

**INCIDENCE AND PATTERN OF INJURIES DURING THE
NATIONAL RUGBY SEVENS CIRCUIT.**

DR JOHN WAMUTITU MAINA

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PRINCIPAL INVESTIGATOR AND DECLARATION:

I hereby declare that this study is my original work and has not been presented for dissertation at any other university.

Dr. Wamutitu J. Maina

M.B.Ch.B. (NBI 2009)

H58/69051/2011

Sign _____ Date _____

SUPERVISORS:

1. PROF. Atinga J. E. O. MB.ChB, MMed (NBI); MCHOrth (Liverpool)

Professor of Orthopaedic surgery

Chairman Department of Orthopaedic Surgery,

College of Health Sciences

School of Medicine

University of Nairobi

Sign _____ Date _____

2. DR. Vincent M. Mutiso MBChB, MMed (NBI), FCS (ECSA)

Consultant Orthopaedic Surgeon and Senior Lecturer

Department of Orthopaedic Surgery,

College of Health Sciences

School of Medicine

University of Nairobi

Sign _____ Date _____

CERTIFICATE OF AUTHENTICITY.

This is to certify that this thesis is the original work of the author.

The research was carried out during the Kenya National Rugby sevens circuit in Nairobi, Kisumu, Mombasa and Nakuru.

The Kenyatta National Hospital/ University of Nairobi Ethics & Research (KNH/UON-ERC) Committee number of approval is P464/07/2015.

Sign.....Date.....

PROF. Atinga J. E. O. MB.ChB, MMed (NBI); MCHOrth (Liverpool)

Professor of Orthopaedic surgery

Chairman Department of Orthopaedic Surgery,

College of Health Sciences

School of Medicine

University of Nairobi

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LIST OF ABBREVIATIONS.

ANOVA – Analysis of Variance.

CEO – Chief Executive Officer.

FC – Football Club.

IBM – International Business Machines.

IRB – International Rugby Board.

KNH – Kenyatta National Hospital

KRFU – Kenya Rugby Football Union.

PMH – player match hours

RICG – Rugby Injury Consensus Group.

RWC – Rugby World Cup.

SPSS – Statistical Package for Social Sciences.

DEFINITION OF TERMS

Amateur—a person who is engaged in a sport for pleasure, largely or entirely without remuneration.

Maul—a maul occurs when three or more players, including the ball carrier and at least one other player from either side are in contact together. The difference between a ruck and a maul is that the ball is not on the ground in a maul.

Professional— sports participants who are financially remunerated for the time they spend playing or training.

Player match hours – match exposure calculated by multiplying number of matches by number of players per team and duration of each match in hours. Expressed as a fraction of 1000 hours.

Ruck – the ruck is a phase of play where one or more players from each team, who are on their feet, in physical contact, close around the ball

Scrum—a formation of players when restarting play where the forwards of a team form up with arms interlocked and heads down and push forward against a similar group from the opposing side.

ABSTRACT.

INTRODUCTION: Rugby in Kenya has grown to become a very popular sport. Numerous tournaments are played each year with some attracting international teams.

The injury incidence, patterns and risk factors remain poorly understood. In Kenya rugby has only recently gained popularity and as previous studies have shown injury incidence tends to increase as professionalism and competitiveness increases.

Proper understanding of injury patterns and potential risk factors is paramount in formulation of injury prevention guidelines, indeed injury prevention is a part of the game.

OBJECTIVE: To study the incidence and pattern of rugby sevens injuries during the Kenya national rugby sevens circuit.

DESIGN: A whole population cross-sectional study among 150 Kenya Rugby Union registered players.

STUDY SETTING: The 2015 Kenya national rugby sevens circuit. Five tournaments were played in Nairobi, Nakuru, Kisumu and Mombasa

METHODOLOGY: Match injuries sustained during the whole tournament were recorded in real time. The team clinicians (physiotherapists and/or doctors) were the primary data collectors. The injury report form as developed by the rugby international consensus group was used to record injuries.

RESULTS: There were 150 players from 12 teams participating in 311 matches (285 regular and 26 final matches). The incidence of injuries was 96.3 per 1000 player match hours(103.3 for forwards and 93.9 for backs). The incidence of injuries in overweight players was significantly

higher than in normal weight players (133.6 versus 69.4 per 1000 player-match hours, $p = 0.034$). The most commonly injured body parts were; the ankle 10 (6.7%), head or face 9 (6%), foot or toe 7 (4.7%), anterior thigh 6 (4%) and posterior thigh 4 (2.7%). The incidence of injuries was higher during the finals (103.6) compared to the regular matches (94.2).

CONCLUSION: The overall incidence of injuries was 96.3 per 1000 player match hours. The lower limb was the most common single anatomic entity sustaining injuries with ankle injuries being the most common location of injury (6.7%). Sprains/ligamentous injuries were the most common type of injury (15.3%). BMI was found to be an independent risk factor for injury, overweight players had significantly higher injuries than normal weight players, $p = 0.034$.

INTRODUCTION.

INTRODUCTION TO RUGBY.

Rugby is a contact collision sport played at amateur and professional levels. The game is a physically demanding contest that involves bouts of running and sprinting with tackles and collisions. Musculoskeletal injuries are quite common.

There are several variants of the traditional 15-a-side game :

- Rugby sevens
- Rugby tens
- Touch rugby
- Rugby league (thirteen players a side)

Sevens rugby as the name suggests consists of seven players in each team. Traditionally it was considered a bit of fun to wind down the season, it is now viewed as an integral part in the development of the sport and has been included in the 2016 olympic games in Rio de Janeiro, Brazil(1).

Rugby union is a popular sport in Kenya, in particular due to the success of the Kenya sevens team in the rugby sevens format and tournaments like the Safari sevens that have attracted international teams.

In Kenya rugby is governed by the Kenya Rugby Football Union (KRFU). The Kenya Rugby Football Union (KRFU) was formed in 1923(2).

Rugby was introduced by the British and the first recorded game in 1909 was between the 'British officials' and white settler farmers in Mombasa. Until mid 1970's rugby was exclusively

played by expatriates this changed with the formation of indigenous teams like Mwamba FC and Mean Machine FC(3). Today Rugby is played almost exclusively by indigenous players in Nairobi, Nakuru, Kisumu and other major towns.

The Kenya sevens team continues to enjoy immense success in international tournaments that saw them ranked 5th in the world in 2012 (currently 9th)(4). The Kenya National sevens team is currently one of the 15 'core teams' of the IRB sevens with a guaranteed place in all eight events each season.

The annual 'safari sevens' held in Kenya is promoted as being Africa's Premier rugby sevens tournament drawing crowds of over 20,000.

TEAMS AND POSITIONS.

Teams are composed seven players; three forwards and four backs.

Forwards:

- Two props.
- Hooker.

Backs:

- Fly half.
- Centre.
- Winger/fullback.

