Incidence of football injuries in disadvantaged adolescent male football players in Gauteng, South Africa

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand,

Johannesburg, in partial fulfilment of the requirements for the degree

of

Master of Science in Medicine in Sports Medicine

Johannesburg, 2013

DECLARATION

I, Katharina Grimm, declare that this research report is my own work. It is being submitted for the degree of Master of Science in Medicine at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

day of March 2013

DEDICATION

to

Astrid Junge, PhD,

Head of Research FIFA Medical Assessment and Research Centre,

for all she taught me on scientific scrutiny, meticulousness and persistence,

and her continuous professional and personal support.

ABSTRACT

Football is the most popular sport among male black adolescents in South Africa, many of whom are disadvantaged with limited access to health care. While international studies indicate a high risk, information on football injuries in these players is non-existent. At the same time, potentially aggravated consequences of injuries without adequate care make prevention a priority. According to the “sequence of prevention model”, assessing the incidence, severity, risk factors and mechanisms of injuries is precondition for the development of effective preventive measures. This study was the first to investigate injury epidemiology in disadvantaged African youth. Systematic injury recording proved generally feasible. Injury incidence was comparably low with mostly minor and no severe injuries. Injury characteristics complied with international data. Applying methodological standards as per international consensus definitions in this setting was constrained, resulting in limited comparability and generalizability of results. We question whether sustained injury surveillance is needed at all levels of play since accepting cohort studies in comparable population groups would allow focussing on prevention in disadvantaged settings.

Acknowledgements

I would like to express my gratitude to the injury recorders of the Centre of Exercise Science and Sports Medicine (CESSM) - without their enthusiasm and perseverance the study would not have been possible:

- Saffiya Cachalia
- Alex Cimato
- Nicola Foltan
- Philippe Gradidge
- Stephanie Murphy
- Jennifer O'Neill
- Kabelo Senne
- Thando Fana Zulu

The coaches and players of all teams deserve special thanks for their collaboration and contribution, and for trying so hard to comply under difficult circumstances. I would like to thank the school principals of Emshukantambo, Lamula, Mapetla, Matselitso, Seannamarena, Senaoane, Ponego, Progress and Veritas High School for agreeing to participate in the study.

Dr Sello Motaung is given sincere thanks for his efforts in instructing and monitoring the coaches and supervising the injury recorders. I am also grateful to Mrs Nicolette Labuschagne and Mrs Lauren Mann for their filing and organising of reports, and their personal support throughout.

I thank Professor Alan Rothberg for his supervision of the finalisation of this report.

The FIFA Medical Assessment and Research Centre F-MARC is acknowledged for the funding support of the study.

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1. Introduction

1.1 Football as a preventive and educational tool in an adolescent population

Physical activity has been identified to play a major role in the prevention of non-communicable diseases worldwide, making its promotion an important and affordable tool in public health.[1] Regular exercise is not only able to reduce risk factors for chronic disease in adolescents and adults,[2,3] but may also be used in the treatment of numerous diseases from metabolic syndrome-related disorders to cardiovascular and musculoskeletal disease,[4] all of which are of growing importance in developing countries.[5] Physical activity of children and adolescents has been shown to, on the one hand, provide short-term benefits particularly for bone and mental health and have therapeutic effects on disease such as asthma, and, on the other hand, influence adult physical activity levels and exert several long-term protective health effects.[3,6] Besides increasing fitness, sports participation improves motor coordination and socialisation skills.[7]

A report by the *United Nations Inter-agency Task Force on Sport for Development and Peace* stated that additional benefits can be postulated if the physical activity was undertaken in the form of sport, as participation in sport could increase levels of self-esteem, confidence, resilience, teamwork and discipline.[8] The particular value of sport with regard to the quality of life and the physical, mental and moral well-being of its population has been repeatedly recognised by the South African government, who aims to facilitate participation in sports.[9]

Football played on a leisure time base has been shown to effectively stimulate musculoskeletal, metabolic and cardiovascular adaptations important for health maintenance, thereby reducing the risk of developing lifestyle-induced disease in young and middle-aged men.[10] The popularity of football globally offers a promising approach not only to effective health prevention by playing itself, but also for information and education, particularly in population groups not easily reached by usual prevention campaigns. In South Africa, as in other developed and developing countries, more and more non-governmental organisations systematically use the game of football as a powerful tool to promote self-responsibility in health care and to develop social skills in the youth. Disadvantaged black male adolescents seem a population group particularly in need for innovative approaches to this kind of education. Disadvantaged in this context is defined as “Deprived of some of the basic necessities or advantages of life, such as adequate housing, medical care, or educational facilities.”[11]

1.2 The “sequence of prevention” model

However, in order to tap the full potential of the game of football in enhancing the physical and mental well-being and health by playing and by football-related education, negative effects such as injuries and their consequences need to be minimised.[12] The direct consequences such as pain, short-term disability, school and sport absence might be combined with long-term sequelae such as osteoporosis.[13] The injured may also lose their enjoyment of playing. There are hardly any data on the long-term consequences of youth injuries, but particularly injuries to the growth plate may potentially cause significant disability.[14] Injury prevention in youth sports has therefore become a major objective of sports physicians and public health officers alike.[15,16] Given the definition of “disadvantaged” above which includes the lack of access to adequate medical care, injury prevention becomes vital in the intended target population of black male South African adolescents in order to allow for maximum benefit from education and prevention while averting damage due to insufficient or unqualified treatment.

According to arguably the most commonly cited model of injury prevention in the literature, the “sequence of prevention” model, prevention of sports injuries must follow a four-step approach which is presented as a logical sequence.[17] According to this concept, the first step in injury prevention has to be the assessment of the magnitude of the injury problem with regard to the incidence and severity in a specific target population. Performance of this step requires a sound methodological approach with a clear definition and adequate sample selection of the target population at risk, a standardised approach to injury and exposure recording, uniform definitions of injury and injury severity and a study design suited to reflect the injury situation in the target population.[18,19] Secondly, the risk factors and injury mechanisms that contribute to the occurrence of football injuries in this population must be identified. The description of the inciting event or mechanism of an injury is key to understanding the causes of injury,[20] and there are a variety of research approaches to describe these mechanisms, each with its own limitations and possibilities.[21] Only once these factors are known for the target population, adequate measures to reduce the future risk and/or severity of football injuries can be developed and implemented in a third step (e.g. a specifically designed exercise-based prevention programme). In a fourth step, the effect of these measures must be evaluated by repeating the first step, ideally by means of a randomised trial.

Despite its popularity, this approach has a number of limitations which may become of major importance when investigating populations in a less organised setting lacking the logistic possibilities and manpower of established clubs, leagues and football associations as encountered in the target group of disadvantaged male adolescent players in South Africa. A major shortcoming of van Mechelen's model is that it does not consider the need for research into implementation issues.

Therefore, the "sequence of prevention" model has more recently been amended with two more steps considering the individual situation of a target population and the resulting specific implications for the implementation of preventive measures.[22] The different steps of this "Translating Research into Injury Prevention Practice" (TRIPP) framework for research are illustrated in figure 1.2.1. It implies that the ideal conditions required to perform high-quality injury surveillance and to conduct e.g. a randomised controlled trial (RCT), even though critical to develop the scientific base for effective injury prevention, do not necessarily translate into real-world injury prevention in sports and football. This applies even for the same setting and target population where an RCT has been conducted once the project staff or trained injury recorders are withdrawn and the supervision and responsibility of the researchers for reporting of the results are no longer present to ensure correct and consequent implementation of the preventive measures on an ongoing base.

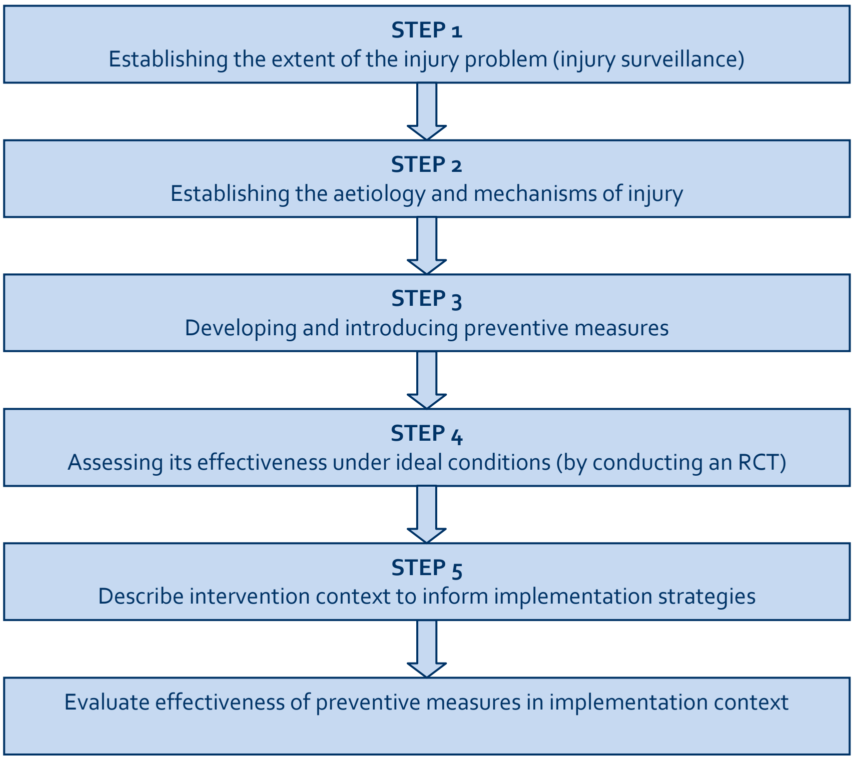

Figure 1.2.1 **The "Translating Research into Injury Prevention Practice" (TRIPP) framework for research leading to real-world injury prevention by Finch (2006)**

1.3 Popularity of football in adolescent black male South Africans

In line with trends observed worldwide,[23] participation in sports in South Africa has seen a continuous growth trend in recent years, particularly among the youth.[24] In the group of the 13-18 year old, football is by far the most popular sport (figure 1.3.1).

