INCIDENCE OF FOOTBALL INJURIES IN DIFFERENT AGE GROUPS AT A PROFESSIONAL FOOTBALL CLUB

Vernon Glen Lagrotteria Curtis

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SUPERVISOR:

PROF A TRAVILL

(University of the Western Cape)

ABSTRACT

Football is the most popular sport in the world, and it continues to have a progressive annual increase in the number of active players and the number of games played per season, which in turn leads to an increase in the frequency of injuries. Football is extensively researched worldwide, however, some current studies confirm that the results on football injury factors are limited, as well as inconsistent and incomplete. It is recommended by several literature sources, including those of FIFA, that an injury prevention program needs to be developed, and research on the risks and prediction of injury incidence undertaken.

The main aim of the study was to examine interrelating factors of football injuries through the various age groups at a designated football club. The study aimed to expose the injury risk factors and patterns present in the various age groups.

In addition to age, various other critical factors, which relate to injury, were researched. Special attention was given to the injury prevalence relating to age, anatomical area of injury, anatomical distribution of injury, injury type, training versus match injury prevalence, number of visits per injury and vulnerable periods for injury during the season. A particular focus of the study is related to the "sidedness" of the injury and its relationship with injury incidence, anatomical area, and injury type, and therein lays the uniqueness of the present study.

The football players from the designated professional football club constituted the sample population. The sample consisted of all the injured players from the five different age groups, whose injuries (resulting from football participation) were evaluated and recorded by the club

physiotherapist, biokineticist or doctor. Data were collected over a two-year period, beginning in 2001 and ending in 2002.

A standardised injury report form (Appendix 1) was used to record all the injuries evaluated. The recorded data were entered onto spreadsheets, according to various age groups (under 11, under 13, under15, under 17 and PSL seniors). The injuries were then subdivided into various subsections, e.g. the injuries were categorised into set anatomical areas and set injury types.

The management, coaching, and medical staff of the selected football club all operated according to professional football club standards. They are all qualified and experienced in their fields and they have to adhere to the expected standards and ethics of their professions. When treating a player's injury, there was always a qualified physiotherapist, biokineticist or doctor on hand (there were two physiotherapists at the club - a juniors' physiotherapist, which only treated the youth up to the under-17 team, and a seniors' physiotherapist who only treated the PSL players). It was therefore expected by all that injuries be treated according to professional standards.

According to existing studies definite injury patterns are prevalent in various age groups. These studies found certain ages to be more prone to certain types of injuries.

The study sample consisted of a total of 178 subjects (recorded injured players only) who incurred a total of 1258 injuries from 2001 to 2002. Out of the 1258 injuries, the juniors total made up 677 injuries, and the PSL team alone made up 581 injuries.

An increase in the number of injuries, as well as the number of treatments per injury, was noticed with an increase in age group. 821 injuries occurred during training, whereas 437 injuries occurred during matches.

The lower body made up an estimated 80% of the total body injuries, compared to 20% for the upper body. An analysis of the anatomical area of injury revealed that the injuries to the ankle were the most common, followed by the knee, the hamstrings, and then the back. Muscle injuries, followed by ligament and bone injuries were found to be the most frequently recorded injury types. Further analysis of injury types revealed that ligament sprains, followed by muscle strains were the most prominent. The juniors were more vulnerable to injury in the pre-season and early season, whilst the senior (PSL) players, in addition to being vulnerable early-season, were also vulnerable late-season. Even though right-leg preferred players constituted 61% of the sample and left-leg preferred players only 23%, there were more injuries to the left side (517) compared to the right side (510).

The statistical analysis of the data included cross tabulations, frequencies and graphical presentations. Differences were calculated using the CHI-square test, Pearson correlation's and contingency tables.

The age-specific injury patterns that were noted throughout the study could be used as guidelines for injury prevention programs.

DECLARATION

I declare that **"Incidence of and risk factors for football injuries at different age groups at a professional football club"** is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by means of complete references.

VGL Curtis

…………………………….. **September 2006**

Witnesses:

……………………… **………………………**

DEDICATION

I dedicate this thesis to all my family, friends, and loved ones for all their support throughout this rollercoaster of a journey of my study, and for their personal sacrifices that each has made. Thank you all.

In addition I would like to acknowledge my mother, Rosemary Curtis, by stating that this achievement now is “reaping the seeds you have sown.” “Thank you so much for always being their Mom.”

I would also like to express my gratitude to my partner, Yolande Smith, for all her patience, love and support.

I would especially like to dedicate my study to my ever-loving grandparents, Ferdi and Pina Lagrotteria, who sadly passed on during the progress of my study. *Rest in peace Lagrots.*

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CHAPTER ONE

Introduction

1.1 General Rationale and Background

Football (soccer) is considered to be the most popular sport in the world and it continues to have a progressive annual increase in the amount of active players and the number of games played per season. This in turn has lead to a drastic increase in the frequency, severity and number of injuries. The sport of football attracts tremendous attention and interest from all over the world.

Although football injuries have received extensive scientific attention, there is limited information on the incidence of injuries in football players at different ages. Current risk factors and predictors of football injuries are inconsistent and far from complete (Junge and Dvorak, 2000). Studies on leg dominance, preferred leg, and support leg related to injury is extremely limited. It has also been recommended that the intrinsic factors affecting injury occurrence should be focused on in research. It is also boldly highlighted by several literature sources, including FIFA, as to the urgent need for an injury prevention program in football (Junge and Dvorak, 2000).

This study opposes the opinion of the American Academy of Paediatrics (2000), which states that: "There is no compelling evidence to suggest that age … is associated with specific injuries or overall injury rates."

The increasing incidence of injury has socio-economic and financial consequences. This increase in injury incidence also determines loss of playing time and there are injuries severe enough that can damage or even end a promising football career. South Africa especially needs a more scientific approach to soccer, in attempting to match up to international standards. This study can add significantly to current knowledge on the topic, and can be used by players, coaches, trainers, physiotherapists, biokineticists, doctors and even parents.

Once the injury risk factors are determined, steps can be taken to develop a much needed injury prevention program. Football players should take the approach that "prevention is better than a cure."

The aim of the study is to present relevant scientific football research based on data obtained from real football training and match conditions and make it available so that all persons involved in football can apply it in order to reduce injuries and improve performance of football players. In turn, reduce the amount of playing hours lost due to injury and in the long run improve overall football standards in South Africa.

1.2 Aims of the Study

The study aims to highlight the importance of applying a more scientific approach to football training, conditioning and rehabilitation. The scientific information can be used to enlighten all those interested and involved in the football players' development, namely players, coaches, trainers, physiotherapists, biokineticists, doctors and even parents. The prevalence or frequency of football injuries through ages under 11, under 13, under 15, under 17 and PSL (senior) players were determined. This injury prevalence through the ages will be compared and analysed with relating factors, such as anatomical area of injury and type of injury. These analyses, comparisons and findings should in turn be used to identify possible weaknesses or injury risk factors at the different age groups. Conditioning and prevention programs can be developed in order to prevent these injuries from occurring in these risk areas. A reduction in injuries results in less playing hours lost, a reduced chance of damaging a playing career or occurring an career ending injury, and also a reduction in the financial and socio-economic losses associated with injuries. In the long run it is envisaged that the findings would improve the overall standard of quality in South African football.

1.3 Statement of the Problem

The purpose of the study is to establish whether there is a link between injury prevalence and the relationship with players' age and other specified interrelating factors, with a special focus on the relationship with the football player's "sidedness", at the designated South African football club.

Sub-problems

- To analyse whether the increase in injury prevalence corresponds with an increase in age group.

- To analyse and compare the number of upper body injuries to the number of lower body injuries.
- To analyse the ratio of visits or treatments per injury, in relation to age group, anatomical area and type of injury.
- To analyse the player's "sidedness" (left-leg or right-leg dominant or bilateral) in comparison to the sidedness of the injury.
- To compare the football Training in relation to the Matches injury prevalence.
- To analyse the prevalence of injury during the different periods of the season (Pre-season. Mid-season and Post-season).

1.4 Hypothesis

It is hypothesised that injury prevalence will relate to the age group of the football players (with a sudden increase in injuries in the U/15 to U/17 age group). It is also hypothesised that, with regard to anatomical area, the higher number of injuries will be seen around the ankle and knee joints, while in injury type the highest number of injuries will constitute muscle strains. A higher injury rate is hypothesised during matches when compared to training.

It is also hypothesised that in studying the relationship between injuries and sidedness, the preferred leg would have more strains and impact injuries (bone and muscular injuries) compared to the support leg, which would have more stabilising injuries (ligament, meniscus and stabilising muscles)

1.5 Study Limitations

Due to only the one club being studied, the research was limited to only male football players between the ages of 9 and 34 from one province in South Africa. (The football club only consisted of an under-11, under-13, under-15, under-17 and PSL age group.) The study was also only limited to professional club football players, and only outdoor football. The data that was collected in this study was limited to what the standardised injury assessment form recorded at the club (excluded the severity of injury - mild, moderate or severe injury or the number of days without training or match play).

1.6 Study Delimitations

The present study only used data for the seasons 2001 to 2002. The study only concentrated on certain areas of the football clubs standardised injury assessment form. The study did not opt to make any comparisons or use any data of players that were not injured. The extrinsic factors affecting injury were not analysed either.

1.7 Significance of Study

Dvorak and Junge (2000) recognise that football is the most popular sport worldwide. They state that there are about 200 million players globally. The American Academy of Paediatrics (2000) showed an increase in participation in football ranging from 11.4% to 21.8% annually. With the support of Dvorak and Junge (2000) an increase is also shown in the number of games being played per season. An increase in the number of active players, and an increase in the intensity and frequency of training leads to an increase in the incidence of injuries, resulting in serious financial consequences as well as loss of playing time. Besides for an injury resulting in medical costs, the loss of playing time due to an injury means less players available for selection. Less players available for selection results in the club having to buy more players or having to overplay certain players or play them out of position, which can again result in more injuries and once again further expenses.

Robson (1987) added that about 75% of top professional players could be carrying an injury. Hoy et al (1992) and Lindenfeld et al (1994) suggest that the majority of football injuries are minor. However, Bjordaal et al (1997) stated that some severe injuries do occur, and that players fear these because it could end a promising football career. The Federation Internationale de Football Association (FIFA) supported these results and also highlights the urgent need for an injury prevention program (Dvorak and Junge, 2000).

According to Milroy (2004), anybody playing sports is at some risk of injury. The intensity, frequency, and type of play are influential factors that could affect physical injury. Thus, Milroy (2004) acknowledges, although it is ideal to prevent injuries, the practical goal should be to minimise them.

Bangsbo (1999) admitted that when considering the vast amounts of participants throughout the varied codes of football throughout the world, much more research into football should be conducted. Yoon et al (2004) agreed that more extensive and precise data need to be gathered, in attempt to identify the real risk factors and variables associated with the increased injury incidence in football players. Arnasson et al (2004) also stated that although injury risk in football is very high, there is minimal knowledge on the causes of football injuries.

Grisogono (1989) showed that research into the epidemiology and trends of sport injuries served as a basis for the analysis of injury in order to guide injury prevention risk assessment and management of common injuries. Junge, Dvorak and Graf-Baumann (2004) and Junge, Dvorak, Graf-Baumann and Peterson (2004) supported Grisogono's findings in stating that a detailed analysis of the injuries associated with football is necessary, so that the sources of injury can be better understood and strategies can be built for their prevention. They proposed that a standardised assessment of football injuries offers the chance to monitor the long-term changes or patterns developed in the frequency and characteristics of injury and that the consistency of these results for different groups over different years suggests that "real" differences were found.

Dvorak and Junge (2000) showed significant correlations between risk factors and injury incidence. Their study, which imposed strict injury prevention programs, resulted in an estimated 75% reduction in injuries compared to controls. Based on their multidimensional predictors, Peterson, Junge and Chomiak (2000) supported a similar, but enhanced prevention program.

Studies by Inklaar (1994) also added that current information concerning risk factors and predictors of football injuries is inconsistent and far from complete. Junge and Dvorak (2000) and Inklaar (1994) conclude that when reviewing the literature, evidence of great differences in the results of injury incidence of football players were reported. These inconsistencies could be due to the different studies not following standardised (or the same) definitions, methods of data collection, observation periods, study designs and sample characteristics.

Arnasson et al (2004) also highlighted the extreme importance of using a multivariate model in examining the various factors in injury etiology and in analysing their interrelationships. However, they state that there are only three studies that have actually used a multivariate approach to analyse risk factors for football injuries, and these studies were restricted to a limited number of athletes and risk factors.

Fuller et al (2004) stressed that a football player's personal knowledge and implementation of injury control and prevention was not at an acceptable level. They further explained that the physiotherapists, who are expected to educate players in injury prevention, are already to busy with injury treatment and rehabilitation.

Peterson and Renstrom (1983) found a ongoing increase in the intensity and frequency of training at younger ages. They established that even in contact sports, such as football, training and competition are starting at earlier ages. Children and adolescents train, at times, for 2 to 4 hours for 5 to 6 days a week. Peterson et al (2000), Chomiak et al (2000) and Junge (2000) noted that there were very important differences among different age groups and only a few studies about the incidence of injuries in football players at differing ages have been published. Thibodeau and Patton (1996) concluded that age has biological and behavioural variations during different phases of the human life cycle, putting individuals at greater risk at certain periods of their life.

In a study by Fuller et al (2004) a very important correlation was made between injuries in football and the affect of industry and commerce. Primarily, football players have a higher injury rate than most other occupations (the average injury rate for the UK business field was 0.004 injuries per 1000 hours worked, while in English professional football the injury rate was 7 injuries per 1000 hours of matches or training).

Fuller et al (2004) explained the best practice for injury risk control, in industry and commerce is the use of proactive risk management, using effective control measures, which represent good business practice. (The main factors of risk management involve assessing the hazards, identifying measures to control the risks, estimating the actual level of risk, and evaluating whether this level is acceptable.) Fuller et al (2004) concluded that this management philosophy has not yet been adopted in the football industry, which is possibly why the levels of injury among professional football players are still very high.

Fuller et al (2004) and Singer and Friedlander (2000) highlight that the benefits of risk management should be explained to all affected stakeholders. Players have interest in their own health and have a personal concern of the impact an injury can have on their playing careers. Managers main concerns are the loss of player, due to injury, on overall team performance. The chairmen are concerned about the impact on the financial status of the club. The spectators would worry about the impact on their entertainment. Television stations would be concerned about the impact on viewing figures and sponsors mostly concerned about the exposure of their products. This risk management should involve a cost-benefit analysis. The cost of employing extra players to substitute injured players, and the excess costs of treatment and rehabilitation should be weighed up against the cost of improved injury control strategies.

Garret et al (1994) determined that soccer is also the fastest growing team sport in youth groups today. They suggest that this is due to the sport being relatively safe, requiring minimal special or expensive equipment, it is simple to learn and it does not require specific physical characteristics.

According to Peterson et al (2000), Chomiak et al (2000), Junge et al (2000) and Thibodeau and Patton (1996) there are great differences in injury characteristics among the various age groups. These studies highlighted the fact that only a few studies of football injury incidence at differing ages have been published, and that the training and playing influences on the development of youth players should be one of the most important priorities.

A relevant factor of injury in football, according to Fuller et al (2004) and Yoon et al (2004) was the variation in injury patterns between different physical profiles. They found that although there was no direct evidence that a certain physical profile are at a higher risk of injury, physical profiles was a definite factor in the patterning of injuries. e.g. Asian football players have uniquely different physical builds than those of other continents, with expected variations in their injury patterns. Thus, it would be of great importance to compare the rates and patterns of injuries between various continents, representing various physical profiles. Shepard (1999) and Reilly (1996) supported these claims, and state that ethnic background and racial factors of a player are reflected in their anthropometrical profile.

According to the literature research done by Inklaar (1994), Garret et al (1994) and Junge and Dvorak (2000), it was clear that despite the worldwide popularity of the sport, the current information concerning risk factors and predictors of football injuries are few, inconsistent and incomplete.

1.8 Definitions

Anatomical area – a physical part or area on a person's body.

Chi-squared – a method of comparing observed and theoretical values in statistics.

Football injury – an injury resulting from the participation in official football activities, which leads to an evaluation and diagnosis by a qualified therapist (biokineticist, physiotherapist or doctor).

Injury type – what bodily tissues is affected by the injury (muscle, ligament, bone or tendon.)

Juniors – The category consisting of all age groups younger than the PSL age group (U11, U13, U15 and U17).

Left-sided/preferred – A football player that prefers to kick the ball with his left leg, he is left-leg dominant.

PSL – Premier Soccer League, the South African professional football league (also referred to as "seniors" in this study).

Right-sided/preferred - A football player that prefers to kick the ball with his right leg, he is right leg dominant.

Sidedness – relates to the laterality or to the side of a player, either left-sided or right-sided.

1.9 Ethics Statement

Permission was obtained from the football club to use their data. The football club owns the data and thus it is not necessary to attain permission from each player or their parents. At no time will identities of any players be shared or displayed in this study and confidentiality will never be broken. Even the name of the football club will be kept confidential.

CHAPTER TWO

Literature Review

2.1 Boundaries of the Literature Review

Realistically everything cannot be reviewed, thus certain boundaries must be set to indicate the demarcated field of research. This research was firstly limited to football specific studies and only research done on male football players. The study was also only done on players from a professional football club level (a club that plays in the professional South African league, which is then funded by sponsors, T.V. coverage etc. and runs the club like a business). Also only outdoor football was researched. The review was also only done on studies published between 1988 and 2004.

2.2 Development in Sport Science

According to Reilly (1996) there has been a phenomenal expansion in sport science over the past years and that sport science has not only become registered as an academic discipline, but also a valuable and valid area of professional practice. The improvements in sport science are having a definite effect on sports itself, continuously contributing to new groundbreaking findings, which allow a sportsman to run faster, jump higher or kick a ball harder.

Reilly (1996) identified South American national teams as the founders of applying sport science at a professional level, using specialists in psychology, nutrition and physiology in the preparation of their squads for major international tournaments from the early 1970's. At that time, many countries (including British football) did not welcome the use of specialists. However, in the 1980's, it became evident that the professional football industry could no longer rely on old traditional methods, but had to be more open to scientific approaches to prepare players for competition. In general, the clubs that adopted the scientific approach to football gained noticeable advantages over those clubs that did not (Reilly, 1996).

Reilly (1996) acknowledged that it has taken many years to accumulate sufficient knowledge within sport to be able to put it into a usable form for sport scientists. Reilly (1996) found that there were definite ongoing improvements in the compilation and research of sports science, more specialisation and expertise into the field and an extra effort being made to make it more widely available to the football world. Reilly (1996) considers the inauguration of the First World Congress of Science and Football (which was initiated in Liverpool in 1987) to be one of the most significant and influential step-ups in sport science to date.

2.3 Factors Directly Affecting the Study

2.3.1 Injury Risk Factors for the Various Age Groups

Peterson et al (2000) highlighted the fact that there are great differences among different age groups with regard to injury. Peterson and Renstrom (1983) state that children and adolescents are injured more often than adults, but that the injuries were generally less serious. In contrast, Inklaar (1994) stated that senior players sustain more injuries than junior players and that there is a sudden increase in the injury incidence starting from the 14- to 16-year-old age group.

Peterson and Renstrom (1983) suggested that the higher injury incidence in the senior football players could be due to the fact that children are physically smaller than adults, so less force is involved at the time of the accident. They added that children's body tissues are significantly different to those of adults: their bone structures are more resilient and adaptable, and their muscles, tendons and ligaments are generally stronger and more elastic.

Chomiak et al (2000) showed that, in comparing age groups, there is a general tendency for an increase in the relative proportions of muscle strains, ligament ruptures and meniscus tears. In contrast, there was a decrease in joint sprains, contusions and spinal injuries with increased age. De Vries and Housh (1994) determined that because of children's resilience of tissues, overuse injuries are relatively rare in young people; however there has been a progressive increase in recent years. This is possibly due to the more intensive training in children's football.

Chomiak et al (2000) showed that when comparing the age groups there is a general tendency for an increase in the relative proportions of muscle strains, ligament ruptures and meniscal tears. In contrast – there was a decrease in joint sprains, contusions and spinal injuries with increased age.

Contrary to most of the other literature, the American Academy of Paediatrics (2000) stated: "There is no compelling evidence to suggest that age…is associated with specific injuries or overall injury rates."
Some studies analysed the developmental influences of injuries in juniors in greater detail. According to Garret et al (1994) – clinicians reported that it is vitally important to be aware of how age groups differ (from children to adults) with regard to their physical development and potential injury patterns. Reilly (1996) also acknowledges that the building blocks of football excellence are developed during the footballer's growth process. Physiological determinants of performance are partly determined by genetic inheritance, thus individuals must be cautiously taken care of during childhood and adolescence, if full sporting potential is to be recognised.

Shepard (1999) and Reilly (1996) considered the ideal age to start teaching soccer specific skills to be between 9 and 12 years old, during which it is expected that early maturing children should perform better than late maturing children. These junior players are selected predominantly based upon their speed, while endurance, anaerobic capacity and muscle force all tend to be less important than in their adult counterparts.

Reilly (1996) determined that chronological age is not always the most suitable determinant of biological maturity. Early developers might be at an advantage in football due to their size, and they might be pushed into certain suited positional roles (centre back or centre forward) to take advantage of their height. Late developers may develop into potential champions only when they have finished the growth process. But Ekblom (1994) highlights that this growth spurts might start as early as 10 years and as late as 16 years.

Garret et al (1994) and Peterson and Renstrom (1983) agreed that adolescents have certain vulnerabilities determined by their stage of development. These studies show that in adolescents' the physes and apophyses are still open, and that their cartilage are at their weakest during puberty and towards the end of their growth period, when they lose their elastic properties. This all puts the epiphyseal cartilages at risk of traumatic disruption.

Garret et al (1994) stated that adolescent' ligaments and tendons are probably at their peak tensile strength, and might be stronger than the bone to which they are attached (this situation is reversed in adults). This could result in avulsion (growth plate) fractures, where the bony attachment of the ligament or muscle is torn away from its origin, instead of the actual muscle or ligament tearing.

Garret et al (1994) explained that another factor that affects adolescent development was developmental abnormalities, which were quite common in the lower leg, causing patellar instability.

Another very important factor contributing to injuries in junior football players was the dramatic increase in forces placed on their immature skeletons. These increases were due to muscle hypertrophy made possible by the excess adolescent hormones. Bouchard and Malina (1991) added that the gradual growth in muscle fibre diameter and fibre length with age, added to the increase in total muscle mass of the body. They stated that relative muscle mass increased from about 42 % to 54 % of body weight in boys between age 5 and 17 years. This hypertrophy allowed for longer and more intensive training sessions. Garret et al (1994) summarised that it signifies a child's skeleton meeting an adult world.

Peterson et al (2000), Chomiak et al (2000), Keller et al (1987) and the American Academy of Paediatrics (2000) also state that the vulnerable injury period (age 14 to 16) could be due to varying factors. Factors discussed included weaknesses in techniques and tactics, as well as muscle strength, endurance, coordination, and the high intensity of play in the less experienced, younger players. They also state that aggressiveness begins to increase at this age. In addition, the pubertal maturity and growth spurt lead to higher speeds, higher joint reaction forces, and impact forces on collision.

However, the body condition, muscle coordination, and strength were not adequately developed yet.

Chomiak et al (2000) showed that the most dominant injuries in the 14- to 16-year-old age group (which were generally less severe) are spinal problems (24 %), joint sprains (23 %) and contusions (23 %), while fractures, muscle strains, ligament ruptures and meniscal tears were rare.

Shepard (1999) suggested that height and lean body weight continue to improve towards the ideal, within the U16's to U18's, due to a combination of certain training methods, and the increased pressures of selection for the team.

In the 18- to 25-year old age group, muscle strains (26 %) and joint sprains (23 %) were the most frequent injuries, followed by ligament ruptures (19 %)

2.3.2 Injury Incidence

2.3.2.1 Injury Incidence through the Ages

According to Kuhn et al (1997) and Lewin (1989) the incidence of football injuries is defined as the number of new injuries in a specific period divided by the total number of players exposed to injury (population at risk). Dvorak and Junge's (2000) research revealed an estimated 10 to 35 injuries per 1000 football playing hours. They determined from various studies that in the overall analysis of injury incidence rates, the senior football player's rate reaches between 0.5 and 45 injuries per 1000 hours of football (practices and matches). Fuller (2000) found that the average number of injuries per player per season was 2.7 injuries. Arnasson et al's (2004) study showed that 56% of players sustained injury during the season, while their literature showed that other studies proportion of injured players ranged between 65% and 91%.

With regard to the juniors' injury incidence, Shepard (1999) found that adolescent and preadolescent football players, in general, suffered 5 to 73 injuries per 10 000 player hours (which they considered relatively low).In youth soccer tournaments their results showed an injury rate of 140 injuries per 10 000 hours. Garret et al (1994) literature review on football injuries for 6 to 19 year olds showed an incidence rate of between 0.51 and 19 injuries per 1 000 hours.

Ekblom (1994) stated that there is definitely a lower injury incidence in youth compared to senior players (senior players sustain 15 to 30 times more injuries than younger players). Ekblom (1994) and Junge et al (2004) consider that the fewer injuries in the younger age groups are possibly due to the lighter mass of players, and their lower velocity of play, which results in an overall reduced force. There also tends to be fewer incidences of illegal play or tactics in youth football.

Arnasson et al (2004) claim that there is a definite pattern developing for certain injuries, possibly due to the evolution of football into a faster, more demanding game.

2.3.2.2 Injury Risks

Fuller et al (2004) stated that risk relates to the probability that an undesirable occurrence will take place. The most common risk for all stakeholders in professional football is injuries to players, which causes them to be unavailable for selection. The affects of injury could therefore lower the total quality of the available team, in turn lowering the teams potential playing performance and financial gain for the club and in the long run – reducing the clubs chances of success. Fuller et al (2004) considered the main objective of managing this risk is to attempt to minimise the impact of injuries on players.

Fuller et al (2004) stated that any strategy for controlling the risks of injury comprises three stages: Firstly, injury prevention, secondly, injury treatment and thirdly, injury rehabilitation (which are all subject to budget constraints).

Arnasson et al (2004) study showed that age, player exposure and previous injury were identified as the main risk factors for injury amongst professional football players. Their study results show that age, higher body fat % and history of previous strain intensify the risk of hamstring strains. Risks for groin strains involve higher body fat % and a history of previous strain to the same side. The major risks for ankle and knee sprains are a history of previous sprain to the same area.

Yoon et al (2004) determined that different levels of skill also affect the patterns of injury and their results show that lower skill levels were associated with a higher rate of injury frequency. Garret et al (1994) explain that the higher skilled teams control the pace of the game, and so the work rate will be dictated by the style of play. So the superior trained team will use their fitness levels into pressurising their opponents into making mistakes. Yoon et al (2004) suggest that teams from continents with lower skill levels be expected to have higher injury frequencies.

Arnasson et al (2004) support the statement that understanding individual risk factors for injury in football is necessary to develop preventative measures. However, they highlight the vital need for a multivariate model to analyse the contribution of various factors in injury etiology, and to study their interrelationships.

2.3.2.3 Injury Incidence Related to Exposure Time

According to Kuhn et al (1997) and Lewin (1989) the injury incidence can be estimated more precisely if the duration of exposure is considered. The risk of injury per exposure is defined as the number of new injuries divided by the time all players spent in games and training sessions. This is calculated per 1 000 hours of exposure. Junge and Dvorak (2000) added that injury incidence should be subdivided into injury rates per 1 000 match hours, and 1 000 training hours.

According to Junge and Dvorak (2000) to calculate exposure related incidence, the amount of playing and training time for each player must be known. They state that some of the authors have documented the individual amount of game and training exposure time for each player (Engstrom et al, 1990). According to Ekstrand and Tropp (1990), Hawkins and Fuller (1999) and Inklaar et al (1996), the exposure time seems to have been estimated by multiplying the number of players by the hours of weekly participation and the weeks per season.

Arnasson et al's (2004) study showed that football players in the highest and the lowest exposure categories had a lower injury rate than players in the intermediate exposure level. This could be due to the fact that lower level exposure players trained for fewer hours, which lead to less exposure time, and thus fewer injuries. While the higher exposure players have less injuries than the intermediate level, because they are considered to be in better physical condition.

2.3.2.4 Match Versus Training

Junge et al (2000) and Grantham (2004) found that senior football players participate in an average 25 to 32 matches per season. They also found that seniors trained an average 9.9 hours per week during the preparation period and 6.0 hours per week during the competition period. They estimated that training time totalled 241 hours per player per season and match time totalled 27.7 hours per player per season.