PLAYING AREA.

Sevens is played on a standard rugby union playing field, the field measures up to 100 metres long and 70 metres wide. On each end there are H shaped goal posts.

BACKGROUND.

Rugby in Kenya has grown in leaps and bounds in the last decade. Increasing levels of professionalism and sound management of the game have been translated to successes both on and off the field. The top tier league cup in Kenya, the Kenya cup, had eight teams in the 2000/2001 season. Currently the number of teams in the 2014/2015 is fourteen. There are 40 indigenous clubs and a total of 40,000 registered rugby players of whom 3,000 are women. Rugby is a formal sport in secondary schools and most recently (2008) was admitted as a primary school sport. Numerous tournaments are held each year; nine at club level, four at the schools level(2).

Rugby is played at different levels: amateur, semi professional and professional. Concerns are frequently raised regarding the safety of the game. Fatalities and spinal cord injuries have a low incidence but carry the biggest threat to the wellbeing of the player his family and friends(5). They are also the most publicized complication(6).Rugby has the highest reported injury incidences irrespective of the definition of injury used (7)

Sport	Standard of play	Definition of match injury (incidence per 1000 hours of player exposure)		
		Semi-inclusive*	Fully inclusive†	All medical treatments‡
Rugby union	International	58 ⁴	218 ⁴	NA
	Club	45 ¹	120 ¹	NA
Rugby league	International	NA	NA	NA
	Club	39 ¹¹	NA	346 ¹¹
Soccer	International	17 ^{¶31}	42 ³¹	81 ³¹
	Club	5 ¹³	26 ⁸	35 ³²
Ice hockey	International	NA	79 ⁷	NA
	Club	NA	78 ⁷	NA
Cricket	International	NA	2.8 ¹⁰	NA
	Club	NA	1.8 ¹⁰	105 ³³

NA, data not available.
*Players missed at least one match.^{12 13 34 35}
†Players missed at least one training session or one match.^{7 8 10 15 36 37}
‡Players required medical attention from the team doctor.^{11 14 33 38}
¶Value calculated from injuries reported in international tournaments resulting in ≥4 days absence.
§Value calculated from the reported incidence of 57 injuries per 1000 days of cricket assuming a six hour playing day.

Table 1: A comparison of injury incidence in rugby and other sports using different definitions of ‘injury’⁽⁷⁾.

The epidemiology of injuries has been extensively studied among professional and amateur players especially in developed countries.⁽⁷⁾⁽⁸⁾⁽⁹⁾⁽¹⁰⁾. In Kenya (a developing nation) rugby is played at an amateur and semi-professional level. Semi professional players have higher physiological capacities than amateur players⁽¹¹⁾. This means that the Kenya Rugby population is quite unique as it is a mix of both semi-professional and amateur players playing against each other. Studies done on predominantly professional or amateur players may therefore not compare.

Rugby sevens tournaments are a popular spectator sport and in Kenya most counties hold at least one major tournament each year. Sevens tournaments are held in a typical rugby league field. The duration of a match is shorter consisting of with halves of 7 minutes each and a 1 minute halftime break, the final match of a competition may be played in two halves of 10 minutes and a 2 minute halftime break⁽⁴⁾. Most tournaments are held over a weekend (Saturday & Sunday) which means that the players may not get enough rest and may play with injuries from the previous day/match. Amateur players participating in a tournament may be particularly

susceptible to injuries. Indeed Gabbet et al found that increased physiological demands in a tournament may hasten the onset of fatigue and predispose to injury especially among amateur players(12).

Professional rugby players have access to medical services and protective gear. They are well remunerated to offset the potential risks of injury(13). Conversely, amateur players are not paid for any training or match participation, they rely on other forms of employment to generate income. The situation in Kenya is that some players may receive a stipend for match participation and also a portion of the prize money during a tournament. An injury may pose a considerable health and financial loss to an amateur player(13). Gabbet et al found that most injuries sustained by amateur rugby players are severe and usually result in a loss of training, playing and employment or study time. Moreover they are accompanied by significant direct and indirect economic costs(13).

Worldwide preventive measures have been implemented by various unions to reduce the incidence and severity of injuries. Non fatal-catastrophic injuries and permanently disabling injuries have received a lot of attention in South Africa and New Zealand. Rugbysmart and Boksmart are two such strategies developed in New Zealand and South Africa respectively. Both Rugbysmart and Boksmart have proved successful in reducing catastrophic injuries(14)(15).

Kenya has limited data on injury incidence, severity and potential risk factors in rugby. As such formulation of injury prevention programs would heavily rely on information from other countries that may not be similar to the Kenyan landscape.

LITERATURE REVIEW.

Rugby is a very popular sport worldwide and in Kenya. The nature and philosophy of rugby is that it's a contact sport and it carries one of the highest reported incidences of injury irrespective of the definition used(7).

Definitions and methodologies in literature of injuries in rugby have varied and created inconsistencies in data. This has also made inter study comparisons difficult(16). The International Rugby Board established the Rugby injury Consensus Group (2007) to address the issue of definitions and methodologies and to standardize the recording and reporting of injuries in rugby (17). The rugby international consensus group statement is the document approved for methodology of rugby research by World Rugby.

Several studies have documented the incidence of injuries in rugby(7)(9)(10)(11)(12). Typically Injury incidence increases as playing standards increase(18).Victor et al reported an incidence of 55.4 injuries per 1000 match player hours among amateur rugby sevens players during a tournament in the United States of America(19).Fuller et al reported 119.8 injuries/1000match player hours during the 2012/13 international rugby sevens world series amongst professional players(20). This twofold higher incidence among professional players has been attributed to higher playing intensity at the elite level(21). Overtraining and monetary gain has also been implicated as reasons why professionals may carry an injury into a game(18).

Locally Muma et al recorded an injury incidence of 42.5/1000match player hours which was significantly lower than most international studies that have used the Rugby International

Consensus Group protocols 2007. In his study training injuries were not recorded, the participants were also amateur players and this may contribute to the very low injury incidence(22).

A comparison of the incidence of injuries of amateur rugby union and soccer has indicated that rugby union is associated with a higher injury rate than soccer(23). In the same study Junge et al found that rugby players sustained 1.5 times more overuse and training injuries. They also had 2.7 times more match injuries than soccer players(23). Indeed rugby has consistently had the highest injury rate when compared to other sports like cricket(24), ice hockey(25) and soccer(26).

Site and type of injury

Despite differences in the nature of rugby sevens compared to the 15-a-side game the underlying general causes, i.e contact leading to injuries is the same. The main difference is the nature of injuries(20). Fuller et al demonstrated that lower limb injuries were the most common injuries among all players for the whole duration of the international rugby sevens series from 2008 – 2013. Lower limb injuries were also found to be the most common site of injury during the Rugby World Cup 2011(9). However, the mean and median severity of injury observed was significantly higher during the rugby sevens series(42.7/1000mph)(20) than during the Rugby World Cup(23.6/1000mph)(9).

