A COMPARISON BETWEEN CHRONIC ANKLE INSTABILITY AND POSTURAL CONTROL **AMONG 15'S RUGBY PLAYERS WITH OR WITHOUT ANKLE INJURIES IN KENYA**

By

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ABSTRACT

Background: Rugby is a complex, contact sport, comprising walking, jogging, running, and interspersed with sprinting and static exertions. The static and dynamic postural stability are fundamental in changes in direction and centre of gravity and incorporating players' rapid reactions during playmaking. These lead to increased susceptibility and frequency of ankle injuries, leading to chronic ankle instability in the long run.

Aim: The study aimed to compare chronic ankle instability and postural control among rugby players with/without ankle injuries in Kenya.

Method: This cross-section study included 127 participants with/without chronic ankle instability. The groups with/without completed the demographic sports history questionnaire, Cumberland ankle instability tool (CAIT), and star excursion balance test (SEBT). The CAIT was used to categorize the group into the CAI group and the healthy group, and the SEBT reach directions were used to measure reach distance in three directions (anterior, posteromedial, and posterolateral). The demographics characteristics, CAIT score, and reach distances were analyzed using mean, frequency, standard deviation, Pearson product-moment, one-way ANOVA, and paired t-test.

Results: A non-significant difference was demonstrated among the three groups for age, height, and weight ($p>0.05$). There was no significant association between demographic characteristics and CAI and the control group. Only the anterior reach direction was significant concerning CAI limbs and the control group. The paired t-test revealed a significantly greater mean difference in the dominant versus nondominant leg in the CAI group for anterior reach direction (80.30±9.23 vs 75.98±6.61; $p<0.01$) and the control group (74.84±6.88) vs 75.98±6.61; $p=0.01$) respectively. There was no significant difference between the no CAI groups and CAI groups ($p>0.05$).

Conclusion: There is a strong correlation between postural control and ankle stability, mostly in the anterior reach direction, between the CAI groups and the no CAI groups. Therefore, the anterior reach direction of a SEBT can be used to assess the postural control of rugby players with chronic ankle instability.

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LIST OF ABBREVIATIONS

ANT	- Anterior
PM	- Posteromedial
PL	- Posterolateral
SEBT	- Star Excursion Balance Test
YBT	- Y-Balance Test
CAI	- Chronic Ankle Instability
CAIT	- Cumberland Ankle Instability Tool
IRB	- International Rugby Board
COP	- Centre of Pressure
KRU	- Kenya Rugby Union
RFUEA	- Rugby Football Union of East Africa
SD	- Standard Deviation
CI	- Confidence Interval
NACOSTI	- National Commission for Science, Technology and Innovation

CHAPTER ONE

1. BACKGROUND

1.1 INTRODUCTION

The field-based game of rugby had its beginnings in the early 1820s football matches which were played at rugby schools in England. William Webb Ellis, a rugby school senior, is credited for creating the distinctive playing sport of rugby union in 1823 (Murray, Murray, and Robson, 2014). Rugby union mostly consists of two main variants – the Sevens and the Fifteens. While the fundamental game rules are similar for each of these rugby varieties, there are a few differences for Rugby Sevens. With Rugby Sevens, the game is mostly speeding up taking into consideration the smaller player pool (Williams, 2015). It involves selecting seven sportsmen on the field from both teams (instead of fifteen), five replacements, and five intersections; Instead of seven, (Gabbett and Ullah, 2012).

Internationally, Australian rules were originally implemented in the 1820s and 1830s by England (the country of origin) and the three other participating countries: Scotland, Ireland, and Wales. Rugby union has become a popular sport all over the world, thanks to British military personnel, abroad college students, and ex-pats (Collins, 2013). The game then spread to other countries including New Zealand in the the1860s, Australia, Canada, the United States, Argentina, and South Africa in the 1870s; Fiji and France in the 1880s; Zimbabwe and Japan in the 1890s and Samoa, Tonga, Trinidad and Tobago, and Kenya in the early 20th century (Beneke, 2015). The World Rugby Union, previously known as the International Rugby Board (IRB), supports more than 100 associated regional unions. South Africa, Australia, New Zealand, France, Ireland, Fiji, Scotland, Argentina, England, and Wales dominate the game's highest levels. However, South Africa, Ireland, New Zealand, France, England, and Scotland are the most reliable top performers in the world (World Rugby, 2024).

Kenyans enjoy playing rugby, in part because of the national team's success in the rugby sevens circuit and the popularity of competitions like the Kenya Cup, Rugby Elgon Cup, Eric Shirley Shield, Rugby Super Series, Safari Sevens, which have been expanding yearly and occasionally feature multiple global teams. (KRU, 2017). The Kenya Cup consists of twelve clubs from Kenya Commercial Bank Rugby Club, Kenyatta University Rugby Club, Mwamba Rugby Club, Strathmore Rugby Club, Catholic University Rugby club, Nakuru Rugby Club, Kabras Sugar Rugby Club and Oilers Rugby Club.

The World Rugby Union injury surveillance conducted at the Rugby World Cup in 2003, 2007, and 2011, reported a range of 90 to 98 injuries/1000 match hours (Fuller et al. 2011). Rugby is a contact sport that involves Jumping, kicking, lineouts, running, tackling, collision, and scrummaging. This leads to an elevated risk of sustaining musculoskeletal and neurological injuries compared to any other sport. Fuller et al. (2006) investigated on the types of contact and their association with rugby injuries in the English premiership context. They found out that tackles accounted for the highest number of injuries and great loss of time in matches (Fuller et al. 2006). Lateral ankle ligament injuries were the common injuries reported during matches and training and accounted for more than half of the absence due to injury and more than a quarter injuries were recurrent (Sankey et al. 2008). Among ankle sprains injuries, 77% were lateral sprains and 73% involved isolated rupture or tear to anterior talofibular ligaments (Fong et al. 2009). The ankle can be injured in two ways: an inverted (lateral sprain) or an everted (medial sprain) injury. This occurs when the ankle rolls beyond its normal range of motion, causing the ligaments to rupture (Doherty et al., 2016). An uncomfortable fall, a slide, poor approach, twisting the ankle, or instability on uneven terrain can potentially damage the lateral ankle ligament. The risk of injury goes up when a player is fatigued as this promotes instability (Hiller, Kilbreath, and Refshauge, 2011). Recurrent ankle sprains, which are characterized by ankle giving way and discomfort, can lead to chronic ankle instability (Ganesh et al., 2015). According to Al-Moher and Al-Kenan (2016), chronic ankle instability (CAI) was explained as the player's experience of abnormal ankle symptoms, such as frequent sprains, continual distress, swelling, pain, and avoidance of daily activities.

Riemann (2012) described repeated ankle sprains as ongoing symptoms following an initial ankle sprain. Repeated ankle sprain is linked with multiple factors like static alignment, muscular weakening, poor proprioception, and ligamentous damage. When these factors are not addressed, injuries may occur resulting to decreased quality of life and level of function among athletes. Chronic pain and arthritis may also result (Raut, 2015). Athletes with chronic ankle instability frequently report losing confidence when walking on rough surfaces, and they must wear an ankle orthosis (ASO) for stability or ankle strapping when participating in rugby or other activities that put a lot of strain on the lateral ligaments (Zwiers et al.,2016).

Although ankle lateral collateral ligament damage is a potential cause of this chronic ankle instability there are several other potential causes such as postural control deficiency, neuromuscular deficiency, and proprioceptive deficiency (Thompson, et al., 2017).

Upon assessment, a player is typically asked about their history of ankle sprains, how their ankle has previously been treated, and whether they have had any surgical treatments. The therapist may also inspect the player's ankle for painful spots, oedema, and indications of ankle instability. (Kaminski and Hartsell, 2002). A physical examination of the foot and ankle will aid in checking for equines contracture, hindfoot alignment, and other widespread hypermobility symptoms (range of motion). Romberg tests for body awareness can also be used to diagnose chronic ankle instability. X-ray or other imaging examinations such as MRI may be useful in evaluating the ankle further (Malem et al., 2016). Anterior drawers testing and taller tilt testing are common provocation tests that are used to diagnose lateral ankle sprain (Ko, Rosen, and Brown, 2017).

