

**PREVALENCE AND PATTERN OF INJURIES AMONG PLAYERS
AT THE UNIVERSITY OF THE WESTERN CAPE VOLLEYBALL
CLUB**

By

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ABSTRACT

In addition to football and basketball, volleyball has become a very popular sport globally over the last 30 years. The International Federation of Volleyball represents about 150 million players in approximately 170 countries. While a large body of research has been conducted regarding the nature and prevalence of volleyball injuries internationally, very little has been done locally or on the African continent to assess the status of injuries incurred at professional or amateur levels. The aim of this study is to determine the prevalence of injuries sustained by professional volleyball players of a club in the WPVU in one season. An exploratory, descriptive, non-experimental approach was used for this study on 42 volleyball players at the University of the Western Cape Volleyball Club. A self-administered questionnaire that was based on a questionnaire used in a Dutch national volleyball study was used in the present study. A response rate of 89.4% was obtained. The collected data were captured and analysed by means of the Statistical Package for Social Science version 14.0 (SPSS). The associations between variables were evaluated by means of the chi-square test and a 5% level of significance was used. The results were displayed using tables, bar chart, and pie chart. Most of the volleyball players sustained one or more injuries in the season, giving a prevalence rate of 88.1%. The incidence rate was 1.2 injuries per player. Injuries prevalence was higher among male players 54.1% than female players 45.9%. Among the injured players, ankle and knee injuries showed the highest injury prevalence with 25.5% for each followed by 19.6% for shoulder injuries. The study revealed 69.2% injury prevalence with a higher significance ($p=0.04$) that players who are injured in the ankle were in contact. Half of the injuries (50%), which occurred gradually, were prevalent in the shoulder, followed by the knee (28.6%), then the ankle and fingers (14.3%). Players in the left and right front row were significantly ($p=0.008$) more prone to be injured during spiking. Awareness programmes highlighting prevention strategies and physiotherapy intervention are

required for coaches and players at the University of the Western Cape Volleyball Club to assist in the prevention of volleyball injuries.

KEYWORDS: Volleyball; University of the Western Cape; sport; injuries; prevalence; pattern; prevention; incidence; players; nature.



DECLARATION

I hereby declare that “*PREVALENCE AND PATTERN OF INJURIES AMONG PLAYERS AT THE UNIVERSITY OF THE WESTERN CAPE VOLLEYBALL CLUB*” is my own work, that it has not been submitted in whole, or in part, 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 means of complete references.

Signature:

Hassan ABDELNOUR
Student number: 2634759
November 2008



Witness:

Mr. Hamilton PHARAOH

DEDICATION

To my mother MADINA ALZAIN and my father MUBARAK HASSAN. To my uncle we missed KHALID ALZAIN.

To my brother ALZAIN MUBARAK.

To my sisters MARWA and SAFA MUBARAK.



ACKNOWLEDGEMENTS


I TRULY APPRICIATE THE CONTRBUTION EXTENDED TO ME BY:

- Prof. Gasim Badri for all his support, together with all my colleagues and staff in Ahfad University for Women.
- Dr. Abdulrahim Mohammed Ahmed and Dr. Sameer Shaheen with all the staff in Kartoum Sheshire Home for the knowledge, best wishes, and support during the development / acquisition of my experience as a physiotherapist in Sudan.
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ABBREVIATIONS

ACL	Anterior Cruciate Ligament
AI	Ankle Injury
AS	Ankle Sprain
CAVB	Confédération Africaine de Volleyball
CPUT	Cape Peninsula University of Technology
DF	Dorsi Flexion
FIVB	International Federation of Volleyball
GHJ	Glenohumeral Joint
MSI	Musculoskeletal Injuries
NFHS	National Federation of State High School
UE	Upper Extremity
UK	United Kingdom
USA	United States of America
USHS	United States High School
UWC	University of the Western Cape
SASSU	South African Student Sport Union
USVBA	United States Volleyball Association
SASSU	South African Students Sports Union
SD	Standard Deviation
SHC	Student Health Center
SPSS	Statistical Package for the Social Sciences
WPVU	Western Province Volleyball Union

Chapter one

Introduction

1.1. Introduction to the chapter

The current study is aimed at determining the prevalence of sport injuries and examining the preventative actions implemented among players at the University of the Western Cape (UWC) Volleyball Club. It further describes how sport injuries can affect the performance of volleyball players at UWC.

This chapter will include background information regarding volleyball in general and volleyball injuries specifically, worldwide and at UWC. The definition of volleyball and the incidents of injury are included and linked with some studies related to injury prevention and incidents. The chapter also includes the problem statement, aims of the study, objectives, significance of the study, and definitions of the terms. Finally, the chapter will end with the outlines which state the chapter's contents.

1.2. Background

Volleyball is one of the most widely played sports in addition to football and basketball. It has become a very popular sport globally over the last 30 years (Stasinopoulos, 2004; Verhagen, Van Der Beek, Bouter, Bahr, & Van Mechelen, 2004). The International Federation of Volleyball (FIVB) represents about 150 million players in approximately 170 countries (Stasinopoulos, 2004). The Volleyball World Championship was started in 1974 for men by the FIVB and is now run every four years. Three years later, the women's version was added to the championship. The

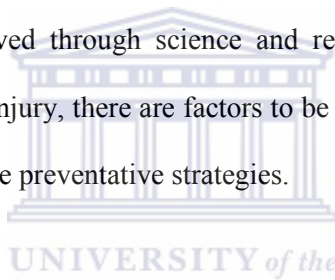
Volleyball World Cup is another event established in 1965 for men and in 1973 for women. It was established in order to fill the gap between the world volleyball championships and the Olympic Games. The leading teams in the Volleyball World Cup are automatically entered into the Olympic Games. The Volleyball World League is also an important event that was created in 1990 for men and organised by the FIVB. The final games are usually played in Poland. It includes 12 teams participating in the final games from 5 continents.

Beach volleyball joined as an Olympic sports event in 1992 at the Barcelona Olympic Games. It was then added officially to the Olympic Games in 1996 during Atlanta Olympic Games (Bahr & Reeser, 2003). In beach volleyball, the energy produced is higher due to the locomotion on sand. Indoor volleyball players usually find it difficult to jump on sand, because the ability to transfer position during playing, is more difficult on the sand as compared to hard court volleyball. Furthermore, the energy needed in beach volleyball is much more, because the player needs to cover a greater percentage of the court, which necessitate the development of stronger leg muscles (Quadriceps and Hamstring) as well as the necessary power to overcome the compliant nature of sand (Smith, 2006).

Volleyball can be a very active sport that can provide an excellent level of aerobic and healthy exercise. In addition, it requires low body fats because it is a sport that involves rapid and forceful movements of the body as a whole (Verhagen et al., 2004). There are difficult movements that need to be achieved while playing volleyball. For example, volleyball players have the best vertical jump ability compared to any other sports. Vertical jumping is a frequent movement required in volleyball, and it needs low body fat in the body mass (Davies, 2002). Therefore, exercise and training towards reducing the body fat in volleyball are recommended by volleyball coaches for the players. Due to the huge forces involved in vertical jumping and in other movements in volleyball, it is expected that injuries would occur. It is recognized that the overall

injury rate in volleyball is relatively low when compared to other team sports but injuries do occur in a discipline-specific pattern (Reeser, Verhagen, Briner, Askeland, & Bahr, 2006; Stasinopoulos, 2004). Researchers have attributed this difference in injury rate to the non-contact nature of the game (Stasinopoulos, 2004; Verhagen et al., 2004; Bahr & Bahr, 1997). The prevalence of certain injuries, such as acute Ankle Sprains (AS) in volleyball is, however, comparable to those found in contact sports such as soccer and basketball (Bahr & Bahr, 1997).

Injuries in sport are common due to contact with player, ground, objects, and other reasons such as pressure, overuse, and falls. Weakness is also a common cause of injuries. For example, physical weakness due to a previous injury, may lead to an injury in the same area. Preventing or treating the injury can be achieved through science and research. According to Hawkins & Metheny (2001), in dealing with injury, there are factors to be considered like knowing the injury extension, the mechanisms, and the preventative strategies.



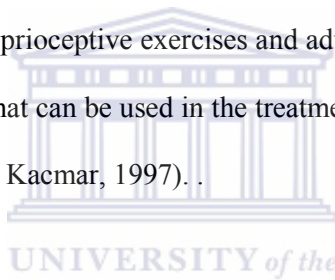
Physiotherapy is a branch of rehabilitation that deals with musculoskeletal injuries. Therefore, physiotherapy intervention is very important in injuries as general. Spinal cord injuries, sport injuries, and work related injuries are in need of proper physiotherapy rehabilitation after the injuries have been sustained (Frontera, 2003).

The immediate physiotherapy rehabilitation helps in fast recovery and getting patients back to the normal body activities. A worker can have the ability to get back to his work quickly the same affects to athletes. Physiotherapy can help in protecting the damaged tissues which will help healing in the inflammatory stage and pain control. In addition, it helps in muscle flexibility, strength, proprioception, and balance especially during activities with assistive devices like walking with walker, crutches, and using tape or splint. Flexibility to the muscles aids in improving the normal range of motion into the joint which will encourage the joint to return to the normal activity (Frontera, 2003).

Ankle, shoulder, and knee injuries are common injuries in volleyball which need physiotherapy care for rehabilitation (Bahr & Bahr 1997). Research showed that early mobilization in Ankle Sprain (AS) shows better outcomes than immobilization (Briner & Kacmar, 1997).

In addition, physiotherapy management results to fewer residual symptoms and improves the range of motion and early return to sport. The physiotherapy treatment in Ankle Sprain (AS) will focus on reducing pain, swelling, and restoring the ankle motion as well. That can be achieved through applying ice bath with specific exercise (Jibuike, Paul-Taylor, Maulvi, Richamond, & Fairclough, 2003).

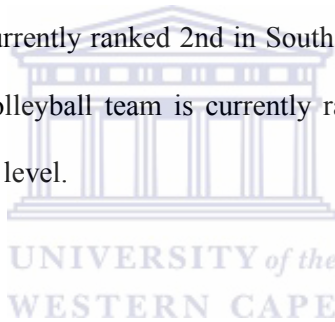
Taping and bracing will help in better protection of the ankle to avoid injury occurrence. Furthermore, physiotherapy techniques like soft tissues therapy, stretching, mobilization, strengthening, weight bearing, proprioceptive exercises and advice about returning to sport are all important physiotherapy aspects that can be used in the treatment of Ankle Sprain (AS) as well as other volleyball injuries (Briner & Kacmar, 1997).



While a large body of research has been conducted regarding the nature and prevalence of volleyball injuries internationally (Saavedra, 2003), very little has been done locally or on the African continent to assess the status of injuries incurred at professional or amateur levels even though researchers believe that the injury prevalence in Africa could be the same or higher than the cases observed in the developed countries and the reason behind may refer to the financial factor. Researchers have recognized the need to collect data on the incident and prevalence of injuries within specific sports and across a range of sports (Finch, 1997). One of the most important reasons for collecting data on the incidence of sports injuries, is to provide a guide for injury-prevention and improve sport safety. Agustsson, Agustsson, thomee, & Svantesson (2006), expressed their concern that an increase in the ratio of injury among volleyball players might be attribute to an increase in frequency, intensity and duration of injury, which lead to a need to

increase the prevalence of treatments. Increase in duration of injury may lead to absence from sporting activities in most cases.

Volleyball currently has a high profile status as a priority sports code in the Western Cape and recently received the Western Cape Sports Award of Federation of the Year 2001. The Western Province Volleyball Union is the Governing Body for the sport of Volleyball in the Western Cape, South Africa. The UWC Volleyball Club is one of 18 clubs affiliated to the Western Province Volleyball Union (WPVU). The UWC volleyball club consists of some of the top tertiary and club level volleyball players as well as administrators and coaches in the Western Province. Their participation includes the highest level of competition, as individual players take part in events such as the World Student Games as well as All Africa Games. The female volleyball team of the UWC is currently ranked 2nd in South Africa, 1st at Provincial level and 1st at tertiary level. The male volleyball team is currently ranked 3rd in South Africa, 3rd at Provincial level and 9th at tertiary level.



1.3. Problem statement

There has been a lack of research in Southern Africa regarding the prevalence and type of volleyball injuries sustained by professional volleyball players. It is of vital importance to apply information about volleyball injuries that occur frequently, in order to provide a basis for preventative measures.

1.4. Aim of the study

The primary aim of this study is to determine the prevalence of injuries sustained by professional volleyball players of a club in the WPVU in one season.

1.5. Objectives

The specific objectives of this study are:

- To determine the prevalence of volleyball injuries sustained among the UWC Volleyball Players in a volleyball season.
- To identify the sites, nature and cause of injuries sustained among the UWC players in a volleyball season by the researcher.
- To identify the intrinsic and extrinsic factors associated with the injuries sustained among the UWC players in a volleyball season.

1.6. Significance of the study

The UWC Volleyball Club participates at a very high level of competition with great success. This puts the players at risk of sustaining injuries due to the intensity needed to be successful. The physical demand placed on the players during training and competition therefore increases the risk of injury. Literature shows that very little research has been done on the prevalence of these injuries and its associated risk factors. The prevalence of injuries and its associated risk factors is needed in order to formulate preventative, treatment and rehabilitation measures in which Physiotherapy can play a pivotal role.

1.7. Definitions of terms

Sport: Sport is any activity and experience the human can practice to increase the level of activity to the body and it is focused on fitness, recreation, athletics or leisure (Richard, 2005).

Injury: Defined as any incident that occurs during warm up or competition that requires medical attention (Zemper & Pieter, 1989) and cause the player to be absent from sport participation either in a training or match session (McKay, Payne, Goldie, Oakes, & Stanley 2001) .

The definition used in this study is the same as in many other studies related to volleyball which is that injury occurs as a result of participation in volleyball, forcing the player to leave the court

for the rest of the match or training session and/or leading to a reduction in the level of training or matches. (Augustsson et al., 2006; Bahr & Reeser, 2003; Verhagen et al., 2003).

Injuries can be classified as mild, moderate and severe. The severity of an injury was defined based on the time of absence due to the injury. The injuries were divided into three categories. “Minor” was defined as an injury leading to an absence from training/matches of no more than 1 week. An injury leading to an absence of 2-4 weeks was defined as “moderate”, and “major” was defined as an injury leading to an absence of more than 4 weeks (Augustsson et al., 2006).

Volleyball: Volleyball is an Olympic sport played by two teams separated by the use of a net. Each team consists of six players. The teams should keep the ball, which is not allowed to touch the surface, in any of the team zones. The net is about 39 inches in width and 9.5 in length. The height of the net from the ground is about 2.24 meters (Aagaard, Scavenius, & Jorgensen, 1997).