A review of all sevens series data revealed that the most common type of injury was joint (none bone/ligament) for both backs (42.9%) and forwards (47%)(20). This was consistent with other data from the rugby world cup 2011(9). Comparison with data from the 2003 Rugby World cup

was difficult because of the definition of injury and the severity of injury used. The tool used to record injuries was also different. However, it's important to note that Best et al found that head neck and face injuries were the most common location of all injuries sustained(27). Lopez et al also found that head and neck injuries to be the most common site of injury (33.3%) among a cohort of American amateur sevens players during a tournament. In that study however they did not use the standard RICG tool to record and analyze data. Lopez also acknowledges that a shortage of personnel may have led to underreporting of injuries(19).

Locally Muma et al found that the most common injuries sustained during the 2010 Kenya cup 15 a side league season were the lower limb 41.2%, upper limb 24.6%, head and neck 26.4%. Forwards also had a higher injury incidence, 44.7/match player hours as compared with backs 40.83/match player hours(22). There is however no data locally amongst rugby sevens players.

Catastrophic injuries

Sports related catastrophic injuries are rare(5). However, their long-term consequences and severity make them the most devastating injuries to a player his family and friends(28).The incidence of catastrophic injuries between 2008-2011 was estimated to be 2.00 per 100000 players in South Africa(29). The incidence was comparable to other countries. Senior level players have also been found to have a significantly higher incidence than junior players, more stringent variations in the law particularly in the scrum have been implicated in the lower incidence among junior players(29). These variations include, not being to push a scrum more than 1.5m and not being able to wheel a scrum. In New Zealand these law changes have been found to reduce the incidence of spinal cord injuries(30).

Forwards versus backs

There were no significant differences in injury incidences for backs and forwards in a review of all international sevens world series data(20). The difference in injury incidence during the rugby world cup 2011 was also not statistically significant, 85.3/1000pmh and 93.8/1000pmh for forwards and backs respectively. Earlier studies had suggested that injuries were more common among forwards than backs(11). These studies were done on semi professional players and did not follow the RICG protocol.

There were no statistically significant differences in mean or median severity of injuries between backs (46.5 % 32) or forwards(37.6 & 24) in the 2012/2013 sevens rugby world series(20).The majority of injuries sustained were in the lower limb for both forwards (63.3%) and backs (58.8%). Injury prevention programmes can be directed towards utilizing exercises that improve proprioception, core stability and muscle strength.

Timing of injury.

Most amateur rugby league injuries are sustained in the second half of matches. Furthermore, injury incidence increased significantly in successive matches(12). Fatigue caused by a lower aerobic capacity in amateur players may be the reason for this pattern. During sevens tournaments players are required to compete repeatedly on the same day and on subsequent days with little time for recovery in between. Questions have been raised regarding the benefits of rugby league sevens versus the attendant high injury rates that have been related to fatigue. Among professional players during the 2012/2013 rugby world series, no statistically significant difference was found in injury rates between the first and second halves of matches (20). This

further suggests that improvements in physiological conditioning and training should reduce the injury incidence among amateur players.

Risk factors for injury

Risk factors for injury in any sports person have been grouped as either intrinsic or extrinsic.

Intrinsic factors are specific to the individual and include age, sex, anthropometric characteristics, fitness, psychological characteristics, health status and injury history. Extrinsic factors include the nature of the sport, environmental conditions, equipment(31)(32).

A review of the literature revealed three studies that examined the various and/or specific risk factors to injury(33)(34)(35). There is agreement on the risk posed by certain factors but on others the evidence remains equivocal.

Intrinsic risk factors

While Quarrie et al and Chalmers et al reported no association between injury rate and age. Lee et al reported a twofold higher injury rate for players aged 25-29years when compared to players aged 16years and below(33)(34)(35). Locally Muma et al did not report an increase in injury rate with increasing age of players(22).

Quarrie et al (2001), Lee (2001) and most recently Chalmers (2012) all found that players who were engaged in strenuous physical activity >40hrs a week were at higher risk of injury compared to less active players(33)(34)(35).

Research into the psychology and attitudes towards violence of amateur rugby league players by Mellor et al revealed that a large percentage of amateur players are likely to injure an opponent through foul play(36).

Extrinsic risk factors

Rugby is a physical contest, as such ground hardness is considered a major contributor to injury. Ground hardness is a combination of soil type, structure, usage and environmental conditions. Orchard established that the risk for non-contact anterior cruciate ligament injury increased on harder ground(37). Lee and Garraway reported that injury incidence was higher on harder ground than on softer pitches(38). Locally out of 8 rugby pitches assessed by Muma et al six were classified as bad and two as good. Muma et al concluded that suboptimal pitch conditions were a significant contributor to preventable injuries(22).

Use of mouth guards has been shown to significantly reduce the rate of complications following orofacial trauma (39). Use of the headgear has been found to reduce the incidence of scalp abrasions but was not protective against concussions (40). It is likely that players wearing headgear may become more aggressive and/or less cautious negating any benefit accrued. Locally, acquisition of personal protective equipment is a financial burden that most players may not be willing to bear.

Injury prevention in rugby

According to Willem Van Mechelen injury prevention in all sports follows a certain sequence, the so called 'sequence of prevention' model:(32)

There are four steps to the model:

1. Establishing the magnitude of the sports injury problem.
2. Establishing the etiology and mechanism of the injury.
3. Introducing preventive measures.
4. Assessing the effectiveness of these preventive measures by repeating step 1.

Rugbysmart and Boksmart are two injury prevention programmes in New Zealand and South Africa that have been developed in line with the sequence of prevention model. Brown et al found that within just four years of implementation of the Boksmart program there was a significant reduction in serious injuries in South Africa(15). The Rugbysmart programme of New Zealand also had a similar success story(14).

This suggests that a solid understanding of the epidemiology of injuries in rugby and their risk factors is paramount to formulation of successful injury prevention programmes.

JUSTIFICATION.

Effective prevention of injuries in rugby is dependent on identification of the injury problem and the potential risk factors and/or causes of injury.

There are currently two Kenyan studies that describe the epidemiology of injuries in rugby, Wekesa et al in 1996 published an epidemiological study of injuries at the rugby world cup prequalifying tournament held in July 1993(41). More than ten years later Muma et al described the incidence and pattern of injuries among rugby union 15-a-side players(22).

There are no local studies in the published literature that describe the epidemiology of injuries among rugby sevens players more so at a tournament.

OBJECTIVES:

Broad objective: To describe the incidence and pattern of rugby sevens injuries during the National rugby sevens circuit.

Specific objectives:

- To determine potential risk factors for injury.
- To determine risk factors associated with injury severity.
- To evaluate referee decisions versus injury sustained.

RESEARCH QUESTION.