Studies of Dvorak et al (2000), Peterson et al (2000), Morgan and Oberlander (2001), Ekstrand and Tropp (1983), Engstrom et al (1990), Yoon et al (2004), Grantham (2004) and Reilly (1996) are in general agreement that when comparing the exercise load of matches versus training, there are significantly more injuries occurring during match games than in training. (These above studies showed an estimated range of 3 to 12 times more injuries in matches.)

According to results and literature reviews of Dvorak and Junge (2000), Morgan and Oberlander (2000), Arnasson et al (2004), Junge et al (2004), Fuller et al (2004), Yoon et al (2004), Junge, Dvorak, Graf-Baumann and Peterson (2004) and Grantham (2004) the injury incidence of match exposure compared to training exposure was compiled. Injury incidence for training exposure was relatively similar between most of the studies, averaging 2.1 to 2.9 injuries per 1000 hours, resulting in approximately 1 injury per 19.3 training sessions. Dvorak and Junge's (2000) results proved to have the widest range, showing an injury incidence of 1.5 to 7.6 injuries per 1 000 training hours.)

The studies of Dvorak and Junge (2000), Morgan and Oberlander (2000), Arnasson et al (2004), Junge et al (2004), Fuller et al (2004), Yoon et al

(2004), Junge, Dvorak, Graf-Baumann and Peterson (2004) and Grantham (2004) showed noticeable variations in their results of injury incidence for match exposure. The injury incidence for match exposure ranged from as little as 12 injuries per 1 000 match hours to as much as 144 injuries per 1 000 match hours, which resulted in an average of 72.83 injuries per 1 000 match hours from all the studies, and ranged from 1.2 to 2.7 injuries per match. (It must however be noted that the matches in the different studies varied between normal club matches, to tournaments, to International tournaments, to as elite as the World Cup and the Olympic Games.)

2.3.2.5 Level of Play

Level of play is a factor, which continues to yield contradictory results. Inklaar (1994) reports a higher incidence with a higher level of play. Ekstrand and Tropp (1990) state that the injury incidence is the same across the differing skill levels. While Blaser and Aeschlimann (1992) reported the highest injury frequency in the lower leagues.

2.3.3 Anatomical Area of Injury

2.3.3.1 Upper Body Versus Lower Body

The results and conclusions of Fuller (2000), Shepard (1999), Yoon et al (2004), Arnasson et al (2004), Ekblom (1994), Grantham (2004), Garret et al (1994), Chomiak et al (2000) and Morgan and Oberlander (2000) are in agreement that the lower body has significantly more injuries than the upper body. The results of lower body injury range between 60 % and 90 % of all injuries, with an average of 74.86 %. Garret et al (1994) added that the upper body injuries (10 % to 15 % of all injuries) were mainly caused by collisions between players or when a player hits the ground with the edge of his shoulder or on an out-stretched hand.

2.3.3.2 Injury Distribution

The anatomical distribution of injuries were compiled according to the results of The American Academy of Paediatrics (2000), Chomiak et al (2000), Bjordaal et al (1997), Ekstrand and Tropp (1990), Engstrom et al (1990), Morgan and Oberlander (2000), Grisogono (1989), Junge et al (2004), Junge et al (2000), Yoon et al (2004), Grantham (2004), Arnasson et al (2004), Reilly et al (1988) and Garret et al (1994).

These studies show that ligament sprains of the ankle and the knee are the most predominant injuries in all football players. Knee injuries range between 12 % and 34 % of the total injuries, with an average of 17.22 %. Ankle injuries ranged from 9 % to 31 % of total injuries, with an average of 18.88 %.

Injuries of the thigh (hamstring and quadriceps) made up 20% of all injuries. The foot ranged between 0.3 to 28 % of total injuries, averaging 14.2 % of all injuries. The lower leg made up 11.4 % and the groin made up an estimated 8.8 % of all injuries.

The head and neck constituted an average of 13.7 % of all injuries, the hand 10.5 %, the shoulder and arm 2.7 %, and the trunk an estimated 5.8 %. These upper body injury estimates were not considered to be too reliable or accurate, due to the fact that there were insufficient studies and that these studies were inconsistent.

Arnasson et al (2004) analysed possible reasons for injury distribution patterns developing in football players. Their study determined that football players are acknowledged to be less flexible in hip abduction, hip extension and knee flexion than the controls in their study. Their reasoning for this was due to the characteristics of the sport – high intensity, short sprints, quick accelerations and decelerations in speed and sudden turns, which all placed a high demand on the muscles, and can quite easily result in muscle tightness. It was also added that inadequate attention is often paid to the flexibility of football players.

2.3.3.3 Anatomical Area of Injuries in Juniors

Garret et al (1994) state that with junior players, as in senior players, most of the injuries occur in the lower body (58 % to 81 %), with an estimated 15 % to 20 % of all juniors' injuries involving the upper body. Shepard (1999) however, include that upper body and head injuries are higher in juniors compared to senior football players.

In discussing ankle injuries in juniors, Ekblom (1994) explained that as in adults, ankle ligament sprains could make up one-third of all injuries. Ekblom's study also found that ankle sprains occur more frequently in players that have had a previous injury to their ankle ligaments; this is mainly due to incomplete rehabilitation.

Ekblom's (1994) study also found that the prevalence of knee injuries in juniors was as high as 20 %. It was highlighted that these injuries must be carefully evaluated; they were very complex, and could involve external mechanism injuries, internal derangements or ligamentous damage. Knee injuries in juniors are mostly due to repetitive micro trauma, and occur frequently on one side only.

Garret et al (1994) and Yoon et al (2004) found that injuries to the lower legs were also very common in junior football players (18.1 %), and that the hip, pelvis and groin accounted for a minimal percentage of the total injuries (3% to 10 % of all injuries).

2.3.4 Injury Type

2.3.4.1 Injury Incidence

The studies of Contiguglia et al (1994), The American Academy of Paediatrics (2000), Dvorak and Junge (2000), Peterson et al (2000), Reilly (1996), Fuller (2000), Reilly et al (1988), Yoon et al (2004), Junge et al

(2004), Ekblom (1994) and Singer and Friedlander (2000) were reviewed to compile statistics of the various injury types.

The above studies were in agreement that the most common types of football injury were muscle strains, ligament sprains, contusions, while there were much fewer fractures and lacerations. Contusions made up the highest injury count in most of the studies, it however showed noticeable variations, ranging between 10 % and 60 % of all injuries, with an average of 43.5 %. Ligament sprains also showed quite a wide variation in results between studies, ranging between 14 % and 41 % of all injuries, with an estimated average of 24.8 %. Muscle strains were common, ranging between 10 % and 30 % of all injuries, with an average of 17.18 %.

The studies showed that wounds made up an estimated 8.2 % of all injuries, muscle tears 6 %, tendon sprains or tendonitis 3 %, fractures 2 %, and meniscal tears 1.6 %. The numbers of these lower percentage injury types did not seem sufficient and consistent enough to make relevant conclusions from.

2.3.4.2 Type of Injuries in Juniors

Garret et al (1994) showed that there were fewer overuse injuries in junior players compared to senior players, and that approximately 75% of the juniors' injuries were not serious enough for loss of playing time.
Shepard (1999) added that two-thirds of all juniors' injuries were mild, with contusions, sprains and strains predominating.

Garret et al (1994) concluded, from their study on youth football players, that in children contusions and abrasions were the most common injuries, making up 30 % to 40 % of all injuries (mostly to the quadriceps, calf, shin or foot). The study also showed that ligament sprains and muscle strains around the knee, ankle and foot were the second most common injuries sustained by youth football players.

2.3.4.3 Reviewing the Main Types of Injury

Contusions

Garret et al (1994) and Reilly (1996) consider that because football is a contact sport, players are at a definite risk of contusion injuries to the body. This could be due to intentional tackles, illegal tackles and accidental collisions. They explain that muscle contusions are non-penetrating blunt impact trauma to muscle tissue, which causes the acute crushing of muscle fibres, bleeding and localised haematomas. Contusions to the head and abdomen are infrequent, but could however be life threatening. Garret et al (1994) found that intramuscular haematomas were caused by bleeding within the muscle, which has not spread outside the epimysium (the muscle belly), which can result in an increased intramuscular tissue pressure, severe pain, disability, that may require surgery.

Ligament and tendon injuries

According to Garret et al (1994) football players are very vulnerable to tendon and ligament injuries due to all the twisting, cutting, kicking, sudden accelerations and decelerations and the repetitive, non-stop action of the game. Reilly (1996) adds that these sprains are due to overstretching of the ligaments. Garret et al (1994) continues in claiming that chronic tendon or ligament injuries are not related to a specific traumatic event, but that those symptoms start slowly and worsen with time. However, the acute tendon and ligament injuries are caused when the load applied to it exceeds the ligament or tendon stress point.

Muscle strains

Garret et al (1994) discussed muscle strains, which are also very common in football. Their study explained that the muscle strains do not occur due to direct trauma, but rather from too much stretch or tension applied to the muscle. Reilly (1996) states that these indirect injuries, which are also termed "muscle pulls", comprise about 30 % of all injuries seen in sport today. The study claims that a player with a muscle strain can still participate in the game, but their performance is likely to be hampered.

Overuse injuries

Reilly (1996) suggested that there are also indirect injuries, which are caused by forces generated within the musculoskeletal structures during activity, which could damage muscles, tendons, ligaments, joint structures or bone.

Reilly (1996) further discusses overuse injuries, which result from the body being exposed to repetitive actions or high loads. These types of injuries are due to training errors, biomechanical abnormalities, inappropriate footwear or terrain. Milroy (2004) adds that when the body is subjected to these repeated movements, especially through the same plane, it could result in injuries, that inadequate recovery would accentuate.

2.3.5 Anatomical Area of Injury Related to Injury Type

2.3.5.1 Injury Incidence

Arnasson et al (2004) found that muscle strains, especially in the hamstrings were the most common football injury, with ligament sprains in the ankle and knee being the second highest. Whereas Junge et al (2000) results rather showed that ankle sprains accounted for the highest percentage (21%) of all injuries, where strains of the groin or thigh made up 16% and sprains in the knee joint only accounted for 5.8% of all injuries. Grantham (2004) found that out of the muscle strains, groin strains were the highest (53 %), followed by hamstrings (42 %) and finally the quadriceps (5 %). (There were noticeable inconsistencies relating to the results of these various studies.)

According to Milroy's (2004) study, concerning Isaac Newton's strike angle, it was shown that injuries occur from varying directions. In contact sports, impact injuries from opponents are very common, and cause a high percentage of injuries. However, Milroy (2004) stated that it is not only the intensity of contact made that influences the injury, but also the angle of the strike (contact) that determines what type of injury is sustained.

2.3.5.2 Match Versus Training

Arnasson et al's (2004) results showed that the injury location of matches compared to training were very similar, except for the upper body having significantly more injuries during matches than in training. When considering the injury types, the results showed that muscle strains occurred predominantly during matches (73%) compared to training (8.4 injuries per 1 000 match hours compared to 0.8 injuries per 1 000 training hours). Ligament sprains to ankles and knees as well as contusions were also much higher in matches than at training. The Incidence of ligament sprains were 5.5 injuries per 1 000 match hours, and 0.4 injuries per 1 000 training hours. Contusions, mainly to the thigh and lower leg, accounted for 5.9 injuries per 1 000 match hours, and 0.5 injuries per 1 000 training hours.

2.3.5.3 The Most Common Football Injuries Reviewed

Head and neck injuries

Garret et al (1994) showed that head and neck injuries make up an estimated 10 % of injuries in football that was consistent with the fact that these body parts make up about 10 % of the total body surface area. Their literature showed that head and neck injuries range between 4 % and 22 % of total injuries. Over time, the mechanism of head injuries has changed from head-to-ball contact injuries to head-to-head contact injuries. This injury is more predominant in matches compared to training.

Back and trunk injuries

Garret et al's (1994) study showed that when combining the injuries of the thorax, back, abdomen, pelvis and groin, it still resulted in fewer than 10 % of total injuries. (Their studies literature, which analysed the same anatomical areas, also showed an injury range of 0 % to 13 % of total injuries, which were mainly contusions, mild sprains and strains.)

Reilly (1996) added that the muscles of the back act to extend, laterally flex, and rotate the trunk and neck, while the abdominal muscles act to flex, laterally flex, and rotate the trunk.

Groin injuries

Garret et al (1994) suggested that the most common symptom of groin injury is simply pain, but that pain can also be referred to the groin from other sources. When an acute injury is caused to the groin muscle, then the injury is minor. But with chronic pain, symptoms might be unclear, and a lot more attention should be given to the treatment.

Garret et al (1994), in agreement with Ekblom (1994), stated that groin injuries made up about 5 % of the total injuries, at an injury rate of 7.6

injuries per 1 000 playing hours. They added that there were three to four times higher groin injury rate in matches than in training.

Reilly (1996) explained that groin muscles act to adduct the thigh, and that these muscles were often tight in football players, which results in groin strain being a common injury.

Knee injuries

Garret et al (1994) showed that knee injuries range between 18 % and 26 % of all injuries, which mostly involve ligaments or meniscal damage.

Reilly (1996) highlights the vulnerability of the knee joint in football being partially due to it being a hinge joint with long levers on either side of the joint. Ekblom (1994) adds that knee injuries can be either traumatic or inflammatory (overuse) injuries, and that to diagnose the knee injury, a complete history and physical examination must be performed.

Garret et al (1994) discussed the important functions of the meniscus in the knee, that it is responsible for transferring force from the femur to the tibia. They state that twisting, cutting and pivoting, which are extremely common in football, are often the cause of injury to the meniscus.

Foot and ankle injuries

Reilly (1996) and Garret et al (1994) showed that ankle sprains made up 17 % to 20 % of all football injuries, and added (with the support of Ekblom, 1994) that the incidence of ankle sprains varies between 1.7 and 2.0 injuries per 1000 hours of exposure to play. Garret et al (1994) showed that an estimated 75 % of all ankle sprains involve the lateral ligaments. They stated that ligamentous damage is primarily caused by the action of tensile loading, and by twisting and shear forces. They highlight the point that ankle injuries were the most common injury in football, and that 85 % of all ankle injuries were sprains.

Garret et al (1994) stated that foot injuries were also very common in football, and that the tendons and ligaments of the feet were also subject to sprain. Feet were vulnerable to trauma, due to stresses of dribbling and kicking, and because football boots offer limited support or protection.

Thigh (quadriceps and hamstring) injuries

Ekblom (1994) explained that muscle strains were one of the most common injuries in football, which predominantly affects the quadriceps, hamstring and groin muscle. It is also seen as the easiest injuries to prevent.

Ekblom (1994) stated that muscle tears (which can be total or partial) were caused by compression (from direct impact) or distraction (result of overload or stretching).

2.3.6. Vulnerable Periods During the Season

Garret et al (1994) highlighted the need for specialised attention during preseason training, to try and reduce injury due to a sudden increase in training exposure. Garret et al (1994) in agreement with Reilly (1996) suggested that players tend to take a complete break during the off-season, which results in them returning to play unfit and overweight. They added that players also lose more weight during preseason training. Garret et al (1994) conclude that during preseason training, there is often an overemphasis on aerobic training, which results in diminished muscular strength as the competitive season begins, which could add to the risk of injury.

Studies of Chomiak et al (2000), Peterson et al (2000), Engstrom et al (1990), Morgan and Oberlander (2000) and Grantham (2004), showed an increased risk of injury towards the end of the season.

Chomiak et al (2000) registered the highest injury rate during the competitive season (49 %), followed by winter preseason (23 %), late competitive season (22 %) and lastly summer preseason (6 %). Morgan et al (2000) showed that 13 % of injuries occurred during preseason, 24 % during early season, 25 % during mid season, 29 % during late season and 9 % during post season.

2.3.7 Relation of Sidedness to Football

Morgan's (2004) study on bilateral coordination documented a situation in a soccer match where a magnificent cross from the right side of the field landed just in front of a right-footed player, on the edge of the big box. All the player had to do was hit it with his left foot, but he literally knocked himself over in attempting to hit it with his preferred right foot. Morgan (2004) highlighted the fact that it is completely unacceptable if a top class international football player does not have an effective left foot. Robson (1987) supported this claim and stated that the majority of individuals, including some famous football players, are "one-footed", meaning they prefer kicking the ball with their natural kicking foot (the stronger) rather than the weaker leg and that the weaker leg, has got to be placed correctly to support body weight as contact with the ball is made.

Roberts (1995) explained the biomechanical working of the body related to leg dominance. He commented that when we deliberately move any one part of our body, we also make compensatory and auxiliary adjustments elsewhere in the body. These adjustments almost always occur without being conscious of them. It is in fact the background activities essential for the support of voluntary movement. (In soccer the support leg is very influential when kicking the ball with the preferred leg.) Robson (1997) adds that when regarding the stronger or natural kicking foot versus the weaker foot, players instinctively prepare themselves to kick the ball with the stronger leg. The weaker leg has got to be placed correctly to support body weight as contact is made (firm stance, head over ball, concentrate).

Morgan (2004) shows that junior coaches have never really attempted to improve the non-dominant side of their players. Davids et al (1988) also show that elite juniors had a lower number of shots on goal with the right and left legs compared to senior level players, but found a progressive increase in bilateral shots at goal with an increase in age.

Davids et al (1988) concluded that the variation between the limbs reached 28.1% in favour of the right leg. Ekblom (1994) supported these results showing clear favouritism for the right leg (69.8%) over the left leg (30.2%). Similar results were found by Junge et al (2000) who estimated 52.8% of players preferred shooting with their right leg, 10.7% preferred shooting with their left leg, and 36.6% players shot with both legs, at a senior level. They found that there were a higher proportion of players that shot with both legs in higher-level teams than in lower level teams.

In the limited research and literature on injury relation to leg dominance, Junge et al (2000) showed that there is a correlation between injuries and preferred leg for kicking the ball. Injuries to the ankle were more frequently found on the dominant leg, whereas injuries to the knee more frequent on the non-dominant leg. (This might be due to the fact that the knee of the pivoting foot is at higher risk of injury if twisted with the foot on the ground.)

Chomiak et al (2000) consider that in non-contact injuries, legs were affected equally, in contrast with contact injuries; the dominant leg was involved significantly more.

Grantham (2004) claims that the differences in strength between agonist and antagonist muscles are believed to heighten the risk of injury in athletes, for example – if the quadriceps muscles have disproportionately more strength than the hamstrings, then a hamstring strain is likely to happen. Similarly, The Sports Injury Bulletin showed that imbalances in muscular strength between legs are assumed to reduce performance and heighten the risk of injury on the less-dominant leg. Reilly (1996) supports this by stating that competitive play could lead to musculotendinous injuries due to the asymmetry, as the football player prefers using the most comfortable leg. The Sports Injury Bulletin further states that athletes use their legs in different ways and, thus, it is expected that strength imbalances occur. Football players are known to "plant" with their non-preferred leg and kick with their preferred leg.

The results of the Grantham (2004) and Garret et al (1994) showed significant variations in force produced between legs. The preferred leg generated a greater velocity, as well as an estimated 6% greater average and peak vertical ground reaction forces than the support leg. These variations could therefore relate to performance, and the risk of injury. The preferred leg kicking action produces an ideal model compared to the non-preferred leg, which produces a less desirable effect. Morgan (2004) also came to the conclusion that coordination on the preferred side is superior in kicking, than the non-preferred leg, which is less accurate and less powerful.

Junge et al (2000) highlighted the correlation found between the location of injury and the preferred leg.

2.4 Factors Indirectly Affecting the Study

2.4.1 Biomechanical Movements in Football

Reilly (1996) considers that a basic understanding of how the muscle functions during soccer skills, such as kicking and running, will be extremely useful in designing training programs, enhancing performance, injury prevention and diagnosis, and rehabilitation programs. Shepard (1999) explains that football predominantly involves kicking and running. It also involves a complex variety of accelerating, stopping, turning, running backwards and sideward, jumping, tackling and other irregular movements. He states that there are as many as 1000 changes in direction of movement, which may occur for each player over a football game.

Reilly (1996) discussed the many different kinds of kicks in football, like the running kick, volley, push pass etc., which can all rate from simple to highly complex in nature. The general kicking action, according to Reilly, 1996, can be broken down into four phases:

Phase 1 – preparing the thigh and the leg during backswing

Phase 2 – rotation of the thigh and leg laterally and flexion of the hip.

Phase 3 – deceleration of the thigh and acceleration of the leg phase.

Phase 4 – follow through.

Reilly (1996) also described in detail the typical kicking action as – placing the support foot at the side and slightly behind the ball. The striking leg is first drawn backwards with the leg flexed at the knee. The forward movement of the leg starts off with the hip of the support leg pivoting around and the thigh moving forward (the knee would still be flexed at this point.) While the primary forward movement is completed, the thigh begins to decelerate. During this deceleration, the lower leg instantly extends past the knee to almost complete extension at contact with the ball. The leg stays straight through ball contact and, then again, begins to flex during the follow through. Garret et al (1994) added that in the youngest age groups it is evident that there is virtually no run up when kicking the ball.

Garret et al (1994) stated that kicking is very different from walking and running, because the initial force for the kick comes from the swing and not from the support limb. Regarding injury, Garret et al (1994) also commented that muscles are in the greatest danger of injury after the kick, and that any additional anterior or medial loads produced at impact could create ideal conditions for knee injury.

Shepard (1999) suggests that during a kick – the ankle joint of the pivot leg becomes more firmly stabilised as skill level increases, with both the knee and hip joints contributing to the maintenance of balance.

Running, as Reilly (1996) explains, is a vital part of football. (Each player within a game covers an estimated 10 kilometres.) The running action can be broken down into the swing and the support stage. The support stage beginning at the point when the foot makes contact with the ground (heel strike) and ends when the foot leaves contact with the ground (toe-off). The swing stage begins at the toe-off, and ends with at heel strike.

2.4.2 Extrinsic Factors

Fuller (2004) and Reilly (1996) listed pitch layout and condition, training programs, warm-up, nutrition, players' equipment and footwear as some of the extrinsic factors affecting football injuries.

Milroy (2004) suggested that a professional football team has to have a capable coach, which will not only help in the complex task of producing players capable of high performance, but also to ensure that a injured player maintains a degree of fitness during injury rehabilitation. According to Reilly (1996), for a coach to be able to manage the multiple roles required of him to support his players, the coaching program, firstly, relies highly on coach-player interaction and, secondly, on the partnership between coach and scientists to identify the most important aspects of football, which should be focused on.

Milroy (2004) stressed that warm-up must be scientific, so that it does not only increase heart rate to match levels, and prepare muscles for aerobic exercise, but also programs each joint's movements to work towards its limitations, to prepare for the increased risk of match unpredictability and match intensity.

Shepard (1999) commented that the diet of a football player must meet overall energy expenditure; it must provide the necessary balance of carbohydrates, fats and proteins, which together should fulfil all the micronutrient requirements. Garret et al (1994) add that there is no magic diet that would enhance performance above that of a properly balanced diet. However, a poor nutritional diet could have a negative influence on training and performance.

Reilly (1996) highlighted that football boots must relate to the needs of the game, provide suitable protection for the foot and allow the foot to perform the purposes expected of it. Chomiak et al (2000) stated that football boots should have adequate cushioning, a rigid heel counter, a flexible forefoot and a wide, slightly curved sole. Shepard (1999) and Ekblom (1994) agreed that knee and ankle injuries occur too frequently due to excessive rotational traction of modern football boots.

According to Milroy (2004) sensible protective wear will spare players many unnecessary injuries, and the football player who insists on not wearing shin pads should be seen as negligent in a sport where countless lower leg impact occurs within the rules of the game.

2.5 Rationale of Methodology

2.5.1 Study Sample

Dvorak and Junge (2000) did an extensive literature review on the number of players observed and the observation periods of 30 similar studies. The number of players making up the study sample ranged from 19, to 25 000, and even 350 000 in one study. The average number of players used was 181.5.

Studies of Ekblom (1994) Vecchiet et al (1992), Arnasson etal (2004), Junge et al (2004), Junge et al (2004), Grantham (2004), Junge et al (2000), Peterson et al (2000), Chomiak et al (2000) and Morgan and Oberlander (2000) were used for study samples. Out of all the studies, the number of players varied between 20 and 496, with an average of 237.91 players studied.

Out of all the reviewed studies the number of injuries ranged between 90 and 901, the average number was 337.92 injuries.

Very few studies actually displayed their training, match and total hours exposed to football participation. Junge et al (2004), in which all FIFA matches and

Olympics matches from 1998 to 2001 were observed, showed a total of 10 155 match hours. Arnasson et al (2004) results totalled 5 968 match hours and 27 871 training hours. Grantham (2004) showed 6 567 match hours, 57 117 training hours and a total of 64 000 hours of football participation. Junge et al (2000) expressed exposure per player as 153.8 training hours each and 34.2 match hours per player, while Grantham (2004) showed 241 training hours per player and 27.7 match hours per player.

2.5.2 Observation Period

The observation periods of studies done by Junge et al (2004), Yoon et al (2004), Arnasson et al (2004), Junge et al (2004), Ekblom (1994) Vecchiet et al (1992) and Grantham (2004) were studied. These studies varied between researching injuries on a seasonal basis (ranged between 1 season of 4 months to 2 or 3 full seasons), injuries for matches alone through the season (50 and 64 matches) or injury incidence through various tournaments (2002 World Cup, Olympic matches, and FIFA tournaments for 1995 to 2001 etc.).

2.5.3 Injury Reporting System

Junge et al (2004) highlighted that the quality and reliability of an injury reporting system is generally dependent on four main areas:

2.5.3.1 Definition of Injury

2.5.3.2 *Source of Information*

2.5.3.3 Characteristics of Injury Documentation Form

2.5.3.4 Availability of Exposure Data

2.5.3.1 Definition of Injury

Dvorak and Junge (2000) state that when investigating injury incidence, one must first define "injury". "Football injury" is a general term, and in reviewing the literature of Engstrom et al (1990), Junge and Dvorak (2000), Junge et al (2000), Grisogono (1989), Junge et al (2004) and Morgan and Oberlander (2001) there is no consensus about its definition, except that injury is a result of football participation.

Junge et al (2004) explain that studies mainly use all physical complaints, regardless of their consequences (Junge et al, 2004), whether the injuries lead to restriction in participation or playing time, or whether the injuries require medical attention or treatment (Yoon et al, 2004).

Junge et al (2004) and Yoon et al (2004) agree that there is a definite advantage of using a broad definition of injury. However, such a definition might lead to an increased injury incidence. It is necessary to assess the impact from the entire spectrum of injuries, from mild to severe injuries, which are of great importance in assessing chronic injuries, and in the future planning of preventative measures.

2.5.3.2 Source of Information

Yoon et al (2004) determined that the reasons for the variations in injury incidence in football players across studies are partially due to the differences in methods of collecting data.

Yoon et al (2004) and Junge et al (2004) summarised that methods of data collecting as follows:

1. By the injured player.

2. The team doctor or physician recognises the injury once informed by the player who considers himself injured.

3. Video analysis of games by independent researchers.

4. Questionnaires.

The player knows best whether he is injured or not. However, they cannot give a medical diagnosis of his injury and there is no objectivity (a player might not report an injury if he feels pressured to play) .

In the majority of studies, according to Junge and Dvorak (2000) and Grisogono (1989), players' injuries are predominantly examined and recorded by a team physician. Arnasson et al (2004) explained that the team physician should collect injuries prospectively on a standardised form throughout the season. The form should include information about type and location of injury, previous similar injuries, duration of injury, and diagnosis. Junge et al (2004) determined that the strength of this injury report form is that when a medical expert who is familiar with the player, their medical history and their actual injuries reports an injury. However, they found that the weakness, when collecting data from many different physicians, could affect the reliability of the data. They concluded that consistent findings demonstrate a high quality of data obtained.

Yoon et al (2004) and Junge et al (2004) stated that although video analysis can be considered objective, medical diagnosis, and severity couldn't be determined.

Junge et al (2000) and Yoon et al (2004) noted an insignificant correlation when using self-administered questionnaires, and that these questionnaires resulted in a higher number of injuries being reported. Arnasson et al (2004) admitted that the main limitation to using a questionnaire, when regarding one of the predominant factors affecting injury (previous injury), is recall bias. This usually causes an underestimation or misclassification of previous injuries, because the player cannot remember the exact injury details.

In determining research design – Junge and Dvorak (2000), Ekstrand and Tropp (1990), Engstrom et al (1990) and Inklaar (1996) stated that it is more effective using prospective research (the injury data is recorded), rather than retrospective study (the involved are questioned about their injury at a later stage). Memory and inaccurate estimations limit retrospective studies.

2.5.3.3 Injury Documentation Form

Junge et al (2004) suggest that the precise characteristics of injury to be documented be determined by the specific aim of the study. It should, however, include a diagnosis including the type and location of the injury.

Bangsbo (1999) stated that studies do not have to involve complex research methods, but more importantly that the study design should ensure that the aim of the study is fulfilled. Bangsbo (1999) suggested that the research should cover a broad area of study with multiple valid approaches.