Prevalence: The word, prevalence, mainly depends on the context in which the word is used. In language, prevalence means the wide extension of something. This extension is usually a measure of a quantity. In the medical field, prevalence refers to the number of disease cases within a population over a given period of time (Verhagen et al., 2004). Prevalence is defined in this study as the number of volleyball injuries that occurred in the UWC Volleyball Teams in the 2006-2007 season. In other words, prevalence can refer to how many people had injuries this year. Prevalence is a more general term which more likely refers to the total number of injuries or diseases at a specific time or during a period of time. The key words to differentiate prevalence from incident are the words (at that point of time) for prevalence and (at a period of time) for incidence.

Incidence: Incidence means the frequency of a certain disease or injury within a given time. For example, the incidence of sport injuries in the year 2001 are 3000 cases which are considered as

new cases to the population. Incidence also means changing a group of people by force (Dick, Weisboard, Gregory, Dyck, & Neudorf, 2006). In this study it refers to the number of injuries that occurred in volleyball during a certain time. In other words, it refers to any event causing certain volleyball players from the UWC to be injured in a match or training session. Incidence will help in studying the risk of certain injuries to the population. Incidence and prevalence are related terms, for example, when the duration of diseases increases, the prevalence of diseases will increase.

According to Rothman (2002), incidence is “something that is measured within a set number of people and in a time period”.

1.8. Outline of chapters

Chapter one describes the basis of the present study. This includes the background of volleyball worldwide, the problem statement, objectives, the aims, and significance of the study.

In chapter two, the literature review highlights essential issues that need to receive focused attention. These include the prevalence and types of volleyball sport injuries, as well as the mechanisms and nature of those injuries. The costs and long-term effects of volleyball injuries are also highlighted. The chapter further shows the risk factors and prevention strategies to counter volleyball injuries. The effectiveness of some physiotherapy modalities used to treat sports injuries, is also demonstrated and the health promotion of volleyball players is mentioned. The importance of epidemiology studies in sports injuries is also reviewed.

Chapter three makes an attempt to explain the methodological issues of the study, including study population and sampling, methods of data collection and the procedure of the study. A self-administered questionnaire survey was used in data collection. Descriptive and inferential statistics were used in quantitative data analysis. Finally, the chapter concludes with issues of ethical consideration.

Chapter four presents a brief description of the main results stemming from this study. The demographic characteristics of the UWC volleyball players are reported. The prevalence of volleyball injuries, most common body locations prone to injury, mechanisms, and nature of injuries are further presented. The chapter further shows the use of physiotherapy services by volleyball players and possible reasons why players do not use physiotherapy services. Finally, the chapter shows the gender difference in volleyball injuries related to this study.

In chapter five, the results of the current study are interpreted and compared with similar studies. An attempt is made to suggest how the problems related to this study can be resolved. Finally, the chapter ends by stating the limitations of this study.

The final chapter, entitled “Summary, Conclusions and Recommendations”, summarises and draws important conclusions from the research and gives suggestions for future work or research.



Chapter two

Literature review

2.1. Introduction

This chapter attempts to provide a review of the available literature directed specifically at volleyball injuries. The literature will concentrate on some important areas related to the study such as the prevalence and incidents of volleyball, volleyball injuries, the common sites and nature of the volleyball injuries, and the factors intervening in the volleyball injuries. In addition, it reviews literature on injury prevention and it highlights the gaps in the literature regarding volleyball injuries. The chapter will include discussion of some specific injuries which are common in volleyball. It will also show the players' positions and the common actions performed by the players in volleyball.

2.2. Volleyball

Volleyball is a popular sport because it requires a minimal amount of sport equipment. In addition, people can participate easily in the sport of volleyball with the minimum of skills and develop skills through a period of practice and participation. That why it became a very popular sport in the world.

2.2.1. History

Volleyball as a sport was invented in 1896 by William G. Morgan in Holyoke, Massachusetts, United States of America (USA) (Reeser & Bahr, 2003). In South Africa, the sport volleyball has grown fast and its popularity has increased despite other sports, especially after eliminating the previous racial barriers attached to sport in South Africa. At UWC, Volleyball currently has a high profile status as a priority sports code in the Western Cape and recently received the Western Cape Sports Award of Federation of the Year 2001. The UWC Volleyball Club is one of 18 clubs affiliated to the Western Province Volleyball Union (WPVU). Their participation includes the highest level of competition as individual players take part in events such as the World Student Games as well as All Africa Games.

2.2.2. Volleyball in recent times

Today, in the USA, volleyball is widely played in colleges. There are 972 women's volleyball teams (National Collegiate Athletic Association, 2002). The National Collegiate Athletic Association (NCAA) conducted the first championship for women in 1981. By the year 2003 the number of participants increased by 36% (Agel, Palmieri-Smith, Dick, Wojtys, & Marshall, 2007). Volleyball is the third highest sport among high schools in America (National Federation of State High School Association, 2002). There are around 14,181 high schools in the USA participating in the National Federation of State High School (NFHS) with volleyball programmes (Melrose, Spaniol, Bohling, & Bonnette, 2007).

There are no gender barriers in volleyball like in others sports such as soccer or rugby. According to Hartmann-Tews & Pfister (2003), the gender ratio in volleyball is 1:1 in Canada. In Spain, volleyball is one of the top ten sports while, in the Czech Republic, volleyball is one of the top two favorite sports for youths and top three for adults. Volleyball is the eighth largest sport in

Norway and there is about 33 000 players (Bahr & Bahr 1997). There are also many Latin American countries that participate in high level competitions such as in international championships. The focus in these Latin American countries toward volleyball is relatively high. For example, Peru spent 80 per cent of its national sport budget on the women volleyball team (Arbena & LaFrance, 2004).

In Africa, Confédération Africaine de Volleyball (CAVB) is the volleyball controlling body located in Cairo, Egypt. It includes 36 African countries and organizes 5 different volleyball activities in Africa such as: African volleyball championship, African volleyball championship under 21, 20, 19, and 18 years old. Egypt, Tunisia, Algeria, Cameroon, and Kenya are the top African volleyball teams in Africa. The African performances internationally are still slow according to some of the studies and research regarding volleyball in Africa.

In South Africa, volleyball had the same history related to apartheid as other sports. In other words, the way of practicing the sport was based on racial classification.

South Africa is the most advanced African country in terms of economy, facilities, and research work regarding sport, but still volleyball studies are not in an advanced stage. There is only one research study done in South Africa on beach volleyball which can be found in academic journals; otherwise, no studies on volleyball injuries in Africa or South Africa however was found with a MEDLINE search using “volleyball”, “injuries” and “South Africa” as search items. The Department of Sport and Recreation in South Africa has an archive on research in sports in South Africa, but no items were found under volleyball injuries.

2.2.3. Mechanisms and positions in volleyball

In volleyball, there are major actions player's needs to perform while playing. During those actions, and due to the fast speed in action, the risk of being injured, is increasing. The major actions during volleyball are as follow:

- **Spiking:** This is when a high amount of topspin is applied to the ball to direct the ball in a short horizontal direction into the opposite team's zone. The spike effect increases with the ball high, which means that the higher setting to the ball, will give better fast spiking. In spiking, overhead arm swing is performed with the body in the air, which means that there is no closed chain support (Jacobson & Benson, 2001). It requires quick timing and adjustment to the ball.
- **Serving:** Is the action of sending the ball into the opposite team's zone after winning one point. The aim while serving is to score and make it more difficult for the opposite team receiving the ball (Masumura, Marquez, Koyama, & Michiyoshi, 2007). The fast serve is also known as "spikes serve" and it is an effective technique to use while serving, due to the high speed of the ball.
- **Blocking:** Is a defensive action to keep the other team from spiking successfully into the blocking team's zone. Most ankle injuries in volleyball occur while blocking (Nelson, Collins, Yard, Fields, & Comstock (2007). Similar to spiking, blocking depends on the vertical jump which involves ankle force to dorsiflexion, followed by knee and hip extension force to increase the jumping (Smith, 2006). That requires strong knee and ankle extensor muscles.
- **Setting:** Is the action of passing the ball to the teammate before spiking over the net.

Most Musculoskeletal injuries (MSI) in volleyball occur due to landing which follows blocking and spiking or jumping before blocking or spiking. According to Salci, Kentel, Heycan, Akin, & Korkusuz (2004), 68% of the MSI occur due to the above-mentioned movements in volleyball.

According to Malousaris, Bergeles, Barzouka, Bayios, Nassis, & Koskolou (2007), Volleyball players are distributed on the playground into different positions:

- **Libero:** The Libero is the player who is in the back court. The Libero's mission is to defend the received ball from the opposite team and the Libero is not allowed to serve or attack.
- **Centre:** The centre is located along the center of the net. His/her main mission is blocking and attacking the ball. The centre's actions require quick movement in blocking and attacking.
- **Hitter:** A hitter is attacking and blocking over the net on the right and left side. A hitter can also receive the ball. In hitting and blocking, vertical jumping is required, risking the body joints into injuries. For example, jumping characterized by a quick eccentric action to the musculature involves the quadriceps. Therefore, injuries on the knee joint are common in this position.
- **Setter:** The setter usually does not receive the ball but hits the ball after the receiver sets it up in a good position for the hitter to spike the ball. The setter needs to deliver a ball that is expected at the point that the hitter/attacker wants it.

2.3. Prevalence of injuries

2.3.1. Injuries

As mentioned in chapter one, an injury is any medical case requiring medical attention.

Injuries can occur in different situations, in sport and in daily life due to different reasons such as; crime, traffic accidents, war, and work accidents additional to sport injuries.

In the USA, injuries are the most common reason for death (Benner, Overpeck, Trumble, Der Simonian, & Berendes, 1999). These injuries often occur due to accidents like fire accidents, motor vehicle accidents, homicide, drowning, mechanical suffocation, and choking.

2.3.2. Injuries in sport

In sport, injury is defined as any physical or medical condition resulting in the player having to miss participating in the sport. The duration of the can be different from one injury to another depending on the severity and condition (Orchard & Seward, 2002). According to Augustsson et al., 2006; Bahr & Reeser, 2003; McKay et al., 2001; Zemper & Pieter, 1989), injury is any incident that occurs during warm up or competition that requires medical attention and causes the player to be absent from sport participation in either a training session or match.

According to Caine, Caine, & Lindner (1996), there are many factors known about sports injuries from the medical and sports medicine literature but the definition of sports injuries still needs to be clarified.

According to Abernethy & Bleakley (2007), 8% of adolescents drop out of recreational sporting activities annually because of injury.

There is a high rate of injuries that occurs during sports. Most of these are not very severe but rehabilitation delay may lead to more severe injury development. This delay, in many conditions

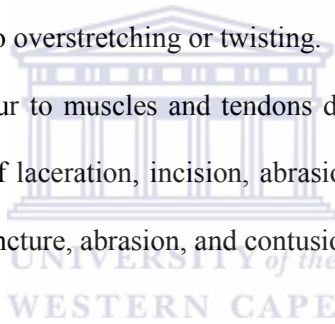
can be attributed to economical, social, and diagnostic challenges of the rehabilitation and treatments process.

The injury can take location in different body areas. There are fractures which usually occur in the bones and can be divided into close, open, osteoarthritis, stress, and avulsion fractures (Stone, Seeley, Lui, Cauley, Ensrud, Browner, Nevitt & Cummings, 2003).

Injury divided into acute and chronic injury occurs in the cartilaginous areas of the body in the form of chronic, acute tears, or contusion (injury to the soft tissues can happen while kicking or falling).

Sprain of the ligaments is another type of acute injury that happens to the ankle, knee, and wrist in the form of ligament pain due to overstretching or twisting.

Chronic and acute strain can occur to muscles and tendons due to overstretch or overuse. Skin also can be injured in the form of laceration, incision, abrasion, puncture and avulsion. Injuries can also occur in the form of a puncture, abrasion, and contusion of the other body organs like the heart, kidney, and eye.



2.3.4. Severity of injuries

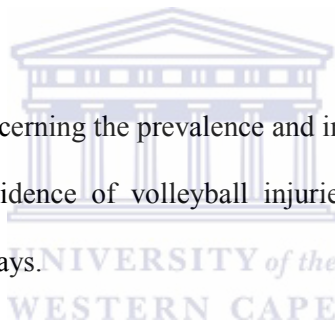
Injury severity can be categorised into three classifications. It is classified as major, moderate, and minor injury. The classification depends on the time that the injury takes to recover. Hawkins & Fuller (1998b), stated that the minor or slight injuries take two to three days to recover while the moderate take four to seven days to recover and the major injuries usually take more than four weeks. Other literature stated different durations and classification, like Orchard & Seward (2002), who classified the severity of injuries according to the number of games missed due to the injury. Caine et al. (1996), classified injuries into four levels. First, injury with no time lost and no effect towards the sport and fitness activities. Second, injuries with time lost and modifying

the duration or intensity of sport and fitness activities. Third, injuries with time lost and causing a player to miss part or all of any sport and fitness activity. Fourth, injury with time lost causing a player to miss part or all of any sport and fitness activity and in alterations in daily life such as crutches.

2.4. Volleyball injuries

It is important to define injuries when assessing incidence and prevalence. Caine et al., (1996), recommended that the volleyball injury definition needs to be directed to injuries occurring as a result of participation in volleyball and resulting in a restriction of the player's participation for one or more days.

There are a number of studies concerning the prevalence and incidence of volleyball injuries. The definition of prevalence and incidence of volleyball injuries has been designed in different sources of literature in different ways.



Incidence can refer to the number of injuries per hours. The injury incidence in volleyball has been estimated to be between 1.7 and 4.2 per 1000 hours of play and is the furthestmost common source of sports injuries (Stasinopoulos, 2004). Studies have proven that volleyball injuries in the United States Volleyball Association (USVBA) are estimated around 2.3 per 1000 hours (Bahr and Bahr, 1997).

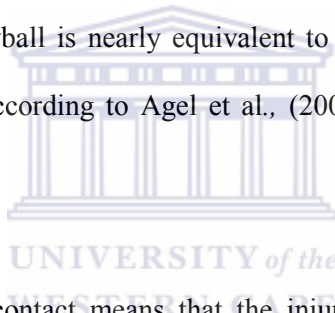
Various studies have indicated that injuries in volleyball are quite common and that they occur in games more often than in training (Agel et al., 2007; Augustsson et al., 2005; Verhagen et al., 2004; Stasinopoulos, 2004; Schultz, 1999; Bahr & Bahr, 1997). There is still debate on the mentioned fact, according to Nelson, et al., (2007), in a study conducted among United States

high school sport athletics, where it was found that Ankle Injuries (AI) during training are much higher than in games. Overuse and acute injuries appear to be equally as common in volleyball as in other sports (Augustsson et al., 2005; Verhagen et al., 2004).

In the national collegiate athletic association, the injury prevalence of the lower extremity reaches up to 55% and 20 % for the upper extremity (Agel et al., 2007).