What is the incidence and pattern of injury in rugby sevens in Kenya?

STUDY DESIGN AND SETTING.

A prospective whole population cross-sectional study conducted during the national rugby sevens circuit.

PARTICIPANTS.

All adult players registered by the various clubs and by the Kenya Rugby Football Union(KRFU) were eligible.

- **INCLUSION CRITERIA.**

Adult players aged 18years and above.

Holders of valid registration with one of the clubs and Kenya Rugby Football Union.

Players registered to play for any of the division one clubs during the national circuit.

- **EXCLUSION CRITERIA.**

Players on national assignment.

Players registered in other clubs other than those taking part in the national sevens circuit.

SAMPLE SIZE.

Fisher's formula for estimating sample size for a single proportion was used applying the Finite Population Correction (FPC):

$$n = \frac{NZ^2P(1-P)}{d^2 N - 1 + Z^2P(1-P)}$$

N = Total population of rugby players in the national rugby sevens circuit

P = Prevalence of injuries during the national rugby sevens estimated at 30% (based on proportion of players injured in the Kenya Rugby Football Union 2010 season).

1-P = 1 minus Prevalence of injuries during the national rugby sevens

Z = Z statistic representing 95% level of confidence (1.96)

d = desired level of precision set to 5%

$$n = \frac{280 \times 1.96^2 \times 0.3(1 - 0.3)}{0.05^2 \times 280 - 1 + 1.96^2 \times 0.3(1 - 0.3)}$$

$$n = 150$$

Considerations were also made to adhere to the RICG requirements of whole population study.(17)

METHODOLOGY AND PROCEDURE.

A background questionnaire was administered before the tournament. Data collected included; age, rugby experience, anthropometric data (height, weight, body mass index) and position played. Data was entered in a questionnaire adopted from the RICG.

Team physiotherapists were recruited to evaluate injuries and assist in collection of data. The principal investigator trained the physiotherapists on data entry and the questionnaire to be used.

Management of serious injuries requiring specialized medical attention/ hospital was left to the discretion of the tournament/ specific team medical personnel. Follow up by the principal investigator to categorize their injuries was done by phone to the specific team medical personnel.

The fields used were those allocated by the Kenya Rugby Union.

Stationery was provided for all the teams.

DEFINITIONS.

The 2007 consensus statement on injury definitions for studies of injuries in rugby was used(17).

- **INJURY.**

A physical complaint caused by a transfer of energy exceeding the body's ability to maintain its structural and or functional integrity sustained by a rugby player during a match or training(17).

- **INJURY SEVERITY.**

The number of days that from the date of injury to the date a player returns to full participation in team training. Injuries were grouped as slight(0-1days), minimal(2-3days), mild(4-7days), moderate(8-28days), severe(>28days), fatal, non-fatal catastrophic(17).

A non-fatal catastrophic injury was defined as a brain or spinal cord injury that results in permanent (>12months) severe functional disability(17).

- **RECURRENT INJURY.**

An injury of the same type and at the same site as a previous injury that occurs after a player has returned to full participation after recovery from the index injury(17).

An 'early recurrence' occurs within 2months of a players return to full participation(17).

A 'late recurrence' is an injury within 2-12months of full recovery(17).

A 'delayed recurrence' occurs more than 12months after return to play(17).

All data was entered in preformatted data sheets and in real time.

STATISTICAL ANALYSIS.

Statistical analysis of the data collected was done using IBMs SPSS version 16.0. Injury incidence was calculated per 1000 player match hours. For the primary objective injury incidence and frequency was calculated for different anatomical sites and injury types and results presented within 95% confidence interval.

For the secondary objectives risk factors assessed included: players age, years of rugby experience and body mass index. The independent effect of each on injury and severity was also assessed.

ETHICAL CONSIDERATIONS.

Approval to perform the study was obtained from the Ethics Research and Standards committee of Kenyatta National Hospital/ The University of Nairobi.

The Kenya Rugby Football Union and each of the participating teams also gave approval to perform the study.

Informed consent was obtained from each of the eligible participants.

RESULTS

There were 150 players from 12 teams participating in 311 matches (285 regular and 26 final matches) played in 5 tournaments during the national rugby sevens circuits with 7 players per match. Therefore the 12 teams contributed a total of 519.45 player-match hours for the season.

Table 2 summarizes player-match hours calculated from multiplying number of matches by number of players per team and duration of each match in hours (final matches were allocated 10 minutes per half and regular matches 7 minutes per half). The total player-match hours comprised 458.9 player-match hours of regular play and 60 player-match hours from the final matches.

Table 2: Player-match hours contributed by teams in national rugby sevens circuit

	Regular matches	Final matches	Total
Tournament 1	60	6	66
Tournament 2	55	6	61
Tournament 3	55	4	59
Tournament 4	55	6	61
Tournament 5	60	4	64
Total matches	285	26	311
Player per team	7	7	Na
Duration of match	0.23 hrs	0.33 hrs	Na
Total player-match hours	458.85	60.6	519.45

Characteristics of rugby players

The mean age of players in the rugby tournaments was 22.99 years \pm 3.29 with an age range between 17 and 32 years. The mean BMI was 26.82 \pm 3.96. The players reported that they had been playing rugby for durations ranging from 1 to 20 years with a mean duration of 6.31 years \pm 3.98.

Table 3: Characteristics of rugby players in national rugby sevens circuit

	N	Mean	SD	Range	
Age (in years)					
<20 years	20(13.3%)				
20-24 years	84(56%)				
25 + years	46(30.7%)				
Total	150	22.99	3.29	17	32
BMI					
Normal weight	50(33.3%)				
Overweight	77(51.3%)				
Obesity	23(15.3%)				
Total	150	26.82	3.96	17.9	41.4
Rugby experience (in years)					
<5 years	57(38%)				
5-10 years	65(48.3%)				
10 + years	28(18.7%)				
Total	150	6.31	3.98	1	20

Overall incidence of injuries

Out of the 150 players recruited and followed up during the national rugby circuit 50 players reported injuries corresponding to a prevalence of 33.3% (95% CI 25.7 – 41%).