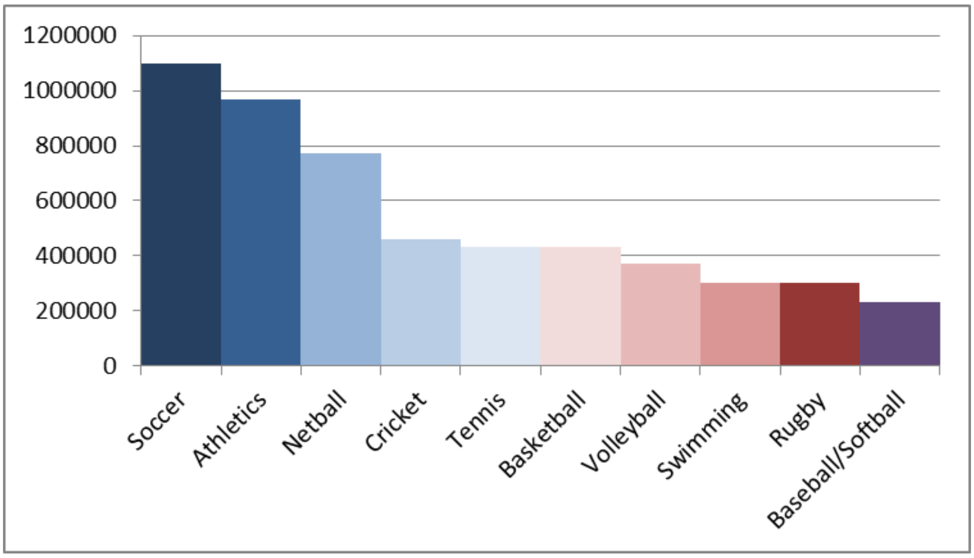

Figure 1.3.1 **Participation in sport in South Africa (13-18 year olds*)***

The social significance and impact of sports differs with ethnicity. In football, the vast majority of youth athletes are to be found among the black population, and 96% of these athletes are male (figure 1.3.2).

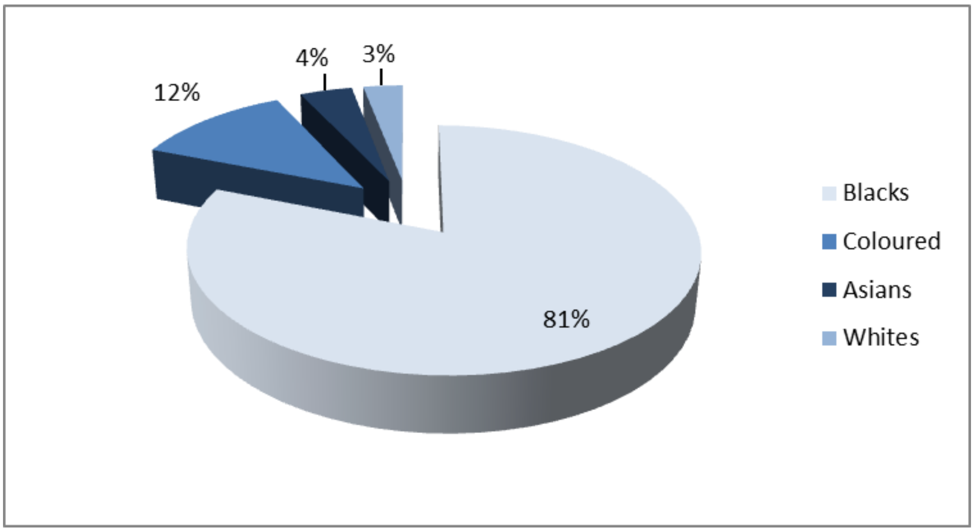

Figure 1.3.2 **Youth participation in football by race**

As compared to other sports in the country, football is far more organised and structured. The South African Football Association (SAFA) as the custodian of the game is structured into 53 SAFA regions and 381 SAFA districts. There are about 20 000 registered clubs and an estimated 50 000 teams apart from the Premier Soccer League (16 clubs) and the 1st Division (30 clubs).

With regard to the need for a tool facilitating or, in fact, enabling access to disadvantaged black adolescent males in order to be able to effectively promote health, social and life skills, these numbers on participation in football testify on the popularity of the sport among this cohort. Together with the high degree of organisation, the forum of football in South Africa therefore appears as an ideal link for this purpose.

1.4 Injury incidence and characteristics in youth and adolescent football

Step one and two of the TRIPP model include the establishment of the frequency, severity, characteristics, causes and mechanisms of injury. Irrespective of the different definitions of injury used and methodology applied in the literature on injury prevention, it is believed that the risk of injury in football is high as compared to other sports.[25,26,27,28]

However, it is a long-standing problem that reported injury incidences in different sports vary considerably depending on the exact definition of injury and injury severity as well as the research design applied.[17,18] Definitions of injury based on either insurance claims, treatment at hospital casualty departments, time loss or self-reported complaints result in extreme ranges of injury incidence and render the results of different studies largely incomparable. The Consensus Statement on Injury Definitions and Data Collection Procedures in Studies of Football Injury in 2006 defined an injury as "any musculoskeletal complaint caused by football" regardless of a consequent absence from play in an attempt to achieve a rather complete cover of injuries.[19]

Injury incidence also needs to be uniformly defined and is ideally expressed as the number of new injuries during a particular period of time divided by the number of persons in the target population. This definition however does not consider the “time at risk” when the sport is performed, the exposure time. Therefore, reporting the number of injuries during e.g. 1000 hours of exposure has become the preferred method, allowing for comparison of different sports and target groups.[18,19,23,29]

Importantly, the risk of injuries in football varies considerably with a number of player characteristics,[30] e.g. age[31] and skill, level of play,[27] resulting in a wide range of reported incidences for different target groups. This implies that injury incidences found in a certain population, even if analysed according to best methodological standards, are not simply transferable to other populations.

Professional adult football players have a risk of injuries that is incomparably higher than that observed in employees in most other occupations.[32] The injury incidence in adult male players ranges from 12-35 injuries per 1000 hours of match play and 1.5 to 7.6 injuries per 1000 hours of total exposure.[33] On average, every elite male football player incurs approximately one performance-limiting injury each year.[34] The incidence of match injuries is about 3-6 times higher than the incidence of injuries during training.[34,35]

Data on injury incidence and risk factors in youth and adolescent players are scarce and inconsistent, again mainly due to different definitions and methods applied.[36,37] In 1994, a study found that male senior players sustain more injuries than youth players based on the incidence of football injuries per 1000 hours of match play.[35] The incidence reported in studies on football players older than 12 years ranges from 4 to 7.6 injuries per 1000 player hours.[38,39,40] A review of epidemiological data in 2005 classified youth football as a relatively safe sport with an injury incidence ranging from 2.3 per 1000 practice hours to 14.8 per 1000 match hours.[41] Similarly, a Swedish study in 1800 players aged 13-16 years recorded injury rates of 2.4 to 6.8 injuries per 1000 playing hours and concluded on a low injury rate in football, recommending the game as a vehicle to increase physical activity in the youth.[42] A recent clinical report from the US stresses the higher incidence of injuries in football as compared to other contact / collision sport such as field hockey, rugby, basketball and American football, but nevertheless advocates the game as a healthy sport increasing physical activity and fitness; at the same time however criticising the wide variation in incidence rates due to different study designs and methods.[37] As seen in adults, too, injury rates in training are lower (3.9) as compared to matches (11.2 per 1000 hrs) in youth players.[40]

Next to their frequency, severity of injuries is a major aspect of safety or risk of a sport. Van Mechelen in 1992 referred to six criteria upon which severity can be described: nature of the injury, duration and nature of treatment, sporting time lost, working time lost, permanent damage and cost.[17] Most injury severity grading systems rely on the period of incapacity caused, resulting in minor (<1week absence), moderate (1-4 weeks of absence) and severe (>4 weeks of absence) injuries with again slight differences in the definition of these three degrees.[43,44,45] Junge and Dvorak in 2000 recommended that football injury severity needs to consider both duration of symptoms and severity of tissue damage.[18] Chomiak et al in their study on severe injuries in football used a definition of more than four weeks of complaints, absence from sport of more than four weeks and severe damage to the musculoskeletal system.[46] The Consensus Statement from 2006 defines severity based on the number of days that have elapsed from the date of injury to the date of the players´ return to full participation.[19] It becomes clear that a consistent and reproducible estimation of severity in these systems does require some medical knowledge of injuries and return-to-play criteria. Severity definition therefore needs to be duly considered when planning data collection and might need to be adapted to the education / knowledge level of the respective target group reporting injuries. Concerning the severity of injuries in football, the majority of injuries is classified as minor to moderate.[38,40,47]

Type and location are further characteristics of injuries. Most injuries in youth players, as in adults, occur at the lower extremities.[38,41,48] Regarding types of injury, ankle sprains are the most common injury, with contusions and strains being the most frequent types of injury.[41] Head injuries, including concussions in youth football seem rare, accounting for only 3% of injuries, but may be underreported.[40] In elite college players, they were mostly caused by contact with another player's head, elbow or foot.[49] Collisions, as opposed to purposeful heading, were also found to be the most likely cause of head injury in players treated in emergency departments.[50] Fractures and dislocations account for approximately 3-12% of injuries. As mentioned above, the type or nature of injury is also an indicator of severity in that it describes severity of tissue damage.[17]

With regard to player characteristics and risk factors, a prevention study in 14 to 19 year-old players reported a significantly higher incidence of injuries in low skill as compared to high skill teams per 1000 hours of training and match play.[51] In a prospective epidemiological study of youth academy players over two seasons, the Football Association observed a higher risk of injury in the age group of 17 to 19 years as compared to players aged 9 to 16 years.[48] In adult football, there is broad evidence that a previous injury represents an important risk factor for another injury,[35,52,53] and this also seems to apply for youth players.[54,55]

A review in 2006 on the incidence and distribution of paediatric sport-related injuries in general concluded on the need for well-designed descriptive epidemiological studies to determine the nature and extent of the problem.[23]

1.5 Injury incidence in football players in South Africa

Injury frequency and characteristics vary with different styles and levels of play, but also between countries and geographical regions.[35,56] This implies that the data reported above from mainly Europe and the United States are not necessarily transferable to African countries and South Africa in particular. Injury data on African and South African players however are very limited.