The data on volleyball injuries showed that there is an increase in the injury rate with the level of participation from school to colleges to clubs. In addition, older studies used to show lower rates of injuries than the recent studies (Caine et al., 2006).

The incidence of injury in volleyball is nearly equivalent to those observed in ice hockey and soccer (Aagaard et al., 1997). According to Agel et al., (2007), injuries in volleyball occur in three mechanisms, which are:



- **Player contact:** Player contact means that the injury occurs due to attachment with another player from the same team or the opposite team. It can be due to a player stepping onto another player's foot or knee. Ankle Injury (AI) is one of the most common types of injury which occurs during player contact. According to Nelson et al., (2007), player contact in volleyball is the most common mechanism for Ankle Injury (AI).
- **Other contact:** It mostly occurs due to hitting/striking other objects while playing, like balls, standard, and floor. In case of injury due to ball contact (mostly in spiking and blocking), fingers are the common injured body parts.

- **No contact:** It can occur due to stressful movement or heavy loading after landing. For example, landing after jumping on single leg. A severe knee, ankle, and shoulder injury usually occurs in a non-contact mechanism.

2.4.1. Ankle injuries

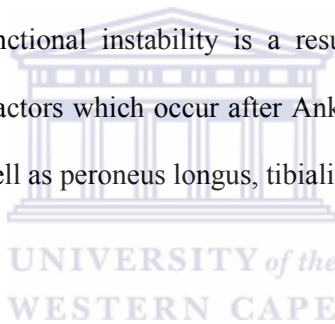
In the past, comparing Ankle Injuries (AI) among the genders was difficult due to the different definitions used to define injuries. Using one definition of injuries, unit of exposure, and reporting system, made the task easier in some studies (Nelson et al., 2007).

Ankle Injuries (AI) accounts for 15-60% of acute injuries in volleyball (Reeser et al., 2006; Augustson et al., 2005; Verhagen et al., 2004; Nelson et al., 2007) and it is estimated that 326 396 Ankle Injuries (AI) occurred nationally among United State High School (USHS) sport athletes in one season, causing the athletes' absence from sport for more than 7 days.

According to Osborne & Rizzo (2003), in the United States of America (USA), Ankle Sprain (AS) ranges between 14 and 33 per cent in all sports-related injuries and up to 40 per cent are with history of previous Ankle Sprain (AS). According to Bahr & Bahr (1997), previous studies indicated that an Ankle Sprain (AS) is the most common type of injury in volleyball, accounting for one-quarter to one-half of the overall quantity of acute injuries. Furthermore, Ankle Sprain (AS) mostly occurs near the net where jumping and landing is performed, while blocking and spiking injuries occur as well. 19% of these types of injuries occur due to landing on a team mate's foot, which is considered as a technical error. But, the previous ankle injuries are still the main risk factors. In addition, severe Ankle Sprain (AS) occurs in 2 million persons every year in the USA. The rate of acute Ankle Sprain (AS) in volleyball is 0.9 per 1000 players' hours, which is almost the same rate as found in contact sports such as soccer and basketball (Stasinopoulos, 2004).

The most common mechanism for Ankle Injury (AI) is forced supination, which occurs when a blocking player's foot lands on the opponent spiker's foot that has crossed the net line (in the "conflict zone"). A study done in the Netherlands by Verhagen et al., (2004) found that 75% to 78% of all players with an Ankle Sprain (AS) experienced previous Ankle Sprain (AS) rehabilitation, including proprioceptive training. Ankle orthoses or taping has been found to assist in active rehabilitation of Ankle Sprain (AS).

Functional instability is the most common complication after Ankle Sprain (AS) and it occurs in 15-60% of athletes who had ankle sprains (Glasoe, Allen, Awtry, & Yack, 1999). Suda, Amorim, & Sacco, (2007), stated that functional instability is a result of muscles' imbalance due to mechanical, motor, and sensory factors which occur after Ankle Sprain (AS) in muscles such as invertor and evertor muscles as well as peroneus longus, tibialis anterior, and gastrocnemius.



2.4.2. Knee injuries

According to Gel et al., (2007), knee injury usually leads to the player being absent for 10 or more days from sport. Knee injuries are reported as acute injuries in most of the cases. That is due to the high ability to generate strength while vertical jumping. The quadriceps produces high strength to help in muscle imbalance between knee extensors and flexors. These will cause overload of the tendons of the knee joint.

Gisslen, Gyulai, Soderman, & Alfredson (2005), found that knee sprains and meniscus tears account for approximately 15% of acute injuries. Anterior Cruciate Ligament (ACL) tears usually occur as non-contact injuries when the player lands with the knee hyperextended. This can be seen much more in female players due to the increase of sagittal tibial translation, which depends on the type and period of exercise performed during the training sessions (Bahr & Bahr 1997).

Furthermore, Gisslen et al., (2005), stated that patellar tendonitis (jumper's knee) accounts for up to 80% of overuse injuries. According to Malliaras, Cook, & Kent, (2006), tendon abnormality accompanied with pain is known as patellar tendinopathy. Patellar tendinopathy may present in 25 per cent of volleyball players. It is quite difficult to treat and can stay with the volleyball player even after quitting from volleyball in a later stage or age. There is a strong association between the Patellar Tendinopathy injury and the jump height accompanied with low range in ankle Dorsi Flexion (DF) during jumping and landing same as the number of years participating in volleyball.

2.4.3. Shoulder injuries

The shoulder joint is called the shoulder complex because it contains different joints such as the Acromioclavicular Joint, Sternoclavicular Joint, Scapulothoracic Articulation, and Glenohumeral Joint. Injuries to the shoulder seem to be the most frequently reported overuse injuries (Augustsson et al., 2005). According to Aagaard & Jorgensen (1996), the shoulder injuries used to be the most serious injuries among volleyball players in Netherland and it counts 15% of the total number of injuries. In addition, shoulder injuries count 8% of the total volleyball injuries in top two divisions of the Norwegian Volleyball Federation (Bahr & Bahr, 1997). Spiking and serving in volleyball are common actions while playing and they apply high stress on the shoulder joint. Spiking can be divided into three phases which are cocking, acceleration, and deceleration. In cocking, the shoulder is in 90 degrees of abduction and the Glenohumeral Joint (GHJ) reaches its maximum rotation. According to Ozbek, Bamac, Budak, Yenigun, & Colak (2006), serving and spiking are the most asymmetrical, powerful movements which require strenuous unilateral action on the upper extremity (UE). In other words, overhead mechanism is performed while serving and spiking. It imposes high weight-bearing on the upper extremity.

This can appear while playing volleyball in the form of repetitive stress on the shoulder and the elbow joints. Therefore, injuries on the shoulder, elbow, wrist, and fingers are expected. For example, Ulnar Neuropathy at the elbow is a common disorder in overhead throwing sports.

The injury can happen in the form of peripheral nerve entrapment which can happen without signs and symptoms and that is why injuries cannot be recognized early before neurological damage has occurred.

Shoulder tendonitis/ impingement/ suprascapular nerve entrapment account for 8-20% of overuse injuries in the top level English male volleyball players (Wang & Cochrance, 2001). Overhead movements such as overhead serving and spiking, may increase the risk of impingement. The increased force occurring at ball contact while the arm is in maximal abduction, may increase the risk of impingement.

Up to 32% of volleyball players have suprascapular nerve compression (Dane, Can, Gursoy, & Ezirmik, 2004). This usually occurs at the spinoglenoid notch (entirely motor at this point). This results in infraspinatus atrophy. The mechanism is particularly associated with the "floater" serve, which involves conveying as little spin as possible to the ball, making passing difficult. This injury probably results because the server purposely stops the follow-through immediately after striking the ball. This retracting of the arm requires forceful eccentric contraction of the infraspinatus.

Suprascapular neuropathy is often painless due to involvement of the motor portion to the infraspinatus only. There was 33% of Suprascapular Neuropathy in high level volleyball players in Germany (Holzgraefe, Kukowski & Eggert, 1994). Pain may result from imbalance in rotator cuff stabilization. According to Wang & Cochrance (2001), there are 9.3 new rotator cuff tendonitis injuries in each 1000 hours of playing in the top level English volleyball male athletics.

Finally, spiking during attacking is the most common action resulting in shoulder injury due to the ball acceleration in mid-air without closed kinematic chain support. It can lead to shoulder complex syndrome in the form of pain such as bursitis, involvement of supraspinatus, biceps tendinitis, and instability of the shoulder. According to Jacobson & Benson (2001), shoulder complexes in some cases, can lead to duration of absence from volleyball for up to one year.

2.2.4. Ulnar nerve injuries

Ulnar nerve injury is a common type of injury in volleyball. It can occur due to different causes such as compression, traction, and friction. According to Ozbek et al., (2006), in most Ulnar nerve cases, there are two abnormalities which usually appear. Firstly, compression occurs due to hypertrophy of the surrounding soft tissues. This hypertrophy occurs due to subluxation or dislocation of the nerve as a result of developmental laxity of the soft tissues which holds the ulnar nerve in its groove inside the cubital tunnel. Secondly, traction of the valgus force, which occurs while throwing, is the reason for performing ulnar nerve injury. All the above-mentioned situations occur when the repetitive flexion and extension occur in the elbow joint while playing volleyball. When the nerve is unstable, it is easy to irritate or inflame it, especially when the shoulder is in abduction and wrist and fingers are in extension.

The Ulnar nerve arises from the medial cord of the brachial plexus through the medial head of the triceps. It goes behind the medial epicondyle of the humerus and through the cubital tunnel distally until it enters the palm of the hand. Any disorder to the nerve may appear in the form of pain at any point of the mentioned route. For example, compression can occur at any point from the axilla to the hand. In the case of compression, it mostly occurs in the elbow joint (Ozbek et al., 2006). According to Hyde & Gengenbach (2007), Ulnar nerve injuries occur as 25% of athletics injuries and that is due to the involvement of the hand in those sports. In Netherland, 42% of Ulnar nerve injuries in adult athletes reported success treatment without surgical treatment (Eygendaal & Safran, 2006).

Table 2.1. Most common locations for volleyball injuries in previous studies.

	Ankle	knee	Shoulder
Agel et al., 2007	44.1%	14.1%	5.2%
Augstsson et al., 2006	23%	18%	15%
Verhagen et al., 2004	41%	12%	9%
Bahr & Bahr, 1997	54%	8%	8%
Bahr et al., 2003	17%	30%	10%



2.5. Injury prevention

According to Parkkari, Kujala, & Kannus (2001), sport injury is the most common type of injury which occurs in western societies. It takes time and effort to treat them, therefore prevention strategies are justified and highly recommended.

Prevention programmes, including close supervision by doctors and physiotherapists, can reduce injuries in sports. For example, Jibuike, Paul-Taylor, Maulvi, Richamond, & Fairclough (2003), stated that direct physiotherapy management in the knee soft tissues and other knee injuries have reduced rehabilitation time and effort by reducing the orthopedic waiting list in the United Kingdom (UK). That requires good training of the physiotherapist practitioners to handle such cases in the emergency department.

2.5.1. Assessment

Sport injuries occur due to intrinsic and extrinsic factors. According to Bahr & Holme, 2003; Caine et al., 1996), intrinsic factors are called internal athlete-related risk factors, which include age, sex, weight, previous injury, and physical strength. Extrinsic factors are known as exposure, training conditions, and external environmental risk factors like training technique, equipment, and weather.

Davies (2002), noticed that muscle assessment is highly affective towards injury prevention because it helps in detecting and preventing injuries occurring due to muscle imbalance and it provides guidelines for resuming sports participation after injuries.

Identifying the factors contributing to injury is the first step towards prevention. Various researchers have stated that it is of vital importance to supply information about volleyball injuries that occur frequently in order to provide a basis for preventative measures (Stasinopoulos, 2004; Verhagen et al., 2004). Furthermore, in view of the global participation rate and the high incidence of volleyball injuries, preventative measures are warranted in volleyball. Augustsson et al., (2005), however stated that although sports injury prevention programmes have gained considerable attention recently, the extent to which these prevention programmes are used and the possibilities of preventative measures to prevent sports injuries are not clear.

According to Jacobson & Benson (2001), better understanding of the spiking mechanism and kinematic can lead to better volleyball attackers' shoulder rehabilitation.

2.5.2. Preventative intervention

Due to the large number of ankle injuries associated with volleyball, a fair amount of preventative programmes for ankle injuries exist. Ankle Sprain (AS) are the most common form of acute

injury and the preventative programme for Ankle Sprains (AS) consisting of technical training and external support was designed to reduce the rate of Ankle Sprains (AS). An external support for an Ankle Injury (AI) should be worn for at least 6-12 months following Ankle Sprains (AS) in volleyball (Bahr & Bahr, 1997).

The previous study by Bahr & Bahr (1997), showed that there are materials used by the players for ankle protection, like ankle braces and tapes, especially among those who had previous injuries.

10% of ankle injuries that occurred in United States High School (USHS) volleyball teams occurred among players wearing an ankle brace and 91.4% of Ankle Injuries (AI) occurring were new injuries (Nelson et al., 2007).

According to Bahr & Bahr (1997), most players intended to use ankle braces or tape regularly in Norway for ankle injuries protection especially players with previous Ankle Injury (AI).

Increases in the prevalence of new injuries require more attention on the preventing devices for both injured and uninjured players in volleyball, especially for common ankle, knee, and shoulder injuries. Agel et al., (2007) stated that more prevention effort is required to focus on preventing the first-time Ankle Sprain (AS) and acute traumatic knee injury.

Taping is another assistive device to be used for injury protection and it became a wide spread protection for fingers and ankle ligament injuries, especially after it was proven that it can apply restriction to the ankle dorsi flexion range of motion during jumping, while simultaneously not affecting the height of the vertical jump performance (Herrington & Al Shebli, 2006). It can minimize the range of flexion and extension in the ankle and that will reduce the risk of injuries which may occur because of the stretching and compression on muscles while targeting to reach high jumping.

Caine et al., (1996), stated that, when the association between certain risk factors and injury is known, it is possible to develop a degree of predictability for those who are at risk. Therefore, the process of providing a prevention strategy in order to prevent or reduce the occurrence of injuries is required through intervention.

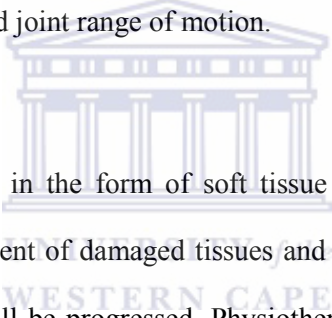
Briner & Kacmar (1997), argued that many of the injuries may be preventable if close attention is paid to technique in sport-specific skills and some fairly simple preventative interventions. Verhagen et al., (2004), further stated that injury prevention programmes should focus on the Ankle Sprain (AS) and concentrate on players with previous Ankle Sprain (AS). Prevention is possible through a training programme that emphasises avoidance of the centre line during practice and teaches players who jump forward when spiking to take longer steps prior to jumping and to jump straight up rather than forward (Verhagen, Van Tulder, Van Der Beek, Bouter, & Van Mechelen, 2005). A study in Norway demonstrated a 50% decrease in Ankle Sprain (AS) with this training strategy, which decreased the reported injuries to 1.7 per 1000 hours.