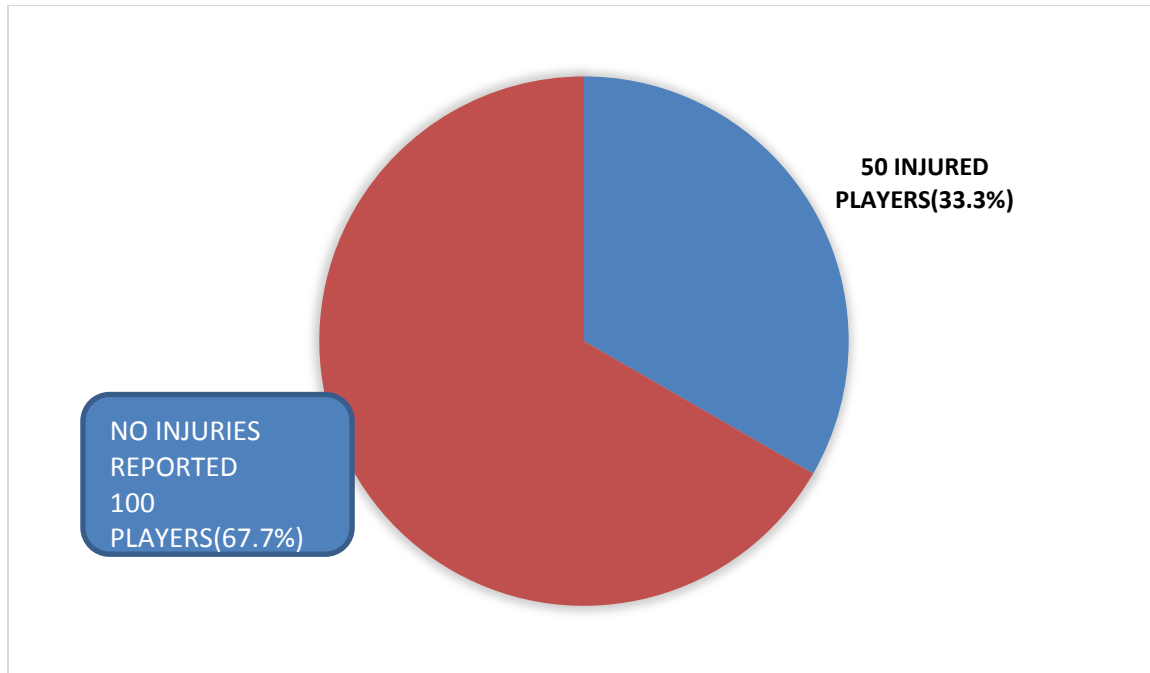


Figure 1: Prevalence of injuries among players in the national rugby sevens circuit

The overall incidence for all injuries combined was 96.3 per 1000 player hours (95% CI 7.3 to 127.1 per 1000 player hours). The incidence of injuries during the finals was 103.6 compared to incidence of 94.2 per 1000 player-match hours during the regular matches.

Incidence of injuries as a function of age, BMI and rugby experience.

Most 84 (56%) players were aged between 20 and 24 years, and approximately one half 77 (51.3%) had normal BMI. Majority of players had been playing rugby for 5-10 years 65 (48.3%) or less than 5 years 57 (38%). Of the three patient factors age, BMI and rugby experience, only BMI was an independent risk factor for injury. The incidence of injuries in overweight players

was significantly higher than in normal weight players (133.6 versus 69.4 per 1000 player-match hours, $p = 0.034$). There were no significant differences in incidence of injuries according to age or rugby experience (**Table 4**).

Table 4: Incidence of injuries as a function of age, BMI and rugby experience.

	N	Number with injury	Incidence rate	95% CI		P value
Age						
< 20 years	20 (13.3%)	5	63.3	26.3	152.2	
20-24 years	84 (56%)	33	117.1	83.2	164.7	0.194
25 years +	46 (30.7%)	12	75.8	43.1	133.5	0.735
BMI						
Normal weight	50 (33.3%)	15	69.4	41.8	115.2	
Overweight	77 (51.3%)	31	133.6	93.9	190.0	0.034
Obesity	23 (15.3%)	4	56.3	21.1	150.1	0.709
Rugby experience						
< 5 years	57 (38%)	18	79.1	49.8	125.5	
5-10 years	65 (48.3%)	22	101.9	67.1	154.8	0.423
10 years +	28 (18.7%)	10	132.1	71.1	245.6	0.188

Anatomic sites injured

The most commonly injured body parts were the: ankle 10 (6.7%), head or face 9 (6%), foot or toe 7 (4.7%), anterior thigh 6 (4%) and posterior thigh 4 (2.7%). 3 questionnaires did not have the anatomical site injured recorded explaining the discrepancy between the total number of injuries reported (50) and the number of anatomical sites injured (47).

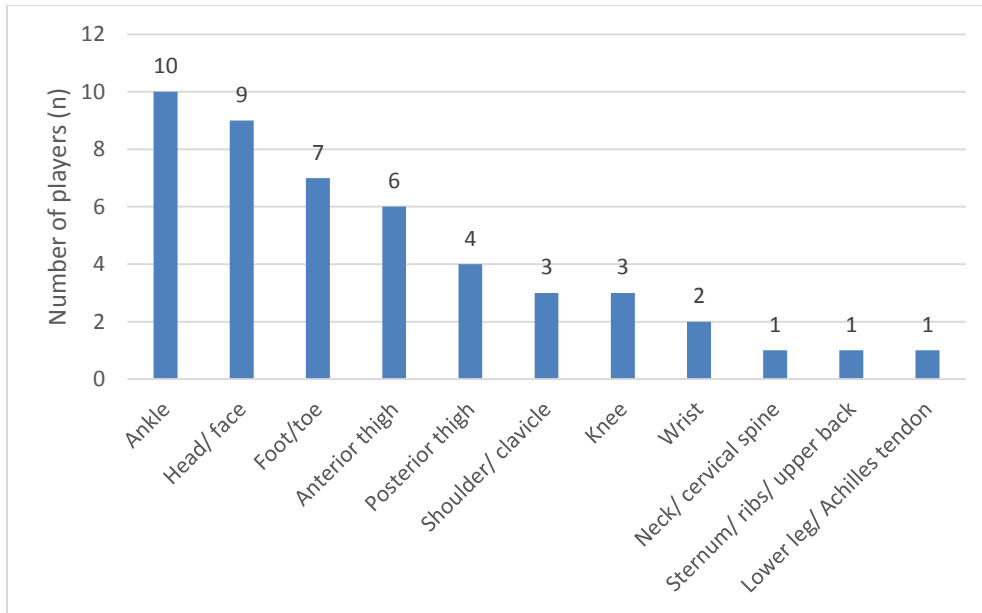


Figure 2: Injuries among players in the national rugby sevens circuit according to anatomic sites involved.

Injury type

The most common types of injuries were sprains or ligament injuries 23 (15.3%), hematomas/contusions and bruises 10 (3.3%) and concussions 5 (3.3%). Each of the remaining type injuries were seen in 2% or less of the players and included muscle injuries, fractures, abrasions, lacerations, visceral injuries and lesions of meniscus, cartilage or discs (Table 5). Abrasions had the lowest incidence at 188.9 injuries per 1000 player-match hours. The specific injury types that had high incidence included sprain/ligament injury (378.7 per 1000 player-match hours), haematoma/contusion bruises (314.8 per 1000 player-match hours) and visceral injury (387.1 per 1000 player-match hours).