With regard to African data, a cross-sectional survey based on a semi-structured questionnaire for players and key informant interviews in seven clubs of the premier league in Nigeria reported an injury prevalence of 81.6% during the 2006 football season.[57] While the authors claim to have adhered to the methodology recommendations of the injury consensus statement,[19] the exact injury definition used in their study is not given, and this together with the use of prevalence and not considering exposure time makes it impossible to compare the data with previous studies elsewhere. A number of other findings were similar to what is reported in the literature: More injuries occurred during match play than during training, and the majority of injuries were caused by contact with other players. The ankle was the most affected injury site followed by the knee, and sprains were the most frequent injury type. More than a third of injuries were recurrent injuries. The authors stressed the economic, physical and psychological implications of football injuries calling for adequate preventive measures, treatment and rehabilitation.[57]

The incidence of football injuries in South Africa is unknown, as no large epidemiological studies have been conducted. Injury recording at an interprovincial tournament for both male and female adolescents in 1999 calculated an incidence of 333 injuries per 10 000 hours of playing, however based on an injury definition as an incident occurring during a match and causing a player to seek medical attention, while injuries occurring on the field and treated at the sideline were not included.[58]

A retrospective survey in 103 first team high school female football players from nine schools in Johannesburg published in 2009 also used the injury definition as per the consensus statement but point and period prevalence of injuries only.[59] Questionnaires in this study seem to have been distributed to players themselves (not clearly specified) and were collected after each session, resulting in a one-year prevalence rate of injuries of 46% and a point prevalence of 33%. The main sites of injury here, too, were the knee (18.6%) and the ankle (17.6%). Again, the design and definitions used in the study make comparisons with other regions and populations impossible.

One report from a study at King Edward Hospital in South Africa over a 42-month period states that 32 players were admitted with severe injuries during this period.[60] The injuries included 18 fractures of the tibial and femoral shaft. Two tibial shaft fractures were compound. Four tibial plateau fractures and five epiphyseal injuries were identified. One patient had a fracture-dislocation of the hip. One patient with a popliteal artery injury presented only 48 hours after the injury had occurred, necessitating an above knee amputation. In the same period, 122 players were treated as outpatients. The types of injury in this cohort were similar to football injuries reported in other countries. The authors concluded that very serious injuries were sustained by casual football players in South Africa, and that urgent measures needed to be taken to prevent such injuries.[60]

In summary, none of the few studies performed in (South) Africa is of sufficient quality with regard to design and methodology to allow for comparison of data or to provide a valid base for step one of the "sequence of prevention" model.

1.6 Injury surveillance in community-level football

Since the publication of van Mechelen's "sequence of prevention" model and as described above, a multitude of studies has been published on the epidemiology of injuries at national, international and professional level. While injury recording at elite level is important, from a public health perspective far more important is the epidemiology of injuries in the millions of community-level players worldwide, both with regard to numbers and impact. Considering the many difficulties of systematic injury recording also described above, it is not surprising that the challenge of injury surveillance at community level has been rarely attempted so far. In football, there are basically two studies to date, one performed in Canada and one in New Zealand.[61,54] McNoe and Chalmers were the first to attempt routine injury surveillance in community football on a broad level.[61] They adopted a cohort study design where 880 community-level players aged >13 years were followed up by repeated telephone interviewing of players over one competitive season. They obtained an extremely high compliance during follow-up which they ascribed to the rapport build up between players and interviewers. Emery et al. used certified athletic therapists to perform baseline assessment and weekly injury recording in 21 adolescent football teams in Canada.[54] A team designate recorded weekly exposure for individual players. They found some incongruence between the different recording systems used for exposure and injury identification, but overall satisfactory completeness and the possibility to correct errors when the study coordinator compared and controlled the records.

1.7 Prevention of injuries in football

With regard to steps 3 and 4 of the "sequence of prevention" model, systematic approaches to injury prevention in football are poorly documented in the literature and were for a long time mostly limited to small populations. There is only one recently published larger study on the nationwide implementation of *"The 11"* injury prevention programme in Switzerland which was not a randomised trial but a cohort study with evidence level III.[62] *"The 11"* is an exercise-based football injury prevention programme developed by FIFA´s Medical Assessment and Research Centre (F-MARC). It consists of ten best-practice exercises focussing on core stabilisation, eccentric training of the hamstrings, proprioceptive training and dynamic stabilisation with plyometrics and straight leg alignment. These exercises have to be performed regularly before training session and are combined with the promotion of fair play as the 11th component of the programme. The programme aims to prevent the most common injuries in football such as ankle sprains, hamstring and groin strains, and knee ligament lesions. It is designed for amateur players and does not require any equipment other than a ball. The Swiss study showed the effectiveness of *"The 11"* in reducing injuries in amateur players at national scale while at the same time demonstrating the considerable logistic challenges and demands on the organisational structures of the sport to achieve such broad reach out.

The evidence with regard to the effect of prevention programmes in youth and adolescent football is even more limited.[37] While most authors acknowledge the need for more research to be done, they unanimously advocate the need for effective prevention programmes in youth players.[41,42,52,54] In their review of the current knowledge about the various steps of the "sequence of prevention" model in children's sports injuries (including adolescents), Collard et al conclude: "Currently, measures that prevent physical activity injuries in children are hardly available and little is known about their effectiveness."[16]

Comparing injury incidence for 7-13 year-old children on community level in four different sports (baseball, American football, softball and football), Radelet et al. concluded that more than the others football should be a priority for injury studies based on the by far highest injury rate.[28]

A randomised controlled trial assessed the effect of F-MARC's *"The 11"* described above in 2100 female players aged 14 to 16 years in Norway.[63] While no differences in injury risk were observed between the intervention and the control group, compliance of teams was found to be rather low. In a consequent cluster randomised controlled trial, the advanced version *"The 11+ - a complete warm-up programme to prevent injuries"* was tested in 125 female adolescent teams in Norway.[64] Based on the lessons learnt with *"The 11"*, the advanced programme *"The 11+"* was developed to increase compliance of coaches and teams by presenting it as a complete warm-up prior to training and match play, and therefore easily integrated into team routines. It further offered different degrees of difficulty and more partner exercises to provide variety and challenge for players. As the precursor version, the *"The 11+"* programme is aimed at amateur players and does not require specific equipment. After a short period of familiarisation, it can be completed in 20 minutes and should be performed prior to each training session and in part before matches. *"The 11+"* coaches were asked to perform the *"The 11+"* as their warm-up prior to training sessions and matches. During the season of eight months, there was a significantly lower risk of any injury, overuse injuries and severe injuries in the intervention group as compared to the control group.

After the completion of this injury epidemiology study and dependent on its results, the plan therefore was to test *"The 11+"* in the target population of adolescent male disadvantaged players as the next step in the TRIPP model. In this regard, it has to be acknowledged that intervention studies largely depend on local situations even when trying to establish an ideal setting.[16]

2. Study aim and objectives

Aim

Determining the incidence and characteristics of football injuries in disadvantaged male black adolescent players in Gauteng, South Africa, during the school year season 2009

Objectives

- Assess the overall frequency of injuries in the study population;
- Describe the location, types and causes of injuries in the study population;

- Evaluate the acceptability and practicability of a standardised injury recording system in the study population;
- Provide indicators for the sample size calculation of a later injury prevention study (e.g. injury incidence) to be conducted in 2010 in the study population.

3. Methods

3.1 Design

The study was prepared in 2008 and conducted from January to October 2009. The incidence, characteristics and causes of football injuries in disadvantaged adolescent male players in Gauteng were evaluated in a prospective epidemiological cohort surveillance study during the school football season 2009.

3.2 Study population

Disadvantaged adolescent male black players from high schools in the Gauteng province of South Africa.

3.3 Sampling

A sample size of 12 (-15) teams, corresponding to about 300 (-350) players, was aimed at to be included in the study to give a 80% power (p 0.5) to record injuries according to the definition below and based on the following estimate derived from the literature: A 15% loss to follow-up and an injury incidence of 15%.[64] The targeted population at schools were identified by the South African Schools Football Association (SASFA) who had agreed to assist in this process and encourage compliance and cooperation by the coaches.

Inclusion criteria were that teams would perform at least two training sessions per week, in addition to match play, or any three football sessions in total; teams with male players only; skill-level of players corresponding to those playing football as part of their regular school sports activities; and “disadvantaged” following the definition given above. Teams were required to have a permanent coach who would stay in this position throughout the study period.