A lateral ankle sprain is commonly associated with persistent ankle instability (Attenborough et al., 2016). Doherty (2016) stated that sprain of the ankle Ligament that didn't heal well or undergo full rehabilitation led to persistent ankle instability among individuals with chronic ankle instability. Repeated ankle sprains weaken the ligaments (or stretch) even more, causing chronic ankle instability and an increased chance of developing balance control(postural) issues (Hosseinimehr, Daneshmandi, and Norasteh, 2010). Chronic ankle instability is diagnosed clinically by the use of international Ankle Consortium Criteria (Feger et al., 2020). The International Ankle Consortium criteria should include the following: ankle sprain with typical symptoms and interruption of physical activities more than 12months prior, and one or more of the following recurrent episode of ankle sprains, regular occurrence of unforeseeable and uncontrolled incidents of excessive inversion of rearfoot also termed as 'give way', subjective perception of ankle joint instability during activities of daily living or sports and confirmation of self-reported instability with approved clinical questionnaires Feger et al., 2020). There was a high prevalence of clinical signs of ankle instability in club rugby for perceived, mechanical and functional instability and those with previous injured ankles were more likely to have unstable ankles (Mellet & Stewart, 2013).

Twenty to thirty percent of athletes with mechanical (anterior and inversion laxity) and functional (strength and dynamic balance) ankle sprains showed ongoing ankle instability after the injury (Hubbard et al., 2007). Simoneau-Buessinger (2016) reported deficiencies in postural control, proprioception, muscular reaction speed, and strength that commonly arose after an acute ankle injury and can cause persistent ankle instability.

These deficiencies caused persistent ankle instability. Chronic ankle instability (CAI) refers to both mechanical and functional instability, and it is the subjective sense of an ankle that is physically stable but feels unstable due to sensory or neuromuscular impairments (Hertel, 2019). Ligament elasticity is what leads to operational ankle instability, whereas postural control issues, neuromuscular problems, muscle discomfort, and mechano-receptor issues lead to mechanical ankle instability (Al-Mohrej and Al-Kenani, 2016). According to Jupil (2013) & Thompson et al (2017), the depletion of mechanoreceptors and the consequent decline in the power of the ankle invertor and evertor muscles are the primary causes of chronic ankle instability. Anomalous proprioception, ankle neuromuscular control, postural control, and power surrounding the ankle are examples of functional variables. Physiological laxity, changes in the joint's synovium, and degenerative disorders that affect the back foot and its stiffness are examples of mechanical causes.

According to Raut (2015), there are extrinsic risk factors for CAI such as the kind of physical activity, the terrain, and the shoes worn, while there may be congenital intrinsic issues such tarsal coalition and joint hyperlaxity. It is crucial to understand that chronic ankle instability typically results from several different causes. The capacity for stability and alignment in a gravitational environment is known as postural control. It is the management of the body's natural position concerning the ecosystem's task. (Riemann, 2012). While Melam et al. (2016) defined postural control as the ability to control the centre of mass around the base of support, Eechaute et al. (2015) defined it as the process of maintaining, achieving, or restoring equilibrium when engaged in any position or activity. The areas of postural control necessary for daily life include the capacity to hold a variety of positions, adapt automatically to deliberate body and extremities motions, and respond to external disruptions (Wikstrom, Fournier, and McKeon, 2010).

There are both dynamic and static forms of postural regulation. For the assessment, static postural control necessitates that the subject creates a steady base of assistance and holds it while reducing segment and body movement (Chimera and Warren, 2016). Conversely, dynamic postural control often means completing a functional task without risking one's support system (Olivier et al., 2015). This might involve moving quickly to a new area by jumping or hopping, or it could involve making methodical segment movements without jeopardizing the established base of assistance (Nelson; et al; 2012).

In Rugby, maintaining dynamic postural control is essential for executing various movements in different planes while maintaining stability on one leg (Coughlan et al., 2014). One might categorize instability as either functional, mechanical, or both and is the state of being unstable and manifests as weakness, poor function, discomfort, and a link to postural control (2008, Journal of Sports Physical Therapy and Orthopaedics). Postural instability is the body’s inability to stabilize during static or dynamic movements. In most cases, postural instability is associated with our secondary reduction in neuromuscular, proprioception, and control. Reduced strength, reflexes, and coordination are hence symptoms of functional/mechanical instability which will affect the stability of the whole body and not the ankles only. There is a meaningful relationship between instability and postural instability, instability of the body. The above-mentioned factors will lead to loss of postural control resulting in instability (Simon et al., 2013).

1.2 PROBLEM STATEMENT

There is no specific study or literature on comparison between chronic ankle instability in club rugby players in Kenya. There is no clinical literature supporting clinical findings related to chronic ankle instability and postural control. The high-impact and frequent directional changes during running, kicking, jumping, collision, lineout, and scrummaging leads to loads on the ankle joint. Ankle injuries are prevalent in Kenya 15’s rugby players due to the physical demand of the rugby sport. The recurrent ankle injuries(ligaments) often leads to chronic ankle instability, impairing the overall performance and impaired postural control. Researchers find conflicting empirical findings about Chronic ankle instability and postural control. Postural control is crucial in maintaining balance, agility, and prevention of injuries in rugby. There is limited literature and no comparative studies on the impact of chronic ankle instability and postural control among 15’s rugby players in Kenya. Thus the need for the study to understand the interconnection between chronic ankle instability and postural control and implementing preventive measures is becoming increasingly important for the amateur rugby and sportsman.

1.3 RESEARCH QUESTIONS

What is the relationship between CAI and postural control among 15’s rugby players with or without ankle injuries in Kenya?

1.4 AIM

To determine whether a relationship exists between chronic ankle instability and postural control among 15’s rugby players with or without ankle injuries in Kenya.

1.5 OBJECTIVES

- To describe the demographic profile of 15’s rugby players.
- To screen for chronic ankle instability among the 15’s rugby players in Kenya.
- To determine if a relationship exists between the demographic characteristics and postural control in 15’s rugby players with and without ankle instability
- To determine whether an association exists between chronic ankle instability and postural control in 15’s rugby players.

1.6 SIGNIFICANCE OF THE STUDY

The study will aid in early detection and understanding of CAI prevalence among 15’s rugby players in Kenya. The study will aid in developing rehabilitation programs tailored and prevent recurrence of ankle injuries. The 15’s rugby player health and fitness is crucial in sustaining success and enhancing performance. The study will provide data on Kenya 15’s rugby players and comparing it with internationally available data offering insight on whether other factors such as playing surface, training methods can contribute to higher or lower incidence of CAI or postural control issues. The study findings can be used to improve rugby training curriculum to emphasis on ankle health, postural stability for 15’s rugby players in Kenya. The study findings can be utilized to offer valuable information for long-term development of rugby, performance enhancement and short and long term player development in Kenya.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 INTRODUCTION

The purpose of this literature review is to assess whether chronic ankle instability and postural control are comparable among Kenyan rugby players with and without ankle injuries. This chapter begins by covering the background of rugby, ankle injury chronic ankle instability postural control, and any relationship that may exist between the two variables. The Cumberland ankle instability tool will be used to differentiate individuals with and without it, and the star excursion balancing test will be discussed.

2.2 SEARCH METHOD

The researcher did a literature search using the electronic databases PubMed, Medline, CINAHL, Sport Discuss, SCOPUS, and Cochrane. The search included articles from 1990 to April 2024. The search technique consisted of three keyword strings separated by the word "AND." These keywords comprised (1) ankle instability, (2) ankle injury/sprain, and (3) postural control/balance-related terms, all of which were grouped with "OR." Inclusion criteria required the studies to compare chronic ankle instability and postural control among rugby players with or without ankle injury. Forty-five papers satisfied the inclusion criteria, whereas 800 articles were rejected because they did not assess or discuss chronic ankle instability, and their research did not involve postural control, balance, or ankle injury.

2.3 RUGBY BACKGROUND

Rugby is a close-contact sport that began at a rugby school in the first half of the nineteenth century (Collins, 2009). Rugby is essentially about running with the ball in hand. It is a mostly common sport that is played between two teams of 15 players each, using an oval-shaped ball on a rectangular pitch. The pitch has a goalpost at both ends and an ‘H’ in shape. Rugby is a popular sport around the world, with players of all ages, genders, and sizes. In 2014, more than 6 million people played worldwide, with 2.36 million registered players (Lance, 2011). Since 1886, the International Rugby Board (IRB) has served as the sport's regulating body, with 101 full members and 18 associate members.