According to Jacobson & Benson (2001), attackers in volleyball could spike without shoulder pain if they perform low Glenohumeral Joint (GHJ) internal rotation when hitting the ball. This action will prevent/avoid shoulder impingement. Socio-economic factors also exist in some cases. For example, in ankle injuries, Nelson et al., (2007), found that the rate of injuries is different between schools, depending on the schools' volleyball field conditions and the quality of their equipment. Thus indicating that volleyball equipment as well as the playing field can influence injury prevention outcomes.

2.5.4. Rehabilitation

According to Frontera, (2003), rehabilitation is the restoration of function; it designed to minimize the loss associated with injuries or diseases. The aim of rehabilitation in sport injuries is to increase the functional performance which depends on several factors such as injury characteristics, sociodemographic, biological, psychological, and social factors.

Physiotherapy is part of the sport injuries prevention and rehabilitation program. It has affects towards the pain management through different modalities such as cold therapy, heating modalities, hydrotherapy, electrotherapy, and traction. In additional, it acts in improving the strength, endurance, flexibility, and joint range of motion.



Most injuries in volleyball occur in the form of soft tissue damage. Treating this damage is important in order to limit the extent of damaged tissues and to reduce pain. Therefore, healing will be promoted and recovery will be progressed. Physiotherapy provides treatment to achieve soft tissue damage rehabilitation. Soft tissue recovery includes three major phases, which include the inflammatory phase, fibroblastic phase, and remodeling phase. In the inflammatory phase, gentle mobilization can be applied to minimize the extent of the damage to soft tissues. In the fibroblast phase, in addition to gentle mobilization, slight exercises can be applied in order to increase tensile strength. In the remodeling phase, mobilization with stretching can be applied to perform the maximum range of motion.

According to Lederman (2003), the physical effect of manual therapy can take place in the local tissue dimension under the physiotherapist's hands. The manual techniques can be applied into

the skin, muscles, tendons, ligaments, joint structure, and fluid systems by assisting tissue repair, fluid flow, and adaptation.

2.5.5. Strength training

Frontera, (2003), stated that the rehabilitation program on overhead activities should focus on progression on flexibility, strength exercises, and increasing load and duration.

Strength training is the use of resistance to muscular contraction to improve strength, size, and performance of skeletal muscles. Weight training, resistance exercise, and isometric training are common methods for the strength training.

Strength training helps in injury prevention, especially in sport. To prevent injuries and improve performance in volleyball, strength training is highly recommended. According to Seigi et al., (2000), it is an important kind of training to the volleyball players because volleyball, as mentioned, requires explosive movement, vertical jumps, intensive serves, and power in hitting. This can be achieved through improved joint flexibility, and increased tendons strength.

There are variables in the strength training needs to be known by the player and the coach as well, like the kind of exercise, the frequency, intensity, and method of lifting during the training (Seigi et al., 2000). In other words, coaches and players needs to observe the difference between each player to design the proper programme for each player, depending on the player experience, needs, and ability. Same mentioned factors need to be used for increasing the workload in the strength training.

2.6. Factors influencing volleyball injuries

In sport, factors related to injuries are divided into intrinsic factors (player-related) and extrinsic factors (environment-related). Age, gender, previous injury, body size, body size, muscles strength, and postural stability are some of the intrinsic factors associated with injuries. Extrinsic factors associated with the injuries are type of sport, exposure time, player position, level of competition, training conditions, training technique, and playing surface.

2.6.1. Intrinsic factors

- **Age**

Age seems to be a risk factor for some diseases such as osteoarthritis. The association between age and injury prevalence is related to the exposure time. In volleyball, it seems to be a risk factor for injuries; older athletes have more exposure time in sport (Verhagen et al., 2004). For younger athletes, exposure time in sport is less; therefore the injuries risks are decreased. But still findings are different depends on each study conditions.

- **Gender**

Some studies showed that females accounts higher injury prevalence in volleyball (Augustsson, et al., 2006; Verhagen et al., 2004). However the relation between sex and injury is still unclear. Study by Bahr & Bahr, (1997), have however shown that males accounts higher injury prevalence in volleyball.

In some cases the high injury prevalence for males are due to the higher participation among males. Aagaard et al., (1997), related the gender factor to the participation rate and the level of competition showing that males are participated more in training activities than females.

Augustsson et al., 2006, found that there is no significant association between gender and other term such as age and exposure time.

- **Height and weight**

Body size used to be measured by height, weight, muscles and fat content in the body. The relationship between body size and injury is not clear. Some studies showed association between the body size and injury. For example, in soccer some studies showed increase injury risk in males with greater height but no association found for females. In running sports speed is related to Height and weight. In volleyball, the height and weight relation are connected to jumping and stability. Players with heavier weight are prone to injuries. Malliaras et al., (2006), found relationship between players having a waste greater than 83 cm and tendón pattelar pathology. That is due to the mechanical affect in performing volleyball actions.

- **Previous injury**

Previous injury is an intrinsic factor associated with ankle injuries in volleyball. Studies showed that most of the ankle injuries which occurred is related to players having had previous ankle injuries (Augustsson et al., 2006; Malliaras et al., 2006).

Recurrences of previous injury usually happen in volleyball (Bahr & Bahr, 1997). Proper rehabilitation and use of protective device reduces the possibility of injury recurrence in volleyball. According to (Nelson et al., 2007; Bahr & Bahr 1997), the use of ankle brace and taping reduced the ankle injuries of the volleyball players in United States of America (USA) and Norway. In addition, it gives positive results for ankle and fingers injuries recurrence (Briner & Kacmar, 1997).

- **Level of fitness**

High level of fitness is associated with injury prevention (Augustsson et al., 2006). As mentioned repetitive jumping in volleyball requires high level of fitness.

To increase fitness, a proper training program is required. Coaches used to make use of gradual progressive polymeric training to increase the players fitness. Increase in duration and intensity in

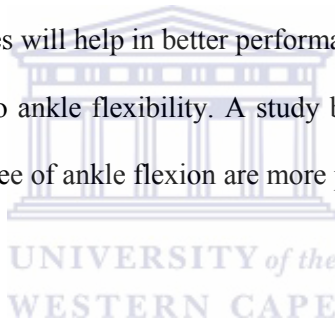
the training program is recommended. Warm up before exercising increases the blood flow and blood supply to the tissues.

- **Flexibility**

There is a positive relationship between flexibility and health. In sport, flexibility of muscles and soft tissues around the joint reduces the chance of injuries occurrence and improve the player performance.

Flexibility assessment during exercises and rehabilitation stages is highly recommended to the volleyball players. Flexibility can be improved or monitored through the use of stretching exercises. In volleyball, the hamstring & quadriceps muscles are used in jumping and landing. Therefore, stretching those muscles will help in better performance and injury reeducation.

Injuries in the ankle are related to ankle flexibility. A study by Milliaras et al., (2006), showed that players with less than 45 degree of ankle flexion are more prone to patellar tendinopathy.



2.6.2. Extrinsic factors

- **Training methods**

Proper methods for trainings are important to avoid injuries. Therefore inadequate warm up can cause muscles strain and due to the applying an over load stretching on the muscle. Increase in the load gradually is the proper and safe way to perform it.

Prevention programme supervision can reduce injury occurrence in cases where the trainer is experienced in sport-specific injuries and have the knowledge of designing training programmes to achieve high performance and prevent injuries (Kraemer, Adams, Cafarelli, Dudley, Dooly, Feigenbaum, Fleck, Francklin, Fry, Hoffman, Newton, Potteiger, Stone, Ratamess, & Triplett-McBride, 2002). Augustsson et al., (2006), stated that there is a need to investigate the effect of supervision and training techniques in the prevention of volleyball injuries. It's important for the coach or players to decide the purpose of the training. Is it strength training or resistance training. Furthermore, some studies showed a positive relationship between strength training and jumper's knee (Lian, Refsnes, Engebretsen, & Bahr, 2003).

- **Level of competition**

Aagaard & Jorgensen (1996), related the increase of overuse injuries to participation in other sport activities due to the increase in training hours. On the other hand, there is positive association between level of competition and skill level. Furthermore, it's possible that younger players with less period of participation in sport are more prone to injuries.

An increase in the level of participation in volleyball helps in developing skills in jumping and landing. Agel at al., (2006), showed that there is a need for players to learn the proper landing techniques to avoid knee flexion and valgus strain.

- **Player position**

In volleyball, there is a relationship between player position and injury occurrence. The player position is linked to the action that the player will be performing in that specific position. According to studies by (Agel et al., 2007; Bahr & Bahr 1997), volleyball players near the net are more prone to injuries than any other position. That is due to the blocking and spiking that the player performs.

According to Salci, et al., (2004), 68% of Musculoskeletal injuries (MSI) occur in volleyball due to landing and jumping which follows blocking and spiking. Agel et al., (2006), found that 42.7% of volleyball injuries occur in the right and left front row. In the same study the setter position accounts for 24.6% and 23.2% occur to players in the back line position.

In addition to jumping, spiking requires strong fast shoulder vertical overhead movements. In spiking, the player used to do different actions such as, jumping in high level above the net and hit the ball. During that there are different mechanisms occurring in the shoulder, wrist, and elbow muscles in the upper extremity to hit the ball. For jumping, lower extremity muscles mainly hamstring and quadriceps take the burden in producing forces. In blocking, the same mechanism occurs to the lower extremity.

- **Surface**

The type of playing surface is related to safety while playing. Indoor volleyball courts increases the risk of injury due to hard surfaces, falling or hitting the floor. One of the safety requirements in playing volleyball is to check the surface. Water or sand on the playing surface may cause sliding and falling.

It's clear that in beach volleyball the nature of the sand prevent the players from injuries during falling. A study by Bahr & Reeser (2003), conducted on beach volleyball players and the nature of the surface in beach volleyball found that more physical strength and more stability is needed by players than with indoor court surfaces. According to Agel et al., (2006), players who train on hard surfaces are more prone to jumper's knee. According to (Smith, 2006), the ability to transfer

position during playing is more difficult on the sand as compared to hard court volleyball. In addition, the vertical jumping requires more energy in beach volleyball and cause more stress on the back muscles.

2.7. Summary

With the increase in the number of people involved in sport and in the number of people from different countries meeting in sport, sport became a significant part of the developed countries and communities. According to Williams (quoted in Cohen, Beaton, & Mitchell, 1979), “the significance of sport in South Africa is quite apparent”. The increased participation in sports, however, increases the exposure to risk factors associated with the occurrences of sports injuries. Agel et al., (2007) showed that there is increased injury prevalence in general, and in volleyball specifically, during games more than during training sessions. Ankle ligament sprain, knee internal derangement, muscle strains of the shoulder and upper leg muscle strains are the most common injury types which occur during games and training sessions.

There is still a lack of information about injuries in volleyball and the mechanism of injury (Bahr & Bahr, 1997). Better surveillance systems are required in sport to ascertain information on common injuries like AS (Nelson et al., 2007). As highlighted in this review of the literature, a fair amount of research on sports injuries has been conducted in Africa and South Africa. These studies covered injuries in cricket (Stretch, 2003), rugby (Haylen, 2004), and cycling (Noakes, 1995) in South Africa extensively. Studies in the rest of Africa covered injuries in athletics (Adegbesan & Onyeha, 2003) and handball (Asembo & Wekesa, 1998) extensively. No studies on volleyball injuries in Africa or South Africa, however, were found with a MEDLINE search using “volleyball”, “injuries” and “South Africa” as search items. The Department of Sport and Recreation in South Africa has an archive on research in sports in South Africa but no items were found under volleyball injuries.

Chapter three

Methodology

3.1. Introduction

This chapter explores the methods utilized in the study. Included in this chapter are descriptions of the research settings, study sample and the study design, measurement tools and procedures. The pilot study and how the data analysis was carried out are also discussed. The chapter will end with the ethical considerations for the study.

3.2. Research Setting

The study was conducted at the University of the Western Cape (UWC), which has one of the top volleyball clubs at Tertiary level. There are no studies in the Western Cape or in South Africa showing the prevalence and the nature of volleyball injuries. There is a need to define the risk factors and the associations between the risk factors in order to recommend useful treatment programmes.

UWC is located in the northern suburbs of Cape Town in South Africa. The university was established in 1960 by the South African government as a tertiary institute for the so called coloured people only. The establishment of the UWC was as a result of the Separate University Education Bill in 1957. UWC has modern sports facilities like an athletics track, a cricket oval, netball courts, tennis courts, volleyball courts, as well as an equipped gymnasium. It also has a stadium and swimming pool. The University of the Western Cape Sport Council (UWCSC) represents the student organisations in the South African Student Sport Union (SASSU). All sport activities at UWC are administrated by the sport administration office which is located near the stadium. In total, there are approximately 24 sports codes at UWC.

Accessibility to facilities, admission and membership to the various clubs at UWC is offered to the students, the staff, and the public. In the case of an injury, the UWC physiotherapy department provides services through the clinic which is staffed by a physiotherapist and senior physiotherapy students. The Student Health Centre (SHC) is in charge of all emergency cases.

UWC Volleyball Club is one of 18 clubs affiliated to the Western Province Volleyball Union (WPVU). The UWC volleyball club consists of some of the top tertiary and club level volleyball players as well as administrators and coaches in the Western Province. Their participation includes the highest level of competition, as individual players take part in events such as the World Student Games as well as All Africa Games. The female volleyball team of the UWC is currently ranked 2nd in South Africa, 1st at Provincial level and 1st at tertiary level. The male volleyball team is currently ranked 3rd in South Africa, 3rd at Provincial level and 9th at tertiary level. Information about injury prevalence and incidence in UWC Volleyball Club will encourage for further in-depth studies.



3.3. Study design

The study is quantitative research study. An exploratory, descriptive, non-experimental approach was used for this study. Mitchell & Jolley (2001), stated that, with exploratory research, the researcher is free to discover any relationship that exists between any variables to be explored. According to Sousa, Driessnack, & Mendes (2007), quantitative research plays an important role in developing evidence-based knowledge. It can quantify relationships between and among variables. On the other hand, the only disadvantage of this method is the fact that it cannot clarify anything about the effect. The descriptive design is the most common in the non-experimental approach. The study form will be based on a one-time survey as one of the most common forms of research with a clear, strong, and appropriate design. The exploratory design was chosen due to the study aim which is to know the prevalence of the volleyball injuries.

For quantitative, the focus will be in explaining and knowing facts as is the case in this study, which is the research design chosen to answer the research question. Looking to the questionnaires, it consists of quantitative variables as the normal situation in the quantitative design.