Exclusion criteria were less training and match sessions per week, mixed teams, no permanent coach and teams that did not meet the “disadvantaged” definition. Players with current injuries were excluded from the analysis but not from the study (see also drop outs).

Selection process

Permission for the study was obtained from the Gauteng Department of Education’s Research Officer to approach the schools and coaches/teachers and from SASFA. SASFA further facilitated approval on behalf of the Gauteng provincial Department of Sport, Recreation, Arts and Culture. SASFA invited 20 schools as participants for the study according to the criteria given above. Initial contact was with the principals of the schools in the first instance, by staff of the Centre of Exercise Science and Sports Medicine (CESSM), and then through the identified coach at those schools. The identified teams were invited to participate after explanation of the project to the coaches.

3.4 Data collection

3.4.1 Instruction and training

The injury recorders (n=6) were instructed in December 2008 during two workshops and one-to-one instructions were they received specific training on the protocols for injury classification and recording. The ability of injury recorders to record injuries using standardised methods was tested in a mock situation to assess their understanding. Further quality control took place through site visits and reviews of the data collected.

From 15-20 December 2008, the coaches of all teams from schools that had responded to the initial invitation (n=11) participated in two workshops with the research team. They were in detail instructed how to record individual player and team participation for each training session and match at the beginning of each session, including reasons for absence of the player during the study period.

3.4.2 Outcome measures

Baseline characteristics of players

Data on baseline characteristics of teams and players included playing position, age, stature, body weight, dominant leg and previous injuries (appendix 1).

Exposure and injury recording

All assessment methods with regard to exposure and injuries followed the recommendations of the consensus statement by Fuller et al and are explained in detail below.[19] During the study, exposure report and injury recording forms were collected by the specially trained injury recorders on a weekly base. The injury recorders travelled to the respective schools on the day scheduled for their training to meet with both the coaches and players. The same injury recorder was supposed to visit the same teams during the study.

Recording of exposure time: The coaches received standardised exposure report forms with the names of their teams and all the players registered based on the school/SASFA team lists when entering the study (appendix 2). On the exposure forms, individual player exposure to both training and match play was to be documented. Information regarding risk factors such as the field conditions could be included for individual players and teams to provide an indication of the conditions of play, but was not to be included in the analysis. The exposure report forms were collected from the coaches once a week.

Recording of injuries: Recall bias is a well known problem particularly with regard to minor injuries. We aimed to minimise this bias by generally limiting the recall period to one week.[65] On the weekly visits of the injury recorders to the training site, all players had to report one after the other and were interviewed on a one-to-one base. The injury recorder was required to explicitly ask each individual player on the occurrence or non-occurrence of injury. Every injured player was then interviewed to assess aspects of the injury based on the standardised injury questionnaire (appendix 3). This one week period was however exceeded if a player was not present at the recorder´s visit or when training was cancelled and the injury recorder could not meet the team. In these instances, the recall period could extend to two or three weeks. Many studies report on injuries occurring within a one-year recall period which has been shown to be unreliable with a tendency to forget particularly less serious injuries.[65,66,67] Junge et al reported that two-thirds of injuries were forgotten over a one-year recall period: the less the symptoms and the longer ago an injury, the more likely it was not recalled.[18] One study in community level sports reported good to moderate agreement of self-reported injury incidence over four weeks compared with objective data.[68] Importantly, with regard to our study population´s age group, Shrier et al concluded that self-reporting by youth athletes within a recall phase of three weeks was in acceptable agreement with parent and coach reporting.[69]

According to the consensus statement, all injuries defined as "any musculoskeletal complaint caused by football" should be recorded by interviewing each individual player of the team.[19] Such injury recording included whether it caused the player to be unable to fully take part in the next match or training session and the number of days from the date the injury occurred until the player was fully fit to take part in all types of training and matches as an indicator of injury severity. It is important to note that according to the injury consensus statement, the day of injury is day “zero” and not counted in the calculation of severity which is based on days.[19] That means that if a player is injured in the first minute of a match and not able to continue to play, no time loss will be recorded if he is able to train or play the next day. This concept might be difficult to understand for a player. Further, in this study, decisions on when to return to play after an injury were based on the players´ and/or coaches judgement without medical assessment. This is however a situation generally encountered with minor injuries at amateur levels of play worldwide and therefore appeared acceptable. Severity was classified as minor (1-3 days absence), mild (4-7 days absence), moderate (8-28 days absence) and severe (more than four weeks absence). Other indicators of severity mentioned in the consensus statement such as individual or team performance, costs of rehabilitation, uninsured and insured costs or long-term impact on a player´s life were not applicable to the study setting.

Further, the injured body part and type of injury were recorded incl. diagnosis based on the Orchard code.[70] With regard to step two of the sequence of prevention model, it was documented if the injury occurred during training or match play, if the player had had a previous injury, whether the injury was caused by trauma or overuse, non-contact or contact and, in the latter case, if foul play was involved and if yes, how this was sanctioned (see appendix 3).

In order not to introduce bias, the injury recorders were not allowed to treat any injuries during their site visits.

3.4.3 Incentives

To increase motivation and compliance of players, they received FIFA “Fairplay” caps, pins, lanyards, pens etc. at the beginning of the study with the prospect of another reward provided by the CESSM at completion of the study. To increase motivation and compliance of coaches, they also received caps, pins, pens and FIFA writing pads at the start of the study.

3.4.4 Compliance of coaches

Compliance of coaches was assessed during the weekly visits when injury recorders collected the exposure forms. The players and coaches were reminded of the importance of the study for their own health / health of their team, and the incentives for participating.

Non-compliance by either coaches or players as identified in the follow-up was directly addressed by trying to establish the reasons, and it was attempted to assist in correcting such problems by visits and follow-up phone calls of the senior researchers.

3.4.5 Ethics

All data were made anonymous and coded to protect privacy and ensure confidentiality of data. Parents and players were comprehensively informed of the objectives and nature of the “sequence of prevention” project extending from injury recording to establish epidemiology as a first step to the later planned intervention by implementing of *“The 11+”* as well as any potential benefits and risks, and their consent (appendices 4 and 5) obtained prior to embarking on the study. Ethics approval had been applied also for the complete “sequence of prevention” project consisting of both epidemiology and intervention through the University of the Witwatersrand’s Human Research Ethics Committee (HREC) (Medical) and was granted on 13 March 2009 (protocol number M081005).

3.5 Data analysis

The data were analysed for baseline characteristics, injury incidence (total of injuries, percentage of players injured; injuries per 1000 training hours, injuries per 1000 match hours), severity, location and causes of injury in the study population over the period of the study using descriptive statistics (Microsoft Excel 2010). Baseline characteristics of players and exposure were assessed for normal distribution and compared between injured and non-injured players using the t-test for independent samples for continuous number variables (age, mass, exposure) and using the Fisher's exact test for categorical variables (boots, any previous injury, previous injury at same site).

Drop-out: Players who missed >20% of the training sessions for reason other than injury were to be excluded from the analysis (as were players injured at the start of the study, see above). This was based on the requirements for the later intervention study where a minimum number of prevention programme sessions per week needed to be performed to achieve an effect. By defining drop-outs identically in this study, we hoped to get a better estimate of the true drop-out rate to be expected in the intervention study where it would need to be considered in the sample size calculation for the intention-to-treat analysis. For teams, the drop-out rate referred to non-compliance of coaches as defined above or any other reason resulting in a team to miss the corresponding amount of sessions, or if more than 60% of players within a team are non-compliant or absent.

4. Results

4.1 Study population

Of the initially 20 schools initially identified by SASFA, 11 responded (response rate 55%) and all of them agreed to participate after explanation of the study aims and objectives. Of the schools that agreed, the coaches of two schools were consequently no longer accessible. Accordingly, nine schools corresponding to nine teams in Gauteng agreed to participate in the study.

This led to a final sample size of nine teams resp. 204 players only instead of the intended 12-15 teams and 300-350 players. As there was no time to recruit new teams and the probability to find more teams willing to participate was low based on the initial experience with the schools selected by SASFA, this deviation from protocol was accepted. Since there were absolutely no injury epidemiology data available for this study population, it was decided to nevertheless attempt to define some key points for the later intervention study despite the smaller sample size.

The assent form of all the 204 players and their parent's consent form were collected. All 204 players completed the baseline characteristics assessment in January 2009, and all but one player completed the complete follow-up from the first visit of the injuries recorders beginning of February 2009 to their last visit end of September 2009, accounting for a drop-out rate of 0.2%. Two-hundred and three players were documented with individual exposure data during the whole study period of eight months, and, accordingly, all teams completed the study.