Rugby union was previously an amateur sport, but in 1995, official financial limits were lifted, making the game openly professional at the highest level for the first time (Scianitti and Mathew, 2011). Rugby union spread outside its original country of Great Britain and Ireland to Australia, New Zealand, South Africa, and France. The expansion occurred during the British Empire and was driven by French supporters (Rugby Europe). The game spread to other countries that made rugby their national sport, including Fiji, Georgia, Madagascar, New Zealand, Samoa, Tonga, and Wales. International matches between Scotland and England began in 1871. The first World Cup was held in 1987 and was held every four years. The six nations in Europe and the rugby championship in the southern hemisphere are being held annually. The national club and provincial competitions include the Premiership in England, the top 14 in France, the Bunning NPC in New Zealand, the League One in Japan, and the Currie Cup in South Africa.

Club rugby in Kenya began in 1923 when the Nondescripts and Harlequins were founded. Following this were the following events and clubs: the Black Rock Festival (held over Easter), the Mean Machine (1976), the Black Blad (1978), the Barclays Bank and Watembezi (1980), the Nakuru and Damu Pevu (1986), the Enterprise Cup (1980), the Kenya Cup (1986), the Eric Shirley Shield, the Mwamba Cup, the Black Rock Festival (held over Easter), and the Seven Apart Competition Series (M et al., 2006). Kenya Commercial Bank (KCB), Nondescripts RFC, Nakuru RFC, Oilers RFC, Kabras RFC, Strathmore University, Catholic University, Kisumu RFC, Black Blad RFC, Home Boys RFC, Mwamba, and Harlequins are now the best rugby teams competing in the Kenya Cup League (Kiganjo et al., 2003). The league is played on a home-and-away basis, and the team with the most points at the end of the season is crowned as the Kenya Cup Champions.

2.4 DEMOGRAPHIC PROFILE OF A RUGBY PLAYER

In Kenya, the game of rugby is not as professional as compared to other rugby-playing nations and this is evident by a high number of young players who decline to pursue rugby as a career (Mse et al., 2006). Mse et al. (2006) reported that 78% of the participants were below 25 years, 10% were between 26-30 years and 11% were between the 30-35 age bracket in Kenya. Mse et al. (2006) reported a high number of young players playing rugby in Kenya and a decline in the number of older players playing the game. This could be attributed to different careers taken by the older players, and this makes it difficult for them to get time for training and playing the sport over the weekend. The same study on demographic characteristics and dietary supplements reported that Kenya rugby league was mainly dominated by students (74%), followed by self-employed players at 12%, and 7% by other occupations (engineers, teachers, and accountants). In addition, most players have played for their clubs for 3-6 years accounting for 50% of players, 7-10 years for 24%, and 16% less than 2 years. The players' ages range from 18 to 40 years, with a mean of 22.80 years, as stated (Muma N. et al. 2012).

2.5 ANKLE INJURY

Rugby is a contact sport where players make sudden direction changes and controlled movement of the center of gravity while reacting to on-field events (Green, Blake, and Caulfield, 2011). Globally, UK and USA treat 2 million ankle sprains annually and this leads to a financial burden of USD 2 billion in health costs (Xue et al., 2021a). Ankle injuries represent 11% of match-day injuries and 15% of training injuries according to the Rugby Union (Sankey et al., 2008). The most common locations and types of training and match-day injuries reported at the Rugby World Cup (2019) were as follows: ankle injuries (24%); head/face (22.4%); muscle strain (20.3%); ligament sprain (16.0%); and posterior thigh (12.6%) (Fuller et al., 2020). Repeated lateral ankle sprain leads to functional limitation development with an ongoing history of giving way in the ankle (Van Rijn et al., 2008), resulting in chronic ankle instability. The explosiveness, jumping, change in pace, and quick change in direction increase the risk of ankle injuries, particularly on uneven surfaces. During running, players are required to run, change direction, and leap away from other players at high velocity (Burca et al., 2017). Rugby is a collision-contact sport that involves tackling and being tackled by an opposing player and approximately 61% of rugby injuries happen during tackles, which are considered the most dangerous phase of play. The most common ankle injury occurs to the ball carrier (Burcal et al., 2017). South African club rugby players commonly display clinical signs of ankle instability, including perceived, mechanical, and functional instability. Notably, players with a history of ankle injuries are more prone to experiencing unstable ankles (Mellet & Stewart, 2013).

New Zealander Super 12 recorded 10%, Australian players recorded 11%, the 2003 World Cup recorded 14% and players in the Scottish district recorded 20% of ankle injuries (Mellet and Steward, 2013). After an initial ankle injury/sprain, it is estimated that one out of every three individuals develop chronic ankle instability (Burcal et al., 2017). The ankle joint moves through extreme ranges from dorsiflexion to inversion to plantarflexion and inversion which stresses the elastic lateral ligament, leading to high inversion sprain (Burcal et al., 2017).

One of the many risk factors linked to a higher chance of ankle sprain injuries is impaired balance (Green and Sharp, 2020). Bahr et al. (2005) developed a comprehensive injury-causation model developed and highlighting the mechanism of injury importance for example landing from a jump, and injury event of ankle biomechanics. Meeuwisse (1994) explained the interaction of intrinsic (predisposing factors), and extrinsic risk factors that make athlete susceptible to ankle injuries.

2.6 CHRONIC ANKLE INSTABILITY

Hertel (2002) described CAI as a disorder that occurs after one or more acute ankle sprains and is characterized by persistent symptoms which include episodes of ‘‘giving way” a sense of instability, recurrent ankle sprains, and functional deficits. Gribble et al. (2014) defined chronic ankle instability (CAI) as the occurrence of uncontrolled and unpredictable episodes of excessive inversion of the rear foot that do not result in acute lateral ankle sprain. Ganesh et al. (2015) described it as a debilitating condition characterized by recurrent ankle sprains, persistent pain, and repeated instances of giving way. In 2016, Al-Mohrej and Al-Kenani described chronic ankle instability as the patient's perception of an abnormal ankle, characterized by a combination of symptoms including recurrent sprains, persistent discomfort, and swelling, pain or tenderness, avoidance of daily activities, wobbly or unstable ankle, and repeated turning of the ankle, especially on uneven surfaces or when participating in sports. Riemann (2012) defined it as recurrent ankle sprains and persistent symptoms following an initial ankle sprain.

Chronic ankle instability is multifactorial with contributions from static alignment, muscle weakness, poor proprioception, and ligamentous injury. When left untreated, the condition decreases one’s level of function and quality of life and has the potential to lead to arthritis and chronic pain (Raut et al., 2015). With CAI, patients will often report that they no longer feel confident walking on uneven ground, or that they need to consistently wear an ankle stabilizing orthosis (ASO) play sports or engage in activities that cause high strain on the lateral ligaments. This condition can be caused by lateral collateral ligament injury of the ankle; however, it may be caused by multiple other factors (Thompson et al., 2017). Chronic ankle instability (CAI) may be subdivided into mechanical and functional ankle instability, each of which may lead to repetitive ankle sprains (Freeman et al., 1965).

Functional ankle instability is mainly caused by the deafferentation of damaged sensory receptors as hypothesized by Freeman et al (1965). McKeon et al. (2010) proved that an interruption in the afferent connection of sensory receptors may be responsible for the decrease in postural control during single limb stance in those with chronic ankle instability. Subsequent studies have reported the clinical manifestation of functional ankle instability, in which motion is physiological but no longer under voluntary control (Tropp et al., 1985). There is insufficient muscle strength, proprioception dysfunction, postural control disorders, and neuromuscular disorder with functional ankle instability population due to injury to the mechanoreceptors of the involved joint caused by a first ankle sprain, the signal transduction process failure, resulting in the muscle tone imbalance of the involved ankle joint caused by repeated sprains (Donahue et al., 2014). In addition, low proprioception is also associated with worse sports performance, higher injuries of ankle-related sports injuries, and the progression of post-injury osteoarthrosis (Freeman et al., 1965). Delahunt et al., (1976) investigated how neuromuscular control in functional instability participants demonstrated decreased floor clearance and a more inverted ankle joint. According to Guzman-Munoz et al., (2019), four weeks of neuromuscular training improved postural control of college volleyball players with functional ankle instability.