The non-experimental approach here will help in knowing the causes of the facts and the relationship between the independent and dependent facts. Therefore, that will help in categorizing the data later in the data analysis.

3.4. Study population

The study population consisted of all volleyball players at the UWC Volleyball Club that were willing to participate in the study. The UWC Volleyball Club's current membership stands at 47 members. The two male teams consist of 25 members and the two female teams consist of 22 members. They are currently registered with the UWC Sports Council, Western Province Volleyball Union league (WPVU) and the South African Students Sports Union (SASSU). The UWC volleyball teams consist of some of the Western Province's top tertiary and club level volleyball players as well as administrators and coaches.

3.5. Research instrument

The instrument used was a self-administered questionnaire that was based on a questionnaire used by Augustsson et al., (2005), in a Dutch national volleyball study. The participant could indicate one or more selections in the questionnaires. The questionnaire, comprising of 15 questions, was divided into two parts (Appendix C & D). The first part deals with demographic information, which includes gender, age, height and weight, years of volleyball experience, sports participation (volleyball and other sports), the use of preventative measures, and previous injuries which can focus on the aims of this study and determine the prevalence of injuries sustained by professional volleyball players of a club in the WPVU in one season.

In the second part, the questionnaire included an injury profile section. This section includes whether the injury occurred during training or a match, the skill performed, the injured player's court position, and anatomical location of the injury, and this is to identify the sites, nature and cause of injuries sustained and to identify the intrinsic and extrinsic factors associated with the injuries sustained. Questions regarding the ability of the player to complete the match or training session and whether the injury resulted in any absence from training and/or matches, were also recorded.

Information regarding physiotherapy services was also obtained through three questions. The three questions were asking about the accessibility to the physiotherapy services, the reason for not accessing such services, and the opinion about the need of physiotherapy services for injuries. The first question was given five category responses: *Always, very often, often, sometimes and never*. For the second question, players were given possible reasons for not using physiotherapy services and had to choose one or more responses by placing a tick. The second question was given four category responses: *Financial, not informed, absence of service, and ignorance*. The third question was given four category responses: *Strongly agree, agree, disagree, and strongly disagree*.

The injury definition used in this study was an injury that occurred as a result of participation in volleyball, forcing the player to leave the court for the rest of the match or training session and/or leading to a reduction in the level of training or matches. The severity of the injury has been graded by the time of absence from training and match participation. The injuries were divided into three categories. "Minor" was defined as an injury leading to an absence from training/matches of no more than 1 week. Injury leading to an absence of 2-4 weeks was defined as "moderate", and "major" was defined as an injury leading to an absence of more than 4 weeks. Furthermore, recorded injuries were divided into either acute (that is, resulting from a sudden event during organised volleyball) or overuse (resulting from volleyball, but without a sudden event during organised volleyball).

3.6. Validity and Reliability

Validity and reliability are two of the most important criteria by which a quantitative instrument's adequacy is evaluated (Polit, Beck, & Hungler, 2001). Validity refers to the extent to which an instrument measures what it is supposed to be measuring (Sarantakos, 1997). Face validity refers to whether the instrument looks as though it is measuring the appropriate construct (Polit et al., 2001). Unlike reliability, validity of an instrument is extremely difficult to establish. Like reliability, validity has a number of different aspects and assessment approaches. To ensure validity of the instrument, the research instrument used in this study was questionnaire which was used in previous study by (Augustsson et al., 2005). The questionnaire has been tested on the Cape Peninsula University of Technology (CPUT) volleyball team, which is not included in the study, to obtain views about the design and to achieve face validity.

3.7. Pilot study

The questionnaires used in this study were pre-tested in a pilot study on the CPUT male and female volleyball teams during a training session to determine the clarity of the questions. The pilot study included a total of 21 players divided into 13 females and 8 males. It was pre-tested over a period of two days. The players answered the questions without any difficulties except for the term plyometrics, in the first part of the questionnaires, which was not clear to some players. Therefore the use of push-up as an example of a plyometrics exercise was given to explain the meaning. In a push-up exercise, there is pre-loading eccentrically before contracting the muscles concentrically (Lees & Smith, 1996). Another problem in the questions occurred in the first question asking about the number of year's participation in volleyball. Some players participated in volleyball for a period less than one year. For that question, the option then included "less than one year". The time period taken to complete the questionnaires was around 10-15 minutes.

Reliability was tested to check the ability of the questionnaires to give consistent results using the test-retest method. A group of 5 volleyball players from CPUT answered the questionnaires in

two separated rounds. The interval between the two tests was one week. The consistency of the answers was checked using Wilcoxon sign rank test. The test statistics supplies between 0.95 and 1 for all questions and this result provides good support for test-retest reliability.

3.9. Procedure

Before the volleyball season of 2006/2007 permission and ethical clearance was obtained from the UWC Research Grant and Study Leave and Higher Degree Committee. Permission was also sought from the UWC Sports Administration, volleyball coaches and players. Both players and the management received consent forms (Appendix A & B). The data was collected by the researcher during the 2006/2007 WPVU season. In the Western Province, outdoor and beach volleyball take place over the period of October to February of each calendar year. Questionnaires were distributed to the players before training sessions by the researcher. The volleyball teams trained at Belhar Sport Centre in Bellville. The data was collected within a period of 4 months, from November 2006 to February 2007. The completion of the questionnaire took about 10-20 minutes. The questionnaires were administered after the training sessions and after competitions. The questionnaires were self-administered at that particular time and were collected immediately after each session. During this period, some players of the teams joined the Colleges World Cup in Thailand and were out of the country for one month representing South African colleges' national volleyball team.

During 2006/2007 session, players completed a questionnaire on demographic variables as outlined under the research instruments. An injury recorded on the second part of the questionnaire was outlined under research instruments. Exposure time of each player was noted and recorded by the researcher, i.e. the total duration of each of the training sessions and matches.

3.10. Data analysis

Completed data was captured on spreadsheets using the Microsoft Excel programme in preparation for analysis. The data was then transferred into the Statistical Package for the Social Sciences (SPSS) version 14.0. Prevalence tables were used to describe categorical data, while means and standard deviations were used to describe continuous data. Injury prevalence was calculated as the number of injuries reported per volleyball player. An Independent Sample t-test was used to compare means. The level of significance was set at $p < 0.05$. Injury incidence was calculated for all volleyball players and for males and females separately, as the number of new injuries (n) reported per 1000 hours of play (total, match, or training, as appropriate) using exposure time (h) of each individual player, i.e. injury incidence = $n/1000h$ (Phillips, Frantz, Amosun & Weitz, 2001). Data for males was compared to data for females.

3.11. Ethical considerations

Ethical clearance and approval from the UWC Research and Study Grants Committee was sought before the study got underway. Written consent from UWC Sports Administration, WPVU league and the coaches was obtained before the study commenced. Furthermore, signed informed written consent was obtained from each participant. The aim of the study was explained to the relevant administrative bodies and the volleyball players. The volleyball players were assured that all the information collected from the study would be kept confidential and anonymous. All the volleyball players had the right to withdraw from the study at any time. The research findings will be made available to all the stakeholders with recommendations, if any.

Chapter four

Results

4.1. Introduction

This chapter presents the results of the study. The socio-demographic characteristics of volleyball players are presented under various headings. Data about injury prevalence, mechanisms, nature and effect, body parts and structures of the commonly injured are provided. The opinions about physiotherapy, physiotherapy access, and the challenges to physiotherapy access by volleyball players are also presented.

4.2. Socio-Demographic Characteristics of Volleyball Players

A total of 47 volleyball players were expected to participate in the study. A total of 42 players participated and completed the questionnaires, which yielded a response rate of 89.4%. The response rate among the females was higher at 90.9% (20/22) compared to 88% (22/25) among the male volleyball players. Among the participants, 47.6% (n=20) were females and 52.4% (n=22) were male volleyball players, as shown in Table 4.1.

Table 4.1. Sociodemographic characteristics of the sample (n=42)

Gender	N	%
Male	22	52.4
Female	20	47.6
Participation in other sports activities		
Yes	15	35.7
No	27	64.3
Time playing volleyball (in years)		
<1	2	4.8
1-2	2	4.8
3-4	8	19
5-6	3	7.1
>6	26	61.9
No answer	1	2.4

Total exposure time to volleyball was 4358 hours per week, 2508 hours for males and 1848 hours for females. The mean total exposure time was 103.7 hours for each player. The mean for both genders was 114 hours for males, 97 hours for females. The mean exposure time per week was

5.2 hours for male and 4.4 hours for female. The mean of the exposure time for injured players was 108 hours and 92.4 for non-injured players.

As shown in Table 4.1., less than half 35.7% (15/42) of the volleyball players were engaged in other sports beside volleyball such as beach volleyball, soccer, and swimming. All 15 players engaged with other sports indicated having one or more injury.

Table 4.2. Volleyball players' ages

Gender	N	Mean	SD
Male	22	24.6	7.8
Female	20	25.6	5.8
Total	42	25.1	6.9

As shown in Table 4.2 the mean age of the volleyball players is 25.1 years old (SD=6.9). The volleyball players that participated in the study were aged between 15 and 40 years old.

The mean height among males was 182.5 cm (8.5SD) and females was 165.2 cm (8.6SD). The mean weight was 80.16 kg (12.9SD) for males and 63.3 kg (10.9SD) for females.

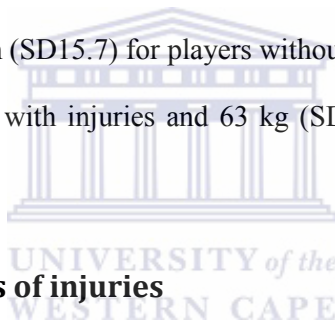
4.3. Prevalence of injuries in season

A total of 51 injuries occurred during the season 2006/2007, giving an injury incidence of 1.2 injuries per player. The majority of the volleyball players, namely, 88.1% (37/42) sustained at least one or more injuries during the season. Of those who sustained injuries, 54.1% (20/37) were males and 45.9% (17/37) were females. Six players (14.3%) did not sustain any injuries.

Table 4.3. Percentage of injuries sustained by gender

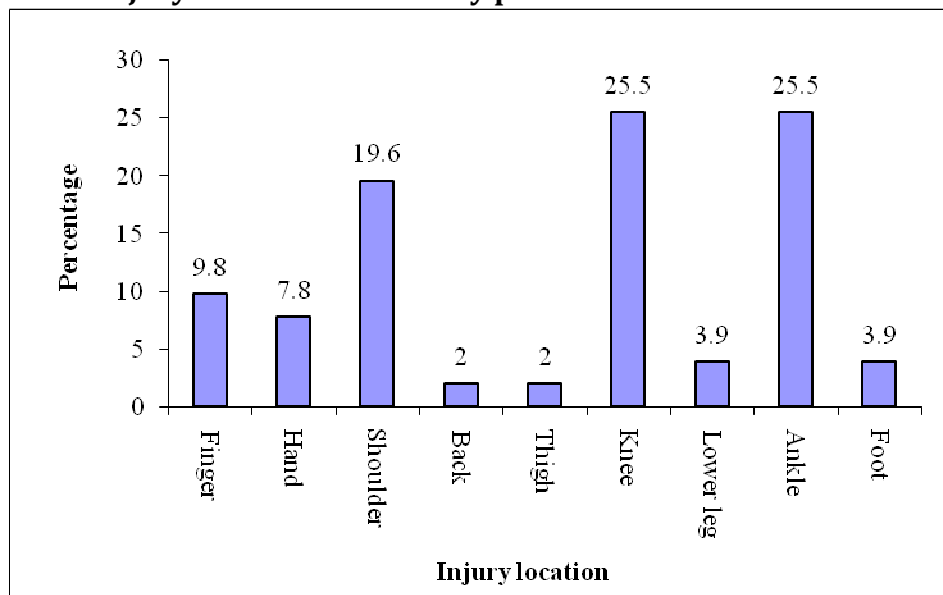
	1 or more injury	No injury	Total
Male	20 (90.9%)	2 (9.1%)	22 (100%)
Female	17 (85%)	3 (15%)	20(100%)

In total, 90.9% (20/22) of the male volleyball players sustained injuries and 9.1% (2/22) sustained no injuries, while 85% (17/20) of the female volleyball players sustained injuries and 15% (3/20) sustained no injuries, as illustrated in Table 4.3. No significant association was found between gender and injuries sustained. Among players without any injury the mean age was 21.4 (SD7.2) and 25.6 (SD6.8) among players with injuries. The mean height was 174.2 cm (SD11.9) for players with injuries and 170.3 cm (SD15.7) for players without any injury. The mean weight was 72.2 kg (SD13.7) among players with injuries and 63 kg (SD24.3) among players without any injury.



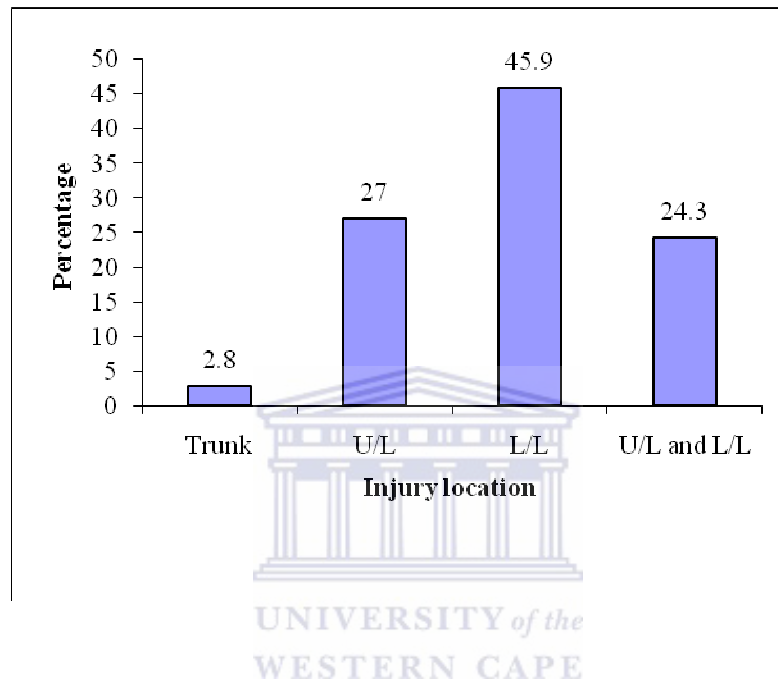
4.4. Sites, nature and causes of injuries

Figure 4.1. Injury location in the body parts



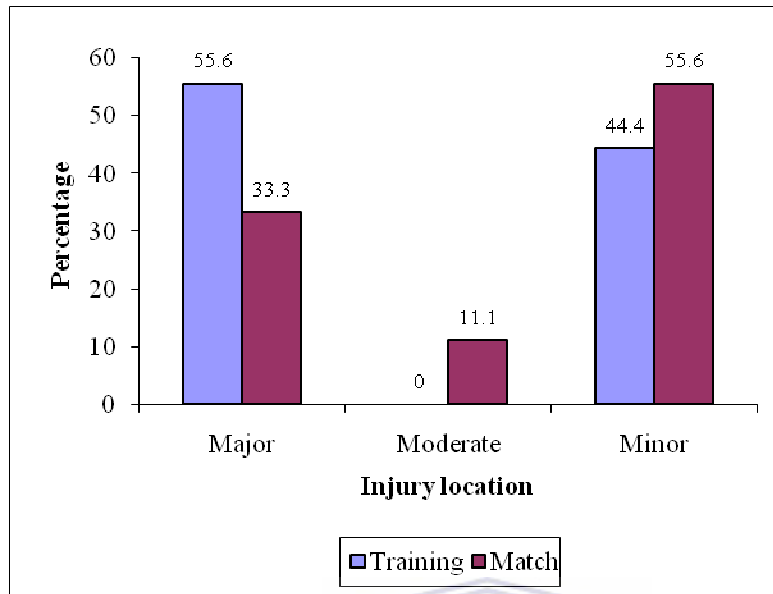
As shown in Figure 4.1 injuries according to body parts (calculated from the total number of injuries) occurred as follows; knee and ankle occurred at the highest rate 25.5% (13/51), followed by injuries in the shoulder 19.6% (10/51), fingers 9.8% (5/51) and hand 7.8% (4/51).