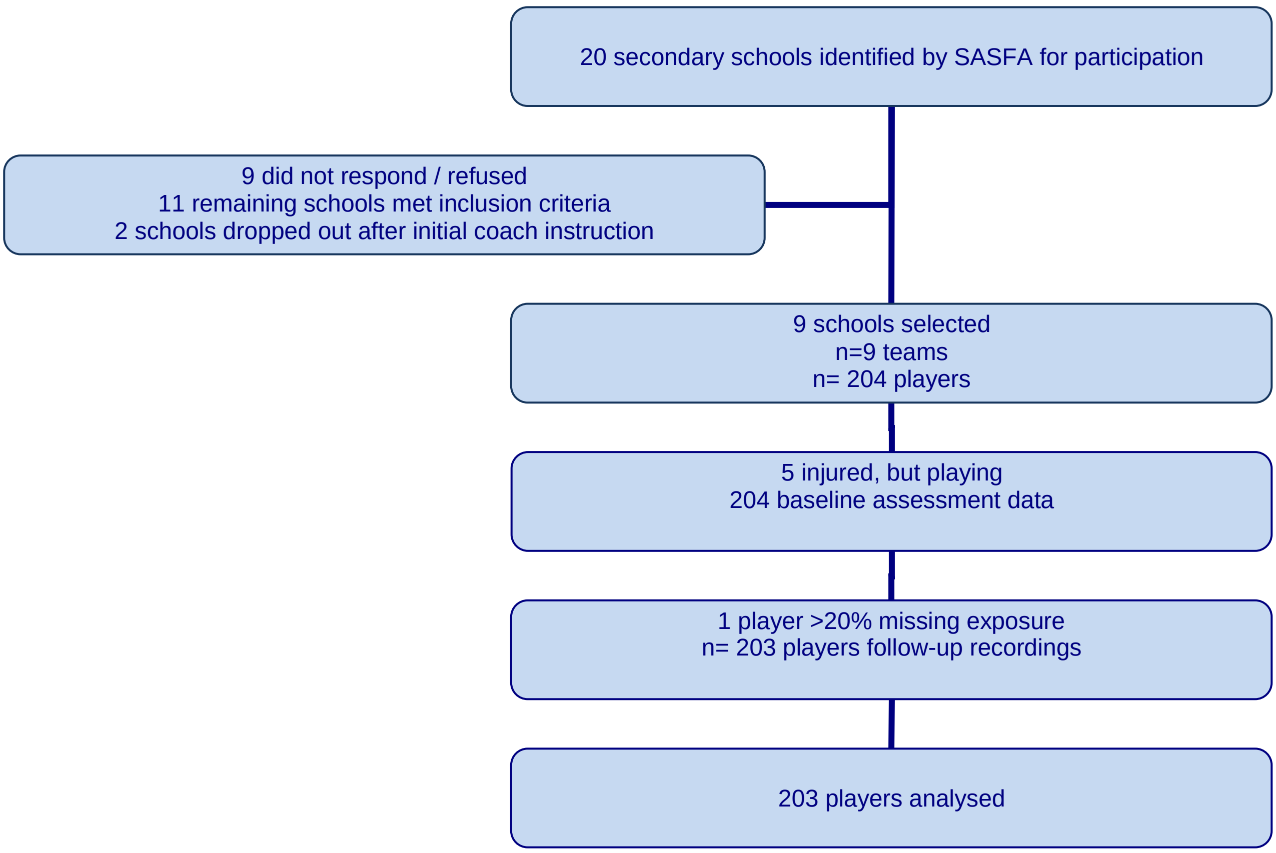

Figure 4.1.1 **Flow of study participants from initial invitation of schools over recruitment and follow-up visits of the injury recorders**

4.2 Baseline characteristics

The injury recorders (n=6) of the CESSM examined the players of all teams selected to participate in the study from 12 - 17 January 2009. Table 4.2.1 shows the baseline characteristics of the players (n=204) initially enrolled in the study.

Table 4.2.1 **Baseline characteristics of players in the study population overall and per age group**

n	Age (years) average (range)	Height (cm) Mean (range)	Mass (kg) Mean (range)	Boots	Barefoot	Previous injury
204	16 (13-21)	164 (123-184)	53.6 (31-75)	186 (91%)	18 (9%)	48 (23.5%)

Different from what was expected from the school grades, 69 players (34%) turned out to be over 16 years at baseline assessment (three players were 13 years, 35 players were 14 years, 52 players were 15 years, 45 players were 16 years, 42 players were 17 years, 12 players were 18 years and 7 players were 19 years). Eight players were 20 years of age and above. This led to a deviation from the protocol as planned in that these 69 players, though older than the targeted 14-16 years of age, were retained in the study in order to maintain a reasonable sample size. Average age was 16 years and therefore within the target age range.

The vast majority of players (91%) played with boots. Forty-eight players (24%) at baseline assessment reported to have suffered a football injury previously.

4.3 Exposure recording

Exposure recording was performed from 2 February to 25 September 2009 during 34 weeks. Total exposure to football was 15,966 hours, the total training exposure was 9,195 hours and match exposure 6,770 hours. Weekly exposure data were missing in two teams (22%) corresponding to 39 players (19%) in February. Average total exposure per player was 9.8 hours per month, average exposure to training and match per player was 5.6 and 4.1 hours per month respectively. Total, training and match exposure per team and player and month varied considerably. The average total of exposure was 78 hours (CI 15.5 – 187) per player.

Based on any three football activities of minimum 45 minutes per week, a minimum exposure of about 540 min corresponding to nine hours per month would have resulted. This was regularly not achieved by five of the nine schools, reasons being either cancellation or shortening of football hours in favour of other school subjects during individual weeks, often repeatedly or in sequence. At individual schools, training activities were omitted for a whole month. Strikes by school teachers in June and August further affected lessons. Individual coaches were difficult to get hold of, requiring repeated visits and often retrospective recording for two or even three weeks. Some teams showed identical recordings of training and match exposure for teams and each individual player over months despite repeated reminders to record individual exposure times.

4.4 Injury incidence

A total of 46 injuries were recorded in 41 players (20% of all players), resulting in 2.9 injuries per 1000 hours of exposure. In 11 cases, the same body part had been previously injured. Five players each suffered two injuries, in two of these it was a re-injury. Seventeen injuries occurred during training and 29 injuries occurred during match play, accounting for an incidence of 1.8 injuries per 1000 training hours and 4.3 injuries per 1000 match hours.

With regard to baseline characteristics, injured players were on average 16.2 years old (range 14-21) and weighed 54.9 kg. Non-injured players were 16 years old (range 13-21) and weighed 53.7 kg on average. Two injured players played barefooted (both of which suffered an ankle sprain), all played both on gravel and grass. Thirteen injured players were midfielders, eight defenders, five strikers, two forwards, six wing players, four back players and three goalkeepers. There were no significant differences in baseline characteristics for age, mass and boots/barefoot playing. Significant differences were observed for any previous injury ($p=0.0039$) and for total exposure hours per player with 94 hours for injured and 74 hours for non-injured players ($p=0.001$). However, both groups showed considerable variation in exposure. Table 4.4.1 shows the details of the comparison of baselines characteristics in injured and non-injured players.

Table 4.4.1 **Baseline characteristics of injured players compared to non-injured players**

Age (years)	n	Age (years) average (range)	Mass (kg) Mean (range)	Boots	Barefoot	Any previous injury	Average exposure per player
Injured players	41	16.2 (14-21)	54.9 (40-72.4)	39 (95%)	2 (5%)	17* (41.5%)	94 hrs** (25 – 180)
Non-injured players	163	16.0 (13-21)	53.7 (31-75)	147 (90%)	16 (10%)	31* (19%)	74 hrs** (15.5 – 186)

*p.0039; **p=0.001)

With regard to injury characteristics, 55% were contact injuries (of the contact injuries, 40% were due to foul play) and 20% of injuries occurred without contact with another player. A total of 12 injuries (26%) were classified as overuse injuries without an acute trauma. Seventy-six per cent of the injuries were to the lower extremity, with the ankle being the most often injured joint prior to the knee (34 resp. 24% of all injuries). A sprain was the most frequent injury type (61%) with contusions (22%) and strains the next frequent types. An ankle sprain was the most common diagnosis (15 resp. 33% of all injuries). Average absence from play was 3.4 days (range 0-21 days). No-time loss injuries accounted for 24% of all injuries. Seventy-four per cent of injuries were of minor to mild severity (<3 days of absence from play). Only five injuries were of moderate severity, meaning they resulted in more than a week's but less than a month absence from play. No injuries were severe (causing more than a month of absence; see table 4.4.2). Separate calculations for incidence and characteristics of training and match injuries are also shown in table 4.4.2.

Table 4.4.2 **Injury characteristics of 46 injuries suffered by 41 players**

	Total	Training	Match
Exposure hours documented	16‘015	9‘196	6‘770
Average exposure per player (hrs)	78	45	33
No of injuries	46	17	29
Injuries per 1000 hrs	**2.9**	**1.8**	**4.3**
Previous injury to same body part	24% (11)		
Circumstances			
Non-contact	20% (9)	24% (4)	17% (5)
Contact with another player	33% (15)	29% (5)	34% (10)
Foul play	22% (10)		34% (10)
Overuse	26% (12)	47% (8)	14% (4)
Injured Body part			
Face	(1)	(1)	
Wrist	(3)	12% (2)	(1)
Elbow	(1)	(1)	
Shoulder/clavicle	11% (5)		17% (5)
Trunk	(1)	(1)	
Hip/groin	(2)	(1)	(1)
Thigh	(3)	12% (2)	(1)
Knee	24% (11)	24% (4)	24% (7)
Lower leg	(2)	(1)	(1)
Ankle	34% (16)	18% (3)	45% (13)
Foot	(1)	(1)	
Missing	0		
Type of injury			
Dislocation	(1)		(1)
Sprain / ligament	61% (28)	53% (9)	65% (19)
Strain / muscle fibre rupture	13% (6)	29% (5)	(1)
Contusion	22% (10)	18% (3)	24% (7)
Laceration/ abrasion/ blister	1		(1)
Missing	0		
Estimated severity of injury			
0 days (minor)	24%(11)	35% (6)	17% (5)
1-3 days (mild)	50%(23)	53% (9)	48% (14)
4-7 days (mild)	15%(7)	12% (2)	17% (5)
> 1 week < 1month	11%(5)	0	17% (5)
> one month	0	0	0
Expected time-loss injuries			
Injuries per 1000 hrs	**2.2**	**1.2**	**3.5**

5. Discussion

This was the first study to investigate the incidence and characteristics of football injuries in male black adolescent players in a disadvantaged community setting in Africa applying current scientific standards. Sample size was estimated based on international injury frequency data in football and selection criteria for the study population were defined to achieve the required data quantity and quality. Baseline assessment was performed in all players initially enrolled in the study. Injury recording based on international consensus statement standards with weekly individual and team exposure recording was attempted.[19] Though the drop-out rate was 0.2% for players and 0% coaches, the quality of data was insufficient for more detailed or multi-regression risk factor analysis because the targeted sample size was not achieved, players did not meet inclusion criteria with regard to age, and total exposure to football was considerably lower than what would have been expected based on the original selection criteria.