According to Tropp (2002), mechanical instability is characterized as an abnormal ligament around the ankle joint complex. Mechanical instability manifests as excessive inversion, rear foot laxity, and anterior talocrural joint laxity, possibly due to ligament instability or degenerative and chronic inflammatory processes when evaluating CAI, the patient is typically asked about their history of ankle sprains, previous ankle treatment and any surgeries they may have had. The therapist will also examine the patient's ankle for tender areas, signs of swelling, and instability (Kaminski & Hartsell, 2002). A comprehensive physical examination has a 96% sensitivity and 84% specificity for diagnosing chronic ankle instability (Bonnel et al., 2010). The examination should encompass a specific assessment of hindfoot alignment, equinus contracture, and general signs of hypermobility. Testing proprioception with a Romberg test is also helpful in the diagnosis of CAI. X-rays or other imaging examinations such as MRI may be helpful in further evaluating the ankle (Melam et al., 2016). Ko, Rosen, and Brown (2017) noted that lateral-sided ankle tenderness, range of motion, and provocative tests including anterior drawer testing and talar tilt testing also aid in the diagnosis of CAI.

The main predisposing factor for the development of CAI is the history of at least one previous lateral ankle sprain (Attenborough et al., 2016). Doherty et al. (2016) observed that CAI usually develops following an ankle sprain that has not adequately healed or was not rehabilitated completely. Repeated ankle sprains often cause – and perpetuate – CAI. When you sprain your ankle, the connective tissues (ligaments) are stretched or torn. Each subsequent sprain leads to further weakening (or stretching) of the ligaments, resulting in greater instability and the likelihood of developing additional problems in the ankle (Hosseinimehr, Daneshmandi, and Norasteh, 2010). It is estimated that as many as 50-60 percent of patients who sustain an ankle sprain do not seek evaluation or treatment from a healthcare professional and this increases their likelihood of suffering from CAI. About 20- 30% of acute ankle sprain patients develop chronic ankle instability (Hubbard, et al., 2007). Pionnier, et al., (2016) explained that following an acute ankle sprain, deficits in postural control, proprioception, muscle reaction time, and strength typically occur, which can lead to CAI. Mechanical ankle instability is induced by ligament laxity; while functional ankle instability is caused by postural control deficits, neuromuscular deficits, muscle weakness, and proprioceptive deficits (Al-Mohrej and Al-Kenani, 2016). Jupil (2013) described the main causes of CAI as decreased proprioceptive abilities because of a loss of mechanoreceptors and decreased muscle strength of invertor and evertor muscles. On their part, Thompson et al. (2017) noted that the major factors contributing to chronic ankle instability can be divided into two categories: mechanical and functional. Mechanical factors include pathological laxity, synovial changes in the joint, and degenerative conditions affecting the hindfoot and hindfoot stiffness while *functional factors* include impairments to proprioception, neuromuscular control of the ankle, postural control deficits, and strength deficits around the ankle.

Raut (2015) argues that there are intrinsic and extrinsic risk factors for CAI with the type of physical activity, type of ground, and type of shoe wear regarded as extrinsic risk factors while intrinsic conditions may be congenital, such as tarsal coalition and hyperlaxity of joints. It is therefore important to note that chronic ankle instability is frequently due to a combination of multiple factors. Individuals with chronic ankle instability often demonstrate impaired postural control, particularly during challenging tasks (McCann et al., 2017; Sierre-Guzman et al., 2018; Simpson et al., 2019).

Epidemiologically ankle injuries account for 8-20% of rugby injuries and lateral ankle sprain accounts for 85-90% of injuries occurring at the ankle joint (Mellet and Steward, 2012). Sankey et al. (2008) reported that 43% of the ankle injuries sustained in rugby union are lateral ankle sprains that lead to pain, function limitation, and temporary disability. Many rugby players develop recurrent lateral ankle sprain which leads to Cin overall (Van et al., 2008). Trojian et al. (2006) reported that poor postural control among rugby union players is a risk factor for ankle injuries. Maeda et al. (2023) reported that reduced ankle range of motion, foot malalignment, and decreased performance on a single leg are risk factors for developing CAI.

2.7 CUMBERLAND ANKLE INSTABILITY TOOL (CAIT)

The popularity of athlete/patient-reported outcome measures is gaining recognition and the importance of monitoring the subjective effectiveness of treatment received (Vuurberg et al., 2018). The current management results of ankle instability are often evaluated using patient-reported outcome measures in combination with radiographs or manual tests, performed by the physician (Lorn et al., 1996). Athlete/ patient-reported outcome measures provide feedback on sport/patient view of their complaint and combine efficiency with reliability and low cost (De Noronha et al., 2008). An ankle sprain is one of the common injuries that can be assessed using patient-oriented outcome measures and is one of the most common sports injuries. In addition, many self-reported outcome measures have been developed to assess foot and ankle complaints (Doherty, et al., 2006). In addition, foot and ankle outcome measures and ankle ability measures (FAAM) have been validated for assessing functional disability in patients with CAI (Vuurberg, et al.,2018).

Hiller et al. (2006) designed Cumberland's ankle instability tool (CAIT), which proved to have high content validity and reliability and was originally developed in the English language. Docherty et al (2006) and Cruz-Diaz et al. (2013) translated and cross-culturally adapted the Cumberland ankle instability into Spanish and Brazilian Portuguese to provide non-English speaking populations with valid and reliable versions of the tool. The questionnaire's main advantage is its 9-item structure, minimizing athlete/patient burden and increasing reliability. The CAIT can measure the severity of instability using numerical values (Cruz-Diaz et al., 2013). The CAIT is filled out for both the left and right ankles, making it possible to assess both ankles individually. The CAIT is a 9-item scale measuring the severity of functional ankle instability. The total score ranges from 0 to 30 items focusing on the degree of difficulty in performing different physical activities per ankle. The CAIT can discriminate between stable and unstable ankles and measures the severity of experienced functional instability, with a cut-off value of 27.5 points (Hiller et al., 2006). The recent literature suggests that a cutoff score of more than or equal to 25 results in improved test characteristics thus, enhancing the accuracy of the tool in differentiating individuals with and without chronic ankle instability (Wright et al., 2014). Hiller et al. (2006) reported test-retesting reliability of ICC 2.1=96, a sensitivity of 82.9%, and a specificity of 74.7% while Wright et al. (2017) established the minimal clinically significant difference of 3.08 and minimal clinically important difference of more than or equal to three.

A study was done on the Dutch population with and without ankle instability using a Cumberland ankle instability tool and concluded that this tool is a valid and reliable instrument fit to assess ankle instability. In addition, this tool may be dependable in the evaluation of ankle instability complaints compared to the foot and ankle outcome scores (FAOs) because of the minimization of patient burden due to the lower amounts of questions (Vuurberg et al., 2018).

A study on cross-cultural adaptation and validation of the Korean version of the Cumberland ankle instability tool concluded that the Cumberland ankle instability tool-Korean appears to be valid and dependable and could be useful in assessing the Korean-speaking population with chronic ankle instability. In addition, CAIT-Korean could be a useful tool in international research and treatment (Jupic et al., 2015). This study will utilize the CAIT to group the Kenya rugby players playing the Kenya Cup into those with and without chronic ankle injury.

2.8 POSTURAL CONTROL

Postural control is the ability to maintain equilibrium and orientation in a gravitational environment. It is the control of the body's position concerning the task in the environment (Riemann, 2012). Eechaute et al. (2015) defined postural control as the act of maintaining, achieving, or restoring a state of balance during any posture or activity while Melam et al. (2016) viewed it as the ability to control the center of mass relative to the base of support. Having the ability to maintain various positions, respond automatically to voluntary body and extremity movements, and react to external disturbances represents the domains of postural control required in daily life (Wikstrom, Fournier and McKeon, 2010).

Postural control can be grouped into static and dynamic categories. Static postural control requires the individual to establish a stable base of support and maintain this position while minimizing segment and body movement during the assessment (Chimera and Warren, 2016) while dynamic postural control often involves the completion of a functional task without compromising one's base of support (that is, ability to exert ongoing control of the center of mass when the base of support is changing) (Olivier, Stewart, Olorunju and McKinon, 2015). A study by Coughlan et al., (2014) reported that assessment of dynamic stability is fundamental in the caution of movement in rugby union, where the player needs to control and maintain the multiplanar movements pattern while on a single-leg stance.