Table 5: Types of injury among players in the national sevens rugby circuit

	Frequency (n)	Percent (%)	Incidence	95% CI	
Injury type					
Sprain/ligament injury	23	15.3	378.7	251.7	569.9
Haematoma/contusion bruises	10	6.7	314.8	169.3	585.1
Concussion	5	3.3	182.0	75.7	437.4
Muscle rupture/strain/tear/cramps	3	2.0	281.0	90.6	871.3
Fracture	2	1.3	209.3	52.3	836.8
Abrasion	2	1.3	188.9	47.2	755.6
Laceration	2	1.3	220.5	55.1	882.0
Other injury	1	0.7	438.1	61.7	3110
Lesion of meniscus/cartilage or disc	1	0.7	207.2	29.1	1471
Visceral injury	1	0.7	387.1	54.5	2748

Injury type based on anatomic site involved.

Most sprains or ligament injuries that occurred during the national rugby sevens involved either the ankle (n = 9) or foot/ toe (n = 5). Five out of the 10 hematomas, contusions or bruises that were reported involved the anterior thigh. All the five concussions were associated with injuries to the head or face.

Table 6: Injury type according to anatomic site involved in injury

	Total (n)	Ankle	Head/ face	Foot/ toe	Anterior thigh	Posterior thigh	Other
Injury type							
Sprain/ligament injury	23	9	-	5	1	-	8
Haematoma/contusion bruise	10	-	-	1	5	2	2
Concussion	5	-	5	-	-	-	-
Other	9	1	4	1	-	2	1
Total	50	10	9	7	6	4	11

Playing position

There were 106 (70.7%) players playing as backs and 44 (29.3%) players were playing in forward positions. The incidence of injuries among the forwards was 103.3 injuries per 1000 player-match hours compared to 93.9 per 1000 player-match hours among the backs. These difference incidence of injuries was not statistically significant ($p = 0.763$).

Table 7: Playing position during rugby matches and incidence of injuries

	N (%)	Injuries (n)	Incidence per 1000	95% CI	P value
Forwards	44 (29.3%)	14	103.3	61.2 – 174.4	0.763
Backs	106 (70.7%)	36	93.9	67.7 – 130.2	

Injury type according to playing position

The players in the back positions appeared to have higher rates of sprain or ligament injuries and concussions as shown in Table 8. Out of the 23 sprains/ ligament injuries that occurred 19 were in backs and of the 5 concussions that occurred during the circuit 4 were in backs. The remaining types of injuries did not show important differences based on playing position.

Table 8: Injury type according to playing position

	Playing position	
	Forward	Back
Injury type		
Sprain/ligament injury	4	19
Haematoma/contusion bruise	5	5
Concussion	1	4
Muscle rupture/strain/tear/cramps	1	2
Fracture	1	1
Abrasion	1	1
Laceration	1	1
Other injury	0	1
Lesion of meniscus/cartilage or disc	0	1
Visceral injury	0	1

Causes of injury

Of the 50 injuries that occurred, 46 injuries were caused by direct contact while the remaining 4 injuries were not attributed to contact. The predominant event that caused contact injuries was the tackle. As shown in Table 9, most players with contact injuries were either tackled 19 (41.3%) or tackling 9 (19.6%) other players at the time of the injury. Other leading causes of contact injury were collisions 7 (15.2%), maul 4 (8.7%) and ruck 4 (8.7%).

Table 9: Contact event leading to injury.

	N (%)
Activity	
Tackled	19(41.3)
Tackling	9(19.6)
Maul	4(8.7)
Ruck	4(8.7)
Lineout	1(2.2)
Collision	7(15.2)
Other	2(4.4)

Dangerous play and violation of laws

There were five (10%) injuries that were judged by the referee to have been caused by a violation of the rugby sevens laws of play (Table 10). The incidence of injuries associated with violation of laws was 268.4 per 1000 player-match hours. Conversely, 4 out of the 50 injuries (8%) were caused by dangerous play based on referee decision. The incidence rate of injuries associated with dangerous play was 293.1 per 1000 player-match hours.

Table 10: Incidence of rugby injuries related to dangerous play and violation of laws

	N (%)	Incidence per 1000	95% CI
Violation of laws	5/ 50 (10%)	268.4	111.7 – 645
Dangerous play	4/ 50 (8%)	293.1	110-781.1

Return to full participation

Of the 50 injured layers, 41 reported a duration between injury and return to active participation in rugby presented in Table 11. Most players returned to active play within a month of the injury with 13 (31.7%) players returning after 8 – 28 days and 10 (24.4%) returning to play after 4 – 7 days. There were 7 (17.7%) players who returned to active playing within one day of the reported injury. Backs sustained more injuries overall but also more severe injuries and upto 24% returned to play more than 28 days after the injury compared to forwards at 16%(table 12).

Table 11: Duration between injury and return to full play during national rugby circuit.

	Frequency (n)	Percent (%)
Duration before returning to active play		
0-1 days	7	17.1%
2-3 days	2	4.9%
4-7 days	10	24.4%
8-28 days	13	31.7%
>28 days	9	22.0%

Table 12: Severity of injury and playing position

	Forwards	Back	Total
Return to full participation			
0-1 days	3	4	7
2-3 days	0	2	2
4-7 days	3	7	10
8-28 days	4	9	13
>28 days	2	7	9

DISCUSSION

The primary objective of this study was to report the incidence and describe the pattern of injuries sustained in rugby sevens during a tournament.

The overall incidence of all injuries was 96.3 per 1000 player match hours. The most common location of injury was the ankle (6.7%) followed by the head or face 9 (6%), foot or toe 7 (4.7%), anterior thigh 6 (4%) and posterior thigh 4 (2.7%). The lower limb was thus the most common single anatomic entity sustaining injury. The most common types of injuries were sprains or ligament injuries 23 (15.3%), hematomas/ contusions and bruises 10 (3.3%) and concussions 5 (3.3%).

The overall incidence of injuries in the Kenyan rugby sevens population was slightly lower than overall data from the rugby world series 96.3 versus 106.0 per 1000 player match hours(20). The difference though not statistically significant and may point out to an increase in competitiveness and professionalism in the Kenyan game.

Player characteristics

The average Kenyan player is 22.9 years old comparable to counterparts at a higher level of play; 23.3 years from the rugby world series 2008-2013(20). In this study age was not found to be an independent risk factor for injury after adjusting for other factors. Chalmers et al observed an association between age and injury risk however the strength of that association was inconsistent among various age groups(33). Lee et al reported almost twofold higher risk for players aged 25-29 compared to players aged 16 and below(35). The evidence relating to age as a risk factor therefore remains equivocal.

In this study we calculated the average BMI to be 26.82, Muma et al found 26.96 during the 2010 rugby union season(22). Internationally Bronwen et al found a mean BMI of 28.5 kg/m² (42). The Kenyan player is therefore lighter and smaller than his international counterpart in professional rugby. We were also able to demonstrate that BMI was an independent risk factor for injury. This is consistent with other studies where heavier and taller players were found to have higher injury rates(34). This may be because fast players with a higher BMI will have a larger momentum going into the contact phase of play, they may also be overconfident and go dangerously into tackles. During the contact phase of play the player with the lower momentum is injured four times as often as the player with the higher momentum(43).