Study observation periods have also varied. Hawkins and Fuller (1998) and Hawkins and Fuller (1996) investigated injuries during tournaments, Ekstrand and Tropp (1990) examined the entire year or season and Inklaar et al (1996) studied half the season.

Junge and Dvorak (2000), Chomiak et al (2000) and Peterson et al (2000) divided the players of their research study into ages. Grisogono (1989) further classified injuries according to anatomical distribution. Chomiak et al (2000) and Junge and Dvorak (2000) broke injuries further into injury types, according to specific bodily tissues injured.

Arnasson et al's (2004) unique study, on the multivariate risk model, explored injury incidence, type and location of injuries in professional male football players related to varying factors (age, body size, body composition, previous injury and player exposure) which could be seen as risk factors in this model. Shepard (1999) included that body mass still remains the most commonly used reference standard for most types of data.

2.5.3.4 Availability of Exposure to Football

Junge et al (2004) stated that information about the exposure time has to be added for calculation of risk incidence. They however found very few studies that did actually report the exposure-related incidence of injury during football.

Arnasson et al (2004) showed that exposure time were calculated as the duration of matches or training during the season multiplied by the number of players present in play.

Ekblom (1994) stated that it is more useful to compare injury rates when they are expressed as incidence per unit time. Arnasson et al (2004) explained that exposure was estimated, based on each teams schedule and personal communication with the coaches. Injury incidence was calculated as the number of injuries per 1 000 match or training hours. Precision of the reported injury incidence rates depends on the accuracy of the injury, exposure registration, and diagnosis.

2.5.4 Statistical Analyses

In statistical analysis, Junge and Dvorak (2000), Arnasson et al (2004), Peterson et al (2000) and Smith et al (1997) all recorded data on computers, using frequencies, cross tabulations, descriptive statistics and means. Differences were examined using chi-squared test, with the significance level being 5%. Tables were used to determine significance of Pearson correlation's between variables. Arnasson et al (2004) added that a multivariate logistic regression analysis was used, and the use of “p” values to evaluate predictor variables. P values of under 0.05 were considered statistically significant.

2.6 Summary of Literature Review

Football, which developed from multiple origins from all corners of the world, is undoubtedly the most popular sport worldwide and it only keeps growing more progressively every year (among youth and senior players). Due to this increasing number of football players and increase in the intensity and frequency of play there is an overall escalation in the number and severity of injuries in football, which results in increased financial consequences, and loss of playing time.

Research showed a correlation between certain risk factors and football injury incidence (football injury incidence was found to be more accurate and valuable when expressed per exposure time). Some of the most important correlations were found when relating injury incidence to player’s age, with huge differences found in injury patterns between various ages. Anatomical area of injury, type of injury and anatomical area related to injury type might be the most common factors studied in football injury, but it is still considered extremely important and necessary in analysing football injury incidence and patterns. There were certain contrasting results and theories regarding physiological factors and physiological profiles of players, as well as vulnerable periods during the season relating to football injury. Researches on sidedness, relating to football injuries, are very limited. It is, however, found to be one of the most needed and valuable areas of study.

There is urgent need for an injury prevention program and more extensive and precise research work to be done on all football injury variables. Despite the worldwide popularity of the sport, current risk factors and predictors of football injury are few, inconsistent and incomplete. These studies done on football injuries are critical to the development and improvement of sport science.

CHAPTER THREE

Methodology

3.1 Study Population and Sample Size

The population consisted of 113 football players from a designated football club, during the 2001 and 2002 football season. The numbers for each age group were U11=20, U13=21, U15=22, U=22 and PSL=28. The study sample consisted of all the football players from the club who were confirmed injured, by the club physiotherapist, biokineticist or doctor.

3.2 Observation Period

The research had a two-year observation period, covering the pre, mid and post season of 2001 and 2002.

3.3 Definition of Football Injury

This study has defined football injury as: “An injury resulting from participation in official football activities, which leads to an evaluation and diagnosis by a qualified therapist (biokineticist, physiotherapist or doctor).”

3.4 Source of Information

The team physiotherapist, biokineticist or doctor examined the players. The researcher of the study was part of the medical team and assisted with the recordings, the diagnosis and the rehabilitation of injuries, but had to always be accompanied, guided and overseen by one of the qualified physiotherapists, biokineticists or the doctor. Each visit was recorded to date, name of player, age group, injury on left or right side, during training or match, type of injury, anatomical area and the treatment performed (Appendix 1).

With regard to study design - a prospective quantitative study was used. The research was done on large quantities of injury recordings at the club.

3.5 Description of Injury Documentation Form

Injury frequency or incidence were classified according to: Anatomical area of injury, injury type, match versus training sessions, the preferred versus the support leg, vulnerable periods during the season, and the amount of visits per injury for all 5 age groups.

3.6 Availability of Exposure to Football

In this study injury incidence was expressed per 1 000 hours of football exposure by way of methods used by Junge and Dvorak (2000), Kuhn et al (1997) and Lewin (1989)

- Risk per player per specified period (per match, training or total)
  = Number of injuries in a specific period / players exposed (population)

- Risk of injury per exposure time (per match, training or total)
  = Number of injuries / total exposure time

- Risk per 1000 hours of exposure (per match, training or total)

  = Number of injuries x 1000 / total exposure time

3.7 Statistical Analyses

3.7.1 Sampling and Logistics

Due to the competitive nature of professional sports and the Premier Soccer League (PSL) it was considered ethical not to target more than one professional sports club, from an injury investigation point of view. In planning the study, some researchers might be of the opinion that it is beneficial to include two or more professional football clubs, and to compare the injury patterns. In this study only one professional football club was selected.

A comparative study could be undertaken between different sports types, for example: rugby and football (soccer). Such a decision could be criticised due to the fact that it would take the focus off the sport specific injury patterns that could develop. The style of rugby leads to a wider distribution of body injuries (injuries to upper body and lower body are mixed) and has very different injury patterns amongst the ages.

In devising the injury report form (data collection form) other international studies were kept in mind.

3.7.2 Statistical Methods

The aim of the statistical analyses was to best use the data contained on the recorded injury sheets. The data collected were relevant to the topic investigated, namely injuries in football (soccer). The age groups covered started at the U11 and included all the age groups up to the PSL, so that the sequential development of the style of play would be covered. The football players, whom were the subjects of this study, were predominantly from local origin. However, the types of injuries are reasonably similar amongst the soccer playing countries due to the similarities in rules that govern play on the field.

Most of the recorded data were categorical, nominal, ordinal or discrete in nature, for example: varying age groups (ordinal), different injury types or anatomical areas of injury (nominal), sidedness of injury (nominal) or re-injury (nominal). In the analysis, emphasis was placed on the graphical methods to communicate the results coming from the information contained in the data (to make easy communication of complex biological data.)

Categorical data give rise to statistical results that can be measured and compared, for instance, the two calendar years covered in this research project. Some of the data and information were compared by means of chi-squared analysis. Some of the frequencies or rates of injuries were displayed in bar graphs.

Stem-and-leaf diagrams were used to study the distributions, for example to compare the number of injuries per individual in several age groups: under 11, under 13, under 15, under 17 and PSL. In some cases, where applicable, side-by-side box plots were employed to enable robust group distributional comparisons.

Both Pearson and Spearman correlations were used to study the associations between various measurements and derived variables, but scatter plots were employed to gain insight into the bivariate distributions. Inferential statistics were applied to both correlations, when necessary. To investigate these relationships in greater depth, regression methods were applied.

In most cases, non-parametric methods were applied to make deductions from the results, due to the relatively small subgroups and other distributional aspects.

CHAPTER FOUR

Results

4.1 Age-Related Variables of Football Injury

4.1.1 Football Seasons 2001 and 2002

The 2001 and 2002 seasons were compared to determine if any injury patterns or irregularities were noticeable between seasons. Studying two seasons, opposed to one, gives the study less chance of making an error and more chance of consistency and accuracy. Variations between the two years could signify possible areas of error or areas that need special attention. The two seasons injury statistics were generally quite similar. The number of players per age and season categories is depicted in Table 4.1.

Table 4.1 Number of players per defined age and season

Age Group	U/11	U/13	U/15	U/17	PSL
2001	18	21	24	24	28
2002	19	22	22	23	27
"Individuals"	**26**	**33**	**36**	**38**	**45**

Cohort principles (persons grouped together with common statistical characteristics) were applied to explain some of the patterns occurring in this research. The players were categorised into five age groups: under-11 (U11), under-13 (U13), under-15 (U15), under-17 (U17) and the Premier Soccer League team (PSL), consisting of the senior players. The "Individuals" row counts are the number of individuals who were there over the two years (this count illustrates the change in squads over the two years).

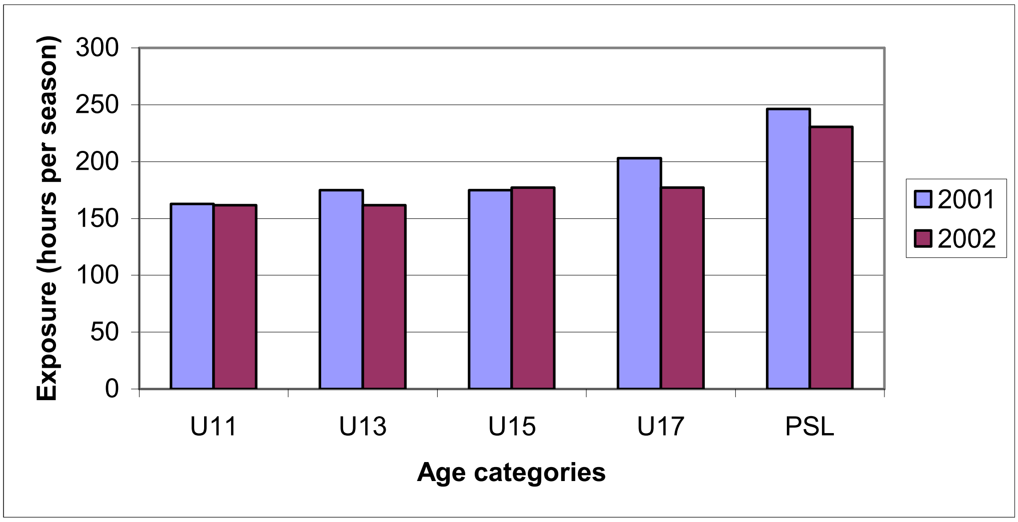


Figure 4.1 Training exposure times for 2001 and 2002

Training exposure times and match exposure times (2001 compared to 2002) are shown in Figures 4.1 and 4.2. Training exposure times for 2001 and 2002 were similar for the U11 to the U17 groups, but these training exposure times increased noticeably for the PSL groups. There was on average less exposure hours for 2002 compared to 2001.

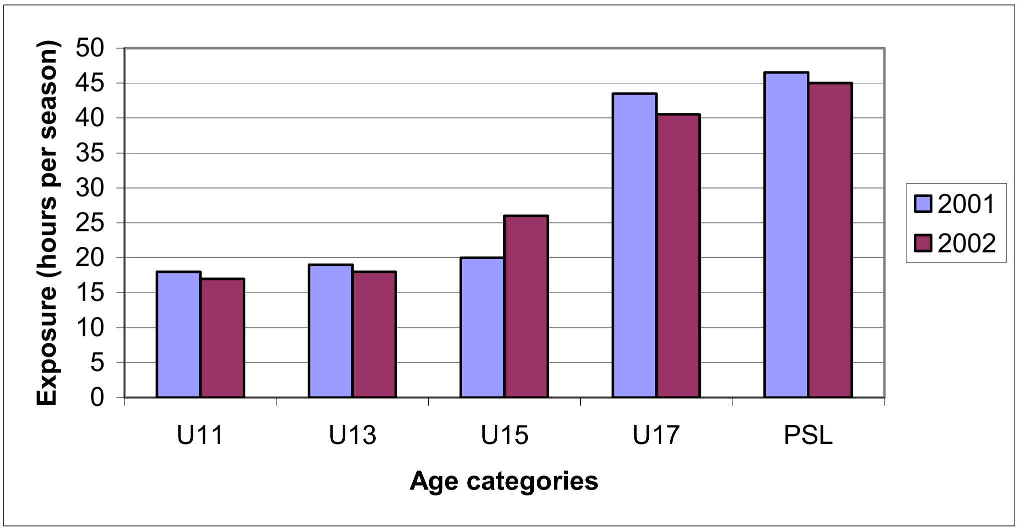


Figure 4.2 Match exposure times for 2001 and 2002

The match exposure times were similar for both seasons for the U11's and U13's, but increased rapidly in the U15's and even more so in the U17 and PSL groups. This was mainly because matches are of longer duration in the older age groups compared to the U11's and U13's.

Table 4.2 Number of injuries sustained during 2001 and 2002 seasons for different age categories.

Year		Age Group					
		u11	**u13**	**u15**	**u17**	**PSL**	**Total**
2001	Injuries	28	49	78	148	279	582
	%	5%	8%	13%	25%	48%	100%
2002	Injuries	33	72	121	148	302	676
	%	5%	11%	18%	22%	45%	100%
Total		**61**	**121**	**199**	**296**	**581**	**1258**

Table 4.2 summarised the injuries sustained during 2001 and 2002. A total of 1258 injuries were recorded over the two seasons. An increase in the total number of injuries was recorded in 2002 (676 injuries) compared to 2001 (582 injuries). In studying Table 4.2 it could be observed that there was an increase in the total injury count as age increased. The most outstanding number was the increase in injuries for the U15 age group, which increased from 78 injuries in 2001 to 121 injuries in 2002.

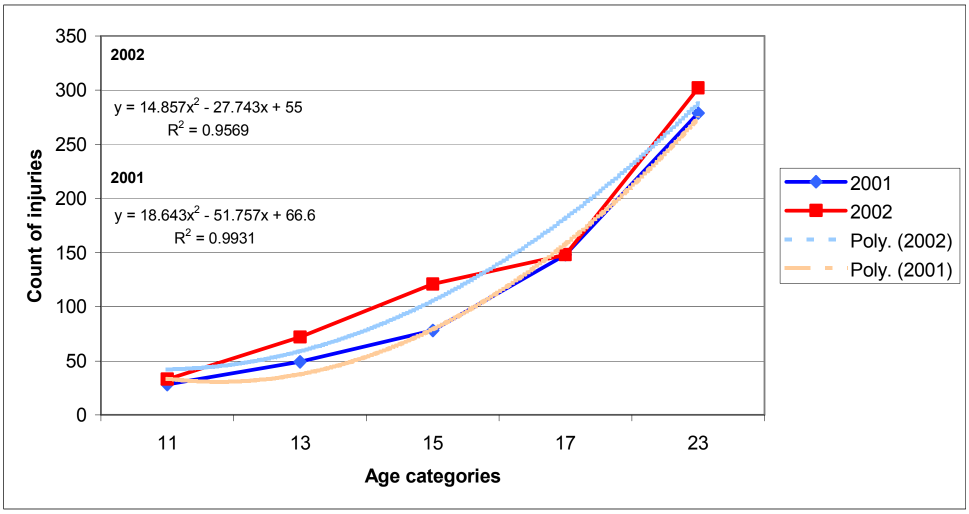


Figure 4.3 The number of injuries per age group

The injury rate of the two years are well described by means of quadratic functions with respect to the age mid points (the PSL average age was 22 years, it was however categorised as 23 due to the heavy tail displayed by this age distribution, and also due to the fact that the upper limit of the lower ages were used).

With reference to the number of injuries per age group, a good fit (for 2001, $R^2 = 0.99$; for 2002, $R^2 = 0.96$) was achieved for both regression analysis lines. This implies that for both seasons age is highly related to the count of injuries for each group.

The regression lines should not be extended beyond the lower limit (10 years of age) or beyond the upper limit (say, 30 years of age) because the regression line was calculated according to the ages 10 to 30.

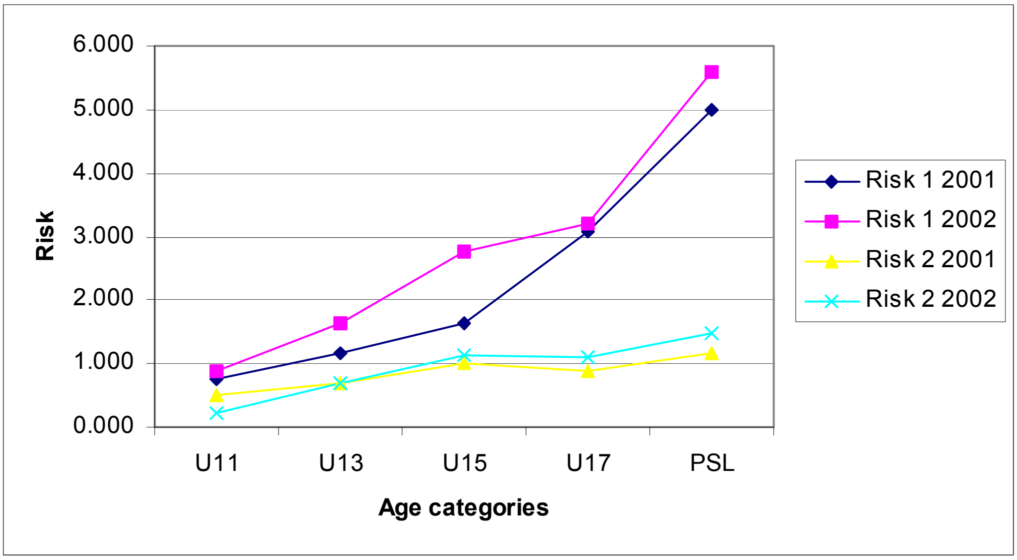


Figure 4.4 Injury risks for various age groups for 2001 and 2002

There was a gradual increase in Risk 1 for both years, with the highest increase-taking place in the U17 and PSL groups. There is only a real difference between 2001 and 2002 (Risk 1) in the U15 group, where there was a higher risk in 2002 compared to 2001. For Risk 2, 2001 was similar to 2002 for all other ages.

4.1.2 Injury Prevalence in the Various Age Groups

In this section juniors (U11 to U17) were grouped together and compared to PSL players. The injuries of the junior players were also studied separately in their respective age groups.

Stem	**Leaves**
1	11111 11111 11111 11111 111
2	22222 22222 22222 22
3	33333 33
4	44444 44444 4444
5	55555 555
6	66666 6
7	77777 7
8	88
9	9999
10	0000
11	1
12	22
13	33
14	4
15	55
16	666
17	
18	8
19	
20	00
21	1
22	2
23	
24	4
25	5
26	
27	
28	
29	
30	0

Figure 4.5 The total number of injuries of junior players

As can be seen in Figure 4.5 there was 23 juniors who had only incurred 1 injury, 17 players with 2 injuries, 7 players with 3 injuries and so forth. The Stem-and-Leaf diagram for the juniors is asymmetrical, which means it is clearly skewed (one sided) towards the larger values (representing the greater number of injuries). The juniors tend to have a lower number of injuries per player (compared to senior level players). Only five juniors had more than 20 injuries. This phenomenon of extremes may be statistically described as accident proneness.

Stem	**Leaves**
0,1	11111 11
2,3	233
4,5	44445 5
6,7	67
8,9	8999
10,1	1
12,3	222
14,5	455
16,7	67
18,9	8
20,1	0
22,3	33
24,5	4445
26,7	66
28,9	
30,1	1
32,3	33
34,5	
36,7	
38,9	8

Figure 4.6 The total injuries of the PSL team.

The Stem-and-Leaf diagram for the PSL group is much flatter and displays a heavier tail than the distribution of junior players. This shows that there were a large number of players with fewer than ten injuries, however, it skews very gradually towards the larger number of injuries and is relatively dispersed. This shows that the PSL group, on average, had a higher number of injuries per player than the juniors.

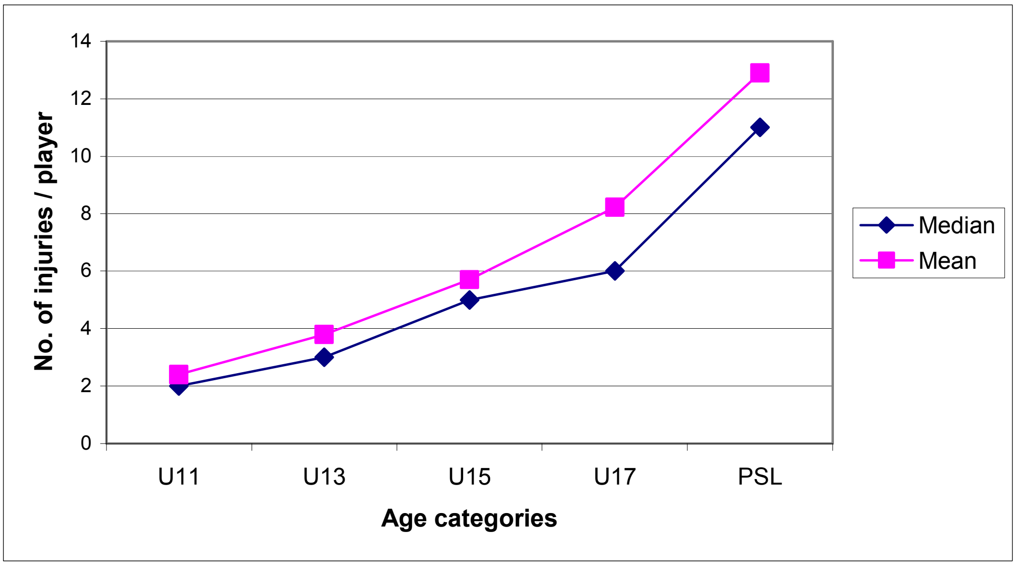


Figure 4.7 The number of injuries per player for 2001 and 2002 combined

The mean was found to be consistently higher than the median for all age groups (Figure 4.7). This means that the distribution for all the age groups displays a heavy tail towards the larger values. In other words, all the age groups experienced a higher frequency in the lower number of injury categories, and the frequencies narrowed as the number of injuries increased. This graph may be non-linear in nature because the players without any injuries were excluded from the analyses. This may affect the U11 and U13 groups to a larger extent than the older age groups, due to the shape of the distribution (high number of individuals with 1,2,3,4 injuries during 2001 and 2002 season).

Table 4.3 Descriptive statistics for the total number of injuries per age group (including the proportion of single injuries)

	Age Group				
Descriptive Statistics	**U11**	**U13**	**U15**	**U17**	**PSL**
Median	2	3	5	6	11
Mean	2.4	3.8	5.7	8.22	12.9
1st Quartile	1	1	2	2	4
3rd Quartile	4	4.25	8	11.5	23
Proportion of players with single injuries *	48%	34.40%	8.60%	19.40%	15.60%

* Over each season.

As with the median and mean, a definite pattern was apparent when studying the 1st and the 3rd Quartiles (there was also a general injury increase with age). It was also important to note that the inter-quartile range increased with age. There was a consistent decrease in the proportion of players with single injuries over each season, with an increase in age, except for the U15 age group.

Table 4.4 Summary of injury statistics for 2001 and 2002

All injuries 2001	**582**
All Injuries 2002	***676***
MATCH injuries 2001	**202**
MATCH injuries 2002	***235***
TRAINING injuries 2001	**380**
TRAINING injuries 2002	***441***
TOTALS for all, match and training	**1258**

The number of match injuries and the training injuries were higher for 2002 than for 2001, which is consistent with “all injuries” patterns. There were more training injuries than match injuries for both seasons.

Table 4.5 Number of injuries, age-group exposure, and various risk counts during training (for all age groups for 2001 and 2002)

Age	Season	Weeks	Hours	Injuries	Risk 1*	Risk 2**	Risk 3***
U11	2001	*29.6*	162.8	*11*	0.611	*0.068*	67.568
	2002	*29.4*	*161.7*	*29*	*1.526*	*0.179*	*179.344*
U13	2001	*31.8*	174.9	*25*	1.190	*0.143*	142.939
	2002	*29.4*	*161.7*	*53*	*2.409*	*0.328*	*327.767*
U15	2001	*31.8*	174.9	*43*	1.792	*0.246*	245.855
	2002	*32.2*	*177.1*	*72*	*3.273*	*0.407*	*406.550*
U17	2001	*36.9*	203.0	*92*	3.833	*0.453*	453.314
	2002	*32.2*	*177.1*	*77*	*3.348*	*0.435*	*434.783*
PSL	2001	*34.4*	246.3	*209*	7.464	*0.849*	848.545
	2002	*32.2*	*230.6*	*210*	*7.778*	*0.911*	*910.857*

Risk 1* Risk per player per specific period = Number of injuries in a specific period / players exposed (population)

Risk 2** Risk of injury per exposure time = Number of injuries / total time

Risk 3*** Risk per 1000 hours of exposure time = Number of injuries x 1000 / total exposure time

The number of weeks of training remained consistent for all ages; only the under-11 team had noticeably less training time. The hours of training exposure, related to the weeks of training, followed a similar pattern; however the PSL had longer training sessions, which lead to higher levels of training exposure. When observing the number, of injuries as well as all the risk groups, it is clear that there was a definite increase in injuries with an increase in age.

Table 4.6 Number of injuries, age-group exposure, and various risk counts during matches (for all age groups for 2001 and 2002)

Age	Season	Weeks	Hours	Injuries	Risk 1*	Risk 2**	Risk 3***
U11	2001	*18*	18	*17*	0.895	*0.944*	944.444
	2002	*17*	*17*	*4*	*0.211*	*0.235*	*235.294*
U13	2001	*19*	19	*24*	1.143	*1.263*	1263.16
	2002	*18*	*18*	*19*	*0.864*	*1.056*	*1055.56*
U15	2001	*20*	20	*35*	1.458	*1.750*	1750
	2002	*26*	*26*	*49*	*2.227*	*1.885*	*1884.62*
U17	2001	*29*	43.5	*56*	2.333	*1.287*	1287.36
	2002	*27*	*40.5*	*71*	*3.087*	*1.753*	*1753.09*
PSL	2001	*31*	46.5	*70*	2.500	*1.505*	1505.376
	2002	*30*	*45*	*92*	*3.407*	*2.044*	*2044.444*

Risk 1* Risk per player per specific period = Number of injuries in a specific period / players exposed (population)

Risk 2** Risk of injury per exposure time = Number of injuries / total time

Risk 3*** Risk per 1000 hours of exposure time = Number of injuries x 1000 / total exposure time

In contrast to the training weeks, a gradual increase in the match weeks with an increase in age was observed. The match hourly exposure also increased gradually from the U11s to the U15s, where it then rapidly increased in the U17s and even more at a PSL level (due to the longer match times). As with training, there was a definite increase in the number of injuries and the variety of risks, with an increase in age.

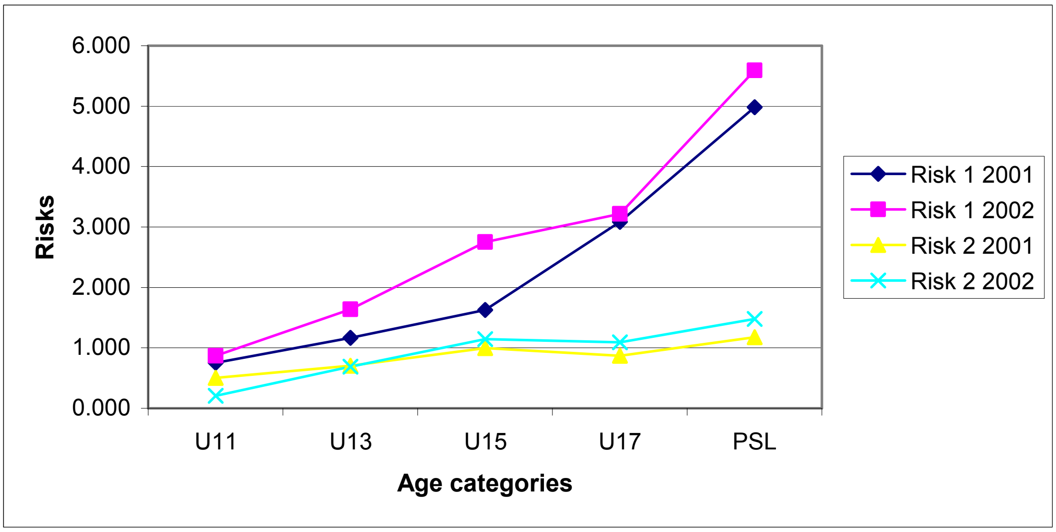


Figure 4.8 Injury risks for various age groups for 2001 and 2002

Risk 1 - Risk per player per specific period = Number of injuries in a specific period / players exposed (population)

Risk 2 - Risk of injury per exposure time = Number of injuries / total time

There was a gradual increase in injury risk with an increase in age. A noticeable increase in Risk 1 (which relates to the risk per player during a specific period, out of the population) was observed for the U15 and U17 groups, which peaked in the PSL group. With Risk 2 (relating to exposure time alone) there was a slight increase from U11 to U15, after which it seemed to plateau in the PSL.