Figure 4.2. Injury location.



As shown in Figure 4.2 the majority of injured players sustained injuries in the lower limbs 45.9% (17/37), followed by the upper limbs 27% (10/37) and 24.3% (9/37) had injuries in both upper and lower limbs. A very small percentage of injuries 2.7% (1/37) were sustained in the trunk.

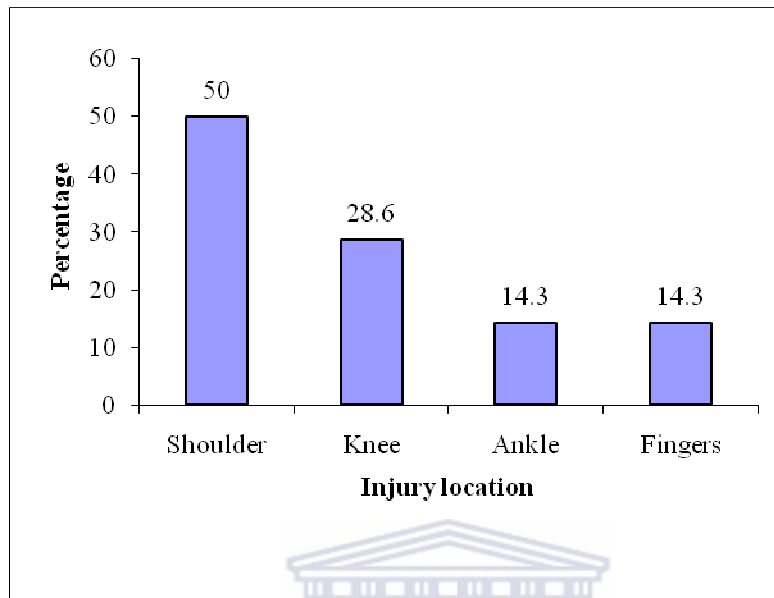
Figure 4.3. Severity of injury



As shown in figure 4.3 most injuries occurred during training were major injuries (55.6%) followed by minor injuries (44.4%) among injured players. Most injuries occurred during match were minor injuries (55.6%) followed by major injuries (33.3%) among injured players.

Seventy three percent of the injured players were absent from training due to injury and 62% (23/37) were absent from matches. Nine (24.3%) of the injured players were not absent from training and 29.7% (11/37) were not absent from matches.

Figure 4.4. Location of gradually occurring injuries.



A third (14/37) of the study sample's injuries occurred gradually, with an equal distribution between males and females. Of those injuries that occurred gradually, 50% occurred in the shoulder (7/14), 28.6% in the knee (4/14), 14.3% in the fingers (2/14) and 14.3% ankles (2/14), as illustrated in Figure 4.4.

Figure 4. 5. Mechanism of injuries.

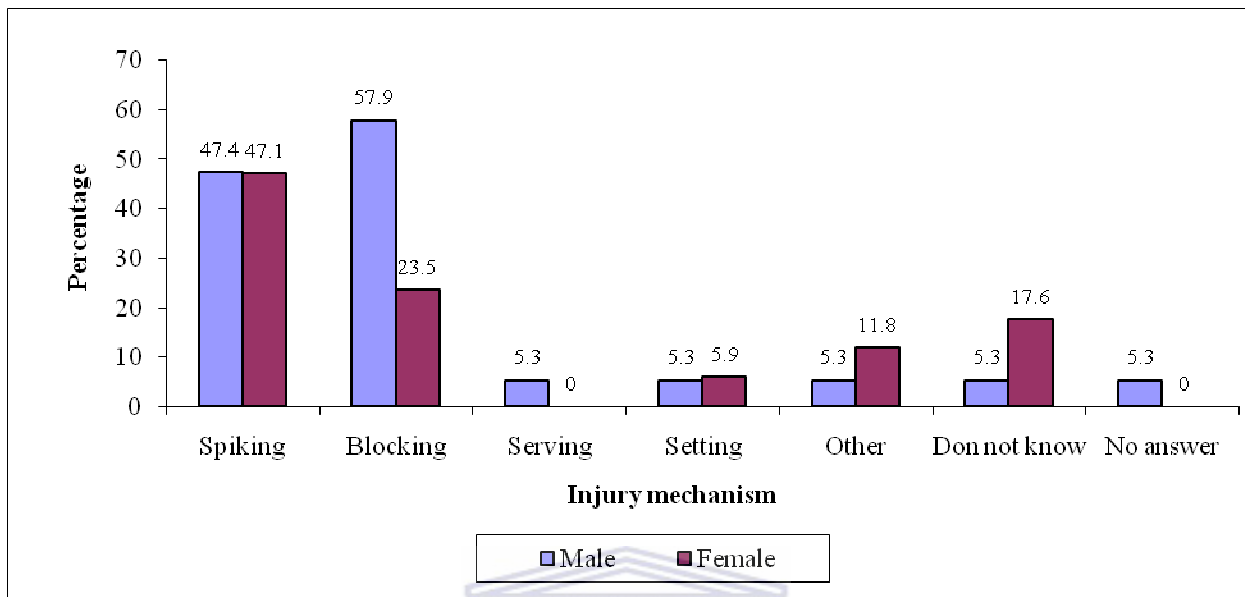
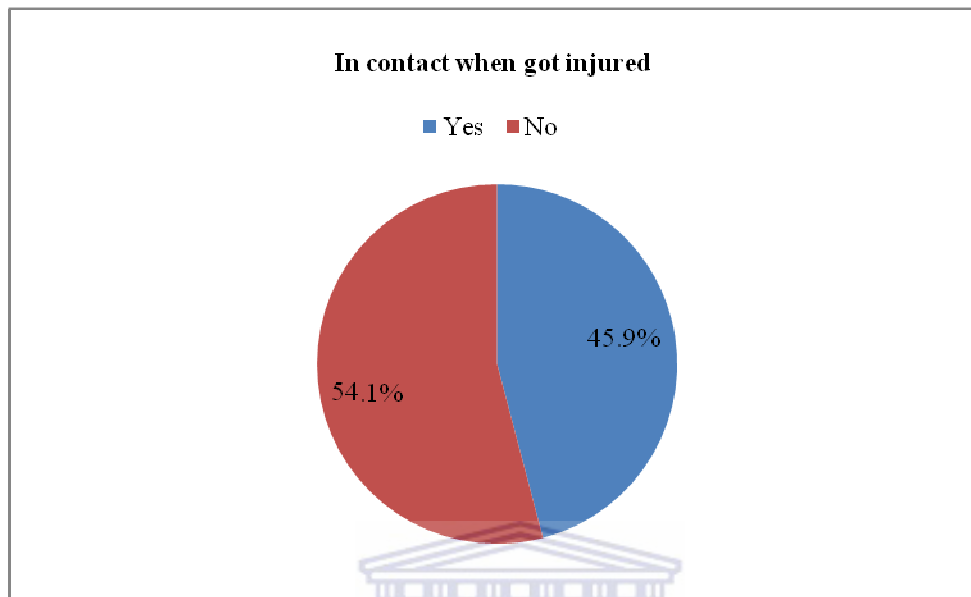


Figure 4.5 shows that 47.4% (9/20) of injured males and 47.1% (8/17) of injured female got injured due to spiking. Due to blocking, 57.9% (11/20) of injured males players and 23.5% (4/17) of females sustain injuries.

The Chi-square test showed that volleyball players in the setter position were significantly more likely to be injured during setting ($p=0.044$). Players in the left and right front row were significantly more prone to be injured during spiking ($p=0.008$).

Figure 4.6. Injuries due to contact with another player.



Most of the injuries 54.1% (20/37) occurred without any contact with another player, while 45.9% (17/37) occurred while in contact with another player, as illustrated in figure 4.6.

Table 4.4. Part of body injured and contact when injured.

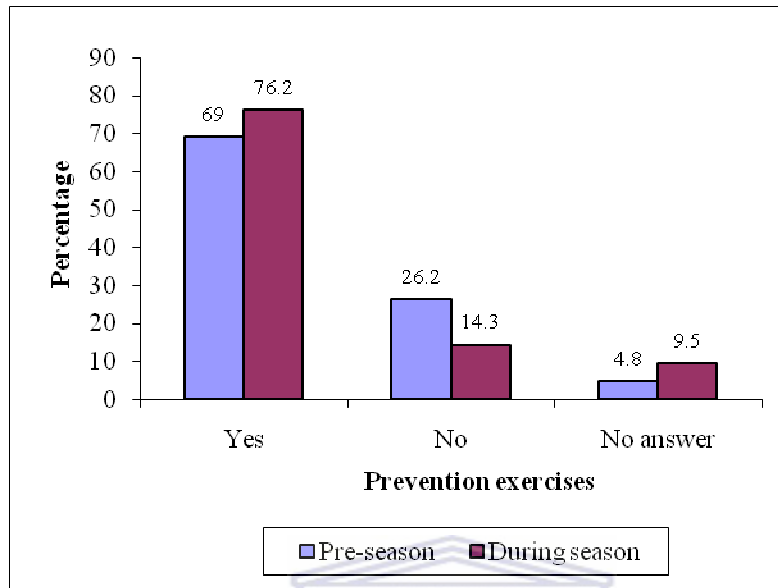
Body injured	In contact when injured		Total
	Yes	No	
Ankle	69.2%	30.8%	100%
Knee	53.8%	46.2%	100%
Shoulder	10%	90%	100%

Table 4.4 shows that most ankle injuries (69.2%) were sustained due to contact with another player while most players who were injured in the shoulder had no contact.

The Chi-square test showed that players who injured in the shoulder are more likely not to be in contact when they are injured ($p=0.009$) while players who are injured in the ankle are more likely to be injured when making contact ($p=0.04$).

4.7. Factors related to injuries.

Figure.4.7. Use of prevention programmes during training and matches.

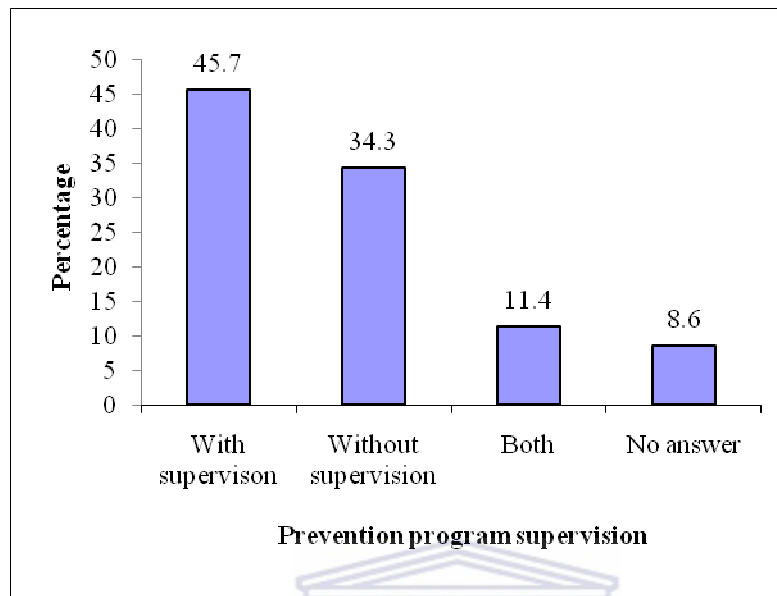


Most of the volleyball players were involved in some prevention programmes pre-season 69% (29/42) and during season 76.2% (32/42), as illustrated in Figure 4.7.

Most of the players (93.1%) did strength training in the pre-season and 78.1% during the season.

Twenty nine (90.6%), of those who performed strength training during the season were injured, while 41.4% (12/29), of those who performed prevention exercises during the season were injured and the areas affected were the ankle and the shoulder.

Fig.4.8. Supervision during prevention programmes



As shown in figure 4.8 45.7% (16/35) of the volleyball players took part in a prevention programme (pre- or during season or both) under supervision (e.g., of a coach), while 34.3% (12/35) of the players had no supervision.

Figure. 4.9. Supervision and type of prevention exercises.