The advantage of assessing dynamic postural control is that additional demands of proprioception, range of motion (ROM), and strength are required along with the ability to remain upright and steady (Razeghi et al., 2016). Visual, vestibular, and somatosensory systems are the main sensory systems involved in postural control (Pionnier et al., 2016). The visual system contributes to postural control by delivering information from the retina to different areas in the brain that allow for object identification and movement control. The vestibular system, which consists of organs located in the inner ear, contributes by interpreting changes in movement, direction, and velocity or speed of movements. This information is sent to the brain stem, which then creates a response that allows your postural muscles to activate and increases your body's awareness. The somatosensory system contributes by relaying information about body position to the brain, allowing it to activate the appropriate motor response or movement (Ko et al., 2017).

To ensure proper postural control, the sensory information from these three systems must be regulated by the central nervous system to produce an appropriate motor response (Gribble et al., 2012). The identified risk factors for postural control deficits include environmental factors such as light conditions, floor surface changes, alcohol, drugs, and ear infection; *neurological conditions* such as stroke, Parkinsons' disease, and spinal cord injuries and behavioral factors such as slouching while sitting, always carrying things on one side of the body, looking down on one's cell phone, carrying heavy backpacks, being stressed and having low esteem and sedentary lifestyle (Agadoni, 2017). In addition, muscle weakness, gait, and balance deficits, visual deficit, cognitive impairment, advanced age, history of falls, and repetitive motion without frequent breaks have also been cited as common causes of deficits in postural control (Doherty et al., 2016; Chimera and Warren, 2016).

The methods used to evaluate postural control have evolved. Early studies focused on abnormalities in postural sway as an indicator of balance disorders, and then later studies progressed to more complex laboratory testing of responses under various conditions. By the mid-1980s, functional tests of balance started to become more prominent (Bakhtiari, 2012). Due to the complexity of the postural control system, balance can be evaluated at both a functional and a physiological level. The functional level can be more directly assessed by functional performance tests of reach and mobility. The physiological level includes measuring the contribution of sensory, motor, and effector components (Pollock, 2010).

Functional assessment tests are commonly used in clinical practice by doctors and physiotherapists due to the speed with which they can be administered and due to the rarely requiring expensive equipment (Mahajan, 2017). Functional assessment tests of balance focus on the maintenance of both static and dynamic balance, whether it involves a type of perturbation/change of center of mass or during a quiet stance (Chimera and Warren, 2016). Konradsen et al. (1990) reported a peroneal dysfunction regarding strength, activity onset, and duration of contraction, which is a prevalent finding in patients with ankle instability. Compensatory postural adjustment (CPA) is associated with disturbances after perturbation and is dependent on feedback mechanisms. Compensatory postural adjustment can be divided into short and long latency responses after perturbation which leads to distinguishing between the reflex and voluntary responses. Therefore, dynamic tasks are more challenging for subjects with chronic instability and may affect postural control strategies. The SEBT and modified star excursion balance test (MSEBT) are two common functional assessment tests of balance that require minimal equipment and can be implemented without difficulty among the sporting population as measures of static and dynamic balance especially in resource-scare settings (Dallinga et al., 2012).

Studies done by Cherng et al. (2007), Slobounou et al. (2008), and Holder-Powell et al. (2000) reported that the agility of rugby players tends to improve with rugby playing experience and age and may be closely related to body balance and physiological measure. The body uses the hip strategy and the ankle strategy to maintain balance in a fixed stance, the hip strategy consists of hip flexion and extension and opposing dorsiflexion and plantarflexion (Balter et al., 200d Fong et al., 2012). The ankle strategy works by maintaining the rigid body mass around the ankle joint axis and ends with a smaller displacement of the center of gravity compared with the hip strategy (Fong et al., 2012).

The musculoskeletal injuries of lower limbs e.g., ankle ligamentous injuries have a long-term negative effect on body balance (Ricotti, 2011). Regardless of the strategy applied, impaired postural control will increase the risk of lower limb injury during a single-leg stance (Gribble, et al., 2004; Yaggie et al., 2002). Approximately 83% of rugby players sustain this type of injury with the knee (25%) and ankle (21%) being only injured and an incidence of 1.52 injuries per player overall. It is evident to explore whether postural control (balance) strategies especially ankle strategy and postural control (balance) performance are compromised in rugby players in Kenya with or without chronic ankle instability.

2.8.1 Assessment of Postural Control

There are several functional assessment techniques such as the Romberg test and various hopping and agility tests. The Romberg test is used to help diagnose tabes dorsalis, dorsal column, and proprioceptive, and is positive when one is unable to maintain an erect posture for over 60 seconds with eyes closed (Khasnis A, Gokula RM, 2003). The sensitivity of the Romberg test and various hopping and agility tests has been questioned in patients with chronic ankle instability. Docherty et al (2005) demonstrated a relationship between side-to-side and figure-8 hop test performance and level of self-reported ankle dysfunction. Other studies have not found various hopping and agility tasks to differ significantly between those with and without chronic ankle instability (Hertel et al., 2006).

2.8.2 Star Excursion Balance test (SEBT)

The star excursion balance test is a rapid, simple, low-cost, and reliable alternative to sophisticated instruments that measure the functional performance of lower limbs (Coughlan et al., 2012). The star excursion balance test consists of eight directions that challenge the subject’s postural control, strength, range of motion, and proprioceptive abilities. The farther a subject can reach with one leg while balancing on the opposite leg, the better functional performance they are deemed to have. The contralateral stance limb needs a combination of better balance, strength, and motion to have the ability to reach further (Hertel J, et al 2000). The Star Excursion Balance Test (SEBT) may provide a more accurate assessment of lower limb function compared to the quiet standing test, according to Clagg et al. (2015). This test involves standing on one leg and reaching out as far as possible in eight different directions while maintaining balance. The stance limb requires ankle, knee, and hip flexion range of motion as well as satisfactory strength, proprioception, and neuromuscular control to execute reaching tasks (Olmsted et al., 2012). The Star Excursion Balance Test (SEBT) is used to assess physical performance and screen deficits in dynamic postural control due to musculoskeletal injuries. It can also help identify athletes at greater risk for lower extremity injuries and aid in the rehabilitation of orthopedic injuries in healthy, active adults (Razeghi et al., 2016). The SEBT requires multiple neuromuscular characteristics that may render it a more effective test to identify athletes who are at greater risk for lower extremity injury (Ganesh et al., 2015). A study by Munro and Herrington (2010) evaluating the star excursion balance test showed that it has excellent interrater reliability as indicated by an ICC of 0.84 to 0.92 while Gribble et al. (2013) established that the normalized maximum excursion distances using SEBT had intra-class correlation coefficients that ranged from 0.86 to 0.92 while the reliability for the non-normalized measurements ranged from 0.89 to 0.94. Similarly, Kinzey and Armstrong (2008) found that SEBT had an intra-class correlation coefficient of 0.67 to 0.87, with six duplicate practice sessions suggested to increase this range above 0.86. Hertel J (2000) and Holme E et al., (1999) reported in their studies that SEBT has a strong intratester and intertester reliability and is also sensitive in the detection of functional deficits associated with chronic ankle instability. (Hertel et al., 2006b) reported that the Anterior(A), the Posteromedial (PM), and the Posterolateral (PL) directions are the most effective in assessing dynamic balance in those with chronic ankle instability.

The study done on simplifying the SEBT with analysis of subjects with and without CAI concluded that the posteromedial, reach direction distance was most strongly associated with the performance of all the reach directions in subjects with and without CAI. In addition, the posteromedial (PM), Anteromedial (AM), and Medial direction (MD) directions were all able to identify statistically significant differences between limbs with and without CAI (Hertel et al. 2006b). A systemic review by Bertrand-Charette et al., (2020) found evidence that the posterior-medial and anterior direction of the modified star excursion balance test can be used to assess motor control and proprioceptive abilities after an ankle sprain and discriminate between stable and unstable ankles. Therefore, the investigator is using the simplified Y- y-balance test to assess and collect postural control data among the Kenya rugby players, playing Keny cup competition with or without ankle injury and to standardize the tool. A Y balance test with three different reach distances was constructed (Anterior, posteromedial, and Posterolateral) i.e. 135 degrees from anterior direction to posteromedial direction, 135 degrees from anterior to posterolateral direction and 90 degrees from posteromedial to posterolateral direction.