5.1 Lessons to be learnt for future prospective studies in this setting

The following discussion will therefore concentrate on the challenges experienced in conducting a prospective cohort study requiring high compliance and discipline of injury recorders, coaches and players in the community setting of disadvantaged black adolescents in South African high schools. It aims at providing a detailed error analysis in order to learn lessons for future studies in this particularly demanding surrounding and outlining some conclusions with regard to the planned intervention study.

<u>Recruitment</u>

Recruitment of schools proved difficult with only half of the invited schools agreeing to participate in the study. Despite explaining the rationale of having to identify the problem first prior to delivering the prevention programme in the following year, the purpose and benefits of the injury recording might have not been entirely clear to the heads of school. It has to be presumed that for these schools, physical activity and football is of far less importance than the mastery of basic education subjects and marks as these might be decisive for the chances of these disadvantaged pupils on the job market.

However, Collard et al in their study on injury prevention in Dutch primary schools also found that only 8.7% of the invited agreed to participate with a non-response rate of more than 70%.[71] A fifth of the invited schools declined quoting lack of time to deliver the prevention programme as their reason. So even in this privileged setting the importance of physical activity for general development, cognitive skills and health of pupils had not transpired to decision makers in schools.

Sample size

The targeted sample size for this study has been 300-350 players, meaning the number of finally enrolled players in the study of 204 failed to achieve this aim by 32%. This deviation from the protocol was accepted in face of the difficulties in school recruitment described above and further difficulties in motivating coaches to participate in the study. Despite repeated explanations, it seems that the purpose and necessity of injury recording without a direct benefit for players might have been difficult to understand for both principals and coaches. With regard to the criteria used for sample size calculation, the actual drop-out rate of only 0.2% instead of the 15% drop-out expected can be considered to be partly compensating for the smaller sample size. The percentage of injured players was also higher than what was used for the original sample size calculation, which further supports the decision to continue with the study.

Age

Schools and grades had been chosen in order to meet the inclusion criteria of the study. However, a third of the players were more than one year older than what was expected from their grade, implying that they had had to repeat one or even more school years. In view of the difficulties during recruitment of schools and the lack of alternatives, this age difference was accepted as a limitation related to the setting of the study in disadvantaged communities and usually not to be encountered in more privileged conditions.[71] Further, average age was within the initially targeted age range of the study.

Exposure recording

Even though the official curriculum for football sessions at the schools complied with the inclusion criteria of the study, the exposure finally recorded did not meet the minimum requirements in more than half of the teams. This might partly be related to the double role coaches had in this study setting, being also teachers. It became clear throughout the course of the year that teachers had their own priorities with regard to learning objectives, likely based on what they believed to be the best respectively most important for their pupils. Whenever illness, strikes or conditions in individual schools required a decision between football and other subjects, the decision would be in favour of the latter. Also, whenever more learning time was considered necessary for pupils, football lessons were cancelled to provide for this.

While the importance of individual and team exposure recording on a weekly base is generally acknowledged, the many challenges to achieve this outside controlled study settings have been often described. The complete recording of exposure times for all but one player throughout the study period appears as a strength of our study, but has to be viewed with caution since it is also highly unlikely, particularly in view of the many other challenges encountered, that they present an accurate reflection of the true participation. Such caution is further indicated by the identical recordings for some teams and players over months. As the injury recorders could not control and supervise all training sessions at the schools, it cannot be excluded that coaches completed their reports rather based on what they thought was expected of them than what they experienced in reality, sacrificing accuracy to completeness.

Collard et al alternatively calculated exposure based on baseline information, questionnaire replies at the beginning and end of the school year, the time assigned to physical activity in the official curriculum and a correction factor for seasonal differences.[71] The authors acknowledged the preferability of weekly recordings but classified this as not feasible in their primary school setting in the Netherlands. They concluded that an overestimation of exposure time might have resulted from their approach, which would be confirmed by our findings of a lower exposure in reality. Junge and Dvorak found the same when comparing weekly recording with retrospective calculation of exposure.[18]

<u>Compliance</u>

A remarkably low drop-out rate was observed with 0.2% for players and 0% for coaches. Only one player was lost to follow-up with only five session recordings during the study period. Obviously, it has to be considered that no intervention had to be followed in this study and comparison with drop-out rates in the literature is therefore limited. However, the diligence in recording exact individual participation times of players needs to be questioned. Again, it seemed as coaches reported what they thought was expected from them: as complete recordings as possible. For example, one coach recorded exactly identical exposure times for all players and the team in the first months despite repeated alerts to the importance of individuality. Only thereafter he recorded different times for some players. Compliance varied among coaches, with some of them not adhering to agreed meeting times with the injury recorders or being unreachable to fix a meeting. This in turn at times led to longer recall periods than one week, likely to influence the accuracy of exposure recording. The incentives offered to them might have been more appealing to the football coach than the teacher in them.

Compliance of players was largely connected to the compliance of their teacher / coach (be present at agreed injury recorder visit times) but in general, players were easily accessible and ready to answer the questions by the injury recorders.

The study by Collard and Verhagen investigating the effect of a school-based physical activity injury prevention programme in a community setting observed only minimal non-response and loss to follow-up which they ascribed to the easy implementation of the programme, its time efficiency and that it fitted well into the school curriculum.[71] Even though we only looked at injury recording without intervention, the last two criteria would seem to be fulfilled in our study, too, but here rather presented basic requirements than success factors per se.

Injury recorders

The injury recorders in this study were exercise and sports science students in their first or second year. A recent Australian study had shown that exercise and sports science students, if properly trained, are reliable exposure and injury recorders.[72] Their influence on the motivation and involvement of the coaches who were usually older and of different social and educational background in our study is however difficult to assess. Here, a more visible presence of a senior researcher might be advisable, ideally with experience in community-based research and with an understanding of the setting.

Injury frequency and characteristics

Forty-six injuries were found in 41 players (20%). The percentage of players injured found in this study corresponds to what has been found in the literature and is slightly higher than the estimated injury rate assumed for sample size calculation. Emery et al in their prospective community youth football injury study observed injuries in 19.2% of players.[54] The injury incidence of 1.8 and 4.3 injuries per 1000 hours of training and match play respectively complies with the reported higher incidence of match injuries in the literature. The incidence figures in the lower ranks compared to the literature using the same incidence definition of injuries per 1000 hours of exposure.[38,39,40,41] Injured players in this study showed a higher exposure on average, but the high variation in individual exposure times makes this finding difficult to assess.

Injury incidence rates are considerably influenced by the accuracy of exposure recording, which has been discussed above, but also by the injury definition. The injury definition used in our study is based on the injury consensus statement and encompasses all "any musculoskeletal complaint caused by football" and was recorded by interviewing each individual player of the team.[19] The different injury definitions used have been described in the introduction.

One major argument for an all-encompassing definition as used here is that the majority of injuries in football is mild and of transient character, and consequently would be missed with an injury definition based on time-loss.[73] Further arguments are that the ability of an injury to reduce performance is unrelated to its forcing the player from the pitch, and it may impact on skills and technique independent from time loss.[74] It has also been argued that any injury may affect long-term health.[44] A broad definition has several advantages in a standardised research setting and at elite level.[30] However, it also requires far more attention by injury recorders and must be carefully explained to players as the concept might not easily reveal itself to them when recording relies on self-reporting. Further, the recall of injuries by players is closely related to their severity, meaning that minor injuries are not as well remembered as major ones.[18]

The major argument against a broad injury definition and for a narrow, time-loss related definition is in fact the reliability and accuracy of data in a real world setting.[75] According to this rationale, reliability of injury recording following a broad definition will be particularly impaired with less motivated recorders. Orchard et al go even further and argued that a missed-match definition is the most functional and accurate.[75] This view however cannot be maintained in a community setting. In addition to the frequent cancellation of matches and the variability of the time period between matches, there are generally many further factors influencing the participation of players in matches in non-professional football.

In our study with self-reporting by players, individual differences in perception and sensitivity to pain and injury rather than motivation will influence reporting. It might be difficult for an adolescent player to understand why he should report any minor contusion or abrasion that only caused brief pain while he kept on playing. These incidents during training or match play are also likely to be forgotten after one week when a player is questioned, and even more so when he is not present at the weekly meeting but only reports after two weeks. Consequently, the concept of an injury definition based on time-loss from training or match play might seem to be more comprehensible from a player perspective. At the same time, the fact that time-loss in our study depended exclusively on the subjective self-assessment of the players without the medical advice usually determining time-loss in other studies, makes this factor a relative consideration holding as many advantages as shortcomings, and rendering it even more difficult to identify the ideal injury definition in this setting.