4.2 Number of Treatments per Injury

The "number of treatments per injury" reflects the number of treatments received for the original injury only. Any new or different injury restarted the injury treatment counter. The number of treatments can be used as a basis for judging the severity of the injury.

Table 4.7 The median, mean, and the percentage of single treatments per injury for all age groups

	U11	U13	U15	U17	PSL
Mean	1.48	1.45	1.84	2.08	2.42
Median	1.25	1.25	1.64	2.04	2.04
1st Quartile	1.00	1.00	1.00	1.25	1.65
3rd Quartile	1.86	2.00	2.27	2.67	3.00
Proportion of single treatments per injury	48.0%	46.9%	28.6%	22.2%	11.0%

The percentage of single treatments per injury in the U11 and U13 groups was high and similar, but there was a substantial decrease in the percentage for the U15, U17 and PSL groups. The U17's group percentage for this category was less than half that of the U11's group while the PSL group was half of the U17's group. This decrease in percentage of single treatments per injury with age and the gradual increase in the median and mean for the number of treatments per injury with age showed that injuries became more severe with age. The difference between the mean and median indicates asymmetry in the distribution of the number of treatments.

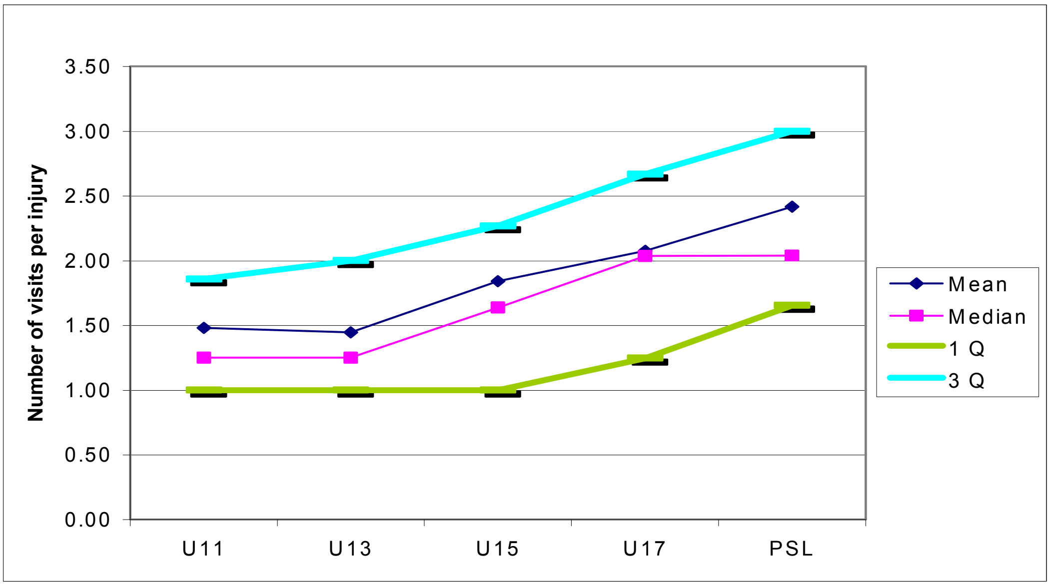


Figure 4.9 The number of visits per injury for 2001 and 2002 combined

The mean for the number treatments per injury per age group is consistently larger than the median (Figure 4.9). The mean and median were similar for the U11 and U13 age groups, but the number of visits per injury increased visibly for the U15's, and continued to increase through the U17's and PSL groups. A case where the mean was found to be larger than the median is indicative of a heavy tail and a high number of treatments. The increase in number of treatments per injury with age is indicative that the severity of the injuries intensified with age. There is an increase in inter-quartile range from the U11 group to the U17's and PSL groups, which means that the number of treatments per injury became more dispersed with age. The simple line-connected association between the mean and median of the various age groups displays a non-linear graph (Figure 4.9).

4.3 Anatomical Area of Injury

The upper body count is made up of head, neck, back, abdominals, chest, shoulder, arm and hands. The lower body count is made up of hips, groin, hamstrings, quadriceps, knee, calf, tibialis anterior, ankle and foot. The flu counts were excluded from the anatomical analysis, as it did not influence body parts.

The lower body is vital in the game of football and, therefore, also necessary to study the relationship between upper and lower body.

Table 4.8 Injury count for the upper and lower body for 2001 and 2002

	2001	*2002*
Upper Body	108	125
Lower Body	447	497
Totals	**555**	**622**

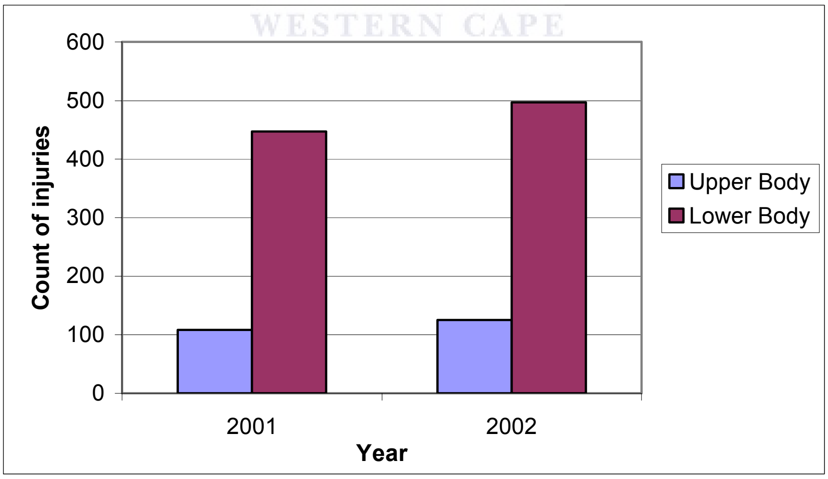


Figure 4.10 Upper and lower body injury counts for 2001 and 2002

From the Figure 4.10 and Table 4.8 it appears that the proportion of lower and upper body injuries remained relatively constant for the two years. The lower body injuries were noticeably higher.

Table 4.9 Percentage of total upper body injuries compared to percentage of total lower body injuries for 2001 and 2002

	2001	2002
Upper Body	19.46%	20.10%
Lower Body	80.54%	79.90%

The count as well as the percentage of injuries of the upper and lower body was used to describe the variation in years 2001 compared to 2002. The two years studied were remarkably similar. Table 4.8 shows a higher injury count in both the upper and lower body, due to the increased total injury count for 2002. The bar chart in Figure 4.10 shows mirrored results across the two years. Table 4.9 best displays the similarities and consistencies across the two years as well as the differences between upper and lower body injuries in football. When rounding off both years, the lower body injuries (80 %) are four times greater than the upper body injuries (20 %).

Table 4.10 Injury count according to body part for 2001 compared to 2002

% of Total	2001	Site	2002	% of Total
0.00%	0	Chest	2	0.30%
0.17%	*1*	***Head***	*2*	*0.30%*
0.86%	5	Abdominal	4	0.59%
2.06%	*12*	***Hip***	*4*	*0.59%*
0.86%	5	Arm	12	1.78%
1.89%	*11*	***Neck***	*15*	*2.22%*
2.23%	13	Shoulder	16	2.37%
3.78%	*22*	***Hand***	*22*	*3.25%*
3.44%	20	Tibialis Anterior	34	5.03%
6.53%	*38*	***Calf***	*31*	*4.59%*
4.64%	27	Flu	54	7.99%
5.50%	*32*	***Quadriceps***	*59*	*8.73%*
6.36%	37	Foot	50	7.40%
9.79%	*57*	***Groin***	*34*	*5.03%*
8.76%	51	Back	52	7.69%
9.11%	*53*	***Hamstrings***	*60*	*8.88%*
15.81%	92	Knee	90	13.31%
18.21%	*106*	***Ankle***	*135*	*19.97%*
100.00%	**582**	**Total**	**676**	**100.00%**

When analysing Table 4.10 it was important to note that 2002 had a higher total injury count (676) compared to 2001 (582). The areas of injury have been arranged in ascending order according to the average over both years.

The ankle represented the highest injury count, followed by injuries to the knee, hamstrings and back. The ankle and knee constituted 34 % of injuries sustained in 2001, the same for 2002. The counts across the two years remained quite stabilised and similar, except for the flu, quadriceps and groin that varied the most. Flu doubled from 2001 to 2002. Quadriceps injuries also almost doubled from 2001 to 2002. Groin injuries present a contrast, where the number of injuries actually reduces noticeably from 2001 to 2002. These anatomical areas, which showed noticeable difference over the two seasons, are areas, which need specialised attention to try and correct.

Table 4.11 Comparison of injuries according to body part for 2001 and 2002(PSL)

Anatomical Area	2001	2002
Abdominals	3	2
Ankle	*52*	*60*
Arm	5	4
Back	*28*	*21*
Calf	22	20
Flu	*3*	*13*
Foot	20	23
Groin	*22*	*6*
Hamstrings	38	48
Hand	*5*	*5*
Hip	4	3
Knee	*37*	*41*
Neck	6	11
Quadriceps	*16*	*29*
Shoulder	8	9
Tibialis Ant.	*10*	*5*
Total	**279**	**300**

Test Statistic CHI-Squared for anatomical area of injury for 2001 compared to 2002 (PSL only) = 25.314

P-Value = 0.0459

The flu and the groin injuries were the main reasons for the difference in distribution between 2001 and 2002 and the p-value being less than 5%, is an indication of the minimal risk of making a mistake if stating that there is a difference between the two years.

Table 4.12 Comparison of upper and lower body injuries for the various age groups (mean number of injuries of each age group is also listed in the last row of the table)

	u11	**u13**	**u15**	**u17**	**PSL**	**Total**
Upper Body	5	19	29	71	109	233
%	*9.3%*	*18.3%*	*15.8%*	*26.2%*	*19.3%*	*19.8%*
Lower Body	49	85	154	200	456	944
%	*90.7%*	*81.7%*	*84.2%*	*73.8%*	*80.7%*	*80.2%*
Totals	**54**	**104**	**183**	**271**	**565**	**1177**
Mean Number of Injuries	2.1	3.2	5.1	7.1	12.6	6.6

In Table 4.12, the totals of the age groups were consistent with the upper and lower body injury counts, which increased with age. However, when looking at the percentages, the U11 upper body count is quite low (9.3%) compared to the other ages, whereas the U17 upper body count is quite high (26.2%) compared to the other ages.

Table 4.13 Upper body injuries based upon anatomical area

(The table displays the count and the column percentages of the injuries for the various body parts for each age group)

	Player Age Groups											
BodyPart	**u11**		**U13**		**u15**		**u17**		**PSL**		**Total**	**Total**
Chest		*0%*		*0%*		*0%*		*0%*	2	*0%*	**2**	***0%***
Head		*0%*	1	*1%*	1	*1%*	1	*0%*		*0%*	**3**	***0%***
Abdominals		*0%*	2	*2%*		*0%*	2	*1%*	5	*1%*	**9**	***1%***
Arm		*0%*	1	*1%*		*0%*	7	*2%*	9	*2%*	**17**	***1%***
Neck		*0%*	1	*1%*		*0%*	8	*3%*	17	*3%*	**26**	***2%***
Shoulder	3	*5%*	2	*2%*	5	*3%*	2	*1%*	17	*3%*	**29**	***2%***
Hand	2	*3%*	11	*9%*	7	*4%*	14	*5%*	10	*2%*	**44**	***3%***
Back		*0%*	1	*1%*	16	*8%*	37	*13%*	49	*8%*	**103**	***8%***

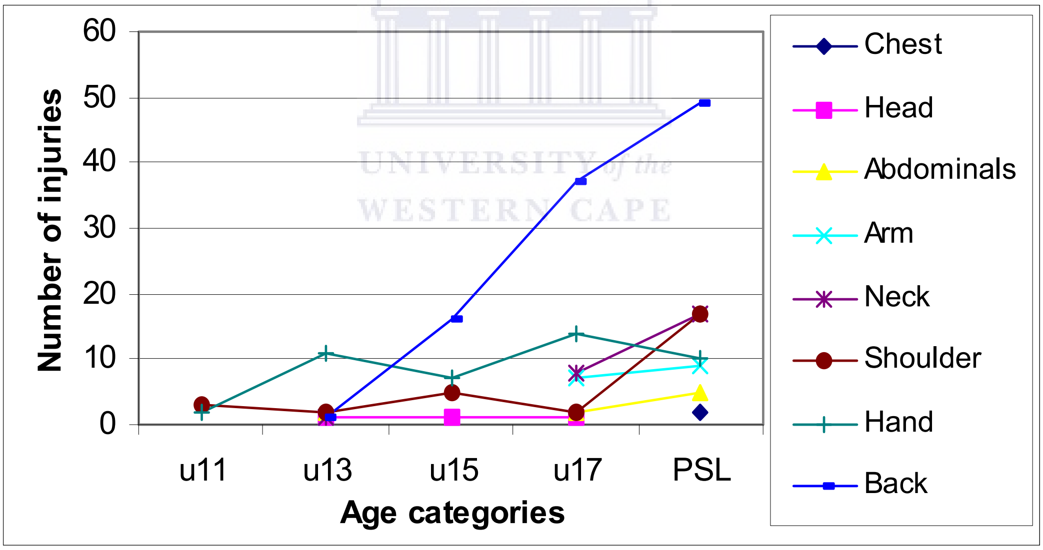


Figure 4.11 Anatomical areas of injury for the upper body for all age groups

In table 4.13 and figure 4.11 no noticeable patterns could be seen for any of the upper body areas, except for the back where the U13 age group injuries increased rapidly, and continued to increase to the PSL group.

Table 4.14 Lower body injuries based upon anatomical area

(The table displays the count and the percentages of injuries for various body parts for each age group)

BodyPart	u11		U13		u15		u17		PSL		Total	
Hip	1	2%		0%	3	2%	5	2%	7	1%	**16**	**1%**
Tibialis Ant.	3	5%	13	11%	11	6%	12	4%	15	3%	**54**	**4%**
Calf	1	2%	5	4%	12	6%	9	3%	42	7%	**69**	**5%**
Quadriceps	1	2%	3	2%	22	11%	20	7%	45	8%	**91**	**7%**
Foot	7	11%	10	8%	16	8%	11	4%	43	7%	**87**	**7%**
Groin	4	7%	6	5%	18	9%	35	12%	28	5%	**91**	**7%**
Hamstrings	2	3%	2	2%	11	6%	12	4%	86	15%	**113**	**9%**
Knee	17	28%	21	17%	27	14%	39	13%	78	13%	**182**	**14%**
Ankle	13	21%	25	21%	34	17%	57	19%	112	19%	**241**	**19%**

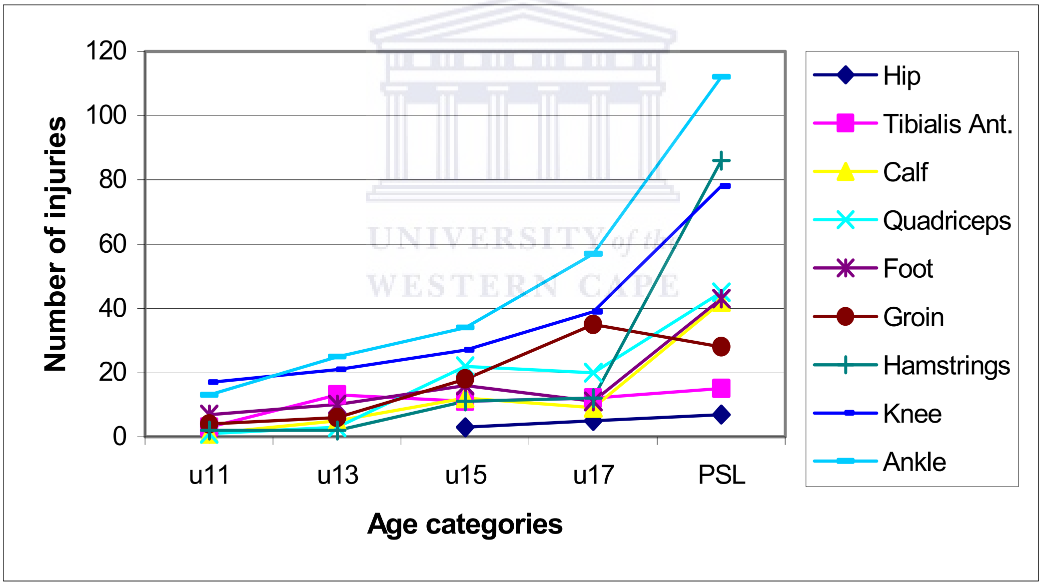


Figure 4.12 Injury count for the lower body for all age groups

The ankle and knee, which represented the highest injury counts for the lower body, showed very similar patterns – gradually increasing from U11 to U17, where it increased sharply in the PSL. The hamstrings, quadriceps and foot injury count also remained quite consistent until the PSL, where the count was higher than the other age groups. The injury count for groin injuries was the highest in the U17 age group.

Table 4.15 Anatomical injuries for PSL players for 2001 and 2002 (in ascending order)

Anatomical Area	Proportion	Sequential Difference
Chest	0.16%	
Head	0.24%	0.08%
Abdominals	0.72%	0.48%
Hip	1.27%	0.56%
Arm	1.35%	0.08%
Neck	2.07%	0.72%
Shoulder	2.31%	0.24%
Hand	3.50%	1.19%
Tibialis Ant.	4.29%	0.79%
Calf	5.48%	1.19%
Flu	6.44%	0.95%
Foot	6.92%	0.48%
Groin	7.23%	0.32%
Quadriceps	7.23%	0.00%
Back	8.19%	0.95%
Hamstrings	8.98%	0.79%
Knee	14.47%	5.48%
Ankle	19.16%	4.69%

The jumps in sequential difference indicated an increase in injury rate, which represents the next threshold level or the next ranked injury. The bottom half of the table consists of injuries for the lower body injuries, except for the back injuries and flu.

As shown by figure 4.11, back injuries in PSL players were relatively high. There was a sudden increase in back injuries from the juniors to PSL players. The knee and ankle injuries again made up the highest injury count. There was quite a dramatic increase from the third highest injury area (hamstrings) to the knee injuries (5.48%) and again from knee injuries to ankle injuries (4.69%). The foot had significantly fewer injuries than the ankle.

4.4 Type of Injury

Table 4.16 Total number of specified types of injuries occurring over 2001 and 2002

% of Total	2001	Injury Type	2002	% of Total
0.17%	1	Skin	1	0.15%
0.00%	*0*	*Meniscus-Tear*	*9*	*1.33%*
0.52%	3	Bone-Fracture	8	1.18%
1.20%	*7*	*Tendon-contusion*	*9*	*1.33%*
1.72%	10	Tendon-Tendonitis	17	2.51%
3.95%	*23*	*Tendon-Tear*	*25*	*3.70%*
4.81%	28	Blanks	54	7.99%
7.22%	*42*	*Muscle-Haematoma*	*72*	*10.65%*
10.48%	61	Ligament-Joint Laxity	43	6.36%
11.68%	*68*	*Bone-Bruise*	*97*	*14.35%*
16.84%	98	Muscle-Stiffness	95	14.05%
20.96%	*122*	*Muscle-Strain*	*109*	*16.12%*
20.45%	119	Ligament-Sprain	137	20.27%
100.00%	**582**	**Total**	**676**	**100.00%**

The types of injuries are arranged in ascending order. Ligament sprains account for the highest injury type for 2002, and the two years combined. For 2001, ligament sprains had only 3 less incidents than muscle strains, the most frequent injury type for that year. The muscle strains and ligament sprains together constitute 41.4% and 36.4% for 2001 and 2002, respectively.

Noticeable variations across the years were observed in meniscus tears, blanks, muscle haematomas, and ligament joint laxity and bone bruises. The “Blanks” were made up of non-orthopaedic injury types, namely influenza. A visible increase in the number of meniscal tears was recorded between 2001 (0) and 2002 (9) (Table 4.16). Muscle haematomas and bone bruises increased quite noticeably from 2001 to 2002. This is an important factor that requires further investigation, due to the fact that both are contact injuries. Ligament joint laxity, in contrast, reduced from 61 to 43 counts.

Table 4.17 Number of specified types of injuries (reduced categories) for 2001 and 2002

Injury Type	2001	2002
Bone-Bruise	29	36
Ligament-Joint Laxity	27	23
Ligament-Sprain	56	67
Muscle-Haematoma	30	20
Muscle-Stiffness	47	51
Muscle-Strain	66	63
Tendon-Tear	12	16
Total	**267**	**276**

"Reduced categories" means that certain injury types that had very low injury numbers were left out of the table comparison. A chi-squared value of 4.7142 (with 6 degrees of freedom) has a probability of 0.6948 occurring under the Null hypothesis of equal distributions. The probability represents the risk of making a mistake when stating that the distributions in year one and two are the same.

Table 4.18 Injury types (categorised into the four main bodily tissues)

BONE INJURIES
Bone-bruise
Bone-fracture
LIGAMENT INJURIES
Ligament-joint laxity
Ligament-sprain
MUSCLE INJURIES
Muscle-haematoma
Muscle-stiffness
Muscle-strain
TENDON INJURIES
Tendon-contusion
Tendon-tear
Tendon-tendonitis
Excluded:
*Blank (flu)
*Meniscus-tear
*Skin

Table 4.18 shows how the injury types have been categorised for easy study. Blanks (flu), meniscus tears and skin injuries were excluded from the summarised injury types due to the fact that their numbers were too low.

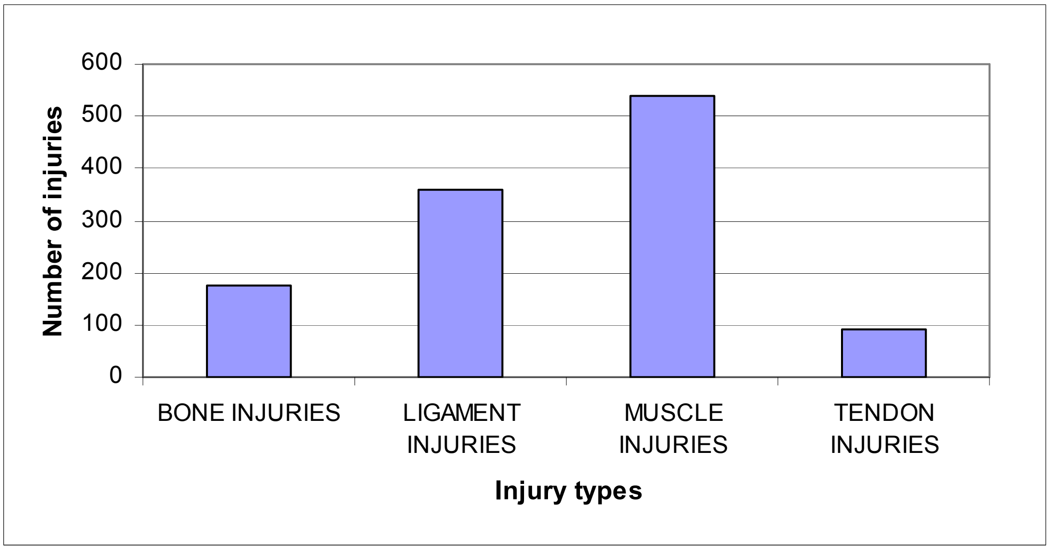


Figure 4.13 Number of injuries for the different injury types

Muscle injuries constitute by far the highest injury count, followed by ligament injuries and then bone injuries. The lowest count was found in tendon injuries.

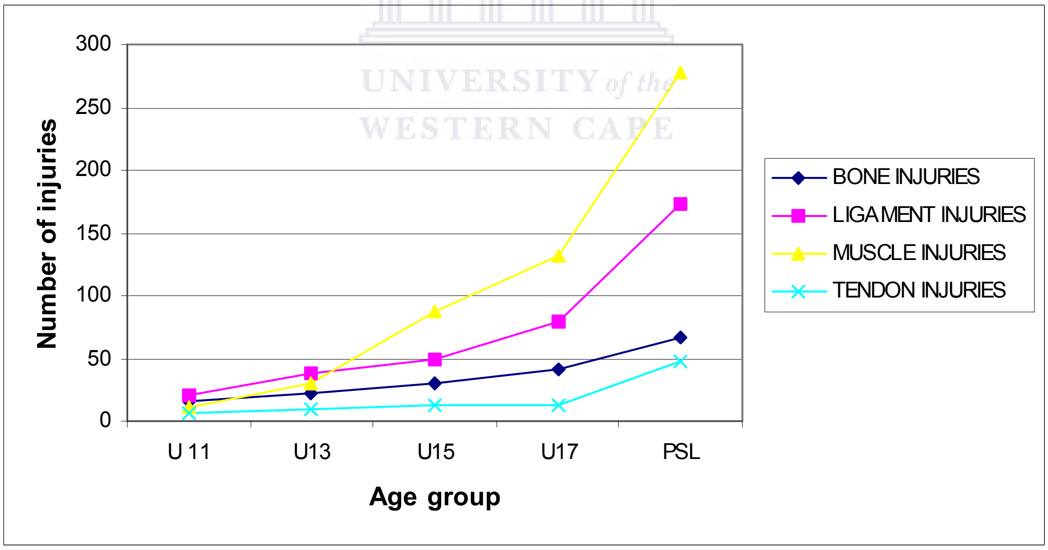


Figure 4.14 Count of injury types for different age groups

Bone and tendon injuries followed the same injury pattern amongst the juniors and only escalated in the PSL group. Ligament injuries remained constant up to the U17 age group, after which it started to increase noticeably. Muscle injuries (the highest injury count) increased progressively from the U13 to the U17 age group, after which it escalated more rapidly in the PSL group.

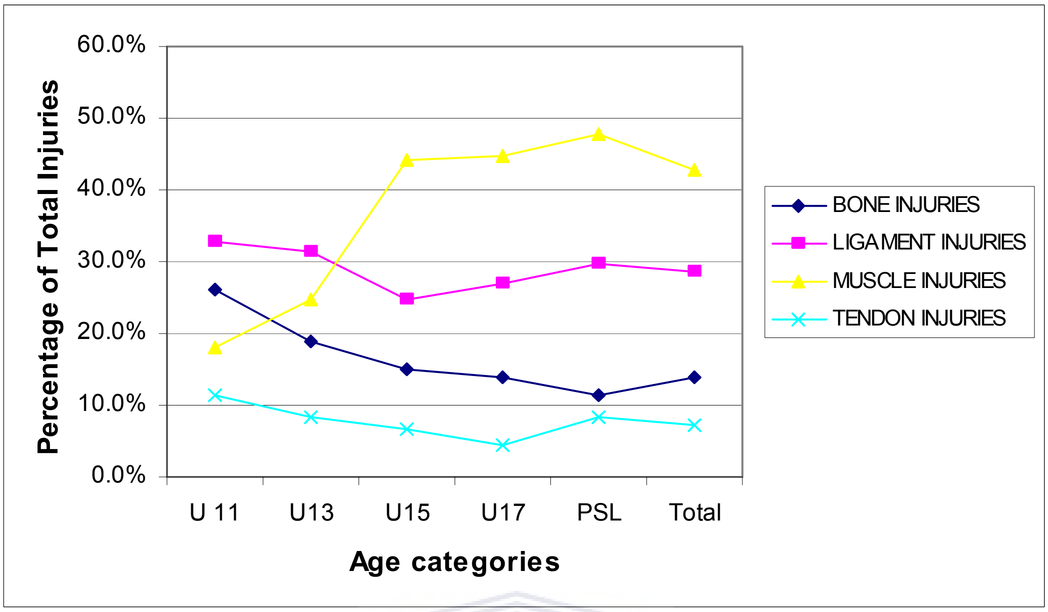


Figure 4.15 Total injuries for each injury type

The percentage for bone, ligament and tendon injuries decreased slightly with age, while remaining relatively constant. The percentage of muscle injuries was low in the U11 group, and gradually increased in the U15 age group, where it seemed to plateau in the U17 and PSL groups.