2.9 ASSOCIATION BETWEEN CHRONIC ANKLE INSTABILITY (CAI) AND POSTURAL CONTROL

In an American study involving 48 subjects (control = 16, coper = 16, CAI = 16), Wikstrom et al. (2010) sought to investigate whether postural control differed between those with and without chronic ankle instability. The measures of postural control evaluated were the center of pressure [COP], time-to-boundary [TTB], and center of pressure - center of mass [COP–COM] moment arm with the copper and CAI subjects were required to stand on their involved limb while controls stood on a matched limb. The results showed that the mediolateral ($p < 0.01$) and anteroposterior ($p < 0.01$) COP velocity was greater in individuals with CAI relative to both copers and controls. Similarly, the peak COP–COM moment arm in the anteroposterior direction ($p < 0.01$) and the resultant mean COP–COM moment arm ($p < 0.01$) was increased in individuals with CAI relative to copers. These measures were thus found to successfully discriminate between established copers and individuals with CAI.

In another American study, Jupil (2013) sought to determine which functional performance tests identified CAI among seventy individuals (CAI = 31, control = 39) from the physical activity classes and club teams of the University of Georgia. The subjects were required to complete the Foot Lift Test (FLT), the Star Excursion Balance Test (SEBT, the Single Leg Hop Test (SLHT), and the Time in Balance Test (TIB) in a randomized order. The findings indicated no significant differences in performance between the groups. In addition, significant correlations were found between the TIB and the FLT, as well as between the Single leg hop test and the SEBT. The study concluded that clinicians may apply the SLHT as a first step in evaluation and then use the 3 other FPTs for further evaluation.

In an Iranian study, Hosseinimehr et al. (2010) investigated the effects of fatigue and chronic ankle instability on dynamic postural control among thirty physical education students from Guilan University. The star excursion balance test was used for the evaluation of dynamic postural control. The subjects also performed a functional fatigued protocol that lasted 15 min. The rating of perceived exertion before, middle, and after the fatigue protocol was measured using the Borg scale. The results indicated that dynamic postural control decreased after fatigue in the two groups ($p<0.05$) as indicated by significant differences in lateral and anterolateral directions of the star excursion balance test ($p<0.05$) between the two groups after fatigue. The study concluded that fatigue and chronic ankle effect on dynamic postural control and their combination increased this effect.

In a recent case-control study conducted in Belgium, Eechaute et al. (2015) evaluated the discriminative properties of the multiple hop test for CAI among 103 subjects (51 with CAI and 52 healthy controls). Between group differences in time scores and balance errors were calculated as well as the area under the curve of these outcomes. In addition, likelihood ratios were calculated based on the most optimal cut-off point. The results showed that subjects with CAI scored significantly worse on-time scores, the total number of balance errors, and the number of change-in-support strategy errors than healthy controls ($P < .001$). The study concluded that subjects with CAI have worse dynamic postural control than healthy controls when hopping and landing and rely on a different postural strategy and that the multiple hop test is a useful discriminative tool for CAI.

In a longitudinal, observational study on postural balance and injury incidence, Olivier et al. (2015) studied the difference in lumbopelvic movement control and static and dynamic balance ability among cricket pace bowlers. Thirty-two, healthy, injury-free, male premier league fast, fast-medium, and medium-pacer bowlers aged between 18 and 26 years participated in the study. The main outcome measures were injury incidence, lumbopelvic movement control, and static and dynamic balance ability. The key findings showed that lumbopelvic movement control tests could not discriminate between bowlers who sustained an injury during the cricket season and bowlers who did not. The study also found that performance in the single leg balance test ($p = 0.03$; confidence interval 4.74–29.24) and the star excursion balance test ($p = 0.02$; confidence interval 1.28–11.93) as measured at the start of the season was better in bowlers who did not sustain an injury during the season. The study concluded that deficient performance in the single leg balance test and the star excursion balance test at the start of the cricket season could be an indication that a bowler is at heightened risk of injury.

In a study to determine the ability of the modified star excursion balance test to differentiate between athletes with and without chronic ankle instability (CAI), Razeghi et al. (2016) sought to assess if the modified SEBT could detect reach deficits in patients with unilateral CAI. A convenience sample of 30 elite and sub-elite women athletes was selected and assigned into two groups: CAI group (Mean ± SD: age: 25±3.5 years; height: 1.68±0.09m; weight: 62.7±7.3kg), and healthy controls (Mean ± SD: age: 26±4.2 years; height: 1.69±0.05 m; weight: 62.7±7.3 kg). The control group was matched in age, height, weight, and the dominant leg with the CAI group with the injured limb in the CAI group being the dominant leg. Independent sample t-test was used for both between-group and within-group inter-limb comparisons. The findings showed that there was no significant difference in any direction of modified SEBT between the two groups in both limbs. In addition, no significant inter-limb differences were also observed within both groups. In a cross-sectional comparative study conducted in India, Khuman et al. (2014) performed dynamic postural control assessments, using a star excursion balance test, among 60 participants [unilateral CAI (n=30) and healthy asymptomatic (n=30)]. For the CAI participants, the study also compared the reach distances of their injured dominant and injured non-dominant limbs. The SEBT reach distances were measured in centimeters (cm) while the participants stood and the score of 3 reach trials was averaged for data analysis. The results indicated that the intra-group comparison of SEBT reach scores demonstrated that the reach distances of the injured limb were significantly decreased in all directions compared to the uninjured limb (p=0.000) among the CAI participants. However, the control group did not show a significant difference in the inter-limb reach distances (p>0.05). Further, no significant difference (P>0.05) was noted in reach distances between the injured dominant and injured non-dominant limb of CAI participants. Based on the findings, SEBT seems to be efficient in detecting dynamic postural control in participants with or without chronic ankle instability.

In a recent cross-sectional observational study conducted in India, Melam et al. (2016) performed a comparison of static and dynamic balance among university-level football and basketball players with chronic ankle instability. Twenty-four collegiate-level players (12 footballers and 12 basketballers) with CAI and were inactive from sports for more than 3 months with a score of 85% or less on the Foot and Ankle Ability Measure Sports scale were included in the study. Static balance was evaluated by the stork standing test, and dynamic balance was assessed using the star excursion balance test. Based on the results, significant differences were observed in the static and dynamic balance between the injured and non-injured limbs for both the football and basketball groups (P < 0.05). This record of differences in the postural balance due to injury supports the need for sports-specific rehabilitation programs for injured players to improve their balance which is essential for playing their sports efficiently.

In a more recent cross-sectional study conducted in the USA, Ko et al. (2017) performed a comparison between single and combined clinical postural stability tests in individuals with and without chronic ankle instability. Fifty-eight individuals were recruited into the study and were grouped as follows: CAI group (n = 25) and control group (n = 33). The participants completed the following clinical tests: the Foot Lift Test (FLT), the Star Excursion Balance Test (SEBT), the Single-Leg Hop Test (SLHT), and the Time in Balance Test (TIB) in a randomized order, with a linear regression model used to determine measures that matched ankle group membership. The results indicated that the most parsimonious combination of tests (SLHT and SEBT) resulted in correctly matching 70.69% (41/58) of participants into groups, which was significantly better than chance. The study concluded that using SLHT and SEBT resulted in improved recognition of participants designated into the CAI or control groups and that using multiple clinical functional tests may be more helpful in determining deficits and intervention effectiveness.

In a study on dynamic postural control and mechanical stability, Wikstrom et al., (2010) compared dynamic postural control and mechanical ankle stability among seventy-two subjects. The subjects were divided equally into three groups: uninjured controls, people with previous ankle injuries but without CAI, and people with CAI. The subjects completed a single-leg hop-stabilization task and then had an anterior drawer test and lateral ankle radiograph performed bilaterally. The dynamic postural stability index was calculated from the ground reaction forces of the single-leg hop-stabilization task. Ankle joint stiffness was measured with an instrumented arthrometer during the anterior drawer test, and fibula position was assessed from the radiographic image. The results indicated that patients with previous ankle injuries but without CAI demonstrated higher frontal plane dynamic postural stability scores than both the uninjured control and CAI groups ($P<0.01$). Further, patients with and without CAI had significantly higher sagittal plane dynamic postural stability scores ($P<0.01$) and increased ankle joint stiffness ($P=0.045$) relative to the control group.