We did not find an association between years of rugby experience and injury incidence. This is in contrast to other studies that have found a bimodal distribution of higher injury rates in players with very little experience (0-3years) and players with >8years experience(34). We contend that this is because the Kenyan player may continue to play at an amateur level for longer and may not be consistent in participation.

There was no statistically significant difference in injury incidences between forwards and backs 103.3 versus 93.9 per 1000 player match hours (p value = 0.763). This is consistent with other studies (20)(34). In our study four out of five concussions were sustained by backs. The incidence was however found to be much higher than when compared to similar studies (20). We contend that this may have been occasioned by different definitions and difficulty of accurate diagnosis of a concussion by team medical personnel. Indeed all five concussions were associated with injuries to the head or face. Backs are involved in more high energy contact events and as such may sustain more severe injuries. The association between playing position and injury severity requires further investigation.

Injury characteristics and patterns

The overall incidence of injuries was 96.3 per 1000 player match hours; there was a significantly higher incidence of injury in the finals as compared to the regular matches 103.6 versus 94.2 per 1000 player-match hours. The final matches were played on the second day of each tournament and teams playing in the final had played a total of six matches. Fatigue, reduced self awareness, cumulative trauma, increased competitiveness have all been shown to increase injury incidence in the latter stages of the game(44)(41)(45). The National sevens circuit also starts soon after a grueling rugby union (15 a side) season in which most players take part. Improving player endurance and conditioning might aid in reducing injury incidence. This must however be balanced against the risk of 'too much' preseason training that may predispose the player to subsequent injury(35).

Most injuries occurred in the contact phase of play. The tackle was the most common contact event to cause an injury. More than 50% of injuries were attributable to the tackle/tackling scenario. The overall incidence of contact events was not reported precluding attributing any contact event with injury incidence and injury severity thereof.

Using a time-loss injury definition for injury severity as recommended by RICG we found that most injuries were of moderate severity (8-28days)(17). This is in keeping with most international studies and thus despite rugby having a high incidence of injury when compared to most other sports the injuries are of a moderate severity. There were no fatal/non fatal catastrophic injuries reported in this study. The reduced compliance by players to medical personnel more so among amateur players with regards to return to play may reduce the accuracy of using a time-loss injury definition to determine injury severity.

The lower limb was the most commonly injured anatomic entity with combined ankle and foot injuries being the most frequent, consistent with most other studies(44). Assuming that ground conditions are suboptimal as observed by Muma et al (22), the high incidence of ankle and foot injuries may be attributable to suboptimal pitches. Since pitches were not graded during this study that association may not be fully accurate and requires further interrogation. Ankle injuries can be prevented using various methods the most commonly employed methods are taping(46), bracing(47) and proprioceptive training(48). In the current study the use of ankle braces and taping was not recorded.

Only 10% and 8% of events leading to an injury were judged to have been a violation of the laws of rugby or due to dangerous play respectively. Rugby as with all sports will always have some injuries in normal play. Referee decisions are vital in protecting the players from some preventable serious injuries. Improved standards of refereeing have been shown to reduce injury incidences especially serious injuries occurring in the scrum (5). Since referees will never be 100% right all the time and some decisions will always remain controversial, awareness of the laws of rugby and discipline by the players alongside improved and continuous training of referees are avenues that can be explored to reduce injury in Kenyan rugby.

CONCLUSION.

In this study we found an injury incidence rate of 96.3 per 1000 player match hours. This is much higher than that reported previously (42.5), it is however comparable to other international studies(9)(20).

Lower limb injuries were the most common with sprains or ligamentous injuries, hematomas/contusions being the most common types of injuries.

Tackling and tackles are the most common contact events to cause injuries with injuries to the lower limb being the most common.

The incidence of suspected concussions was abnormally high which maybe because of unawareness of the correct definition of a concussion leading to reporting of every injury to the head/face as a concussion.

RECOMMENDATIONS.

- I. Improving player conditioning and endurance may reduce injuries attributable to fatigue.
- II. Players should be trained on tackling techniques to reduce the injury risk posed by the tackle/tackling.
- III. Using a time-loss definition of injury severity may not be accurate in the setting of a tournament in amateur rugby.
- IV. Continuous training of referees to empower them to make better decisions to protect the players.

STUDY LIMITATIONS.

- I. Some players returned to play without clearance from the medical team which may have had an influence on the reporting of injury severity.
- II. Some players travelled overnight to the different tournaments and played on the same day of arrival, this particular form of fatigue and reduced mental sharpness was difficult to quantify and was not included in the analysis.
- III. The pitch conditions were not assessed.
- IV. The RICG tool used here does not include the use of personal protective gear, as such their impact on injury incidence and severity cannot be assessed.

FUTURE WORK.

This is the first study among rugby sevens players in Kenya as such it provides benchmark values for incidence, prevalence, nature and pattern of injuries in this unique population.

By assessing and analyzing the potential risk factors for injury we have provided baseline information essential in formulation of injury prevention guidelines. In this study we used the RICG protocol making it easier to draw comparisons to other studies of a similar nature locally and internationally.

APPENDIX A:

Player background data:

Team/player code.....

Age(yrs).....

Weight (Kgs).....

Height (cm).....

Rugby experience(yrs).....

Playing position.....

APPENDIX B

Table 13: Main groupings and categories of type of injuries

Main group	Category
Bone	Fracture
	Other bone injuries
Joint (none-bone) and ligament	Dislocation/ subluxation
	Sprain/ ligament injury
	Lesion of meniscus, cartilage or disc
Muscle and tendon	Muscle rupture/ tear/ sprain/ cramps
	Tendon injury/ rupture/ tendinopathy/ bursitis
Skin	Abrasion
	Laceration
Brain/spinal cord/ peripheral nervous system	Concussion (with or without) loss of consciousness
	Structural brain injury
	Spinal cord compression/transaction
	Nerve injury
Other	Dental injury
	Visceral injuries
	Other injuries

APPENDIX C:

Injury Report Form for Rugby Union
(Team) Player-code: Date:.....