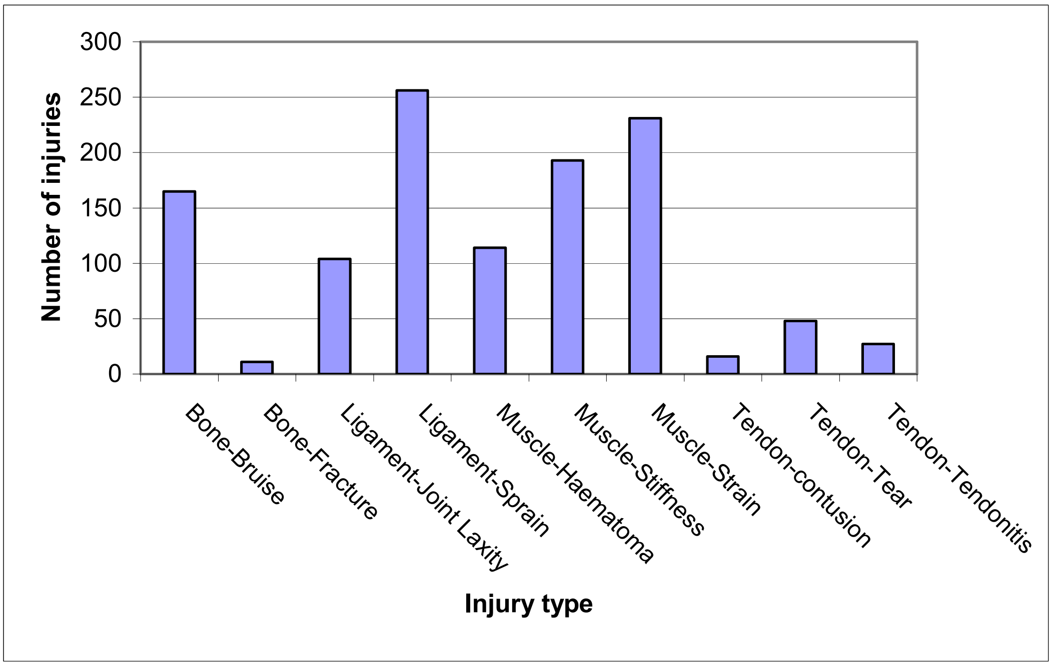


Figure 4.16 Total injury count for each injury type

Ligament sprains represented the highest individual injury type, followed by muscle strains and muscle stiffness. Bone bruise, muscle haematoma, and ligament joint laxity make up the mid-half of the graph.

4.5 Anatomical Area of Injury in Relation to Type of Injury

Firstly, when relating anatomical area of injury to type of injury, for both 2001 and 2002, a high significance was found. A chi-squared value of 2022.6132 (P-Value = 0) was calculated for the overall test statistic, while the chi-Squared for 2001 was 989.8682 and for 2002 was 1144.4699, which means that there is very little risk of error, if one states that the rows (injury type) and columns (anatomical area) are influencing each other.

Table 4.19 Relationship between anatomical area of injury and type of injury for 2001 and 2002

	2001	2002
Degrees of Freedom	84	112
Critical Value 95% (5%)	106.39	137.70
Critical Value 99% (1%)	117.06	149.73
Pearson Chi-Squared	989.87	1144.47

If an analysis of a Pearson chi-squared test is higher than the critical values (99% or 95%), then the relationship is considered as statistically significant. From an analysis of the Pearson chi-squared values, it is clear that the relationship between anatomical area of injury and type of injury is highly significant. This statistically proves that anatomical area of injury has a significant affect on the type of injured sustained.

Table 4.20 Combined anatomical area and injury type for 2001 (eight highest counts)

	2001	**Count**	**%**
1	Knee-Ligament	75	13.56%
2	Ankle-Ligament	74	13.38%
3	Groin-Muscle Strain	55	9.95%
4	Back-Muscle Strain	49	8.86%
5	Hamstring-Muscle Strain	45	8.14%
6	Calf-Muscle Strain	29	5.24%
7	Foot-Bone Bruise	28	5.06%
8	Quad-Muscle Strain	21	3.80%
	Total	**376**	**67.99%**
	Average for the top 8		**8.50%**

Table 4.21 Combined anatomical area and injury type for 2002 (eight highest counts)

	2002	Count	%
1	Ankle-Ligament	92	14.81%
2	Hamstring-Muscle Strain	51	8.21%
3	Back-Muscle Strain	51	8.21%
4	Knee-Ligament	42	6.76%
5	Foot-Bone Bruise	38	6.12%
6	Quad-Muscle Haematoma	33	5.31%
7	Groin-Muscle Strain	33	5.31%
8	Ankle-Bone Bruise	27	4.35%
	Total	**367**	**59.10%**
	Average for the top 8		**7.39%**

Besides calf muscle and quadriceps muscle strains in 2001, and anklebone bruises and quadriceps haematomas in 2002, the same anatomical areas were rated within the top 8 counts for 2001 and 2002. The order is however quite different.

Table 4.22 Relation between anatomical area and injury type for 2001 and 2002 (ten highest rated)

2001 | 2002

Chi	Injury Type	Injury Area		Injury Area	Injury Type	Chi
120.87	Bone Bruise	Foot	**1**	Foot	Bone Bruise	116.70
67.79	Ligament-Joint	Knee	**2**	Quadriceps	Muscle Haematoma	100.04
48.06	Muscle Strain	Groin	**3**	Ankle	Ligament Joint	71.43
45.21	Ligament-Joint	Ankle	**4**	Back	Muscle Strain	67.35
40.63	Muscle Strain	Back	**5**	Hamstring	Muscle Strain	49.67
37.01	Bone Bruise	Tibialis Anterior	**6**	Knee	Tendon Tendonitis	45.06
32.71	Muscle Strain	Hamstring	**7**	Groin	Muscle Strain	42.67
30.22	Muscle Haematoma	Quadriceps	**8**	Knee	Meniscus Tear	34.37
14.88	Tendon Tear	Ankle	**9**	Tibialis Ant.	Bone Bruise	30.32
12.75	Muscle Strain	Calf	**10**	Knee	Tendon Tear	20.59

For both years, bone bruise and foot had the highest correlation. The ankle and ligaments, back and muscle strain, hamstring and muscle strain, and tibialis anterior and bone bruise also rated high for both years. A number of inconsistencies were found. An example is the knee's correlation to ligament, which was rated second highest for 2001, but did not feature in the top 10 ranked correlated injuries for 2002. Muscle strains of the groin also reduced quite drastically from 2001 to 2002. Where quadriceps and haematoma started off low in 2001, it progressed to second for 2002.

Table 4.23 Injury area and injury type correlations for all age groups (ten highest rated)

	Injury Area	Injury Type	Injury Count
1	Ankle	Ligament Sprain	103
2	Back	Muscle Stiffness	100
3	Hamstring	Muscle Strain	87
4	Knee	Ligament Sprain	86
5	Foot	Bone Bruise	66
6	Ankle	Ligament Joint Laxity	63
7	Quadriceps	Muscle Haematoma	44
8	Ankle	Bone Bruise	38
9	Knee	Ligament Joint Laxity	31
10	Tibialis Anterior	Bone Bruise	30

The ankle and ligament sprains made up the highest correlation count, followed by muscle stiffness in the back. Hamstring strains (3^{rd}) and knee sprains (4^{th}) had a similar count, and then foot bone bruises (5^{th}) and ankle ligament laxity (6^{th}) that had a lower count. The last four places on the above table had a noticeably lower number of injuries compared to the upper half of the table.

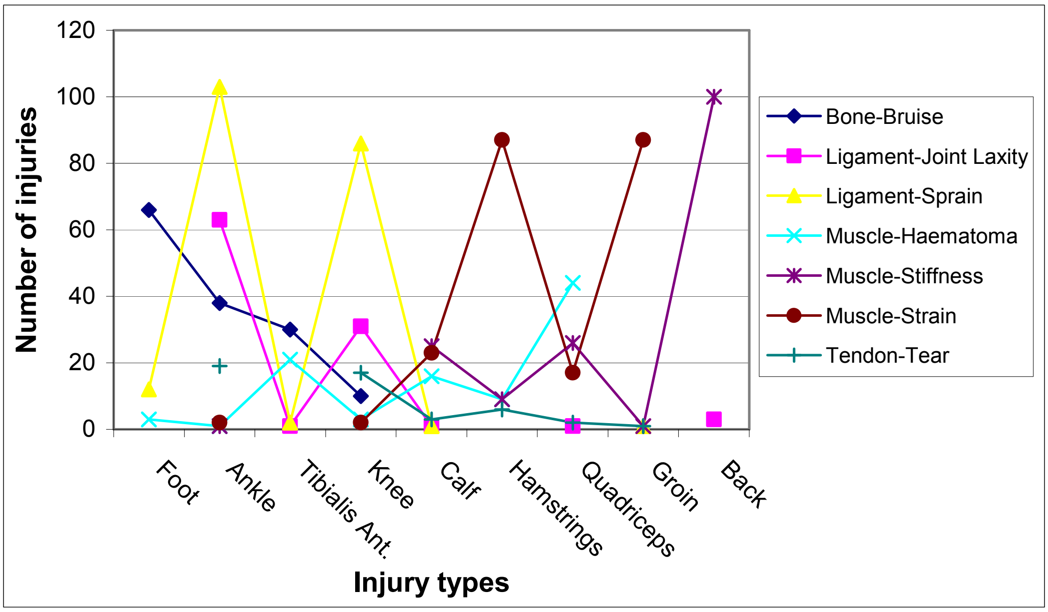


Figure 4.17 Injury type count in correlation to anatomical area

Ligament sprains of the knee and ankle resulted in two of the highest injury types, muscle stiffness of the back, and muscle strains of the hamstring and groin also had very high counts. Bone bruises of the foot and tibialis anterior, joint laxity of the knee and ankle, and haematoma of the quadriceps were also noticeably high.

Table 4.24 Excluded anatomical areas and injury types (due to too few recorded injuries from each)

Body parts removed - Flu (blanks), Head, Shoulder, Hand, Abdominals, Arm, Chest, Hip, Neck, Skin **Injury types removed -** Bone fracture, Meniscus tear, Tendon contusion, Tendon tendonitis, Blanks (flu)

4.6 Vulnerable Periods During the Season

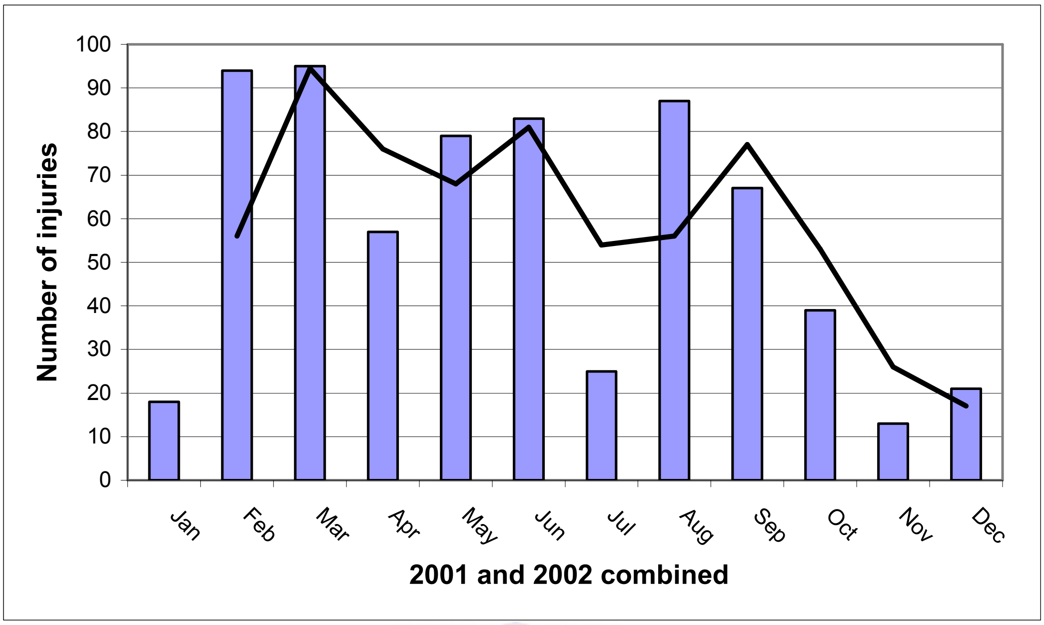


Figure 4.18 Total number of injuries for juniors during a season

When observing the juniors' injury counts throughout the year it is shown that February and March (preseason and start of the season) clearly has the highest injury count. January, November and December show the lowest injury counts (off-season). There is a season break in July, which shows the lowest injury count for the season (February to October). There is a general decrease in injury count from early season to late season.

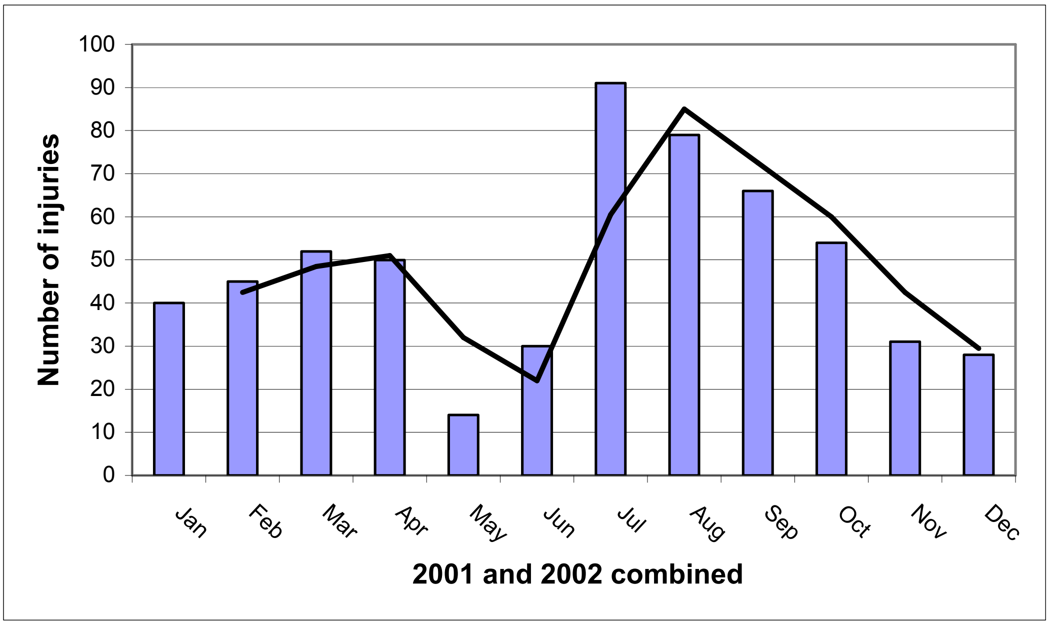


Figure 4.19 Total number of injuries for seniors during a season

The highest injury counts for seniors are found to be during July and August (early season) and progressively decrease until December, where the injury count slowly starts to increase towards the end of the season. May and June show the lowest injury counts (off-season).

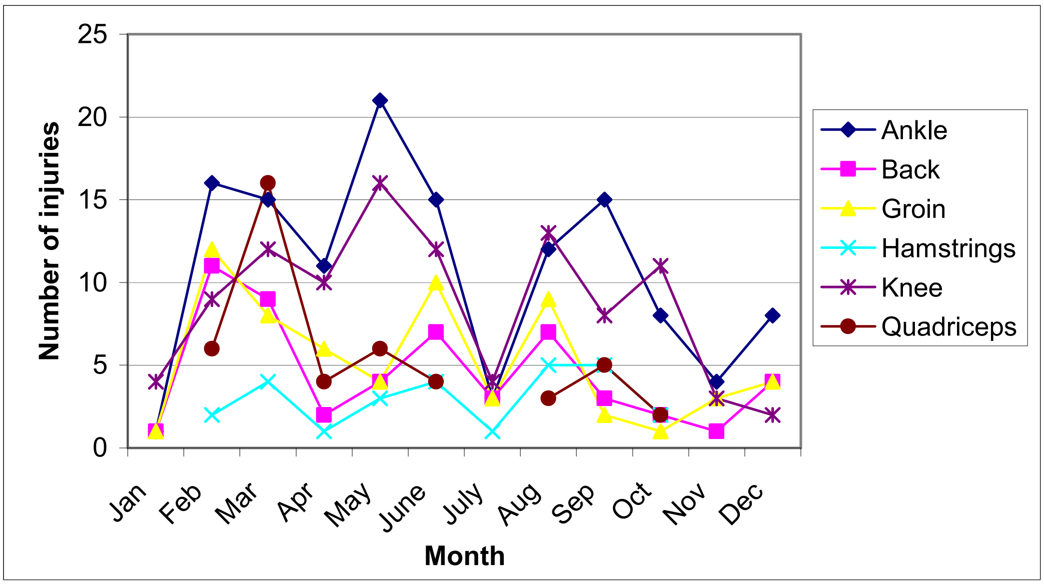


Figure 4.20 Number of injuries per anatomical area for juniors

The injury count for the ankle was the most prominent, with three distinct high points (peaked in February, May and September). The knee, which also had one of the highest numbers of injuries, followed a very similar injury count pattern to that of the ankle. The back, groin and quadriceps injury counts all peaked during the early season (February to March) and, generally decreased throughout the season. There is however, a sudden increase in muscle injuries from May to June, and August to September.

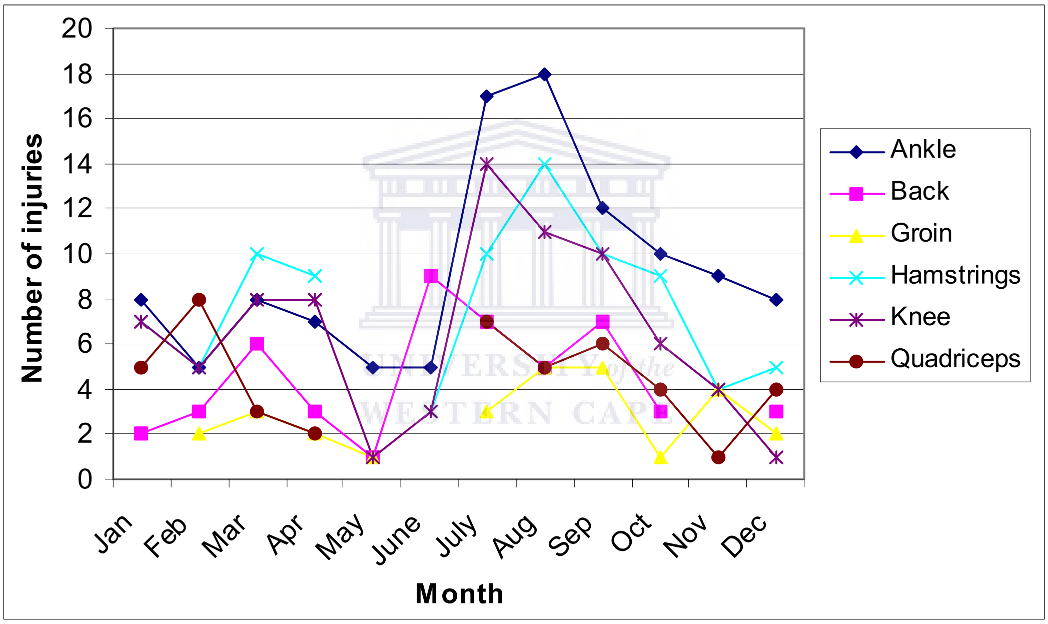


Figure 4.21 Number of injuries per anatomical area for seniors during a season

As with the juniors, the injury-count for two joints (ankle and knee) was quite high, and followed similar patterns. The hamstring and back injury counts peaked during the early season, and thereafter gradually declined, while the groin and quadriceps generally remained quite balanced throughout the season.

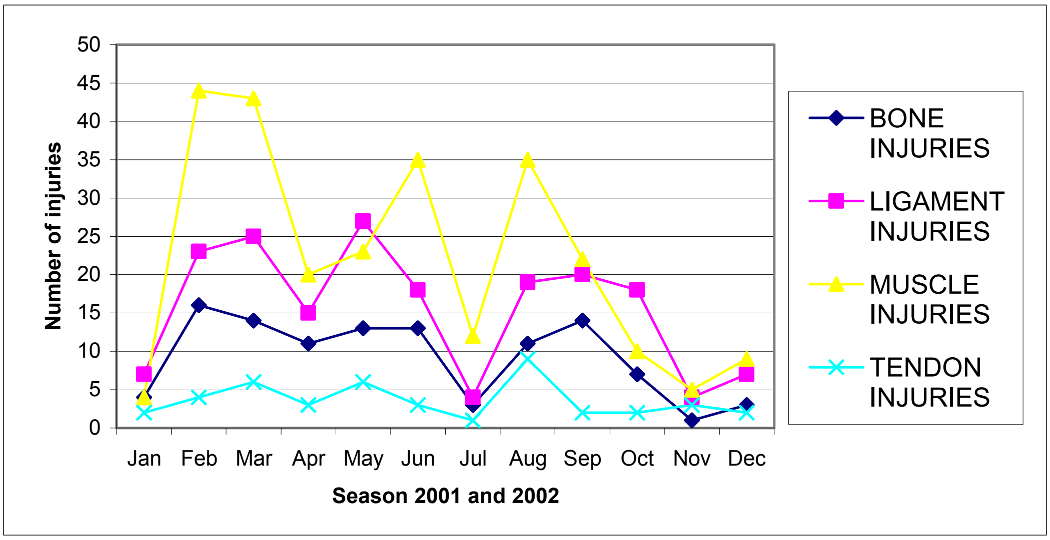


Figure 4.22 Variation in injury type (number of injuries) for juniors during a season

All the injury types followed a similar pattern, reaching high points (peaks) at early season and then again on either side of the July break (mid-season). Muscle injuries were by far the highest and had the most prominent peaks. Muscle injuries are followed by ligament injuries, then bone and tendon injuries. There was a drop in injury count during July, due to the season break.

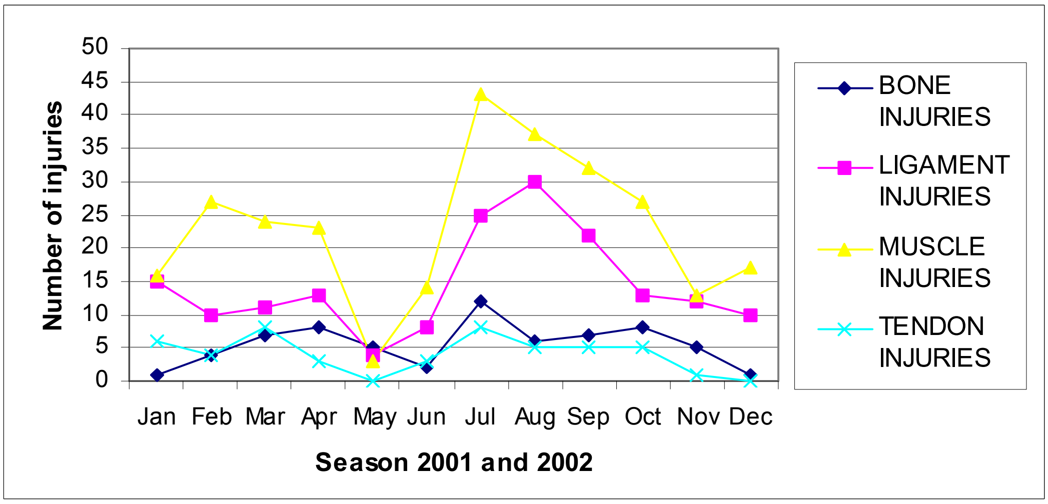


Figure 4.23 Variation in injury type (number of injuries) for seniors during a season

As with the juniors, all the injury types generally followed a similar pattern, peaking in early-season, then gradually decreasing and plateau towards the end of the season. Muscle injuries once again were the highest, as with the juniors, followed by ligament, bone and tendon injuries. The drop in injuries was during the off-season (May to June).

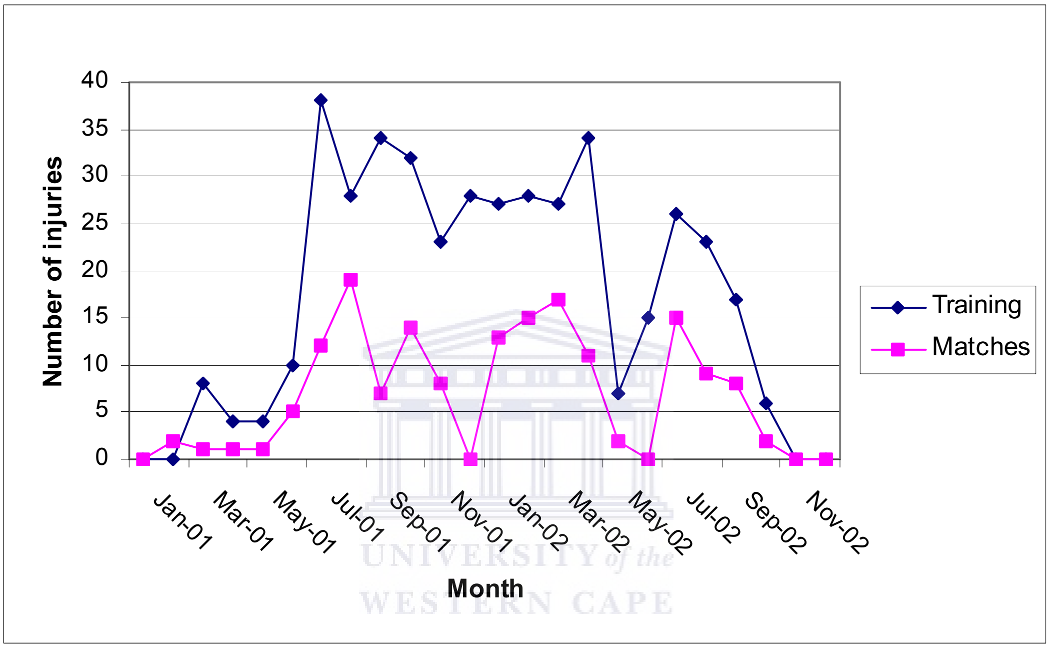


Figure 4.24 Monthly injury count for training versus matches (for PSL) during a season

The above graph showed that the number of training injuries was more than the number of match injuries. This was due to the fact that there was much less match time exposure than training exposure. The injury counts of the matches and the training followed a similar pattern throughout the months of both years.

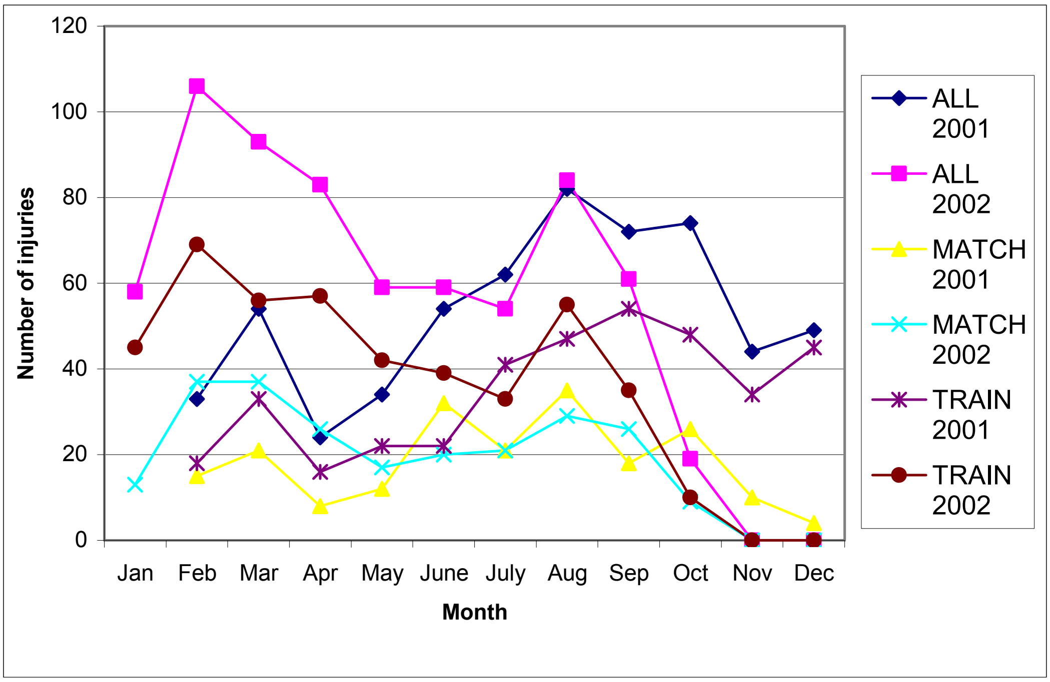


Figure 4.25 Totals for "All", match related and training related injuries for each month ("All" relates to the combination of match and training totals)

Quite a different pattern can be noticed when comparing the injury counts (match, training and all) for 2001 compared to those of 2002. The injury counts for 2001 (training, match and "all") were initially low at the beginning of the year, but progressively increased throughout the season (peaking in September). In 2002, the injury counts (training, match and all) peaked initially and then gradually decreased (except for the one other high point in September).