It can however be concluded that it is likely that the self-reporting by the adolescent players in our study represents an underreporting of injuries as per the all-encompassing injury definition. Underreporting particularly of minor injuries is likely due to the difficulties for players in evaluating what means absence from play, to the lack of medical counselling and to the recall periods. It seems important to more carefully and in detail explain the injury definition in the planned intervention study to ensure a more comprehensive and sound understanding by players in order to reduce underreporting.

Other authors share the concerns with regard to the use of consensus-based injury definitions at community level. A methodologically similar study (observational prospective cohort survey), however in four different community sports including football, and in children, also provided coaches with an exposure (team roaster) form and an injury recording form.[28] The coaches were instructed in the completion of forms prior to the start of the season and received incentives. During the season, they were then contacted weekly by either telephone, email or in person. Injury incidence in this study cannot be compared with the results of our study due to different injury definition and the use of athlete exposure for incidence calculation (one athlete participating in one event (game or practice)). An injury was defined as one requiring on-field evaluation by coaching staff, or causing a player to stop participation for any period of time, or requiring first aid during an event. The broadness of this definition resembles the one used in our study, and difficulties in the understanding of the injury definition by coaches were observed. The coaches, in football more than in the other sports, showed difficulty in reporting minor injuries such as bruises, which could have affected reported injury rates. These findings would comply with those in our study. Problems were encountered with regard to compliance of coaches who considered the weekly recordings a burden.

Radelet et al in their study acknowledge that a comparison of coach / player reported injury events with researcher reported injury would allow for assessing the accuracy of data, but considered this beyond the scope of their study.[28] Having an injury recorder or other research staff present at all sessions of all teams seems in fact beyond the scope of any community-based study.

The injury incidence found in our study cannot be compared with most of the other studies in African players described in the introduction due to the substantially different definitions and methods.[57,58,59] Zerguini et al used the same injury definition and recording method following 20 senior men's teams of the Congolese national football league over one season.[76] They reported a comparably high injury incidence of 182 per 1000 hours of match play and 9.8 time-loss injuries per 1000 hours, however using independent and trained physicians for injury recording and assessing match play only. This and the higher level of play limit the comparison with our data.

With regard to comparing the injury incidence found in our study population with the international literature, Junge et al in their one-year follow-up of 14-18 year-old players found an incidence of 0.9 to 4.9 injuries per 1000 hours of exposure, however based on a time-loss definition of injury.[77] Timpka et al in their prospective cohort design study found a similarly low incidence of 2.4 injuries per 1000 hours of match play only in their community-based study in 1800 Swedish 13-16 year-old players.[42] They also used a time-loss definition of injury implying that with a definition encompassing all injuries their injury rate would have been higher.

Emery et al in their community football study reported an overall incidence of 5.6 injuries per 1000 exposure hours.[54] McNoe and Chalmers found an incomparably higher injury incidence of 46.9 injuries per 1000 hours of match play and 9.1 injuries per 1000 hours of training, using a time-loss or medical attention, though the latter including self-treatment, definition of injury.[61] Apart from this difference in definition, their study was similar to ours in that they also used a prospective cohort design study in community-level players of a mean age of 16 years. They also relied on self-report by weekly telephone interviews of players for both exposure and injuries and achieved a remarkably low loss to follow-up with a retention rate of players of 91%.They explained their high injury rate with their broad injury definition and exact exposure recording. Only one other study, using the all-encompassing injury definition as in our study, established an injury incidence within the same high range as McNoe et al with 47.5 injuries per 1000 hours of match play and 15.4 per 1000 hours of training in amateur players at an average age of 16 years.[78]

The location, type and cause of injury in this study do not differ from football injury characteristics in the literature in different settings. In compliance with other studies, the majority of injuries occurred in the lower extremities with the ankle being the most often injured joint before the knee. Sprains, contusions and strains were the major diagnoses and injuries were in general minor to mild (see detailed discussion below). The extremely high frequency of sprains might need to be seen in the light of self-reporting by players without medical counselling even though injury recorders were trained to assist players and enforce as precise recording as possible. This limitation applies in general to the correctness of diagnoses incl. and particular with regard to overuse injuries as well as to the previous occurrence of an injury of the same type which might indeed be difficult to assess for a player at this educational level.

However, using alternative recorders such as coaches or parents might not rectify the problem in this setting. In fact, Shrier et al recommended to explore the use of self-report by youth players as a valid and cost-effective alternative to parent- and coach-reporting based on their comparison of injury reporting by 11-17 year-old football players with the same by their parents and coaches, even though in a small population only.[69]

What were classified as overuse injuries by players made for 26% of all injuries in this study which seems comparably high. In youth players, Chomiak at al found 18.5% and Junge et al 14.9% of overuse injuries.[46,78] It is likely that the high percentage found in this study is due to a lack of complete understanding by players of what overuse exactly means. It has to be considered that this is also not always easy to distinguish clinically.

<u>Injury severity</u>

The severity of injury according to the consensus definition and as used for example by FIFA at their competitions is based on the estimate of absence from play by the team physician expected from him as an expert.[19,30] In our study, no severe injury occurred causing an absence from play of more than four weeks. While this was confirmed by the complete weekly exposure recordings, the accuracy of the recorded data with regard to severity of injuries in this study has to be questioned. It is known that athletes and players with medical advice will challenge the healing process by playing with injuries.[79] In our study, players by definition had limited access to proper medical care, so their return-to-play was solely based on their own self-assessment of pain and impairment, influenced by their eagerness to play and other personality factors. This implies that the application of this consensus definition has its limitations in a community setting, and even more so in a disadvantaged community with limited access to medical care.

This view is shared by the authors of the other two community setting studies described in this report. Emery et al referred to the problem with regard to minor injuries where return to play is determined more or less exclusively by players in any amateur setting.[54] Many different factors contribute to this decision, such as the importance of a game or training, pain tolerance, motivation, and personality factors. These factors differ for each athlete, which affect the precision of equating time loss with severity of injury. McNoe and Chalmers were also not convinced that in community-level football ‘‘return to play or participation’’ is a reliable indicator of recovery from injury, as many players reported that they continued to train and play while injured whereas others did not return to football as soon as they had recovered from their injury.[61]

<u>Comparing injured with non-injured players</u>

Baseline characteristics such as age, mass and footwear did not differ significantly between injured and non-injured players. Injured players in our study population had significantly more often suffered from a previous injury at any location as compared to non-injured players. This finding is in line with what is reported in the literature, e.g. Emery et al reported that football players with a previous injury had a 74% increased risk of a further injury as compared to previously not injured players.[54,55] In view of the lack of access to adequate medical care of the players in our study, insufficient treatment and healing of previous injuries is rather likely. Inadequate rehabilitation and premature return to play are repeatedly reported injury risk factors and are likely to represent a major consideration in populations without access to proper medical care.[80]

Studies have shown an association between training and risk of match injury, with those who completed less training hours being at a greater risk of injury in a match.[81] In our study, however, football exposure in the injured players was significantly higher than in the non-injured players.

5.2 Generalizability of results

Only 55% of the initially invited schools responded, and of these, only 9 (45%) could be included in the study. A comparison of variables between participating and non-responding/non-included schools was not performed, and the study was limited to Gauteng. Therefore, it is difficult to comment on the generalizability of results to all schools in a disadvantaged environment in South Africa.

5.3 Strengths and limitations of the study

Based on the definition of the term “disadvantaged”, and the selection of schools included, the sample population seems a good representation of “disadvantaged high school adolescent black football players in Gauteng.

Self-reporting has been considered a drawback of injury recording studies.[61,71] Krosshaug et al describe “significant methodological limitations” to be considered with self-reporting: the ability of the player to comprehend and recall what actually took place, when it happened, influences by other observers of the incident, change of recollection with time, filtering of the description by the injury recorder.[21] Grimmer et al. compared adolescent self-reporting of injuries by adolescents at primary and secondary schools in Australia with a one-week recall with parent reporting, and concluded that adolescent self-reporting of recreational injury is reliable.[82] In this regard, the level of education and intellectual abilities of the disadvantaged players in our study has to be considered. The weekly interval of interviewing players can be considered a strength of this study as in other studies, the recall period often referred to a whole season or year.[71] The period of one week in our study limited recall bias, but was in some cases exceeded when individual players were absent or did not report during the visit of the injury recorder.

The limitations of applying the injury consensus definitions developed for an ideal research setting to self-reporting of disadvantaged youth players have been described above.

To control for extrinsic injury factors in this study design is impossible, yet it is rather likely that environmental, training (pitch surface), equipment and individual playing and training conditions in the different schools influenced injury rates of teams. The observed injury rates have to be seen against this highly variable background.

Coaches and their dedication have been the backbone of this study and results highly dependent on their motivation and involvement, which might be considered a limitation. The delegation of exposure and injury recording to coaches is a common approach as these are usually present at both training and match activities.[28,83] Even though the delegation of data recording to study coordinators or research assistants might improve results, it is not a realistic approach in a disadvantaged community setting.

The low exposure recorded in our study is clearly a limitation and does limit the relevance and generalizability of the data considerably.

6. Conclusions

This study was the first to examine the incidence and characteristics of football injuries in black male disadvantaged adolescent players in South Africa using a systematic approach. According to the “sequence of prevention” model proposed in the literature, prevention of football injuries must follow a four-step approach, with the first one being the assessment of incidence and severity of injuries in a target population. Despite multiple epidemiological studies carried out internationally, information on the incidence, characteristics and causes of injuries in African players is scarce, and almost non-existent in youth disadvantaged football players with limited access to adequate health care. One reason is that the circumstances of playing in this population pose numerous obstacles to implementing the “sequence of prevention” model.