In a descriptive study on SEBT and its application in rugby union players, Coughlan et al. (2014) sought to determine the performance of selected SEBT reach directions among elite junior rugby union players and determine if differences existed between the forward and back position units. The study recruited 102 healthy male elite rugby union players (age = 17.9 ± 1.1 years, height = 1.83 ± 0.07 m, body mass = 90.5 ± 11.3 kg). The participants were assessed on the Anterior (ANT), Posterior-medial (PM), and Posterior-lateral (PL) reach directions of the SEBT. The findings showed that no significant differences in dynamic postural stability were observed between the forward and back position units.

Olmsted et al. (2012) investigated whether the lower extremities reach tests of the SEBTs could identify impairments in individuals with chronic ankle instability. The study focused on the effectiveness of star excursion balancing tests in detecting reach deficits. Twenty individuals with unilateral, chronic ankle instability (height = 176.8 ± 4.5 cm, mass = 82.9 ± 21.2 kg, age = 19.8 ± 1.4 years) and twenty uninjured subjects (age = 20.2 ± 1.4 years, height = 178.7 ± 4.1 cm, mass = 82.7 ± 19.9 kg) matched by sex, sport, and position were enrolled in the research. For data analysis, the individuals stood on each leg and the reach distances were measured in centimetres (cm), with an average of three reaches in each of the eight directions. As compared to the matching limb of the uninjured group, the group with chronic ankle instability had a substantially lower reach (78.6 cm against 82.8 cm) when balancing on the injured limb. For identifying reach deficiencies between and among participants with unilateral chronic ankle instability, the SEBT seemed to be an effective tool.

In a prospective mixed-model study, Springer et al. (2007) evaluated the normative values for the uni-pedal stance test (UPST) with eyes open and closed across age groups and genders. Healthy subjects (n= 549), 18 years or older, performed the UPST with eyes open and closed. The mean and best of 3 UPST times for study participants were documented and inter-rater reliability was evaluated. The results showed that there was a significant age- dependent decrease in UPST time during both conditions. Inter-rater reliability for the best of 3 trials was determined to be excellent with an intra-class correlation coefficient of 0.994 (95% CI, 0.989-0.996) for eyes open and 0.998 (95% CI, 0.996-0.999) for eyes closed.

In an exploratory case-control study conducted in the USA, Hertel, Braham, Hale, and Olmsted-Kramer (2006) sought to determine which components of SEBT were most affected by CAI. Forty-eight young adults with unilateral CAI and 39 controls, matched in age, height, and weight, performed 3 trials of the 8 SEBT tasks with each of their limbs. Separate exploratory factor analyses were performed on data for both limbs of the CAI and control groups. Pearson product-moment correlations were calculated to identify the relationships between the different reach directions. The results showed that subjects with CAI reached significantly less on the anteromedial, medial, and posteromedial directions when balancing on their involved limbs compared to their uninvolved limbs and the side-matched limbs of controls. Anteromedial, medial, and posteromedial reach tasks may be used clinically to evaluate for functional deficits related to CAI instead of evaluating all 8 tasks.

Esteves et al. (2022) conducted a recent study comparing the differences in postural control between healthy individuals and those with chronic ankle instability. Twenty healthy subjects and sixteen chronic ankle instability subjects underwent a single leg balance test using a force plate for sixty seconds on both stable and unstable surfaces. On the stable surface, the Centre of Position Amplitude and COP Velocity were computed. The correlation dimension of COP mediolateral displacement was low in the chronic ankle instability group with statistical significance (P=0.05), but there was no difference between the groups for any of the other traditional variables. On the stable surface, there were no differences found either with the nonlinear analysis. The only measure that demonstrated a significant difference between the groups, according to the study's findings, was the associated dimension of COP displacement during a one-leg stance on a stable surface. In addition, the lower value of these variables in the chronic ankle instability subjects may implicate a balance control system with more difficulties in adapting to the environment and chronic ankle instability subject to balance control (Esteves et al., 2022). In a systematic review and meta-analysis done by Xue et al., (2021) on chronic ankle instability and proprioception deficits association. The reviewers concluded that kinesthesia, passive, and active joint position sense of ankle inversion, and kinesthesia of ankle plantarflexion are impaired in chronic ankle instability when compared with uninjured contralateral limb.

A study done in Australia and the United Kingdom sought to investigate the relationship between the perception of stability and the objective performance of dynamic stability in this population (Forsyth et al., 2022). The Cumberland ankle instability tool was used for screening and categorizing the groups into chronic ankle instability, copers, and healthy participants. Each participant from each group was evaluated using the star excursion balance test to reach distances in the Anterior, posteromedial, and posterolateral directions, and the average of the reach distances was analyzed. The study's findings showed a moderately significant correlation (P<0.001) between the reach distances measured by the star excursion balancing test in all directions for the chronic ankle instability group and the posterolateral direction (P<0.005) for the copers. In summary, the Cumberland ankle instability instrument score and the star excursion balancing test have a somewhat significant correlation in the population with chronic ankle instability. Furthermore, it draws attention to the differences between objective and subjective stability and reinforces how crucial it is to use both kinds of measurements for ongoing evaluation in practice (Forsyth et al., 2022). The study indicates the importance of the postural control assessment tool and the significant decrease in reach distances of individuals with chronic ankle instability. In Kenya, there are no studies done on a comparison between postural control and chronic ankle instability among rugby players in Kenya. Therefore, we can't generalize the findings and results in another part of the world to fit the Kenyan context. The researcher conducted the study to either support or refute the narrative that rugby players with chronic ankle instability have significantly shorter reach distances on the SEBT. This was due to the lack of studies or data on the relationship between postural control and chronic ankle instability.

2.10 KNOWLEDGE GAP

From the reviewed empirical literature, it is evident that both SEBT and Y balance tests are valid and dependable in the assessment of postural balance among diverse sporting groups. However, most of the studies on the two tools have been done in developed countries whose contextual setting is different from most low-income developing countries of sub-Sahara Africa including Kenya. In addition, most of the previous studies evaluated SEBT and Y balance tests, individually and not clinical validation of the two tools concurrently. The reviewed empirical literature also shows mixed results concerning the question of whether there exist significant differences in postural control performance between those with and without CAI. Lastly, there is scanty empirical documentation on the association between CAI and postural control performance as well as on the concurrent validity of SEBT and postural control in Kenya Cup rugby players with and without CAI, and the current study seeks to fill the gap.

CHAPTER THREE

3. METHODOLOGY

3.1 INTRODUCTION

The design, target population, sampling method, research tool, pilot study, relevance and reliability of the study tool, data collection technique, data analysis, presentation method as well as ethical issues, are all discussed in this chapter.

3.2 RESEARCH DESIGN

A comparative study design where all the subjects in the study filled a sports history questionnaire, a CAIT questionnaire, and performed a modified balance test.

3.3 STUDY SETTING

The study was conducted in Kenya among the 15’s rugby players playing in the amateur league in Kenya.

3.4 PARTICIPANTS

3.4.1 Source of Participants

All the twelve Kenyan clubs in the country were invited to participated in the study however 2 clubs refused to participate and were not included. A total of ten clubs out of the twelve participated in the study. Sixteen players were selected from each club and thus a total of 160 players were eligible for inclusion in the study.

3.4.2 Sample Size

The sample size of 161 subjects was calculated using an online Raosoft sample calculator with a 5% margin of error and 95% confidence level. Raosoft assumed a population size of 276 15’s rugby players of twelve teams and each team consisting of 23 players and a response distribution of 50% (see Appendix 1).

3.4.3 Sample Selection

Table 3.1: Inclusion and Exclusion

Inclusion	**Exclusion**
Kenyan Male Rugby players above 18 years	Playing in lower leagues (championship, division two)and players who have played less than 11 games out of the 22 games
have not suffered from cerebral concussions, vestibular disorders, or no self reported lower extremity injuries for the last 3 months before the study	
Playing in the Kenya cup league (first team of 23) players from 01/01/24 for at least 11 out of the 22 games.	

3.5 RESEARCH INSTRUMENTS AND OUTCOME MEASURES

3.5.1 Introduction

Various tools (Appendix 6) were used to collect data including 1) The demographic and sports history questionnaire, 2) The Cumberland chronic instability instrument, and 3) the star excursion test tool.