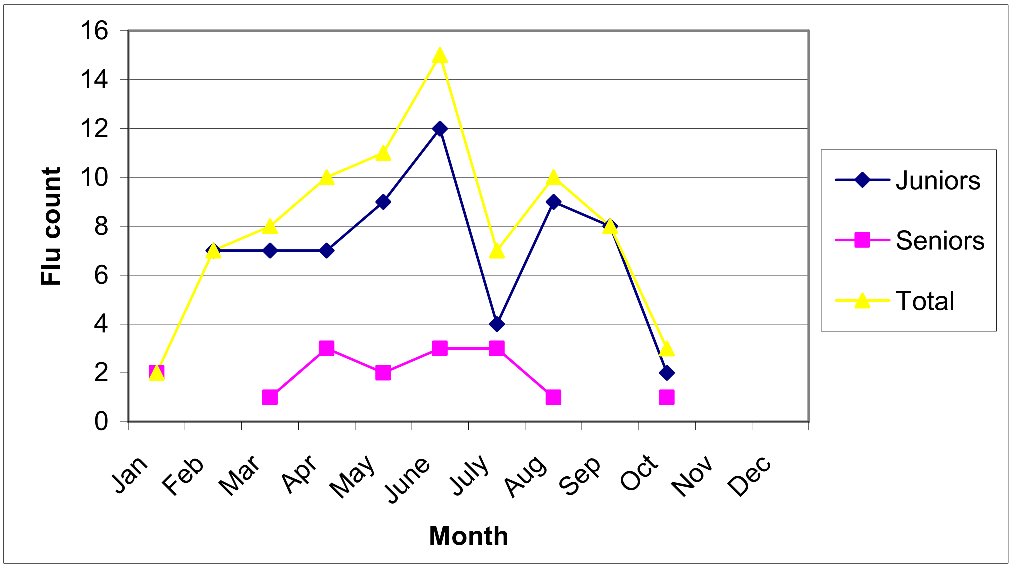


Figure 4.26 Flu count for all players during a season (total are the juniors and seniors combined)

The juniors' flu count was clearly more prominent than the seniors flu count. There was a gradual increase in flu count through the initial part of the year, the flu counts then rapidly increased and reached a high point in June, and then deteriorated again during the season break. There was another sudden increase and high point in flu counts during August to September, and then it gradually decreased again towards the end of the year. The seniors had a constant low flu count from May through to August.

4.7 Sidedness of the Injury

Table 4.25 Injuries according to the players sidedness

Right side	510
Left side	*517*
Blanks	216
Left and right side	*15*
Total Injuries	**1258**

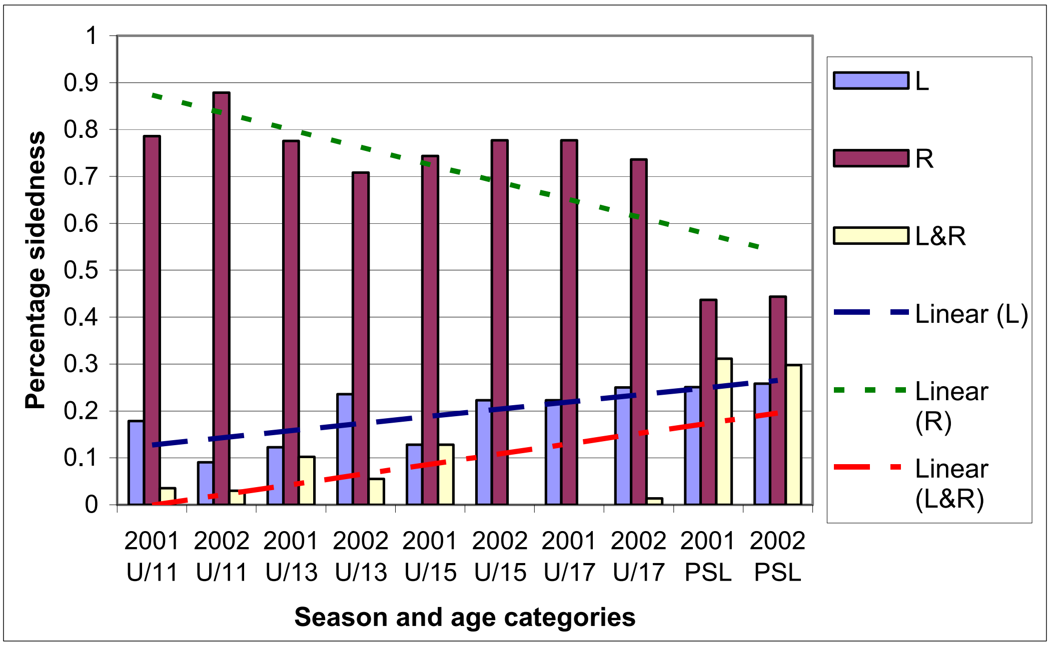
The total number of injuries sustained was 1258. The players' left side surprisingly accounted for the highest number of injuries (517), while the right-side injury count was very similar (510). There were very few players who were injured on both the left- and right-side (15). The "blanks" count (216) consisted of flu recordings, as well as any injuries that could not be classified to a side (for example a neck, back or abdominal injury that was more central to the body).

Table 4.26 Sidedness of injured players for 2001 and 2002

	U/11	U/13	U/15	U/17	PSL	ALL
Left	13%	19%	19%	24%	25%	**23%**
Right	84%	74%	76%	76%	44%	**61%**
L&R Leg	3%	7%	5%	1%	30%	**16%**
	100%	**100%**	**100%**	**100%**	**100%**	**100%**

*L= Left, R= Right

Table 4.26 shows a definite pattern that emerged. There is a general increase in the percentage of left-leg preferred players with an increase in age groups. The percentage of right-leg and left- and right-leg preferred players for the juniors (U11 to U17) remained relatively constant. However, a clear difference could be seen in the PSL group, where there was a visible decrease in the right-leg preferred percentage corresponding with an increase in the percentage of right- and left-leg preferred (bilateral) players.



*L=Left, R=Right

Figure 4.27 Injuries related to leg dominance

The graph more clearly showed the general increase in the number of left-side preferred players with an increase in age group. The right side, and left- and right-side preferred players remained quite constant within the juniors, but a definite change in pattern could be seen when looking at the PSL preferred leg percentages. (A definite decrease in the number of right-sided players corresponded with an increase in the number of left- and right- sided players.)

Table 4.27 Side of injury for right-side preferred players

Injury	U/11	U/13	U/15	U/17	PSL	ALL
Right	47%	36%	43%	40%	42%	41%
Left	41%	44%	39%	36%	47%	42%
Non-sided	16%	20%	17%	24%	13%	18%

When comparing all the age groups percentages to the averages ("All"), there proportions were quite similar. The "non-sided" injuries were made up of flu counts or injuries that could not be classified into a side, but were more central to the body. These non-sided injuries made up a minimal percentage of the total injuries, and remained constant over all the age groups (with an average of 18 %).

Table 4.28 Side of injury for left-side preferred players

Injury	U/11	U/13	U/15	U/17	PSL	ALL
Right	38%	35%	32%	36%	38%	36%
Left	50%	57%	54%	41%	54%	51%
Non-sided	13%	13%	14%	23%	12%	15%

Table 4.28 showed quite a different pattern when compared to the table 4.27. In the right-sided players the left- and right-sided injuries were very similar, whereas in the left side preferred players the left-sided injuries (averaging 51%) are noticeably more than right-sided injuries (averaging 36 %) across all age groups. The "non-sided" injuries are made up of flu counts or injuries that could not be classified into a side, but were more central to the body. These non-sided injuries made up a minimal percentage of the total injuries, and besides for a slight escalation in the U17 age group, these injuries remained relatively constant over all the other age groups (with an average 15 %).

Table 4.29 Side of injury for left- and right-side preferred players

Injury	U/11	U/13	U/15	U/17	PSL	ALL
Right	NA	33%	60%	NA	31%	41%
Left	NA	67%	20%	NA	51%	46%
Non-sided	NA	0%	20%	NA	19%	15%

*NA=Not Applicable

The injury counts for two-footed players (left- and right-sided) for the U11 and U17 were too low and so not reliable enough to research. The average percentage of left-sided injuries (46 %) was more than that of the right-sided injuries (41 %) however; no fixed pattern emerged when comparing the two side's injuries across the age groups. The U13 age group had no non-sided injuries, whereas the U15 and PSL groups had 20 % and 19 % respectively.

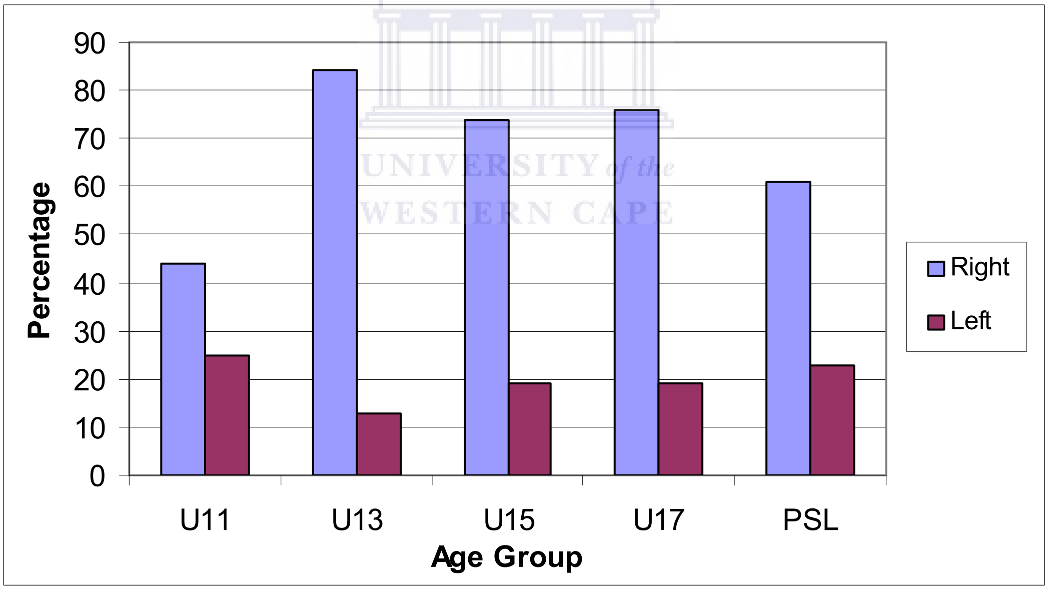


Figure 4.28 Injuries for the right compared to the left leg

The figure showed that the right-leg consistently resulted in a higher proportion of injuries out of the total for all age groups.

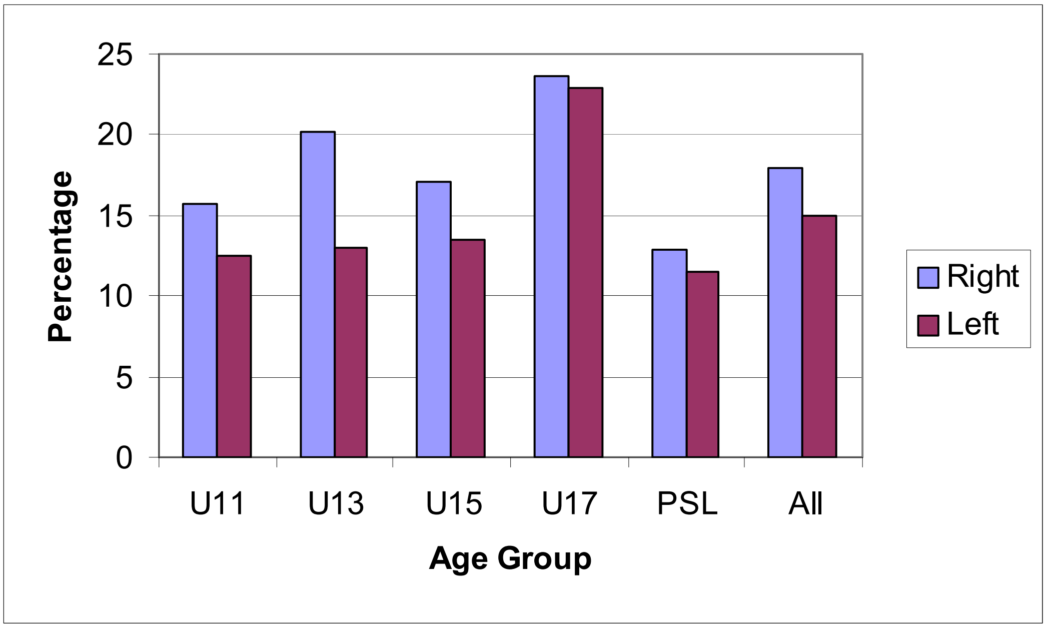


Figure 4.29 Injuries without sidedness for left or right-leg preferred players

In the injuries without sidedness, right-sided players had a consistently higher percentage count. Only the U17 age group's percentages were noticeably higher than the other age groups.

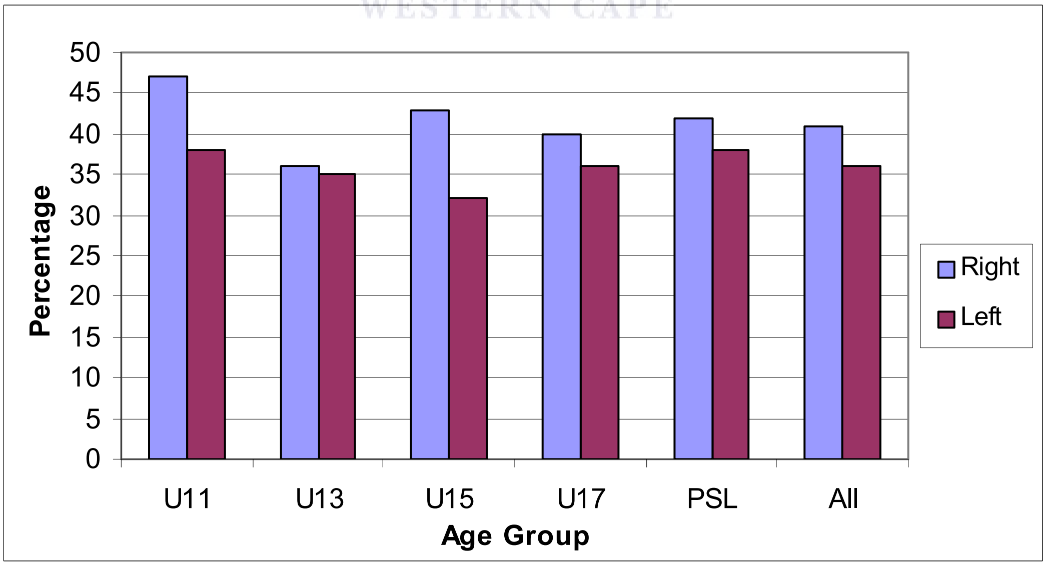


Figure 4.30 Injuries on the right-side (for right- or left-leg preferred players)

The percentage of injuries on the right side remained consistently more for right-leg preferred players across all age groups.

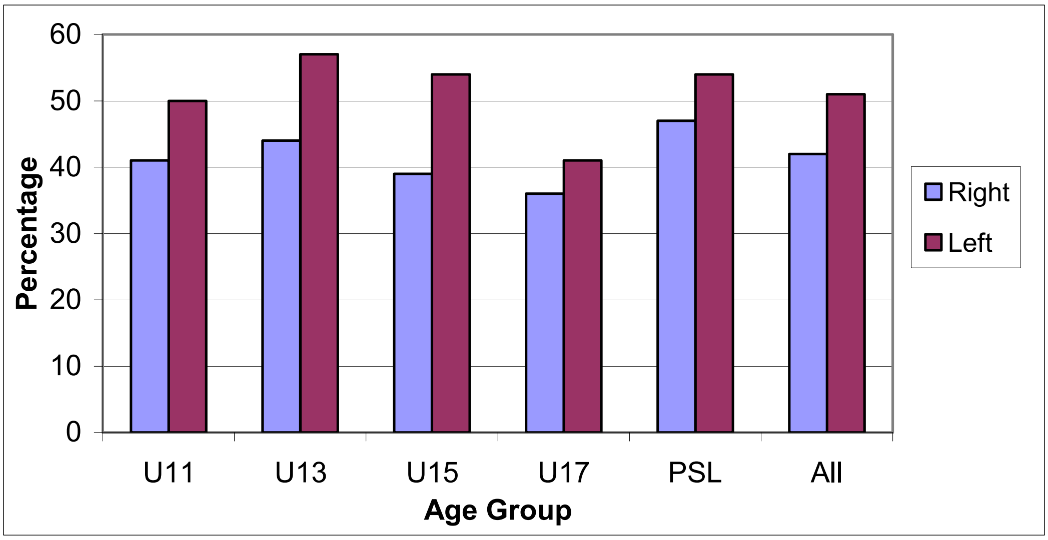


Figure 4.31 Injuries on the left side (for right- or left-leg preferred players)

The percentage injuries on the left side remained consistently more for left-leg preferred players across all age groups.

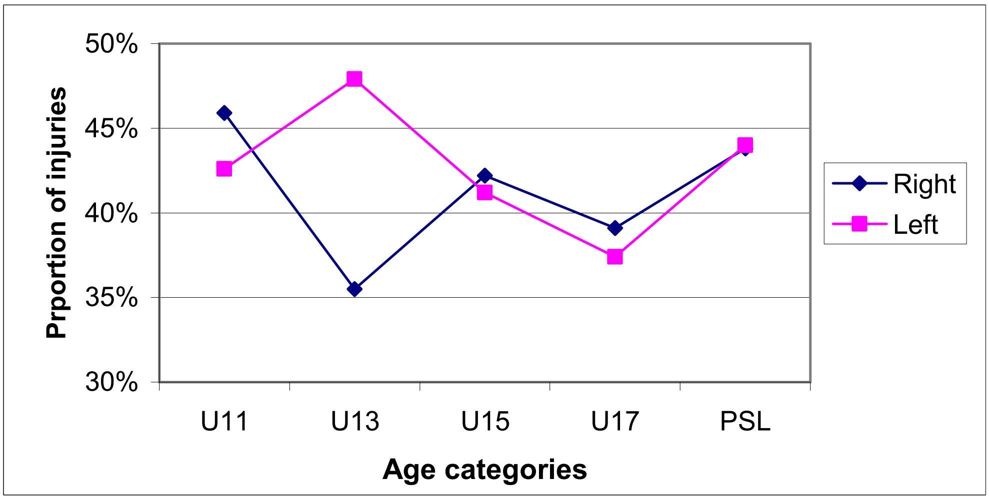


Figure 4.32 Injuries for right-leg compared to left-leg

The total percentages when comparing the right- to the left-leg injury count is quite similar across the age groups, with exception of the U13 age group where there is a noticeable variation between the right and the left total.

Table 4.30 Percentage of players preferred leg in relation to the injury incidence

Age Groups	Categories	Left	Right	L & R
U11	Row %	20%	76%	4%
	Injury Rate	13%	84%	3%
	Difference	***-7***	***8***	*-1*
U13	Row %	19%	72%	9%
	Injury Rate	19%	74%	7%
	Difference	*0*	2	-2
U15	Row %	14%	77%	9%
	Injury Rate	19%	76%	5%
	Difference	**5**	*-1*	***-4***
U17	Row %	25%	69%	6%
	Injury Rate	24%	76%	1%
	Difference	*-1*	***7***	***-5***
PSL	Row %	27%	53%	20%
	Injury Rate	25%	44%	30%
	Difference	*-2*	***-9***	***10***

In Table 4.30, the row percentages were the leg preferences for the soccer-playing age groups, while the injury rate was how the injuries actually occurred with respect to the preferred leg. The difference is calculated by how much the injury rate varies compared to the row percentage. The injury rate was very close to the row percentage for the U13 and U15 age groups. In the U11 age group, the injury rate was lower than expected for the left-leg (-7), and higher than expected for the right-leg (8). In the U17 age group the right-leg had a higher injury rate than expected (7), while the left- and right-sided had less than expected (-5). The biggest differences could be noted in the PSL group, where the right-sided players had a lower rate than expected (-9) and the left- and right-sided players has more than expected (10).

Table 4.31 Observed compared to expected values for varied-sided players

		Left	Right	L & R	
U11	Observed Values	8	51	2	chi (p-value) = 0.370
	Expected Values	12.2	46.4	2.4	
U13	Observed Values	23	89	9	chi (p-value) = 0.765
	Expected Values	22.7	87.0	11.3	
U15	Observed Values	37	152	10	chi (p-value) = 0.089
	Expected Values	33	156	14	
U17	Observed Values	70	224	2	chi (p-value) = 0.00069
	Expected Values	74	205.6	16.4	
PSL	Observed Values	148	256	177	chi (p-value) = 9.799E-10
	Expected Values	154.9	309.9	116.2	

A pattern of an increased number of injuries on the right side became evident towards the senior teams. The chi (p-value) result for all juniors (U11 to U17) show that relations between the observed and expected values were not significant. The relation between the observed and expected values of the PSL group was found to be 9.79924E-10, which means (because p- is less than 0.0001) it is highly significant. With such high significance, the risk of making a mistake is extremely small if one would state that the distribution of injuries is not different from the expected proportions.

Table 4.32 Sidedness of impact injuries for juniors, seniors and "All", related to preferred leg of player

		Right-sided	Left-sided	Bilateral
All	**Right**	105	37	24
	Left	80	46	14
Juniors	**Right**	73	22	4
	Left	56	25	1
Seniors	**Right**	32	15	20
	Left	24	21	13
	Total	**370**	**166**	**76**

There were more impact injuries noted on the preferred leg, for all the age groups. Bilateral players (two-footed) also consistently had more injuries on the right-leg than the left-leg.

Table 4.33 Sidedness of non-impact injuries for juniors, seniors and "All", related to support leg of players

		R-support	L-support	Bilateral
All	**Right**	67	215	77
	Left	99	242	50
Juniors	**Right**	139	26	6
	Left	40	145	9
Seniors	**Right**	41	76	71
	Left	59	97	41

***L=Left, R=Right**

In Table 4.33 the juniors support leg had a vastly higher number of non-impact injuries. There were, however, more non-impact injuries on the right side in junior bilateral (two-footed) players. The seniors, on the other hand, had more non-impact injuries on the left side in both right- and left-leg supported players. Again the right side had a higher non-impact injury count in the bilateral players.

When looking at the combination ("All"), the same pattern as the seniors emerged.

CHAPTER 5

Discussion and Conclusion

Introduction

The purpose of this study was to determine and analyse variations in injuries and injury factors between the different age groups, consisting of under-11, -13, -15, -17 and PSL groups, over two years (2001 and 2002) at a professional football club. The two seasons (2001 and 2002) were compared in order to determine the reliability and the consistency of the data. Any noticeable variations between the two seasons were highlighted as areas for special attention.

5.1 Age Related Variables of Football Injury

5.1.1 Number of Players per Age Group

Results showed that the number of players in each age category (Table 4.1) for the two seasons remained quite stable and consistent. A gradual increase in the number of players with an increase in age group was also noticed over both seasons. This increase in the number of players with age relates to the increase in the count and severity of injuries. Due to this increased risk of injury with age, more players were required in the squad to allow for replacements. Further, the results also showed that an increase in age group is related to an increase in match and training exposure, which caused the players to be at higher risk of injury. It was thus a necessity at the senior age to have more players available in the squad.

It was also shown in Table 4.1 that not only did the number of players increase with age, but also the number of individuals over both years. (Individuals specifically related to the number of persons used over both seasons, so it would not necessarily be the same as the total number of players for both seasons, as the same player would be counted again if used two years in a row.) This increase in the numbers of players, with an increase in age, related to the growing level of professionalism, and the continual need to tactically and technically switch players to fit the style and strategy of the team.

5.1.2 Number of Injuries per Age Group

Table 4.2 showed that injury count patterns were again found to be similar for 2001 and 2002 (there was however a higher injury count for 2002 compared to 2001). The row percentages, which gave a description of the changes in injury counts when compared to other age groups, were also relatively similar.

Table 4.2 and Figure 4.3 showed a relationship between age and number of injuries. For both regression analysis lines (Figure 4.3) good fits were achieved, which implies that in both seasons, age is highly related to the number of injuries for all age groups.

These results contradict the statement by The American Academy of Paediatrics (2000) who claimed that: "There is no compelling evidence to suggest that age … is associated with specific injuries or overall injury rates."

The current results are very similar to those of Inklaar (1994) who also showed that senior players sustain more injuries than junior players. More importantly, Inklaar also highlighted the sudden increase in injury incidence starting within the 14- to 16-year age group, recorded as the U15 and U17 age groups in this study.

Peterson et al (2000) highlighted the fact that there were great differences among different age groups, with reference to injury. Peterson and Renstrom (1983) suggested that children’s bodies are significantly different to those of adults. Besides the obvious increase in injuries with an increase in age, the sudden increase in injury counts in the U15 to U17 groups is possibly due to the physiological changes with age, but more specifically the boys’ growth spurt which generally peaks at that specific age.

Peterson et al (2000), Chomiak et al (2000), Keller et al (1987) also justified the vulnerable injury period (age 14 to 16) being due to certain factors such as weakness in techniques and tactics, as well as muscle strength, endurance, coordination and the high intensity of play in the less experienced, younger players. It was also noted in their literature review that aggressiveness starts to pick up at that age. They also explained that pubertal maturity or growth spurt leads to higher speeds and higher joint reaction forces and impact on collision, however body condition, muscle coordination and strength were not adequately developed yet.

Garret et al (1994) and Peterson and Renstrom (1983) were also in agreement that adolescents have certain vulnerabilities determined by their stage of development. They explained that in adolescent’s physes and apophyses are still open and the cartilages are at their weakest during puberty, and towards the end of their growth period, when they lose their elastic properties. This all puts the epiphyseal cartilages at risk of traumatic disruption.

Garret et al (1994) further added, regarding the sudden increase in injuries in the U15 and U17 age groups, that adolescents ligaments and tendons were probably at their peak of tensile strength and might be stronger than the bone to which they are attached (this situation is reversed in adults). This could result in avulsion (growth plate) fractures, where the bony attachment of the ligament or muscle is torn away from its origin, instead of the muscle or ligament tearing itself. He also explained that boys at that age might suffer from minor developmental abnormalities, which are quite common in the lower leg, causing patellar instability.

Bouchard and Malina (1991) also had certain views on injuries during the growth spurt period. They stated that another very important factor contributing to injuries in junior football players is the dramatic increase in forces placed on their immature skeletons. These increases are due to muscle hypertrophy made possible by the excess adolescent hormones. They explained that the gradual growth in muscle fibre diameter and fibre length with age, added to the total muscle mass of the body. They stated that relative muscle mass increases from about 42% to 54% of body weight in boys between ages 5 and 17 years. This hypertrophy allows longer and more intensive training sessions. According to Garret et al (1994) the child's skeleton must adapt to an adult world.

The overall injury patterns are graphically shown when comparing the stem-and-leaf plots of juniors – U11 to U17 (Figure 4.5) and the PSL group (Figure 4.6). The juniors' asymmetrical stem-and-leaf plot shows that juniors have a lower number of injuries per player, for which they required treatment. While the PSL stem-and-leaf diagram shows that the number of injuries is relatively dispersed, and proves that the PSL team has a higher average number of injuries per player, than juniors.

When comparing the mean and the median of the number of injuries per player per age group (Figure 4.7) the mean is larger than the median, for all age groups. This means that all the age groups experienced a higher frequency in the lower injury counts, and the frequency narrowed as the count of injuries' increased.

The number of injuries per player has got to be kept to a minimum and specialised attention has got to be given to those players who were at higher risk of injury, than the average count of injuries. These players that had a higher than average injury count, could have some form of physical vulnerability or weakness which must be addressed, monitored and improved to ensure a decrease in the number of injuries that occur.

When comparing the first and third quartiles in Table 4.3 across the ages, it was clear that the inter-quartile range increases with age; this was once again due to the fact that the number of injuries became less constant with age. The consistent decrease in the percentage of players with single injuries over each season, with an increase in age group (except for the U15 age group) showed that there were much fewer players in the PSL who had only one injury per season compared to the younger players. The U15 age group has the lowest proportion of players with single injuries, out of the whole club, which could again be related to the sudden developmental changes (growth spurt) at that age.

When analysing Table 4.4 it was important to also take Figures 4.1 and 4.2 and Tables 4.5 and 4.6 into account. In Table 4.6, as was consistent with “all injuries”, match injuries and training injuries were more for 2002 than for 2001. There were also considerably more training injuries than match injuries for both years.

It was vitally important to take exposure time into account when studying injury count. When studying exposure times and injury counts for training compared to matches – there was a much higher number of exposure hours during training. These higher exposure times in training correlated with a much higher injury rate in training compared to matches. Also when looking at the age groups – the highest exposure times found in the senior players correlated with the highest injury rates, and there was a gradual decrease in injuries with a decrease in exposure times, and as the age groups got younger.

However, it can be seen that there was slightly less exposure time in 2002 compared to 2001, but 2002 still consistently had a higher injury count. In training exposure – the U11, U13 and U15 injury counts increased noticeably from 2001 to 2002 (Table 4.5). The U17 had noticeably fewer injuries for 2002 compared to 2001, and both years were very similar in the PSL. The lesser number of injuries for the U17 in 2002 compared to 2001 related directly to the fact that, unlike the other teams whose exposure times for training remained quite constant over the two years, the under-17 training exposure reduced quite noticeably.