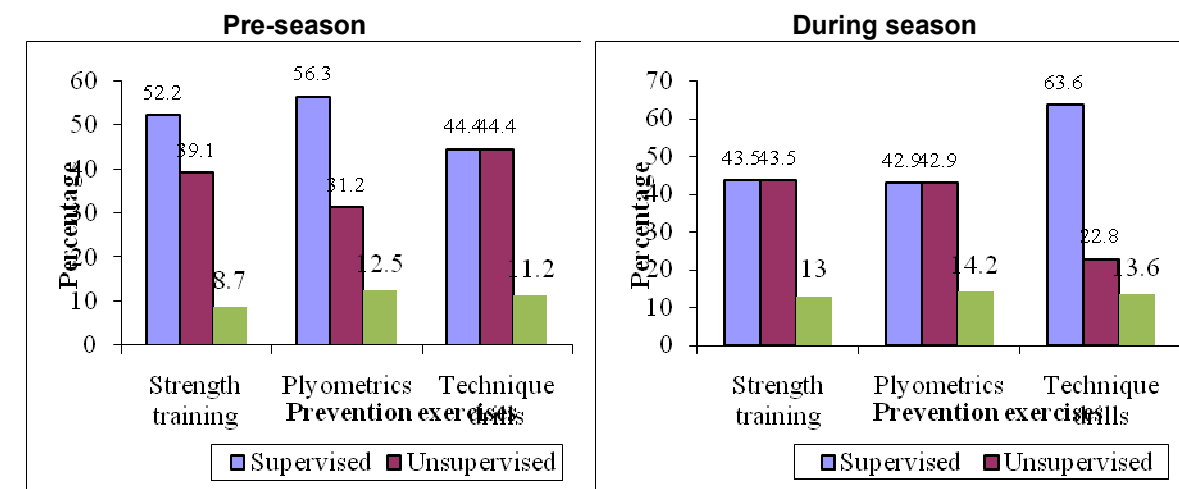
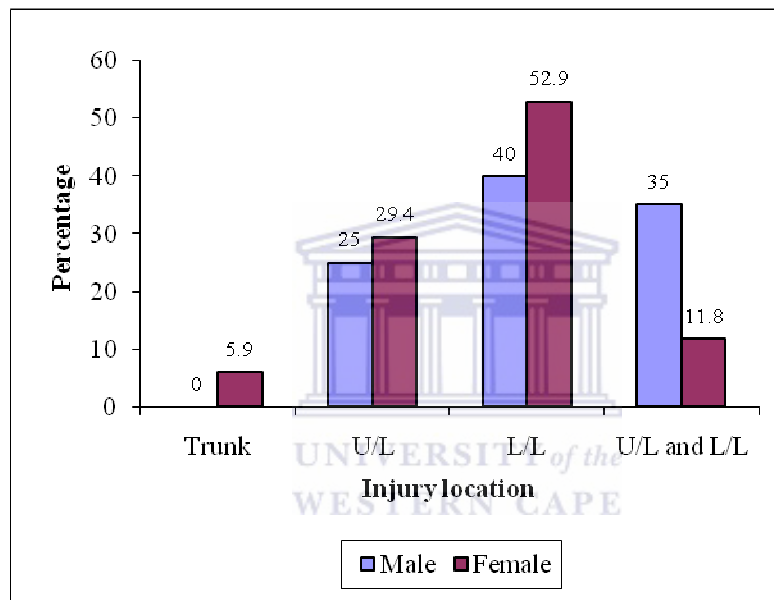


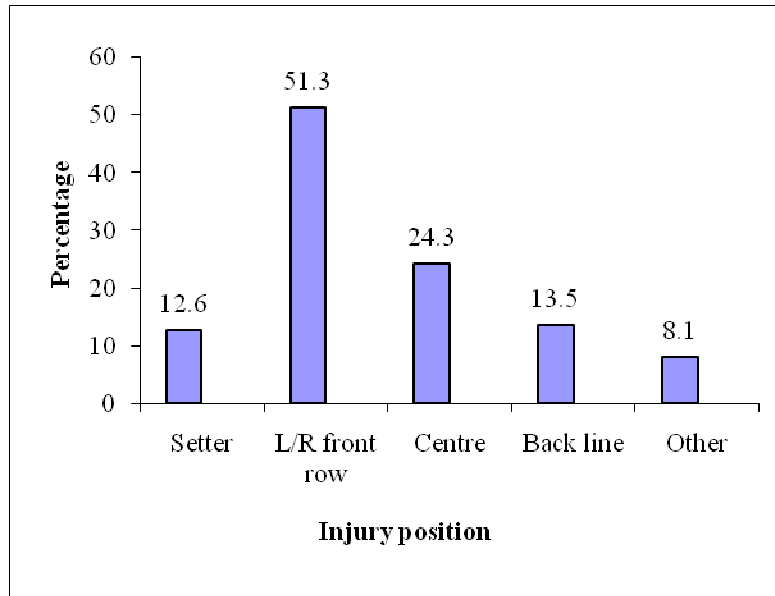
Figure 4.9 shows that the majority of the players who are doing prevention exercises pre-season were doing it with supervision with exception to technique drills where the players were doing both with and without supervision equally. During season, players tend to perform prevention exercises with and without supervision equally with exception to technique drills where they mostly do it under supervision.

Figure 4.10. Injury location by gender.



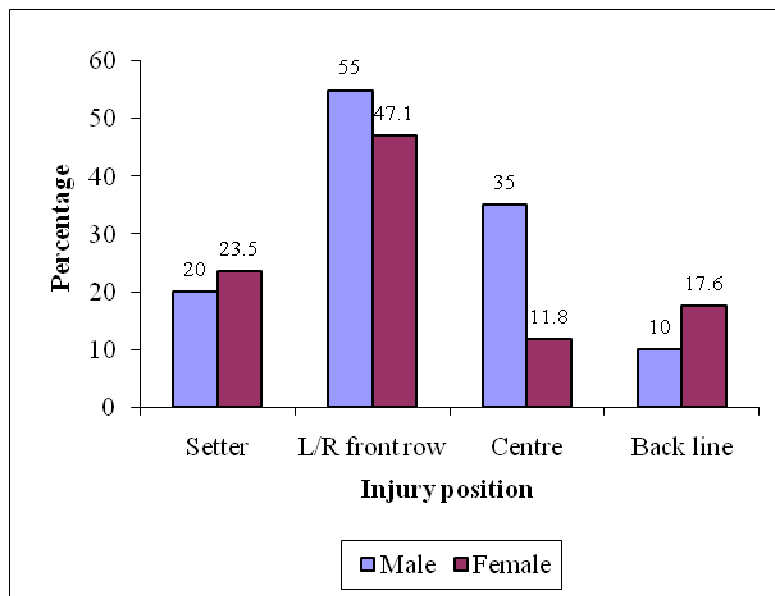
As illustrated in Figure 4.10 most of the injuries for both injured females 52.9% (9/17) and injured males 40% (8/20) occurred in the lower limbs. Low percentage 5.9% (1/17) of injuries for injured females occurred in the trunk and there were no trunk injuries among injured males. Twenty five percent (5/20) of the injured males and 29.4% (5/17) of the injured females sustained injuries in the upper limb.

Figure 4.11. Distribution of injured players according to position



As shown in Figure 4.11, 51.3% (19/37) of the total number of injured players were in the left and right front row followed by the centre position 24.3% (9/37). The least number of injured players 13.5% (5/37) were in the back line position.

Figure 4.12. Distribution of injured players by position and gender.



As shown in figure. 4.12 most of the male 55% (11/20) and female 47.1% (8/17) injured players were in the left and right front row position, as illustrated in Figure 4.5. The second highest percentages of injuries occurring among male 35% (7/20) players were in the centre position and female players 23.5% (4/17) in the setter position respectively. No significant association was found between gender and player position in the injuries.

Figure 4.13. Access to physiotherapy services.

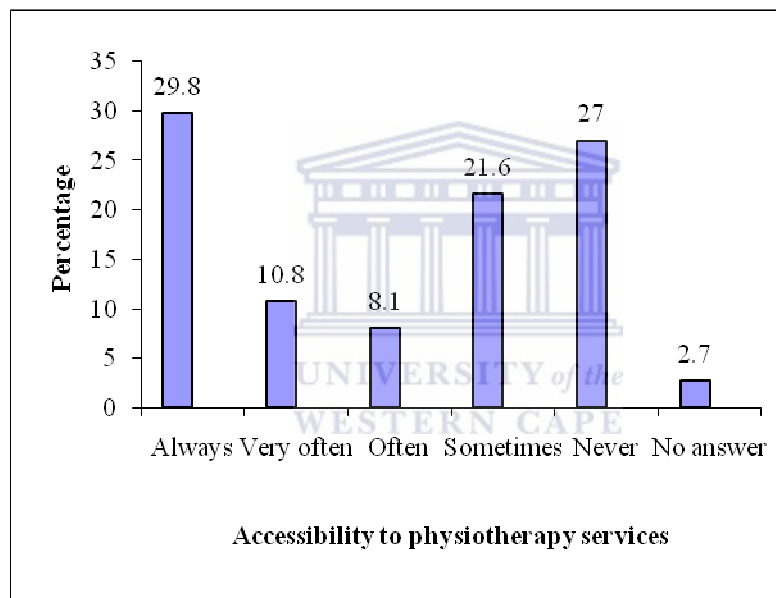
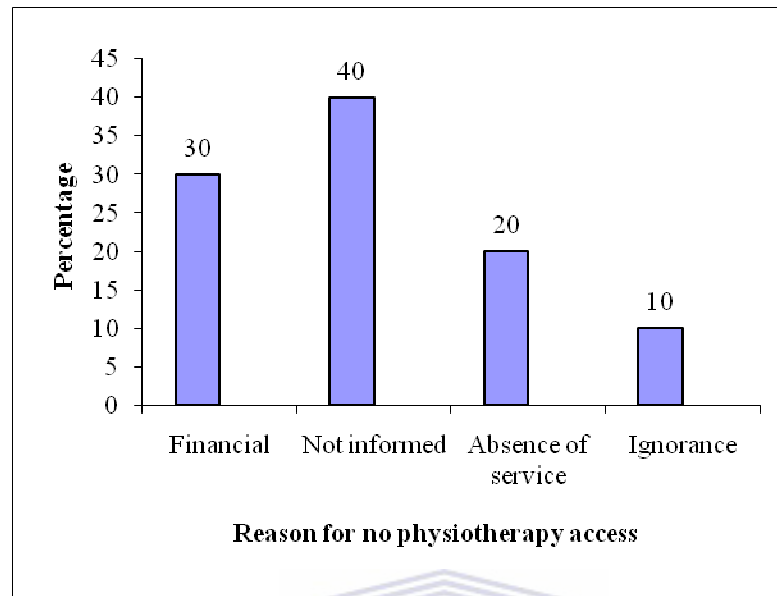


Figure 4.13 illustrates that 27% of the injured players never had access to physiotherapy services while 29.8% always had access.

Figure 4.14. Reason for no access to physiotherapy services.



As shown in Figure 4.14 of the 10 volleyball players who never had access to physiotherapy services, 40% (4/10) indicated that they were not informed about physiotherapy. Thirty percent indicated that the reason for not accessing physiotherapy services was financial. Twenty percent indicated an absence of physiotherapy services, for which the reason is not known.

Of those who did not have access to physiotherapy services, 70% (7/10) strongly agree that there is a need for such services and 60% of those who had access to physiotherapy services (15/25) strongly agree that there is a need for such services. More than half of the injured players, i.e. 59.4% (22/42), strongly agree that there is a need for physiotherapy in the management of their injuries.

Chapter five

Discussion

5.1. Introduction

The aim of the study was to assess the prevalence of injuries sustained by professional volleyball players of a club in the WPVU in one season. This chapter will show how the objectives of the study have been achieved and will discuss all the aspects related to the prevalence of the volleyball injuries at the UWC Volleyball Clubs as well as the sites, nature and cause of injuries sustained. The chapter will compare the findings with other studies in the same field. The findings are the results collected from the UWC volleyball players in a volleyball season.

5.2. Findings in the demographic characteristics

The total response rate in the study was 89.4% from a sample of 47 players. The high response rate supports the validity of the study even though the small sample size limits the generalization potential of the study. The high response rate in this study is similar to previous studies (Bahr et al., 2003; Bahr & Bahr, 1997).

Male participation was higher (52.4%) than in the case of females (47.6%). This was similar to the study conducted by (Bahr & Bahr, 1997). The level of participation among

males and females was different from the previous studies by (Augustsson et al., 2006; Verhagen et al., 2004) which had a higher response rate among females than males. According to Richard, Reeder, & Darling, (2004), the level of participation among females is higher in volleyball.

5.3. Prevalence of injuries

In this study, an injury was defined as any incident that occurs during warm-up or competition that requires medical attention (Zemper & Pieter, 1989) and causes the player to be absent from sport participation either in a training session or a match (McKay et al., 2001). The severity of an injury was defined based on the time of absence due to the injury (Augustsson et al., 2006; Bahr & Reeser, 2003).

The first objective of the study was to determine the prevalence of volleyball injuries sustained among the UWC Volleyball Players in a volleyball season.

In volleyball, there are challenges facing studies in injury prevalence. According to (Augustsson et al., 2006), some players may be absent due to an injury, while others continue, with the same injury.

In this study, there were 88.1% of the volleyball players sustained one or more injuries during the season. This finding was higher than that of a previous study by Augustsson et al., (2006), whereby only 52% of the players sustained one injury or more. The incidence of injury in the current study was 1.2 injuries for each player. This injury incidence was higher than a previous study by (Augustsson et al., 2006), which found an injury incidence of 0.68 per player.

Augustsson et al., (2006), reported that various factors such as better training, experience of coaches, experience of players, proper facilities, accessibility to injury rehabilitation, and proper preventative exercises can be attributed to the decrease in the prevalence of volleyball injuries.

Participants indicated that accessibility to physiotherapy services which forms an important component of injury prevention and rehabilitation at UWC, is limited.

The injury incidence of the current study was lower than the study conducted by Bahr & Bahr (1997), which had an incidence of 1.7 injuries per player. The reason for this is the small sample size of this study and the lesser exposure time which is 4358 player hours per week compared to the study of Bahr & Bahr (1997), which had a sample size of 272 volleyball players with 51588 player hours per week.

Eighty eight percent of the players sustained an injury in the season. There were a total of 51 injuries which occurred in the season. The Injury prevalence was higher in the present study when compared to the previous study by Bahr & Reeser (2003), which found a prevalence of 43%.

5.4. Sites, nature and causes of injuries

The second objective of the study was to identify the sites, nature and cause of injuries sustained among the UWC players in a volleyball season.

Among the injured players, ankle and knee injuries showed the highest prevalence in the present study which correlate well with studies conducted by Augustsson et al., 2005; Verhagen et al., 2004; Bahr & Reeser, 2003; Bahr & Bahr, 1997).

During training sessions, most injuries sustained were major/severe injuries. This compares well with the findings in the study by Augustsson et al., (2006), which showed that most major/severe injuries occur during training.

The reason for overuse injuries occurring during matches, is attributed to the importance of the matches and therefore the increased intensity and over exertion by players (Agel et al., 2007; Augustsson et al., 2006). In the training, Verhagen et al. (2004), related the injury occurrence to the high exposure time.

The rates of injuries occurring were similar among players during matches and training sessions (24.3%) in this study. The study of Augustsson et al., (2006), showed high injury prevalence during training while the study of Bahr & Bahr (1997), showed an increase of injuries during matches.

The majority of injuries pertaining to training and match times, occurred at the ankle, which was similar to the study of Augustsson et al., (2006). It is further supported by other studies which report that ankle injuries are the most common acute injury which occurs in volleyball ((Reeser et al., 2006; Augustsson et al., 2005; Verhagen et al., 2004; Nelson et al., 2007).

This study showed that 33.3% of players had injuries that occurred gradually and they could not indicate whether it occurred during a match, training, or warm-up. This is lower than the rate of injuries occurred gradually in the study of Augustsson et al., (2006), which indicated 41%.

This correlate well with other studies. According to Augustsson et al., (2006), several studies reported an increase in number of injuries occurred gradually and that is due to the increase number of training hours. In this study, number of hours during training was lower than the study of Augustsson et al., (2006).