1A. Date of injury: 1B. Time of injury (during match):

2. Date of return to full participation:

3. Playing position at the time of injury: Not applicable

4. Injured body part:

<input type="checkbox"/> head/face	<input type="checkbox"/> upper arm	<input type="checkbox"/> anterior thigh
<input type="checkbox"/> neck/cervical spine	<input type="checkbox"/> elbow	<input type="checkbox"/> posterior thigh
<input type="checkbox"/> sternum/ribs/ upper back	<input type="checkbox"/> forearm	<input type="checkbox"/> knee
<input type="checkbox"/> abdomen	<input type="checkbox"/> wrist	<input type="checkbox"/> lower leg/ Achilles tendon
<input type="checkbox"/> low back	<input type="checkbox"/> hand/finger/ thumb	<input type="checkbox"/> ankle
<input type="checkbox"/> sacrum/pelvis	<input type="checkbox"/> hip/groin	<input type="checkbox"/> foot/toe
<input type="checkbox"/> shoulder/clavicle		

5. Side of body injured: left right bilateral not applicable

6. Type of injury:

<input type="checkbox"/> concussion (with or without loss of consciousness)	<input type="checkbox"/> sprain/ ligament injury	<input type="checkbox"/> haematoma/contusion/ bruise
<input type="checkbox"/> structural brain injury	<input type="checkbox"/> lesion of meniscus, cartilage or disc	<input type="checkbox"/> abrasion
<input type="checkbox"/> spinal cord compression/ transection	<input type="checkbox"/> muscle rupture/ strain/tear/cramps	<input type="checkbox"/> laceration
<input type="checkbox"/> fracture	<input type="checkbox"/> tendon injury/ rupture/ tendinopathy/ bursitis	<input type="checkbox"/> nerve injury
<input type="checkbox"/> other bone injury		<input type="checkbox"/> dental injury
<input type="checkbox"/> dislocation/subluxation		<input type="checkbox"/> visceral injury

other injury (please specify):

7. Diagnosis of injury (text or code):

8. Has the player had a previous injury of the same type at the same site (i.e. this injury is a recurrence)?
 no yes
If YES, specify date of player's return to full participation from the previous injury:

9. Was the injury caused by: overuse trauma?

10. Did the injury occur during: training match?

11. Was the injury caused by contact? no yes
If YES, specify the activity: tackled tackling maul ruck
 lineout scrum collision other

12A. Did the referee indicate that the action leading to the injury was a violation of the Laws?
 no yes

12B. Did the referee indicate that the action leading to the injury was dangerous play (Law 10.4)?
 no yes

APPENDIX D:

CONSENT BY PARTICIPATING ATHLETES:

Study number.....

Title of study: The incidence and pattern of rugby sevens injuries during the national sevens circuit.

Principal researcher: Dr. Wamutitu John Maina, post graduate doctor Orthopaedic Surgery at

The University of Nairobi.

Purpose of the study: This study aims to document the incidence, pattern and potential risk factors of injuries sustained during the national sevens circuit.

Benefits of the study: Information from this study will be important in formulation of injury prevention guidelines.

Conduct of the study: The study will be conducted during the national rugby sevens circuit. A background questionnaire will be administered and details about the injuries sustained will be collected during the whole tournament. There are no risks involved as this study will only look at injuries sustained and no treatment will be instituted or omitted.

Participation is voluntary and players may choose to withdraw from the study at any time.

There will be NO compensation for participating in the study neither will there be any benefits withheld for participating.

All information will be treated with utmost confidentiality, players identity will **NOT** be published anywhere.

Kichwa cha utafiti: uchunguzi wa utendekaji wa majeraha katika mashindano ya raga nchini.

Mtafiti kiongozi: *Daktari Wamutitu John Maina.*

Sababu ya utafiti: utafiti utakuwa wa kuchunguza maumivu na majeraha yanayotokana na mchezo wa raga wakati wa shindano la taifa la raga.

Manufaa ya utafiti; Ujuzi utakao tokana na utafiti huu utawezesha uundaji wa mikakati ya kuzuia majeraha.

Maadili ya utafiti: mhusika atajaza dodoso kujihusu na dodoso lingine litajazwa na watafiti kuhusu majeraha anayopata mhusika.

Taarifa zote zitashugulikiwa kwa siri nautambulisho wa mhusika hautachapishwa popote.

Mhusika yuko huru kujiondoa kwa utafiti huu wakati wowote.

I the investigator, have explained in detail the purpose of the study and hereby submit that privacy of all data collected will be maintained at all times.

Mimi mchunguzi naapaya kwamba nimemweleza mhusika sababu na maadili ya uchunguzi. Naapa kuwa taarifa zote zitashugulikiwa kwa usiri.

Signature.....

I the undersigned have been explained to and understand the above and voluntarily accept to participate in the study.

Mimi mhusika nimeelewa maadili ya utafiti huu na nimekubali kushiriki kwa hiari yangu bila ya kushurutishwa.

Signature / Thumb print (Patient).....

Tel 1 (patient)...

Tel 2 (patient/next of Kin)...

Dr. Wamutitu J. Maina – TEL 0738640083.

CONTACTS FOR CLARIFICATION/QUERIES:

Kenyatta National Hospital/University of Nairobi Ethics and Research
Committee

Telephone: (+254020) 2726300 Ext 44102

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UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES

PHONE: 254 20 274 0000 Code 00202
Telegrams: 443494
FAX: 254 20 274 3000 Ext 44322

KNH/UON-ERC

Email: knhnh_erc@uonbi.ac.ke
Website: <http://www.erc.uonbi.ac.ke>
Facebook: <https://www.facebook.com/knhnh.erc>
Twitter: @UONKNH_ERC #KenyaHealthResearchEthics

KENYATTA NATIONAL HOSPITAL

P.O. BOX 20713 Code 00100

Tel: 728300-9

Fax: 725272

Telegrams: MEUSUP, Nairobi

Ref: KNH-ERC/A/407

5th October 2015

Dr. John Wamuti Mutia
HS/ERC/51/2011
Dept. of Orthopaedic Surgery
School of Medicine
College of Health Sciences
University of Nairobi



Dear Dr. Wamuti:

Research Proposal: "Incidence and Pattern of Injuries during the National Rugby Sevens Circuit"
(RSC/07/2015)

It is to inform you that the KNH/UoN-Ethics & Research Committee (KNH/UoN-ERC) has reviewed and approved your above proposal. The approval periods are 5th October 2015 – 4th October 2016.

This approval is subject to compliance with the following requirements:

- a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
- b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN-ERC before implementation.
- c) Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH/UoN-ERC within 72 hours of notification.
- d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH/UoN-ERC within 72 hours.
- e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (Attach a comprehensive progress report to support the renewal).
- f) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.
- g) Submission of an executive summary report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.

For more details consult the KNH/UoN-ERC website <http://www.erc.uonbi.ac.ke>

"Protect to Discover"

Yours sincerely,



PROF. M.L. CHINDIA
SECRETARY, KNH/UON-ERC

- c.c. The Principal, College of Health Sciences, UoN
The Deputy Director CS, KNH
The Chairperson, KNH/UON-ERC
The Assistant Director, Health Information Dept. KNH
The Dean, School of Medicine, UoN
The Chairman, Dept of Orthopaedic Surgery, UoN
Supervisors: Prof. Atinga J.E.O, Dr. Oburu E.C.