For match exposure, the U11 and U13 groups had fewer injuries for 2002 than for 2001, while their exposure times were very similar. While from the U15 to the PSL players, match exposure was quite similar over the two years, but 2002 still clearly showed a higher injury count.

Table 4.34 Comparison of injuries per 1000 playing hours

Study	**Age Group**	**Training /**	**Injuries / 1000hrs**
This study	Juniors	Training	282.27
This study	Seniors	Training	879.70
This study	Juniors	Match	1271.69
This study	Seniors	Match	1774.91
This study lit. averages		Train	2.1 – 2.9
This study lit. averages		Match	12 – 144
Dvorak & Junge (2000)			10 – 35
Dvorak & Junge (2000)			0.5 – 45
Shepard (1999)	Juniors		0.5 – 7.3
Shepard (1999)	Juniors – tournament		14
Garret et al (1994)	Juniors		0.51 - 19

Table 4.35 Comparison of training and match hours of seniors

Study	Training / Match	Hours or Sessions
This study	Training	7 hrs / week
Junge et al (2000) & Grantham	Training	9.9 hrs / week
This study	Training	239 hrs / player /
Junge et al (2000) & Grantham	Training	241 hrs / player /
This study	Match	46 hrs / player / season
Junge et al (2000) & Grantham	Match	27.7 hrs / player /
This study	Match	31 matches / season
Junge et al (2000) & Grantham	Match	25 – 32 matches /

According to Table 4.34, it is evident that the results (of injuries per 1000 hours) of this study vary greatly from that of the results reported in the literature. This is due to multiple variables affecting the results. The most important variable influencing the results is the actual definition of injury. The literature reviews have predominantly defined an injury as a football related event that causes a football player to miss out on a certain amount of matches or training time, where the definition for this study is much broader, and includes any new occurrence, that causes a player to visit the physiotherapist, biokineticist or doctor for an evaluation or treatment. These variations in definition, which could cause huge differences in the results, might be due to the researchers of most studies trying to make the definition suit their study and not to make their study suit the definition. It might be also due to the fact that there is no set definition, and who determines what the correct definition actually is?

Another very important factor affecting injury incidence, according to Yoon et al (2004), is that lower football skill levels are associated with a higher rate of injury frequency. They suggest that continents with lower football skill levels were expected to have higher injury frequencies than any of the higher football skill continents. South African football compared to England's football (where the majority of the similar studies were researched) is relatively different and the skill level is generally at a lower level in Africa, and could also be a possible reason for the higher injury frequency in this study.

Arnasson et al (2004) showed that football players in the highest and lowest exposure categories had lower injury rates than players in the intermediate exposure level. When looking at Table 4.35, it is clear that this study's seniors who trained for an average of 7 hours per week, compared to the average 9.9 hours reported in the literature. This study's weekly training time would most possibly fall into an intermediate exposure level, and be considered a high injury risk.

It is also important to compare the other studies training and match times (daily, weekly and seasonal) to these studies. The amount of senior's seasonal training hours of this study (239 hours) is remarkably similar to those of the compared studies (241 hours). The compared studies training are evidently more intense over a shorter period (9.9 hours per week for 24 weeks = 241 hours), while this study is at a less intense level, but over a longer period (7 hours per week for 33 weeks = 239 hours). It should be determined if the more intense approach of training (compared studies) could not also be a possible cause of lower injury frequency, or in other words – the longer, less intense training of this study cause a higher injury frequency.

Although the average number of seniors matches in this study (31) falls within the range reported by the comparative studies (25 – 32 matches per season) in Table 4.35, the seniors of this study average a higher exposure time per player (46 hours per season) compared to the 27.7 hours reported by the comparative studies. Matches and higher exposure are proven to be a risk factor for football players and this might also attribute to this studies higher injury rate.

5.2 Number of Treatments per Injury

Table 4.7 illustrates the proportion of single treatments per injury, and gives us a better understanding of the complexity of the injuries. The U11 (48%) and the U13 (46.9%) age groups' percentage of single treatments were very similar, with these percentages reducing noticeably between the U15 (28.6%) and U17 (22.2%) age groups and reducing once again with the PSL players (11%).

The lower number of treatments generally indicates a less severe injury, so the reduction in the proportion of single treatments with an increase in age, shows that injuries become more serious or severe with an increase in age. Peterson and Renstrom (1983) supported this claim in stating that injuries in children and adolescents are generally less serious than in adults.

The sudden increase in the count of injuries in the under-15 and under-17 age groups correlated with a sudden decrease in the single treatments per injury. So not only was the number of injuries rapidly increasing at this age group, but so too was the severity of the injuries.

As with the U15 and U17, the PSL group showed a continual progressive decline in the proportion of single treatments, which correlated, with an increased count of injuries. This also showed that the number and severity of injuries increase with age, peaking in the PSL group.

When studying Figure 4.9 and Table 4.7, it does not matter if numbers of treatments per age group are compared according to mean, median, 1st quartile or 3rd quartile, the results all remain consistent. The statistics show that there was a progressive increase in the number of treatments per injury with an increase in age, once again supporting the statement that the severity of injury increased with age.

The mean was consistently higher than the median, indicating that there was a long tail skewing down towards the higher number of treatments, which showed that even in the lower age groups, there were some extreme cases which require noticeably more treatments.

The increase in the inter-quartile space, with the increase in age group, meant that the number of treatments per injury became more dispersed with age. This shows that the treatment period at more senior levels is less predictable and inconsistent. With the increase in the number and severity of injuries, as well as the level of professionalism with advancing age, senior players' make more use of available treatments. It would be expected that seniors would be more concerned about ensuring that their injuries had been fully rehabilitated, and there was no impact on their football careers.

5.3 Anatomical Area of Injury

When comparing the number of injuries of the upper to the lower body, whether it be exact counts (Table 4.8), bar charts (Figure 4.10) or percentages (Table 4.9), the two years are not only remarkably similar, but the results are also very similar to that in the literature.

The results and conclusions of Fuller (2000), Shepard (1999), Yoon et al (2004), Arnasson et al (2004), Ekblom (1994), Grantham (2004), Garret et al (1994), Chomiak et al (2000) and Morgan and Oberlander (2001) are all similar. They all determined that the lower body had noticeably more injuries than the upper body in football. Their results of the lower body injury range between 60% and 90% of all injuries, with an average of 74.86%, which is very similar to the present study's lower body injury average of 80.22%. The results of this study has been consistent and similar across seasons (2001 and 2002), and when compared to other studies.

It is expected that more injuries will occur in the lower body due to the fact that football is a sport that involves predominantly the lower body, and that tackles, impacts and movements are mostly below hip level.

Garret et al (1994) added that upper body injuries are mainly caused when colliding between players or when a player hits the ground with the edge of his shoulder or an outstretched hand.

When comparing the anatomical injury sites (Table 4.10 and 4.11) of 2001 and 2002, it is important to note that the two years are being compared, mainly to determine the consistency of the data and to highlight any anatomical areas, which might drop or increase noticeably from one year to the next in injury count.

The injury counts and percentages of the various anatomical areas were generally similar across 2001 and 2002. There were a few exceptions; certain anatomical areas did show quite noticeable variations across the seasons, those are the areas that need the most attention. If there is a drastic variation in injuries, to a certain anatomical area from one year to the next, then there should be a certain factor causing that increase or decrease in injuries, that factor must be found.

Flu exactly doubles from 2001 to 2002; this could be due to certain elements of training conditions, reduced immune system or just a general increase of influenza transmitted from person to person at the club.

A very interesting contrast can be seen between the quadriceps and the groin, where the injury count for quadriceps almost doubles from 2001 to 2002, whereas injuries surrounding the groin reduced drastically from 2001 to 2002.

These highlighted anatomical areas showing variation from year to year is an important area to be studied, in trying to determine what caused these major changes. Changes in training conditions, coaching, fitness, duration and frequency of training and matches, rehabilitation, warm-up and stretching are all possible causes for these changes over the years.

When looking at Table 4.12, that illustrates the number of upper and lower body injuries, the total for lower body injuries (80.2%) and the total for upper body injuries (19.8%) are very similar to that of the compared studies. When looking at the age group percentages for upper body injuries, the U11 and U17 age groups are emphasised. In the U11 age group, there are only 9.3 % upper body injuries, while there is a drastic increase in the U17 age group to 26.2%. In the U11's, the skill level of football is still quite low and the actual ball is generally kept low (below hip level) during play, which reduces the chance of upper body injury. The U11 game is also generally, less physical and competitive, which reduces the need for upper body use.

The highest upper body injury percentage (26.2%), found in the U17, could be due to their developmental changes during that age period. Adolescent's upper body growth generally starts to peak at about 16 to 18 years. These developmental changes and growth, which require the player to adjust to his "new body" cause the player to be at a higher risk of injury. At this age, football players become a lot more physical, and continue to use their upper body a lot more in general play, which also exposes the U17's to a higher risk of upper body injury.

When analysing Table 4.13 and Figure 4.11, no real patterns could be seen between the various upper body anatomical areas of the various age groups. The number and percentages of injuries for the various upper body anatomical areas were generally very low. The only upper body part, which stood out visibly, was the back. There was a progressive increase in the number of back injuries with an increase in age, however the highest percentage of back injuries was found in the U17 age group. This statistic is supported by results of Chomiak et al (2000) who stated that the dominant injury in the 14- to 16-year age group is spinal problems.

The general increase in back injuries with age relates to increasing physical play, use of and contact with the upper body in football play. The sudden increase in back injuries in the U17s' are, possibly due to their developmental changes and growth, and especially the development of the spine, posture and upper body stabilising muscles at that age.

It should however be noted that, in the U17 and PSL age groups, it seemed that the players would find any reason to go for a "back treatment", just to enjoy the luxury of a back massage. It was difficult to tell if the players were actually in for a back massage for injury rehabilitation or for the luxury of it.

Results of the current study, relating to upper body injuries were compared to the results of the American Academy of Paediatrics (2000), Chomiak et al (2000), Peterson (2000), Bjordal et al (1997), Ekstrand and Tropp (1990), Engstrom et al (1990) Morgan and Oberlander (2000), Grisogono (1989), Junge et al (2004), Junge et al (2000), Yoon et al (2004), Grantham (2004), Arnasson et al (2004), Reilly et al(1988) and Garret et al (1994).

According to the literature head and neck injuries averaged 13.7% of all injuries, whereas in this study the head and neck did not even make up 2% of the total injuries. This could possibly be due to the fact that the European players tend to lift or flight the ball more, which leads to much more use of headers in the game and a higher vulnerability to head and neck injuries. South Africans on the other hand are generally more prone to play the ball on the ground, using a lot more dramatised dribbling skills.

Injuries to the hand in the comparative studies made up an average of 10.5% of all injuries. Once again a much higher injury percentage than the injury count to the hand, of this study (3%). Garret et al (1994) explained that the main cause of upper body injury was due to players falling to the ground with an outstretched hand. It could then be true in assuming that players, from these overseas studies, were more likely to "take a dive" (fall to the ground on contact with an opposition player), in an attempt to win a foul.

The average percentage of injuries for the shoulder and the arm in comparative studies (2.7%) were very similar to this study, where shoulders and arm injuries made up a total of 3%. This anatomical area is expected to have a low injury count, due to it being the least used body part in the football game (a player, except the goal keeper, may not use his arm or hand to make contact with the ball, it will be deemed a handball).

The comparative studies displayed an average of 5.8% injuries for the trunk area. This study, which separated the trunk into back and abdomen injuries, totaled 9% of all injuries. A professional football player should use the trunk (abdomen and back) in every aspect of the game, as the core body or "powerhouse" controls the efficiency and power of the rest of the body.

It is important to note that the results for the various comparative studies, for upper body injuries, varied greatly.

Table 4.14 and Figure 4.12 illustrate that the number of injuries to the lower body were much higher than the number of upper body injuries. Because of these higher numbers of lower body injuries, it was easier to compare and analyse any injury patterns that might have developed.

It is more meaningful to study the percentage of injuries to the specified anatomical area, rather than the injury counts to the anatomical areas alone. (A natural injury count increase would be expected as the overall count of injuries does increase with age).

Results of the current study, relating to lower body injuries, were compared to the results of the American Academy of Paediatrics (2000), Chomiak et al (2000), Peterson (2000), Bjordall et al (1997), Ekstrand and Tropp (1990), Engstrom et al (1990) Morgan and Oberlander (2000), Grisogono (1989), Junge et al (2004), Junge et al (2000), Yoon et al (2004), Grantham (2004), Arnasson et al (2004), Reilly et al(1988) and Garret et al (1994).

Injuries to the hip were the lowest out of all anatomical areas, throughout the age groups, in this study. Comparative studies paid very little attention to this anatomical area.

Comparative studies found injuries to the lower leg to average 11.4% of all injuries. This is similar to the percentage of tibialis anterior (shin) and calf injuries found in this study, which constituted 9% of the total injuries. This was a relatively high area of injury, expectedly so, due to its extensive use in football games. However, a proper pair of shin guards should protect the tibialis anterior. The tibialis anterior and calf injuries of this study were relatively constant throughout all the age groups, except for a sudden increase in tibialis anterior injuries in the U13 age group. This is possibly due to their style of play, where the skill level (as in the U11) is still generally quite low and they adopt a "kick and hope" approach (they go heads down and kicking, with no plan to play safe passes, tackles or dribbles, but rather try to run through other players). This age groups style of play and poor timing of the tackles at that age, obviously results in a greater risk of impact injuries to the lower leg.

This study analysed the hamstrings and the quadriceps individually, while the comparative studies analysed the thigh as a whole. The comparative studies averaged a total of 20% for thigh injuries; this study had a similar result, with a total of 16% for hamstrings and quadriceps combined. The percentage of injuries to the quadriceps increased progressively with an increase in age. There was, however, a sudden increase in the U15 age group. The hamstring injuries in this study also increased with age, with a drastic increase from the U17 (4%) to the PSL group (15%). The sudden increase in quadriceps injuries within the U15 age group is possibly due to the players beginning to hit the ball a lot more powerfully, than in the younger age groups. (The main muscle used during the kicking action is the quadriceps). The highlighted increase in hamstring injuries in the senior players might be due to the reduced flexibility of that muscle with age. This reduced flexibility in the hamstrings could be due to continuous muscle strains and tears that players suffer from over their career, that result from the huge demands placed on their hamstrings for it's needs in a football game (running, jumping and kicking).

Foot injury counts in this study were constant through the age groups, but similar to the tibialis anterior injury count of the U13's; injuries to the foot were highest at the U11 level. This could once again relate to these younger players lower skill level and the level of their body's adaptation and development through the game. A football player's foot must adapt to the game of football, like a rugby players' shoulder must adapt to making tackles and scrumming. It does take time for the necessary muscles and bones to develop properly in the foot.

Injuries to the groin in this study (7%) are similar to the groin average of all the comparative studies (8.8%). Groin injuries peaked at the U17 level (12%). This could possibly be related to a developmental vulnerability to the groin at that age. The short muscles might not be able to grow as fast as the rest of the body is growing at that age. Groin injuries were common at that age and it affected the players severely, putting them out of play for months at a time. Special attention should be paid to stretching, warming up and conditioning the groin sufficiently at that age.

This study's results are remarkably similar when compared to the injury percentage averages of all the anatomical areas of the comparative studies combined. In the comparative studies, knee injuries ranged from 12% to 34% of total injuries (average of 17.22%) and like this study, in which the knee injuries averaged 14% of all injuries, was the second highest anatomical injury area.

The ankle was found to be the highest area of injury in both the comparative studies and this study. Ankle injuries in comparative studies ranged from 9% to 31% of total injuries, with an average of 18.88%, while this study's ankle injuries resulted in a remarkably similar 19%.

This study shows that the percentage of knee and ankle injuries reduced with age. That is not necessarily due to injuries to the ankle and the knee reducing with age, but rather more likely due to injuries being more dispersed with age.

Certain injury patterns were identified for the various anatomical areas of the various age groups. The high percentage of foot and tibialis anterior injuries in the U11 and the U13 age groups, the sudden increase in quadriceps injuries in the U15 age group, the drastic increase of groin and back injuries in the U17 and also the high count of hamstring injuries in the PSL group are some of the patterns identified.

Arnasson (2004) discussed possible reasons for injury patterns developing in certain anatomical areas, in football players. Arnasson (2004) research found football players to be less flexible in hip abduction, hip extension and knee flexion compared to the controls (non-football playing subjects) of their study. They argue that the nature of the sport, which involves high intensity, short sprints, quick accelerations and decelerations in speed, and sudden turns, which all place a high demand on the muscles, commonly result in muscle tightness. It was also added that inadequate attention is often paid to flexibility in football players.

When analysing the anatomical area of injuries in the PSL players, the same patterns are seen (Table 4.15). The top ten areas for injury consist of eight lower body areas. The ankle and the knee have the highest injury count. The back is the one upper body area, ranked the fourth highest area of total injuries. The back is emphasised as an area of injury, which needs very special attention in S.A. football players.

5.4 Type of Injury

The total injury types of 2001 were relatively similar when compared to 2002 (Tables 4.16 and 4.17). There were, however, a few injury types that did vary noticeably from the others.

It is important to note the increase from no meniscal tears in 2001 to nine meniscal tears in 2002. The injury count and percentage of muscle haematomas and bone bruises (both impact injuries) also increased noticeably from 2001 to 2002. Ligament joint laxity reduced visibly from 2001 to 2002.

The increase in impact injuries from 2001 to 2002 could possibly be due to the change in coaches, which would result in a change in style of play. If the style of play was a lot more physical, and the players pushed more to fight for the ball, then more impact injuries would be the result.

Ligament sprains and muscle strains make up the two highest injury types for both years (totaling 41.4% for 2001 and 36.4% for 2002 of all injuries).

Table 4.17, which shows the narrowed field of injury types for PSL players, results were even more similar, than when the injury type had more categories. The only noticeable changes are the increases in the number of ligament sprains (56 to 67) and a decrease in muscle haematomas (30 to 20) from 2001 to 2002.

Injuries with low frequencies or that were unrelated (flu) were excluded from the analysis, as done in figures 4.13, 4.14 and 4.15. All these figures have shown that muscle injuries resulted in the highest injury count, followed by ligament, bone and then tendon injuries. It was only at the U11 and U13 age group that muscle injuries were less than ligament injuries, but then muscle injuries began to increase noticeably at the U15 level and even escalated further at the PSL level.

The results of the injury types of this study were compared to the results of studies done by Contiguglia et al (1994), The American Academy of Paediatrics (2000), Dvorak and Junge (2000), Peterson et al (2000), Reilly (1996), Fuller (2000), Reilly et al(1988), Yoon et al (2004), Ekblom (1994) and Singer and Friedlander (2000).

In the comparative studies contusions made up the highest percentage of all injuries in most of the studies, however, there were many variations and inconsistencies between the studies. Contusions ranged from 10% to 60% of all the injury types in the comparative studies, with a combined average of 43.5%. Contusions could not be directly related to this study as contusions could be categorised into bone injuries (bone bruises) or muscle injuries (muscle haematomas and bruises). Garret et al (1994) and Reilly (1996) explained that because football is a contact sport and another player or the ball will knock players, players are at definite risk of contusions to the body. This could be due to intentional tackles, illegal tackles and accidental collisions. Contusions would predominantly make up bone bruises and muscle haematomas, when related to this study.

Ligament sprain counts varied visibly between studies, ranging between 14% and 41% of total injuries, with an average of 24.8%, which was similar to the 29% total ligament injuries encountered in this study. Ligament injuries remained fairly constant across the age groups. Garret et al (1994) also discussed the fact that football players have an increased risk of tendon and ligament injuries, due to all the cutting, twisting, kicking, sudden accelerations and decelerations, and the repetitive, non-stop action of the game. Reilly (1996) adds that these ligament sprains are due to overstretching of the ligaments. Garret et al (1994) also claimed that chronic tendon or ligament injuries are not related to a specific traumatic event, but that symptoms start slowly and worsen with time. However, acute tendon and ligament injuries are caused when the load applied exceeds the ligament or tendon stress point.

The number of tendon injuries in this study (8%) was higher than the average reported by the comparative studies (3%). Reilly (1996) stated that tendonitis is simply an inflammation of a tendon, so this is a chronic injury that builds up over time.

Muscle strains, reported by the comparative studies, ranged from 10% to 30% of all injuries, with an average of 17.18%. Muscle strains of the current study make up 18.54%, again remarkably similar to the average of the comparative studies. Although when analysing the muscle injuries as a whole, the current study has a much higher injury count (42% of all injuries) than the results reported in the literature. Muscle injuries are the only injury type that varied noticeably across the age groups (Figure 4.15). In the U11 age group, muscle injuries fell below ligament and bone injuries, and gradually increased to above bone injuries in the U13's, wherefrom it continued to increase noticeably in the U15 and then stabilised across the U17 and PSL age category. Garret et al (1994) and Reilly (1996) discussed muscle strains (or muscle pulls) and explained that it did not occur due to direct trauma, but rather from too much stretch or tension on the muscle. They state that a player with a muscle strain can still participate in a game, but their performance is likely to be hampered.

Slightly different results were visible when grouping the injury types into fewer categories (Figure 4.16). Ligament sprains made up the highest injury type, followed by muscle strains, muscle stiffness and muscle haematomas. There was also a high injury count of bone bruises and ligament joint laxity. The other injury type counts were very low.

Due to the relatively high number of indirect and overuse injuries in the current study, attention has to be given to possible factors causing and affecting it. Reilly (1996) discussed the effects of these indirect injuries (or overuse injuries), which he found were caused by forces generated within the musculoskeletal structures during activity, which could damage muscles, tendons, ligaments, joint structures or bone. Reilly (1996) further explained that these overuse injuries result from the body being exposed to repetitive actions or high loads. These types of injuries could be due to training errors, biomechanical abnormalities, inappropriate footwear or terrain. Milroy (2004) adds that when the body is subjected to these repeated movements, especially through the same plane, it could result in injuries that inadequate recovery would accentuate. So, frequency and duration of training, matches, and the length of the season, as well as the recovery time after matches and after injuries has to be analysed further, monitored and adjusted accordingly in order to reduce the number of overuse injuries.

5.5 Anatomical Area of Injury Related to Injury Type

Results of comparative studies concur with the findings of the current study that anatomical area of injury does relate to the type of injury (Table 4.19). The correlations were evident over both seasons.

The chi-squared values for 2001 and 2002, displayed by Table 4.20 and 4.21, further show that this study's results remain consistent over the two seasons.

Table 4.20 and 4.21 show that out of the top eight highest counts for relationships between anatomical area and injury type for 2001 and 2002, most of the relationships were the same, the descending order between the two seasons, however, varied.

Calf - muscle strains and quadriceps - muscle strains, which ranked within the top eight in 2001, were replaced by ankle - bone bruises and muscle haematomas in 2002. This again shows that the number of impact injuries increased from 2001 to 2002 and that these areas do need specialised attention in order to determine what caused the increase in this type of injury.

Milroy (2004) explained the relationship between anatomical area and injury type according to Sir Isaac Newton theory on strike angle, which shows that injuries do occur from varying directions. Milroy (2004) stated that it is not only the intensity of the contact made that influences the injury, but also the angle of the strike (contact) that determines what type of injury is caused, on what anatomical area of the player. According to Milroy (2004) Newton's laws in fact determine the extent of the injury.

When studying the chi-squared results of the top ten ranked relationships for 2001 and 2002 (Table 4.22), it must be noted that these correlations are not related to the count of injuries for the various anatomical areas or the various injury types individually, but rather to how the two categories relate to one another. For instance – even though the combination of foot and bone bruise had the highest chi-squared relation for both 2001 and 2002, it ranked quite low down the order when taking the count of injuries into consideration. The relation between foot and bone bruise, ankles and ligaments, back and muscle strains, hamstrings and muscle strains and tibialis anterior and bone bruise rated consistently high for

2001 and 2002. When comparing the relationship between anatomical area and injury type, the correlation should be observed as a whole (e.g. back and muscle strain), as well as the combined injury count (which can be ranked).

Ankle and ligament sprains made up the highest total injury count (Table 4.23), which is supported by the results of Reilly (1996) and Garret et al (1994) who also found ankle injuries to be one of the most common injuries in football, and that 85% of all ankle injuries are sprains. Garret et al (1994) showed that an estimated 75% of all ankle sprains involved the lateral ligaments, and that ligamentous damage was primarily caused by the action of tensile loading and, secondly, by the effects of twisting and shear forces.

The relation between the ankle and ligament joint laxity, and the ankle and bone bruises also rank within the top ten injuries. All these types of ankle injuries could be linked to one another. An anklebone bruise could cause scar tissue or a weakness, which could result in ankle ligament joint laxity, and maybe even end in an ankle ligament sprain, if not treated properly from the start. An ankle injury takes time to heal properly, and any excess force added could influence the severity of the injury.

One of the most important areas that need to be analysed is the injuries of the back, which ranked second highest on the injury list when related to muscle stiffness. Garret et al (1994) results showed that their total trunk injuries fell below 10% and that their compared studies showed a range of 0% to 13% of total injuries, which were mainly contusions, mild sprains and strains. Injuries to the back are much higher in this study compared to any of the results of the compared studies. This problem of muscle stiffness in the back could once again be due to the players going for a back massage unnecessarily, for the luxury and pleasure of it, rather than for an actual injury treatment. Either that, or there is a very serious problem, relating to training conditions or conditioning programs (or lack there of) that are causing the high count in back injuries at the club. When it comes to football performance, the back needs to be kept well conditioned, to support the rest of the body. The back makes up part of the core body (which contributes to balance and strength) and consists of important muscle stabilizers, which in all, greatly influences football performance.

Hamstring muscle strains are ranked third on the injury list (Table 4.23), which is similar to the results of Arnasson et al (2004) and Ekblom (1994) who found that muscle strains are one of the most common injuries in football, and predominantly affects the hamstrings. Ekblom (1994) added that, however, these muscle tears or strains are common in football, it is seen as the easiest injury to prevent. His results state that muscle strains (which can be total or partial) are caused by compression (direct impact) or distraction (result of overload or stretching).

Knee ligament sprains and knee ligament joint laxity also rate in the top ten injury relations (Table 4.23). Garret et al (1994) also showed a very high rating of knee injuries out of all injuries, which mostly involved ligaments or meniscal damage. Reilly (1996) highlighted the vulnerability of the knee being partially due to it being a hinge joint with such long levers (bones) on either side. Ekblom (1994) added that knee injuries could be either traumatic or inflammatory (overuse) injuries, and to diagnose knee injury, a complete history and physical examination must be performed.

Foot bone bruise, ankle and tibialis anterior bone bruise all rate in the top ten injuries (Table 4.23), as well as quadriceps haematoma, which are all considered impact or contact injuries. The predominance of impact injuries was related to football style of play, the physicality of the game, and the player's skill level. Bone bruises or haematomas are not focused on enough, as they are generally seen as a less severe type of injury. However these injuries can result in scar tissue or weaknesses in the anatomical areas affected, or lead to certain anatomical areas attempting to compensate for others, which could all result in more serious injuries. Garret et al (1994) added that the feet are also at higher risk of direct trauma, due to the stresses of dribbling and kicking, and because their football boots only offer limited support and protection.

Figure 4.17 illustrates the highest points of the anatomical area of injury related to injury type. Ligament sprains of the knee and ankle, muscle strains of the hamstrings, and muscle stiffness of the back are the most noticeable in the figure.

5.6 Vulnerable Periods during the Season

Figure 4.18 and 4.19 illustrate the differences seen in total injuries for each month over the season, between juniors and seniors. In the juniors, it is clear that the preseason and early season had the highest number of injuries, and then injuries generally taper off towards the end of the season. In the seniors, the highest injury counts were also found in the early season, their injuries also decreased during the mid-season, but then, unlike the juniors – the injuries increased again towards the end of the season.

The high number of injuries at the preseason and early season, in the juniors and seniors, are possibly due to the players having lost their level of fitness and conditioning during the off-season, and then being forced into doing too much training and fitness, too quickly, during these early training stages. Coaches and players try and get the seasons fitness training over as quickly as possible and don't give enough time to build up to the necessary level. This sudden increase in fitness training drills comes as a shock to the body, and puts the body at a higher risk for injury.

Garret et al (1994), Morgan et al (2000) and Reilly (1996) are in agreement that players need special attention during preseason to try and decrease the incidence of injury, due to the sudden increase in training exposure. They suggested that players tend to take a complete break during the off-season, which results in them returning back to football training unfit and overweight. Garret et al (1994) also adds that during preseason training, there is also an overemphasis on aerobic training, which results in diminished muscular strength as the competitive season begins, which could add to the risk of injury.

The PSL players' gradual increase in incidence of injuries, from mid- to late-season is supported by studies done by Peterson et al (2000), Engstrom et al (1990), Morgan and Oberlander (2000) and Grantham (2004) who all showed an increase in injuries towards the end of the season.