Systematic injury recording based on self-reporting in player interviews proved to be generally acceptable and practicable in this population considering the excellent follow-up rates and compliance of players and, mostly, of coaches. Injury incidence in this study population was comparably low which might however have been influenced by a limited understanding by players of the definition of injury used. As importantly, the majority of injuries were minor and no severe injuries were reported, which further supports the promotion of football as an ideal physical activity and educational tool in disadvantaged youth players in South Africa. The characteristics of injury did not differ from what has been found internationally.

However, the accuracy and reliability of the exposure recording in this study has to be viewed with caution, and the limitations of using the injury consensus definition for self-reporting by players with limited access to medical care have been demonstrated. In general, the findings of this study support the approach of other authors to adopt and tailor an established injury surveillance system (and interventions) to the specific population under scrutiny, even though if maybe at the cost of comparability of results.[61] Simply calculating exposure based on school curriculums as applied by others has to be considered as a valid alternative approach, being aware that this might lead to overestimation of exposure times.[71]

In face of the considerable effort and costs, the question has to be raised if sustained injury surveillance is indeed needed at all levels of play or if, in favour of an optimised efficacy of injury prevention, pilot and cohort studies in comparable population groups should be considered sufficient. This would allow focussing efforts on interventions with proven injury reducing effects – even more so in disadvantaged settings. Similar views have been stated by other authors.[54]

With regard to the planned intervention study that intends to apply the third and fourth step of the model by introducing *"The 11+"* as a preventive measure in this cohort, the following criteria of success to increase reliability and accuracy of recorded results have been identified:

1. To verify the information given by coaches on exposure by player interviewing and more frequent visits by injury recorders;

2. To more extensively explain that actual data recording is important to assess the real-life situation, and appreciate the difficulties encountered in this undertaking by coaches instead of them aiming at complete data sets to satisfy wrongly-perceived expectations;
3. To adapt visits and interview schedules in order to fit better with frequent changes of the school curriculum;
4. To ensure an optimal understanding of the injury definition by players through more extensive explanation and counselling;
5. To more closely monitor, supervise and assist coaches, preferably by more visible presence and involvement of senior researchers.

Appendices

Appendix 1 Player's baseline information

Players' Baseline Information of Team:_______________

Player's code No.[1]	Player's name	Playing position[2]	Age[3] in yrs	Stature, in cm	Body mass, kg	Dominant leg[4], (L/R/B)	Footwear (boots/ barefoot)	Details of previous and current injuries (diagnosis, year)

Notes:
(1) Use additional sheets if required
(2) Goalkeeper, Defender, Midfielder, Forward
(3) Age as at the start of season/year/tournament
(4) **L**eft, **R**ight, **B**ilateral

Appendix 2 Exposure reporting forms

Exposure Report Form (for the documentation of individual players' exposures)

(Team) Player Code No.: __________

Date						
Training /Match						
Study specific variable (Boots or barefoot)						
Study specific variable (other)						

Player Code No. Report the duration of training and match play for each player (minutes)						

Exposure Report Form (for the documentation of team exposures)

(Team) Player Code No.: ________

Date	**Match/ Training**	**No. of players** (fully participating in training)	**Duration of training session** (minutes)	*Study specific variable – state of field played on (grass/gravel/even/uneven etc)*

Appendix 3 Injury reporting form

F-MARC FOOTBALL FOR HEALTH

Injury Report Form

(Team) Player-code: Date:

1 A Date of injury: __________ **1 B Date of return to full participation: __________**

2 A Injured body part

- ❑ head / face
- ❑ neck / cervical spine
- ❑ sternum / ribs / upper back
- ❑ abdomen
- ❑ low back / sacrum / pelvis
- ❑ shoulder / clavicle
- ❑ upper arm
- ❑ elbow
- ❑ forearm
- ❑ wrist
- ❑ hand / finger / thumb
- ❑ hip / groin
- ❑ thigh
- ❑ knee
- ❑ lower leg / Achilles tendon
- ❑ ankle
- ❑ foot / toe

2 B Injured body part

❑ right ❑ left ❑ not applicable

3 Type of injury

- ❑ concussion (with or without loss of consciousness)
- ❑ fracture
- ❑ other bone injury
- ❑ dislocation / subluxation
- ❑ sprain / ligament injury
- ❑ lesion of meniscus or cartilage
- ❑ muscle rupture / strain / tear / cramps
- ❑ tendon injury / rupture / tendinosis / bursitis
- ❑ haematoma / contusion / bruise
- ❑ abrasion
- ❑ laceration
- ❑ nerve injury
- ❑ dental injury

❑ other injury (please specify): ____

4 Diagnosis (text or Orchard code): ____

5 Has the player had a **previous injury** of the same type at the same site (i.e. is this injury a recurrence)?

❑ no ❑ yes

If **YES**, specify date of player's return to full participation from the previous injury: __________

6 Was the injury caused by **overuse** or **trauma**?

❑ overuse ❑ trauma

7 When did the injury occur?

❑ training ❑ match ❑ warm-up

8 How did the injury happen?

❑ Overuse (no acute trauma)

Contact with another player

- ❑ foul play of/by injured player
- ❑ foul play of/by another player
- ❑ tackling
- ❑ accidental collision
- ❑ heading duel

No contact with other player

- ❑ change of direction
- ❑ running
- ❑ jumping
- ❑ shooting
- ❑ hit by ball

❑ others, please specify ____

9 Did the injury necessitate absence from training or matches?

❑ no ❑ yes If yes, for how long?____________________

❑ training ❑ match

Appendix 4 Letter to parents and consent

CENTRE FOR EXERCISE SCIENCE AND SPORTS MEDICINE
UNIVERSITY OF THE WITWATERSRAND

Dear Parents,

We are conducting a research study together with FIFA, called “Prevention of injuries in adolescent male football players in South Africa by implementing “The 11+”.

The aim of the study is to see whether a specific exercise programme will prevent and reduce injuries in young male football players in South Africa.

The players will be asked to answer to health related questions at the beginning of the study, and will also go through some simple measurements such as height and weight. They will then be divided into two groups, one group will train and play as normal, and the other will also train and play as normal, but will replace their warm-up with the specific exercise programme. They will do this programme for at least 30 weeks, and every week they will be monitored for any injuries.

This study will be of benefit to your son and others if it proves that it is effective in preventing injuries and we then use it around the country in many more communities. The study will not cause any problems with your son’s training or performance and there is no cost for you to pay.

If you are comfortable with your son taking part in this research, please sign the attached consent form. If your son is comfortable with taking part in the study, kindly let him sign the attached assent form. Please note that your son can stop being part of the study at any time if he is unhappy.

Yours faithfully

Dr Demitri Constantinou
Director

INFORMED CONSENT

"The F-MARC 11+" – prevention of injuries in adolescent male football players in South Africa.

1. In order to see whether the effect of a specific exercise programme will prevent football injuries, I volunteer to allow my son to answer to questions about medical problems and injuries, have basic measurements such as height and weight; and to do exercises specifically developed to prevent injuries in football players under supervision and guidance for 30 weeks.

2. EXPLANATION OF THE EXERCISES

The exercises will be carefully explained and conducted by trained coaches/mentors.

3. RISKS AND DISCOMFORTS

There are no more risks than doing normal exercises and training when playing football.

4. EXPECTED BENEFITS FROM PARTICIPATION

This project will let us know whether we can reduce injuries in young football players by doing these simple exercises.

5. ENQUIRIES

You can ask questions about the programme. If you have any further questions or need additional information, you can contact and speak to the trainers and/or the staff of the Centre for Exercise Science and Sports Medicine.

6. FREEDOM OF CONSENT

Your permission to allow your son participation in this study is strictly voluntary. You can say no if you want. You can stop your son from being part of the study at any time if you want.
I have read this form carefully and fully understand the study procedures. I consent to my son participating in this study.

______________________________ Signature of parent/guardian

Witness ______________________________

______________________________ Date

Appendix 5 Information child and assent

CENTRE FOR EXERCISE SCIENCE AND SPORTS MEDICINE
UNIVERSITY OF THE WITWATERSRAND

CHILD ASSENT FORM

"The F-MARC 11+" – prevention of injuries in adolescent male football players in South Africa.

1. We are asking you to take part in a study because we are trying to prevent injuries in football players.
2. If you agree to be in this study you will be replying to some forms, doing specific exercises with your trainer/mentor, and be monitored every week for 30 weeks.
3. The exercises will not hurt you, and will only take 20 minutes to do.
4. Your results will help us to set up better exercise programmes so that we can prevent you and the other players from getting injured.
5. Please talk to your mom and/or dad/guardian if you are happy to help us with our study, or if you do not want to be part of the testing. We will also ask your parents if they are happy for you to take part in this study.
6. If you are not sure if you want to answer the questions and do the exercises, you can ask any questions you have about them and what we are trying to measure.
7. If you cannot think of any questions now you can always phone the University on: 011+ 717-3372.
8. If you write your name at the bottom of this page it means you are happy to help us with the study, but if at any time during the study you do not want to carry on you can just let us know and we will not do any more tests or exercises with you.

Childs name: ____________________________ Date: _________________________

Childs signature: _________________________

Signature of research assistant: ____________________________

Date: _________________________

Appendix 6 Ethical Clearance

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Constantinou

CLEARANCE CERTIFICATE	PROTOCOL NUMBER M081005
PROJECT	Prevention of Football Injuries in Adolescent Football Players in South Africa by Implementing "the 11+"
INVESTIGATORS	Dr D Constantinou
DEPARTMENT	CESSM
DATE CONSIDERED	08.10.31
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 09.03.13 CHAIRPERSON ....
(Professor P E Cleaton Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor :

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

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