***	***Day 2***	***Day 3***
Balance Exercises	Single leg squat (30° - 45°) (on the floor, eyes closed)	Single leg stance (on the wobble board, eyes open)	Single leg stance-swing raised leg (on the wobble board, eyes open)
Eccentric Loading	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board
Plyometric Exercises	Tuck jumps. Place feet parallel and shoulder-width apart. Spring upward and tuck both knees toward chest before landing with feet in their original position. Repeat.	Lateral tuck jumps. Performed the same as tuck jumps but side to side over an object. Start with a cone and progress the height of the object. Repeat.	Double leg hops Place feet together, jump up and forward as far as possible. Repeat.
Aerobic Exercise	Single leg hops (performed in pairs, small rhythmic hops jump, throw/catch a ball)	4 point double leg hops forward, backward, left and right (repeat every alternative one in the opposite direction)	4 point single leg hops forward, backward, left and right (repeat every alternative one in the opposite direction)

Week 4	***Day 1***	***Day 2***	***Day 3***
Balance Exercises	Single leg squat (30° - 45°) (on the wobble board, eyes open)	Double leg stance rotate the board (on the wobble board, eyes open)	Single leg stance (on the wobble board, eyes closed)
Eccentric Loading	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board	One leg decline squats ≤60° knee flexion ≥ 90° on a 25° decline board
Plyometric Exercises	Single leg hops Standing on one leg, jump up and forward as far as possible. Alternate and repeat	Squat jumps to receive a pass. Perform a deep squat and then maximum effort jump into the air receive a pass. (emphasis on correct landing)	Squat split jumps to receive a pass. Perform a deep lunge and then maximum effort jump into the air to receive a pass. (emphasis on correct landing)
Aerobic Exercise	4 point double leg hops (performed in pairs, small rhythmic hops jump, throw/catch a ball)	4 point single leg hops (performed in pairs, small rhythmic hops jump, throw/catch a ball)	Jogging with a partner throw/catch a ball with a jump and single leg land

The following changes have not been included as this changes the validity of the protocol. The protocol was designed against the background of a systematic review literature search. Please do comment on the recommended changes in the survey to establish consensus on the proposed change even though they are not included:

- Include exercises to prevent contact
- Include dynamic stabilisation
- Include flexibility

- Include movement Control exercises
- Shorten to a 4-week cycle
- Progress the intensity and not the activity

*Please reflect on the amended changes and copy and paste the URL below. The 5-point Likert Scale survey is aimed at reaching consensus on the recommended changes.

URL: http://goo.gl/f4fW2n

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21 February 2011

To Whom It May Concern

I hereby certify that the Senate Research Committee of the University of the Western Cape has approved the methodology and the ethics of the following research project by: Ms T Pillay (Physiotherapy)

Research Project:	Determining the feasibility of a prehabilitative injury prevention protocol for netball players in South Africa
Registration no:	11/1/22

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

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Proof of editing

14 November 2013

This letter serves as proof that chapters 1 and 7 of Tanushree Pillay's PhD thesis, entitled *Determining the feasibility of a prehabilitative injury prevention programme for netball players in South Africa*, was professionally copy (language) edited. The editing was done in track changes. The applied changes to the rest of the document and the final editing and printing remained the responsibility of the student.

Kind regards

LM Bedeker
BA, Postgraduate Diploma (Translation) *cum laude*, MPhil (Translation) *cum laude*
Accredited member of the South African Translators' Institute (accreditation number 1001437)
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