This increased risk of injury during late season could be due to the senior players not getting enough time to rest between training or matches, or recover properly from injuries. It could also be due to the decreased amount of time and attention contributed to fitness and conditioning, as the season progresses. This could have caused the players' physical condition and fitness level to deteriorate, and allowed the body to be more vulnerable and weaker when exposed to heavy training and matches.

Chomiak et al (2000) found the highest injury rate to be during the competitive season (49% of all injuries). These variations in vulnerable periods during the season are the result of changing methods in training and conditioning. Teams that have a high injury rate during pre- or early-season have not allowed enough time for a gradual improvement, to allow the body to adjust to the high level of training. Teams that have a high injury count early season also have to develop an off-season program, which forces the players to stay fit and conditioned.

Figure 4.20 for the juniors, clearly shows that the number of joint injuries (ankle and knee) increases rapidly early season, peaks mid-season, then after the July break increases again. In the seniors (Figure 4.21) joint injuries peak early season, then gradually decrease and plateau for the remainder of the season. The seniors' joints are more conditioned and adapted for the game, while the juniors, who are still developing and adapting to their growing bodies, are vulnerable to joint injuries throughout the season.

In Figure 4.20 and 4.21 the muscle groups (hamstrings, groin and quadriceps) follow similar patterns of occurrence during a season. In both juniors and seniors, muscle injuries are highest in the early season, and generally decrease through the remainder of the season. This high muscle injury count is possibly due to the level of fitness – muscles are not conditioned, and training generally causes muscle stiffness and pain (Delayed Onset of Muscular Pain). The increased muscle strain count, shown in the figures, could also be due to the reduction in muscle flexibility during the off-season.

One area that was emphasised in the seniors (Figure 4.21) was the incidence of injuries to the back, which was the highest during the off-season. These players could have been encouraged to come in for a back massage during their recovery time to try and relax them more. For the sake of the accuracy of this and all similar studies, it is vitally important to know whether the player came in for a necessary injury treatment or just for luxury and pleasure.

When analysing Figure 4.20 and 4.22, it appears that the injuries of juniors (anatomically and injury type related) were much more inconsistent throughout the season. Injuries rapidly increased at early-season, then decreased slightly, just to increase again before and after the July break (mid-season) and then only taper off towards the end of the season again. This is quite different to the injury pattern of the seniors (Figure 4.21 and 4.23) where their injury counts, for injury type related to anatomical area, increased to their highest points in early season and then generally became more stabilised throughout the remainder of the season. This could be due to the level of the players' physical development, where the seniors' bodies adapt to the physical demands much better.

The injury types are quite consistent with the anatomical areas, where knee and ankle injuries mirrored the injury patterns of ligament and tendon injuries and the groin, hamstring, quadriceps and back showed similar injury patterns for muscle injuries.

Training injuries were clearly higher than match injuries for PSL (Figure 4.24) due to the fact that training exposure was much higher than match exposure. The training and match injuries followed a similar pattern throughout the season. The sudden decrease in the number of injuries was the result of the off-season or seasonal breaks. It did, however, seem that there was a slight decrease in the difference between training injuries compared to match injuries over the season. This was possibly due to fact that as the season progresses, less emphasis was put on training and fitness, and more on practice games and matches.

When comparing the injury counts for all (combined), matches and training (Figure 4.25) – for 2001 versus 2002, different injury patterns could be seen. Injury counts for 2001 were lower at the beginning of the season and gradually increased throughout the season, where the opposite was found for 2002 – the count of injuries peaked at the beginning of the season and decreased throughout the remainder of the season (except for the sudden peak in September). These changes through the season could be due to the implementation of a new coach, changes in training conditions or changes in playing style or techniques.

The junior’s influenza counts were much higher than the seniors (Figure 4.26). The senior’s flu counts, which were only really found between March and August, remained quite low and consistent. The juniors, on the other hand, had many high and low flu counts recorded, throughout the year. Flu counts peaked in June, which is a good indicator of when the juniors’ immune systems might be vulnerable. The juniors need special health boosters in the form of vitamins or an enriched diet during these vulnerable periods (it can also be given to PSL players as a precautionary measure). More attention should also be paid to identifying a player that has flu early, and preventing him from unnecessarily mixing with other players, to try and stop him spreading his flu germs.

5.7 Sidedness of the Injury

Table 4.25 summarised the sidedness of injuries for all the teams. Injuries to the left side (517) slightly outnumbered injuries to the right side (510), with only a minimal number (15) of bilateral injuries.

It was clear when studying Table 4.26 and Figure 4.27 that the totals for "all"(combined) ages for 2001 and 2002, the right leg made up 61% of the preferred leg or dominant leg counts, followed by 23% left leg preferred and then 16% two-footed or bilateral players. Davids et al (1988) concluded that there was 28.1% more right leg preferred players compared to the left leg preferred players. Similar results were seen in a study by Junge et al (2000) who estimated that 52.8% of players preferred shooting with their right foot, 10.7% preferred shooting with their left leg, and 36.6% players shot with both legs at a senior level. Ekblom's (1994) results are very similar to this study, showing 69.8% right leg preferred players and 30.2% left leg preferred players, although there was no mention of two-footed players.

When studying Table 4.26 and Figure 4.27 a definite pattern was visible when comparing preferred leg and age. The percentage of right leg preferred players decreased, while the percentage of left leg preferred players increased with an increase in age. There were some noticeable variations for the counts of two-footed players in the juniors, but the most evident result was the sudden increase in two-footed (both left- and right-leg preferred or bilateral) players at the PSL level.

Davids et al (1988) also reported that elite juniors had a lower number of shots on goal with left and right legs compared to senior players, but found a progressive increase in bilateral shots at goal with an increase in age. Junge et al (2000) supported these claims by showing that there were a higher proportion of players who shot with both legs in more senior level teams than in junior level teams.

This study's results, for both years, for PSL (Table 4.26) were quite similar to the study done by Junge et al (2000). This study found that 44% of players preferred the right leg, 25% of players preferred the left leg and 30% of players were bilateral. Junge et al (2000) results showed that 52.8% of players preferred the right leg, 10.7% of players preferred the left leg and 36.6% were bilateral.

The football game demands more left leg preferred players at a more senior level. The more senior the team – the faster and more accurate the game becomes, the teams need left leg preferred players on the left side of the field to put in crosses, control passes and defend on the correct foot, and so too are right-sided players needed on the right side of the field.

There was a noticeable increase in two-footed (bilateral) players at a senior level, this relates to the needs and the demands of the game. A senior professional player, whether striker, defender or mid-fielder, are required to pass, shoot, dribble or defend accurately with both feet, and are at a certain disadvantage if they are purely one-sided.

When looking at Table 4.27 and Figure 4.28, the percentage injuries were very similar when comparing the left side to the right side of right-leg preferred players, across the ages. But a different pattern could be seen when looking at Table 4.28 and Figure 4.29, which showed the correlation of the side that the injury occurred on, of the left leg preferred players. These results showed that in right-legged players the side of the injury is less predictable, and it had quite an even possibility of occurring on the left or right side. While in left-legged players, there were consistently more injuries on the left leg than on the right (for all age groups), and the total percentage for left-sided injuries (51%) vastly exceeded the percentage of right-sided injuries (36%). The non-sided injuries for left- and right-side preferred players were very similar, and remained quite consistent through the age groups. When looking at Table 4.29 and Figure 4.30, the lower counts of injuries for the left- and right-side preferred players had to be taken into account. Across the ages there was a slight decline in the percentage of left-sided injuries, while the percentage of right-sided injuries remained quite consistent across the age groups. Left-sided injuries still made up a higher overall percentage than right-sided injuries.

The variations in the sidedness of the injury, in relation to the preferred leg of the players, could be due to the amount of left-leg preferred players, playing positions and perhaps even style of play. It was clearly visible in Figure 4.27 that there were a lot less left-leg preferred players than right-leg preferred players across the age groups. This could result in these left-sided players, which are much fewer than right sided players, being exposed to more playing time. The most important factor possibly affecting the side of injury is playing position, and the needs and expectations of a player, while on the field. Why do left-sided players have more injuries on the left side compared to the balance of injuries on right-sided players? Left leg preferred players are fewer or more limited, and so they are placed into very specific positions. Left-sided players will predominantly be made to play on the left side of the field to make maximum use of their left foot - to cross, pass, dribble, shoot or tackle on the preferred left foot.

So these left leg preferred players are required and need to use their left leg much more in the game and are, thus, at higher risk of impact injuries on the left leg than on the right. The right leg preferred players, unlike the left leg preferred players who are generally restricted to the left side of the field, are put into much more all-round positions. They will play on the right side of the field, but also generally make up the centre of the field, from where they are required to use both legs in dribbling, shooting, passing and tackling. Thus, unlike the left-leg preferred players who are forced into using their left leg more, right-side preferred players (central positions) are prone to left- and right-side impact / contact injuries during play.

The sidedness of the injury might also partly relate to the side of the brain used. Left-legged players like left handed people, using the right side of their brain and right-sided players' vice-versa. Left-sided players, using predominantly the right brain, are known to be more creative, and thus, assumed to play with more flair.

This style of play puts these players preferred leg (left) at higher risk of injury, with their delicate touches and footwork, which could either tempt a defending player into a dangerous tackle or result in an injury to the left leg when trying a creative pass, cross or shot.

Chomiak et al (2000) explained that in non-contact injuries, legs were affected equally, in contrast with contact injuries where the dominant leg was involved significantly more. Robson (1997) also added that when regarding the stronger or natural kicking foot versus the weaker kicking foot, players instinctively prepare themselves to kick the ball with their stronger leg.

Figure 4.27 and 4.28 showed that the right-leg preferred players always made up a higher percentage of injury victims than the left-leg preferred.

Figure 4.30 shows that the percentage of injuries on the right side remained consistently more for right-leg preferred players, so too was there a higher percentage of injuries to the left-side on left-leg preferred players (Figure 4.31). According to Robson (1997) players instinctively prepare themselves to kick the ball with their stronger leg. So using the preferred leg more would obviously put it at higher risk of injury, especially an impact or contact injury.

In Figure 4.32 the U11's, U15's and U17's are quite similar with the right side having slightly more injuries in total. The PSL players show the exact same percentage of left- to right-sided injuries. Only the U13 group resulted in a higher percentage of left-leg injuries than right-leg injuries. This could be due to players at that level starting to determine that they don't only have to kick with their preferred leg, but can also use their supporting leg. The high number of injuries shown on the left-leg and foot at this U13 level, is possibly due to this left-leg trying to adapt to more powerful and accurate kicking.

In Table 4.30 and 4.31, when looking at the juniors' action, the U11 and U17 right side preferred players' injuries were higher than expected. When analysing this junior's results on the tables, as a whole, it could be concluded that the differences between the injury rates and percentages were not significant, and were generally quite low. This means that the injuries mostly occurred where it was expected. This once again proves the consistency of the results. No distinct injury patterns could be observed in the juniors' results.

The most noticeable variation and the only comparison that was found to be highly significant, was that of the PSL or seniors group. In the seniors, bilateral (left- and right-leg preferred) players had a significantly higher injury percentage than expected, and right-leg preferred players had a much lower injury percentage than expected. Bilateral (two-footed) players played an important part in senior football, and they had to be used as extensively as possible. Bilateral players are more suitable to play in center field, as they can pass, shoot and dribble using both legs, to either side of the field. Players who played centrally (left to right, not back to front) were generally involved in much more possession and territory than players on the right or left side of the field. The PSL group still consisted of a majority of right-sided players; however the left-side preferred and bilateral players could be seen as more beneficial to the game, and would quite likely be the first choice selection to play. So not as many right-leg preferred players will get as much game time as the left-leg preferred and bilateral players, so less play exposure means less risk of injury.

Table 4.32 summarised the results of the sidedness of impact injuries related to the preferred leg of the players. For the juniors, seniors and for all (combined), in total showed that, as expected, more impact injuries were found on the preferred leg than the support leg, however bilateral players also had more injuries on their right side. The players, as was previously mentioned, instinctively prepare themselves to kick with the preferred leg, and so use their preferred leg much more in contact with the ball, during the game. The players could then get these impact or contact injuries from continuous contact with the ball or from another player defensively making contact with them. The players could incur an injury while taking a shot with their preferred leg or, while tackling and defending with their preferred leg.

Non-impact injuries would generally make up ligament, meniscus, tendon and muscle strain injuries, which is usually not caused by direct contact. Table 4.33 summarised the results of the sidedness of non-impact injuries related to the support leg of players, which should be the opposite of Table 4.32. There is vastly more non-impact injuries found on the support leg in the juniors. The support leg, which should oppose the results of the preferred leg, should have more non-impact injuries, as the ligaments, tendons, meniscus and supporting muscles of the support leg must bear the weight and strain during movement of the preferred leg. The support leg should have less contact injuries during general play. However, in the seniors and "all" (combined), where there were more non-impact injuries on the left side of left leg supported players, there were surprisingly also more non-impact injuries on the left side of right leg support players, and as in the juniors, more right sided non-impact injuries in bilateral players.

The support leg, as previously mentioned, is expected to have more non-impact injuries, as in the left leg of left-leg supported players. But contrary to the expected results, the right-leg supported players also have more non-impact injuries on their left side. This is showing that left-leg preferred players also have more non-impact injuries on their left (preferred) side.

It is questionable whether left-leg preferred players are truly, naturally left-footed or merely trying to create the impression of being left-footed. The other atypical reason could be that the left leg could actually have more physical or anatomical vulnerabilities to non-impact injuries, during a football game. The bilateral players always had more non-impact injuries on the right side, which could be due to the strain put on the right leg when they use the left foot. It could also be because the players are not technically bilateral and the right-leg is not actually strong enough to continuously support the left leg throughout the expected center field role. Football players strive to, and then believe that they can use both feet equally effectively (bilateral), but there is generally always one leg that is genetically designated as the preferred leg, and the other leg as the support leg.

CHAPTER SIX

Recommendations

6.1 General Recommendations

The purpose of this chapter is to highlight the most beneficial conclusions and summarise them into useful football injury guidelines. These guidelines can and should be used by football coaches, managers, physiotherapists, biokineticists, doctors and most importantly the players themselves. These guidelines are aimed at achieving one of the main aims of the study i.e. to bridge the gap between research and the actual training and match conditions, so that the available scientific knowledge about football could be applied more meaningfully. In turn, reducing the amount of playing hours lost due to injury and in the long run: improving overall football standards in South Africa.

A strategy for controlling the risk of player's injury should comprise three stages:

1. Injury prevention
2. Injury treatment
3. Injury rehabilitation (which are all subject to budget constraints).

It is, however, highly recommended that the main focus of the strategy should be aimed at an injury prevention program. The Federation Internationale de Football Association (FIFA) also highlighted the urgent need for an injury prevention program (Dvorak and Junge, 2000). Dvorak and Junge (2000) showed significant correlations between risk factors and injury incidence, and their study, which imposed strict injury prevention programs, resulted in an estimated 75% reduction in injuries compared to controls. Based on their multidimensional predictors (using multiple variables) Peterson et al (2000) used a similar prevention program, but encouraged the ongoing improvements of these programs.

The factors that increase the risk of football injury first need to be determined, so that steps can be taken to develop the much needed injury prevention program. The football world has got to try and take the approach that prevention is better than a cure.

In order to establish what these risk factors are it is crucial that all football teams regularly assess their own players, in an attempt to determine the players' risks to injury. The assessment tool must be standardised and the football-related injuries must be categorised accordingly. These assessments and analysis will allow for the sources of injury to be better understood, and provide the opportunity to monitor the long-term changes or patterns developed in the frequency and characteristics of injury.

The similarity in results between this study and comparative studies suggest there was a consistency in the results, for different age groups and over different years. These consistencies between studies would suggest that real risk factors could be found. The results of these studies (regarding the injury risk factors), must be used to develop exclusive injury prevention strategies and programs, that can be used specifically for the team or players been assessed. Yoon et al (2004) and Arnasson et al (2004) all agree that more extensive and precise data need to be collected, in order to identify these particular risk factors and variables that are effecting the injury incidence in these football players. It is also vitally important to become aware of how the physical development and potential injury patterns differ between the various age groups.

It is also recommended that a multivariate model (a study focusing on multiple factors) be used to analyse the contribution of various factors in injury etiology, and to study their interrelationships.

It is recommended that detailed health and fitness-related standardised assessments are done and recorded, at specific time intervals throughout the football season (for example - pre-season, during season, post-season and post-rehabilitation assessments). These assessments provide a benchmark of the player's overall fitness, and sets standards against which each player can be monitored following injury and rehabilitation. A player's performance results would be tested against their benchmark standards, and this would determine whether the player is suitably fit, and could prevent any undue risk of injury. Shepard (1999) adds that these benchmark standards provide a measurement against which development of chronic injuries can be assessed, and it provides an invaluable guide to rehabilitation.

It is strongly advised, with the support of Fuller et al (2004) that a football player's personal knowledge, and implementation of injury control and prevention, has to be improved considerably. Physiotherapists, who are expected to educate players on injury prevention, are already flooded with injury treatments and rehabilitation. Reilly (1996) stated that a basic understanding of how the muscle functions during soccer skills, such as kicking and running, will be extremely useful in designing training programs, enhancing performance, and in developing injury prevention, diagnosis and rehabilitation programs.

Football club management must also do their own research and cost analysis for the club. The management must compare the cost of employing extra players to substitute injured players and the additional costs of treatment and rehabilitation against the cost of improved injury control and prevention strategies.

6.2 Specific Recommendations

6.2.1 Age Related Variables of Football Injury

It is most important to remember that all age groups are very unique and that their training and match preparation should, in turn, also be specialised to suit their specific needs and take their specific risk factors into account. The coaching staff, biokineticists, physiotherapists, doctors, parents and players need to educate themselves more, in order to provide for the specific needs of each of the particular age groups. All these persons involved in the football players development need to stop using their generalised training programs (use one program for all the age groups) or their generalised fitness, performance and rehabilitation programs, and make their programs age specific.

6.2.2 Number of Treatments per Injury

It is noticeable that there is generally an increase in the number of treatments per injury with an increase in age. This would imply that the injuries are becoming more severe with an increase in age. Special attention must be given to sufficient rehabilitation, and enough recovery and rest time must be afforded to players, to allow for full recovery. Strict fitness tests must be enforced and administered by staff, other than the coach, to determine whether the player is physically fit and completely recovered from injury.

6.2.3 Anatomical Area of Injury

Significant variations were observed in the injury incidence of the different anatomical areas, from season 2001 to 2002. The cause of these main variations, from one year to the next, had to be determined. Changes in training conditions, coaching, fitness, duration and frequency of training and matches, rehabilitation, warm-up and stretching are all possible causes.

The number of injuries per player must be kept to a minimum and specific attention must be given to players, who were at a higher risk of injury. The players, who had a higher risk of injury, must have some form of physical susceptibility or weakness, which must be addressed, monitored and improved to ensure a decrease in the number of injuries that occur.

The comparative studies training exposure was evidently more intense over a shorter period (9.9 hours per week for 24 weeks = 241 hours), while this study was less intense, but over a longer period (7 hours per week for 33 weeks = 239 hours). It could be assumed that the more intense approach of training (comparative studies) could also possibly result in a lower injury incidence, or in other words – the longer, less intense training (of this study) could result in a higher injury incidence.

It must be taken into account that the various age groups do vary considerably in many respects. Generalised conditioning and training programs will not suit all ages. Certain injury patterns can be noted within the various anatomical areas of the various age groups, this shows that specialised training programs must be developed around the specific needs and vulnerabilities of the specific football age groups. This study showed a predominance of foot and tibialis anterior injuries in the U11 and the U13 age groups, a sudden increase in quadriceps injuries in the U15 age group, a high point of groin and back injuries in the U17 and, finally, a high count of hamstring injuries in the PSL group.

The back is the one upper body area (ranked fourth highest area of all injuries in this study), which is highlighted as an area of injury, which needs special attention in S.A. football players. This study has a much higher proportion of back injuries when compared to the comparative studies. It is important to remember that the back is a vital part of the core body (effects balance and strength), which greatly influences football performance.

This study's results are similar and consistent to those of comparative studies, as far as percentages of the knee and ankle injuries are concerned. Most of the comparative studies also showed that the ankle had the highest proportion of total injuries, followed by injuries to the knee. Because the knee and ankle are joints, conditioning programs must be developed around joint flexibility, the proprioception (balance and support) of all the stabilising muscles surrounding the joints and also properly developing the big muscles supporting the joints.

6.2.4 Type of Injury

Results of this study have shown that muscle injuries make up the majority of injuries followed by ligament, bone and tendon injuries. However, muscle tears or strains are still seen as the easiest overall injury to prevent (Ekblom, 1994). Ekblom (1994) stated that these muscle strains (which can be total or partial) are caused by compression (direct impact) or distraction (result of overload or stretching). This gives another very important reason to concentrate on players stretching sufficiently.

This study found that even though ligament injuries made up a high proportion of the total injuries, it remained fairly constant across the age groups. Garret et al (1994) stated that football players are very vulnerable to tendon and ligament injuries, due to all the cutting, twisting, kicking, sudden accelerations and decelerations and the repetitive, non-stop action of the game.

Milroy (2004) adds that when the body is subjected to repeated movements, especially through the same plane, it could result in injuries that inadequate recovery would accentuate. So frequency and duration of training, matches and the length of the season, as well as the recovery time after matches and after injuries has to be analysed, monitored and adjusted accordingly in order to reduce the number of overuse injuries.

6.2.5 Anatomical Area of Injury in Relation to Type of Injury

All people involved in the football player's development must be aware of the correlation between anatomical area of injury and type of injury. It is highly significant (according to this study's results) and specific attention must be given to develop preventative, conditioning and rehabilitative programs for it. There is plenty research and information available, regarding the development of the body through the ages, which should be used in conjunction with the particular clubs injury analysis and statistics. This should give decent incite on injury risk areas to be concentrated on during the season.

6.2.6 Vulnerable Periods during the Season

It is highly recommended that all football clubs and players give special attention to preseason and early season training. It is common practice for most football clubs to subject their players to high training loads during early or preseason training, which generally leads to a similar sudden increases in injuries.

Garret et al (1994) in agreement with Reilly (1996) suggested that players tend to take a complete break during the off-season, which result in them, returning to play unfit and overweight. Garret et al (1994) concluded that during preseason training there is often an overemphasis on aerobic training, which results in a diminished muscular strength as the competitive season begins, which could add to the risk of injury. Coaches and players try and get the seasons fitness training over as quickly as possible, and don’t adequately prepare the body to function at a more demanding level. This sudden increase in fitness training drills comes as a shock to the body, and results in a definite increased risk to injuries.

Teams that have a high injury rate during pre- or early season have not allowed enough time for steady improvement, and allow the body to adjust to the demands of high level of training. These teams, that have this high injury count at early season, also have to develop an off-season program, which forces players to stay fit and conditioned.

When relating to senior players, it is recommended that coaches and players also observe the increased risk of injury during late season. This could be due to the senior players not getting enough time to rest their body or recover properly from injury. It could also be due to the reduction in time contributed to fitness and conditioning as the season progresses. This might have caused the players physical condition and fitness level to deteriorate, and allowed the body to be more susceptible to injury, when exposed to heavy training and matches.

When analysing flu counts, the juniors’ sudden increase in influenza reported during June, is a good indicator of when the junior’s immune systems might be down. Special health boosters in the form of vitamins or an enriched diet are recommended during this period (these health boosters can also be given to the PSL players on a precautionary basis). Early detection will allow for the prevention of the spread of the germs amongst team members.

6.2.7 Sidedness of the Injury

This study is one of the few that have analysed the sidedness of football players and the importance it has on players' performance, prevention of injuries and recovery after injuries. It is highly recommended that further study be undertaken to investigate the correlation between injuries and sidedness in football players.

One sided players (left or right leg preferred) have a definite preference to shoot, pass, dribble or tackle with their preferred foot, which makes the other leg vitally important in supporting the preferred leg. As expected, more impact injuries were found on the preferred or dominant leg, and there were generally more non-impact injuries found on the support leg.

Conditioning and training programs must be sensitive to the sidedness of the individual players. Either more time and effort has to be spent on developing players to use both legs equally or the preferred or support leg must be prepared and conditioned more specifically, to suit its particular needs.

6.3 Extrinsic Factors

Extrinsic factors are the factors, which affect football players indirectly. Football players generally spend a lot of effort to try to keep them in good mental and physical condition. It is then expected in return, from their football club, that the extrinsic factors must be controlled to the best of the club's ability. Fuller (2000) and Reilly (1996) list pitch layout and condition, training programs, warm-up, nutrition, players' equipment and footwear as some of the extrinsic factors affecting football injuries.

The most important and influential extrinsic factor in the game of football is generally the coach. According to Milroy (2004), a professional football team must have a capable coach, which will not only help with the complex task of producing players of high performance standards, but also to ensure that an injured player maintains a degree of fitness during injury rehabilitation. According to Reilly (1996), for a coach to be able to manage the multiple roles required of him to support his players, the coaching program relies greatly on coach-player interaction, and on the partnership between coach and scientists to identify the most important aspects of football, which should be analysed.

It is also greatly advised that specialised attention be given to warming up before and cooling down after training and matches. Milroy (2004) stresses that the warm-up must be scientific, so that it does not only increase heart rate to match levels and prepare muscles for aerobic exercise, but also programs each joints movements to reach its limitation (for the risk of match unpredictability and intensity).

It is also necessary to follow a suitable diet or nutritional plan to ensure that football players meet the overall energy expenditure. Garret et al (1994) add that there is no magic diet that would enhance performance above that of a properly balanced diet. However, a poor nutritional diet could have a negative influence on training and performance.

Another extrinsic factor, which is easy to control, is the proper use of football boots and protective shin guards. Reilly (1996) highlights that football boots must relate to the needs of the game, provide suitable protection for the foot and allow the foot to perform the purposes expected of it. Shepard (1999) and Ekblom (1994) are also in agreement that knee and ankle injuries occur too frequently due to excessive rotational traction of modern football boots. According to Milroy (2004) sensible protective wear will spare players many unnecessary injuries, and that the football player who insists on not wearing shin pads should be seen as negligent in a sport where continuous lower leg impact does occur, within the rules of the game.

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Appendix 1 This Study's Standardised Injury Report Form

Date	Age G	Junior/PSL	Month	Day#	YearT	Tot Vis	Name	Left	Right	BodyPart	Impact/Not	InjuryType	T	M	P Leg	S Leg
26-Feb-01	u11	J-one	2	26	One	1		y		Tibialis Ant.	I	Bone-Bruise		y	R	L
26-Feb-01	u11	J-one	2	26	One	1		y		Foot	I	Bone-Bruise		y	L	R
10-Mar-01	u11	J-one	3	10	One	1		y		Foot	N	Ligament-Sprain		y	R	L
06-Apr-01	u11	J-one	4	6	One	1		y		Knee	I	Bone-Bruise	y		R	L
06-Apr-01	u11	J-one	4	6	One	1		y		Knee	I	Bone-Bruise	y		R	L
24-Apr-01	u11	J-one	4	24	One	2		y		Knee	N	Ligament-Sprain	y		R+L	R/L
26-Apr-01	u11	J-one	4	26	One	1		y		Foot	I	Bone-Bruise	y		L	R
30-Apr-01	u11	J-one	4	30	One	1		y		Shoulder	N	Ligament-Sprain		y	R	L
10-May-01	u11	J-one	5	10	One	1			y	Hip	I	Bone-Bruise	y		L	R
15-May-01	u11	J-one	5	15	One	2		y		Ankle	N	Ligament-Sprain	y		R	L
04-Jun-01	u11	J-one	6	4	One	1				Flu			y		R	L
05-Jun-01	u11	J-one	6	5	One	1			y	Ankle	N	Ligament-Joint Laxity		y	R	L
12-Jun-01	u11	J-one	6	12	One	1		y	y	Ankle	N	Ligament-Joint Laxity		y	R	L
12-Jun-01	u11	J-one	6	12	One	1			y	Ankle	N	Ligament-Joint Laxity		y	R	L
12-Jun-01	u11	J-one	6	12	One	1			y	Groin	N	Muscle-Strain		y	R	L
14-Jun-01	u11	J-one	6	14	One	2		y		Calf	N	Muscle-Strain	y		R	L
19-Jun-01	u11	J-one	6	19	One	1		y		Tibialis Ant.	I	Bone-Bruise		y	R	L
07-Aug-01	u11	J-one	8	7	One	4		y		Knee	N	Tendon-Tendonitis		y	R	L
16-Aug-01	u11	J-one	8	16	One	1				Flu				y	R	L

Age G	Age Group
YearT	2001/2002
TotVis	Total visits
Left/Right	Injured side of body

BodyPart	Anatomical Area
Impact/not	Impact/Overuse injury
T	Training
M	Match

P Leg	Preferred Leg
S Leg	Support Leg