Among the players in this study, only 7.1% had injuries during the warm-up. Is it similar to the low rate occurred during warm up in the study conducted by Augustsson et al., (2006).

Half of the injuries which occurred gradually were in the shoulder and the knee. This is due to continuous overuse of the shoulder (Augustsson et al., 2005; Aagaard & Jorgensen 1996). This is similar to the study conducted by (Verhagen et al., 2004) which stated that the most overuse injuries are sustained in the shoulder and the knee.

This differs from a study by Bahr & Reeser (2003), which found that most of the injuries with gradual onset, occurred in the back. The study by Bahr & Reeser (2003), was conducted with beach volleyball players and the nature of the surface in beach volleyball is different which needs more physical strength and more stability than the indoor court surface. According to (Smith, 2006), the ability to transfer position during playing is more difficult on the sand as compared to hard court volleyball. In addition, the vertical jumping requires more energy in beach volleyball and causes more stress to the back muscles.

5.5. Factors related to volleyball injuries

The third objective of the study was to identify the intrinsic and extrinsic factors associated with the injuries sustained among the UWC players. There are extrinsic factors which relate to volleyball injuries such as the nature of contact in volleyball, level of playing, and the player position. On the other hand gender and participation in other sports are intrinsic factors.

Volleyball is a non-contact sport with a lesser injury incidence than injuries in contact sports such as rugby, basketball, and soccer. According to Resser et al., (2006), the overall injury rate in volleyball is low compared to other sports.

The Majority of the injuries that occurred in the current study were not due to contact with another player. That is similar to the study conducted by Briner & Kamcar (1997), which found that most of the injuries in volleyball were associated with no contact with other player/s. According to Agel et al., (2007), most injuries occurred in the ankle is due to contact. In this study, Injuries occurred in the ankle were significantly due to contact ($p=0.04$).

The performance of prevention exercises also effects injury prevalence. According to (Augustsson et al., 2005; Verhagen et al., 2004; Bahr & Bahr 1997), prevention programmes have gained attention in recent years due to its direct impact in reducing the prevalence of injuries in sports. The performance of prevention exercises pre-season and during season was higher in the

study of Augustsson et al., (2005). In this study the injury prevalence is higher and the performance of preventative exercises is lower.

Prevention programme supervision can reduce injury occurrence in cases where the trainer is experienced in sport-specific injuries and have the knowledge of designing training programmes to achieve high performance and prevent injuries (Kraemer, Adams, Cafarell, Dudley, Dooly, Feigenbaum, Fleck, Francklin, Fry, Hoffman, Newton, Potteiger, Stone, Ratamess, & Triplett-McBride, 2002). The performance of preventative exercises with supervision (45.7%) in this study was higher than without supervision (34.3%). It is different from the study by Augustsson et al., (2005), which shows increased performance without supervision (58%). According to Seigi et al., (2000), proper preventative exercises need enough experience by the coach.

Therefore, performing prevention exercise without supervision is one of the risk factors to the UWC Volleyball Players.

Results show that the training schedule of the UWC volleyball club is limited to 2 or 3 times per week for less than 3 hours per session. In the study by Augustsson et al., (2006) more time was spent on training which enhances the players experience in performing this kind of exercises, leading to better physical performance and experience (Kraemer et al., 2002).

The majority of the players (90%) made use of strength training incorporated in their prevention programme. Ninety two percent of the participants, who performed strength training, sustained injuries of which the knee was the most common joint injured. According to Lian et al., (2003), there is a positive relationship between strength training and jumper's knee.

Players in the left and right front row were significantly more prone to be injured during spiking ($p=0.008$). According to studies by (Agel et al., 2007; Bahr & Bahr 1997), volleyball players near the net are more prone to injuries than players in any other position. In the results it is shown that more than 70% of injuries occurred in the three front positions, which are similar to

the findings of Augustsson et al., (2006). This is due to the fact that players in these positions perform spiking and blocking, which are the most common actions for injuries in volleyball.

Injury prevalence in this study was higher in males (54.3%) than females (45.7%), which is different to what was shown in the study by Augustsson et al., (2006). The reason behind high injury levels among males in this study, is that the male's level of participation in this study was higher than in the study of Augustsson et al., (2006).

Injuries in lower limbs were higher in males than females. This is similar to the study conducted by Augustsson et al., (2006).

There were no female back injuries recorded in this study. This is different from the study conducted by Augustsson et al., (2006), which showed higher female injury incidence in the back.

The reason is the relatively small number of injuries in our study and the small sample size. According to Augustsson et al., (2006); Bahr & Bahr (1997),” No definitive answers regarding injuries to male players compared with female players can, however be obtained of the relatively small number of injuries”.

Another finding of the study was that 35.7% of the volleyball players also engaged in other sporting activities. According to Aagaard & Jorgensen (1996), an increase of overuse injuries is related to participation in other sport activities due to an increase in the training hours. Participation in different kinds of activities also adds variation to training which can lead to a beneficial effect.

Augustsson et al., (2006), expressed their concern that an increase in the ratio of injury among volleyball players might be attributed to an increase in frequency, intensity and duration of the injury, which lead to a need to increase the prevalence of treatments. Early physiotherapy intervention helps in reducing and preventing the injury recurrence because physiotherapy provides treatment to achieve soft tissue damage rehabilitation.

Thirty percent of the UWC volleyball players regularly access physiotherapy and 27.8 % have never accessed physiotherapy services due to different reasons such as not being educated about the use of physiotherapy, financial reasons, ignorance, and no availability of services.

The result of this study showed that the most common reason for not seeking physiotherapy is that players were not informed about physiotherapy (40%). Coaches, players, managers, and policy makers need to be informed about the importance of physiotherapy management in injuries.

5.6. Limitations of the study

- The study cannot be generalized due to the small sample size.

The study was conducted on UWC volleyball clubs with 42 participants and this cannot be generalized to the volleyball injuries in South Africa or to the volleyball clubs in Southern African colleges. It is limited to UWC volleyball club.

- Players who have major injuries did not receive the questionnaire as they were not present at training
- One player may elect to continue playing volleyball due to injury, while another player would stop playing with a similar injury.

Injury recorded in this study upon the discontinuation of the match or training. Therefore, a player who continues and another who discontinues the training or match due to the same injury will affect in a negative way the injury rate.

- There is not enough information about injury structure and details.

The questionnaires do not state any further information about the injury except the injury location. More information about injury details will help to gain deeper knowledge and investigations regarding the nature of injuries.

- Players might be forgetting minor injuries because of the major injuries.

It is easy for the player to remember the major injury which may cause ignorance for the minor injury. In addition, the questionnaires' design did not motivate the player to give attention to the minor injury.



CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1. Introduction

This final chapter will provide a brief summary of the study. In addition, it will address the major issues in a conclusion. Finally, the chapter will include some recommendations.

6.2. Summary

The aim of this study was to determine the prevalence of volleyball injuries sustained among the UWC Volleyball Players in a volleyball season and to identify the sites, nature and cause of injuries sustained among the UWC players in a volleyball season by the researcher. The study also set out to identify the intrinsic and extrinsic factors associated with the injuries sustained among the UWC players in a volleyball season.

The study showed that the injury prevalence and injury incidence was high (1.2 injuries per one player per season) compared to other studies in the same field. The most affected body part during volleyball injuries were the ankle and the knee followed by shoulder. The most common injury position in volleyball was the left and right front row. In addition, the study showed that the most relevant mechanism to injury in volleyball is spiking and blocking. Overuse is the main reason behind shoulder injury. The study showed that severe injuries are the main reasons why players in volleyball cannot complete a match or their training.

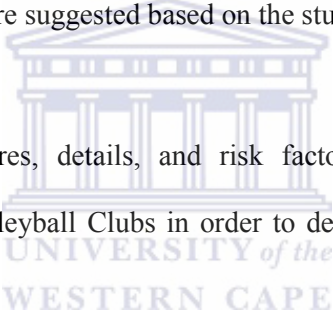
Finally, the study showed that most players did not have access to physiotherapy treatment due to the reason that they were not informed about this facility and due to financial problems.

6.3. Conclusion

The overall injury prevalence among the UWC Volleyball Players is high as 85% of the players was injured. The injury prevalence and the risk to be injured are higher among the male's players. Ankle and knee injuries are the most common types of injuries. Most of ankle injuries occur due to contact. The shoulder injuries which occur due to overuse are relatively high. Players in left and right front row are more prone to be injured during spiking. The physiotherapy is needed to treatment and rehabilitation after injury was found low. Better injury mechanism examination help in develop injury prevention programmes.

6.4. Recommendations

The following recommendations are suggested based on the study findings:

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1. Volleyball injury structures, details, and risk factors should be encouraged to be investigated in UWC Volleyball Clubs in order to develop prevention strategies and to improve sports safety.
 2. Focus and to be placed on shoulder overuse injuries prevention in the UWC volleyball teams.
 3. Awareness programmes about physiotherapy intervention in volleyball injuries are required for the UWC volleyball players.
 4. The outcomes of this study must be made available to coaches, managers and players in the form of seminars or workshops.

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**APPENDIX
A**

DEPARTMENT OF PHYSIOTHERAPY

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Tel: +27 (0) 21 959 2542/ 2546
Fax: +27 (0) 21 959 1217
E-mail: jfrantz@uwc.ac.za
Website: www.uwc.ac.za

Date: 11/10/2006.

**To: Mrs. Ilhaam Groenewald.
Director of Sports Administration.
University of the Western Cape.
Private Bag x17, Bellville 7535, South Africa.**

Re: Permission to conduct a research study.

Dear Mrs. Groenewald

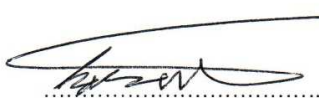
I am a postgraduate student at the University of the Western Cape in the physiotherapy department in South Africa. I am willing to conduct research as a part of the requirements for the MSc (Physiotherapy). The title of my study is "PREVALENCE AND PATTERN OF INJURIES AMONG PLAYERS AT THE UNIVERSITY OF THE WESTERN CAPE VOLLEYBALL CLUB".

The primary aim of the study is to describe the incidence and pattern of injuries among volleyball players at the University of the Western Cape. Data collection will be done by the researcher who is a qualified physiotherapist.

I would hereby wish to request permission to conduct the study among volleyball teams at the University of the Western Cape, South Africa. The results will be made available to you as soon as they have been analysed.

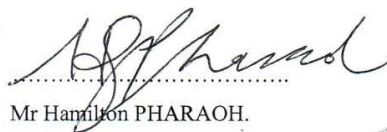
I will be very grateful to you if you will allow carrying on with my study during the volleyball season of 2006/2007.

Sincerely,



Hassan Abdelnour.
MSc Physiotherapy.
University of the Western Cape
Private Bag x17, Bellville 7535, South Africa

Student number: 2634759.



Mr Hamilton PHARAOH.
Supervisor



**UNIVERSITY of the
WESTERN CAPE**

A place of quality, a place to grow, from hope to action through knowledge

APPENDIX

B

DEPARTMENT OF PHYSIOTHERAPY

Private Bag X17, Belville, 7535
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Tel: +27 (0) 21 959 2542/ 2546
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Dear Player

I am a postgraduate student at the University of the Western Cape in the Physiotherapy Department in South Africa. I am willing to conduct research as a part of the requirements for the MSc. (Physiotherapy). The title of my study is "PREVALENCE AND PATTERN OF INJURIES AMONG PLAYERS AT THE UNIVERSITY OF THE WESTERN CAPE VOLLEYBALL CLUB".

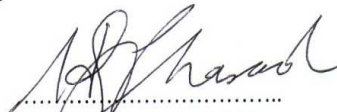
The primary aim of the study is to describe the incidence and pattern of injuries among volleyball players at the University of the Western Cape. Data collection will be done by the researcher who is a qualified physiotherapist. At the start of the season all players will complete a questionnaire on demographic variables. In case of an injury an injury registration form will be completed. On this form the physiotherapist will provide information on the injury location, injury type, and direct cause of the injury. You are assured that all the information will be confidential and anonymous. You have the right to withdraw from the study at anytime. The research findings will be made available to you and your coach/management.

Thank you for your attention and cooperation.

Sincerely yours,



Hassan Abdelnour
MSc Physiotherapy
University of the Western Cape
Private Bag x17, Bellville 7535, South Africa
Student number: 2634759



Mr Hamilton PHARAOH.
Supervisor



UNIVERSITY of the
WESTERN CAPE

APPENDIX D

QUESTIONNAIRES

PART ONE

Participant nr _____

Demographic information

Date: _____

Date of Birth: _____

Height (cm): _____

Weight (kg): _____

Gender: _____



Part 1

1. For how long have you been playing volleyball? _____ (years)
2. How many times per week do you train volleyball (during this season)?
_____ times/week
3. How many hours per week do you train volleyball (during this season)?
_____ hours/week
4. Are you engaged in other sports activities besides volleyball?
No yes
If yes, please specify.....

5. Do you perform some kind of prevention programme, such as strength training, plyometrics or technique drill? ***During preseason***

no yes

If yes: (you can choose more than one option)

strength training

plyometrics (Ex. Push up)

technique drills

During season

no yes

If yes: (you can choose more than one option)

strength training

plyometrics (Ex. Push up)

technique drills



6. If you perform a prevention programme: is it performed with or without supervision (coach or physical trainer)?

supervised


unsupervised

APPENDIX D

QUESTIONNAIRES

PART TWO

Part 2: Injury registration

- At which point did you get injured?
during training
1st or 2nd set
4th or 5th set
during warm-up before match
3rd set
the injury occurred gradually
- In what kind of situation did you get injured?
blocking
serving
do not know
spiking
setting
other (specify) _____

- Were you in contact with another player when you got injured?
no
yes
- What player position did you have when you got injured?
setter
Centre
other (specify) _____
left/right front row
back line
- What part of your body was injured?
head
hand
face
elbow
finger (s)
shoulder

chest	back	hip
groin	thigh	knee
lower leg	ankle	foot
other body region (specify) _____		

6. Injury location?

right side	left side	bilateral
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7. Could you complete the training session/match play?

no	yes
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8. What was the amount of absence from subsequent training session (s) following the injury?

absence more than 4 weeks	absence 2-4 weeks
absence less than 1 week	no absence

9. What was the amount of absence from subsequent match play following the injury?

absence more than 4 weeks	absence 2-4 weeks
absence less than 1 week	no absence

10. Did you get facilities to access physiotherapy services when required?

Always _____ Very often _____ Often _____ Sometimes _____ Never _____

11. If no access to physiotherapy services, what were the reasons?

Financial _____ Not informed _____ Absence of service _____

Ignorance _____

12. Do you think physiotherapy treatment was needed/ helpful for your injuries?

Strongly agree _____ Agree _____ Disagree _____ Strongly disagree



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