3.5.2 Demographic and Sports History Questionnaire

This questionnaire consisted of questions that asked information related to the demographics of participants and their sports history e.g., gender, age height, weight, rugby club, the number of years one has played rugby, and competition history. The questionnaire was developed by the researcher in consultation with the experts in the field.

3.5.3 **Cumberland Ankle Instability (CAIT)**

Cumberland is based on a 9-item-30-point questionnaire regarding the perception of clinical history and function. Chronic ankle instability is a self-reporting tool, where the part total score of CAIT ranges from 0 to 30. Hiller et al. (2011) reported that CAITS can discriminate between stable and unstable ankles, with a value of 25 being the cut-off point. Participants identify the questions in the questionnaires and answer them to the best of their knowledge. A threshold value of ≤ 25 will be used to discriminate between with and without chronic ankle instability among the participants (Hiller et al., 2011). The Cumberland Ankle Instability tool was developed by Hiller et al. (2016). The tool has a maximum of 30 points with a nine-item score. With the cut-off score of 25 points, this means all scores less or equal 25 represent unstable ankles and only 5 points (26-30) represent stable ankles. The nine items include:

1. Pain in my ankle
2. Going down the stairs
3. Making sharp turns
4. Going down the stairs
5. Feeling unstable when standing on one leg
6. Ankle feels unstable when I hop
7. My Ankle feels unstable when I walk, / jog/run / just.
8. Start to roll over on my ankles
9. Incidence of my ankle rolling over and returning to normal.

The participant had to tick one statement in each question that best describe his ankle. The validity and reliability at 83% and test and retest reliability were 96% (Hiller et al., 2006)

3.5.4 **The Star Excursion Balance Test (SEBT)**

The Star Excursion Balance Test (SEBT) is a dynamic test that is suitable to evaluate proprioception around the ankle. A participant was required to complete unilateral squats with both dominant and non-dominant legs, extending the non-stance foot in the anterior, posteromedial, and posterolateral planes as far as possible. All originate from the same spot and the stance foot is at the center and the reaching foot touches the distal end of a tape measure softly without upsetting balance before standing back up. (Gribble, 2013). The distances between the center of the grid or star and the furthest position reached within every direction are used to calculate the SEBT reach distances (Ganesh et al., 2015). The SEBT trials are regarded as failed if the subject fails to sustain a unilateral posture, raises, or moves the perspective foot off the grid, comes to rest with the reaching foot, or fails to return the extending foot to the starting position. Plisky et al. (2016) reported that SEBT intra-tester reliability and between 0.84 to 0.87 in the three directions and test-retest reliability ranged from 0.89 to 0.93, at 95% CI.

3.6 PROCEDURE

Ethical clearance was obtained Appendix 3 and permission was NACOSTI (appendix 2).

3.6.1 Pilot Study

Players in the Kenya Cup League participated in the study. About 10% of the study sample was recruited to participate in the pilot study. The purpose of the pilot study was to evaluate the data collection tool. The pilot was conducted before the research instruments were used in the main study and found no design problems, confirmed that the goals and content were satisfied, and no adjustments were required (Schindler, 2011). Mugenda (2009) declares that 10% of the random sample is sufficient for the investigation tool's pilot testing. The researcher assign each player a number starting from 1 to 160, and selecting the 10th, 20th, 30th, 40th, 50th, 60th, 70th, 80th, 90th, 100th, 110th, 120th, 130th, 140th, 150th, and 160th player to total to sixteen sample size. The 16 participants were recruited from the target population of Kenya Cup players and were not included in the main study. The pilot study was crucial in determining the accessibility and feasibility of the approach to be employed in the main study. The researcher explained the purpose of the pilot study and they participated. They were provided with a written study information letter and informed consent form (Appendix III) and data was collected using the demographic questionnaire, Cumberland ankle instability tool, and SEBT. The participants filled out the questionnaire by themselves and the researcher measured the SEBT reach distances. First, the participants warmed up with squats and were given four trials before the recording was done in a three predetermined orientation. The participant switched from a double to single- legged posture without falling while stretching the contralateral side as far as they could, along the three indicated reach distances direction (anterior, posteromedial, and posterolateral). Using only the distal end of the reaching leg, gently press down on a tape measure using the directional lines. Before the commencement, the participants were given

15 minutes of rest after warmup, and they were required to perform the SEBT along the three selected directions with two minutes of rest in between the trials. All trials were conducted to remove additional stability and balance gained from shoes. The researcher recorded the participant’s reach distances at every trial and calculated the adjusted composite reach distances values. The greatest reach in each of the three reach orientations was added and divided into three to come up with an average reach distance.

3.6.2 Main Study

The data collection took a period of thirty days and was conducted from 8 am to 5 pm every day (Monday to Friday). The researcher and the assistant explained the importance and the purpose of the study and its benefit to the clubs and the Kenya rugby union fraternity. The sampling of sixteen players from eight rugby clubs resulted in a total sample size of 127 participants we were unable to reach our target sample size of 161 participant due to the unavailability of players because of school work and commitment. The research assistant assisted the researcher in the distribution of the questionnaires and measurement of reach distances during the data collection. The researcher had earlier trained the research assistant on the data collection procedures and data capturing. The researcher sampled participant's sampling method until the target sample size of 127 participants was obtained from all eight clubs. The participants were recruited from players playing in the first team, for over 18 years, and who have consented. The researcher informed the participants of the study's goal and invited them to sign a consent. Following the subject's consent, the researcher measured the participant's height, weight, and three reach directions (anterior, posterolateral, and posteromedial), as well as their limb length and the participant then answered the CAIT and demographic questionnaires. Participants completed the questionnaire, and with the researcher's doing, their measurements and warm-up before the measurement.

3.6.2.1 Cumberland ankle instability tool (CAIT)

The CAIT questionnaire was completed for both the left and the right ankles, allowing for individual assessment of each ankle. The participant had to select one statement in each item that best described the affected ankle/ ankles. The CAIT is a 9-item, 30-point scale that quantifies ankle instability using a numerical scale and can differentiate between stable and unstable ankles.

3.6.2.2 Star excursion balance test

The participant lied on a plinth in supine and the leg length was measured by the researcher. Before returning to the initial position, the subject must first bridge and elevate the hip off the plinth. After that, the researcher actively straightens the leg to align the pelvis. The length of the limb was measured in centimetres first from anterior inferior eminence to the medial malleolus prominence on the dominant and nondominant limb. Attaching three sticking tapes to the gym floor with one anteriorly (A) orientated to the apex (A) and the other 2 ranging to posteromedial and posterolateral orientation at 135 degrees were used to measure the reach direction distances (Olmsted et al., 2012). The test subject warmed up before the start of the test, Using both their dominant and non-dominant leg, subjects in the SEBT were required to perform single-leg squats, extending their non-stance foot as far as possible in three predefined orientations - In a grid defined by a center point where the approaching foot is located, the terms front, posteromedial, and posterolateral all originate from that point (Gribble, 2013). The task required the participant to transition from a double-leg to a single- leg position without tripping, while gently applying pressure to a masking tape with the tip of the reaching limb and stretching the contralateral foot along the three designated directional lines. By calculating the distance from the star's center to the furthest position reached in each orientation, the SEBTs measurement were put into numerical form. The participants were permitted to exercise reaching across each of the three directions four times before performing the main reach direction to reduce the learning impact. Before the main trials began, competitors were given a 15-minute pause to rest. After the 15-minute rest, the participant was required to perform the SEBTs along the 3 selected directions three times in each direction with 2 minutes of rest in between the trials. Midway through, the individual's feet were examined and labeled (along the medial border). A boundary was established from the second toe, crosscutting with a line drawn from the dorsal side of the foot (point laterally). This will be the point where the tape converges. To eliminate the extra stability and balance provided by shoes, all trials were carried out barefoot (Gribble et al., 2012). If the player is unable to keep a unilateral standing, raises or moves the stance foot from the grid, touches the ground with the reaching foot, or does not restore the reaching foot to the initial position, the trials were deemed unsuccessful and were deleted and restarted (Plisky et al., 2016). The researcher recorded the participants' reach distances in each trial. Following that, the researcher calculated the adjusted composite reach value. According to Muma et al. (2012), the players' ages range from 18 to 40 years old, with an average of 22.80 years. The average and normalised reach distances were measured on both the left and right limbs. The anterior reach direction, posteromedial reach direction, and posterolateral reach directions were chosen because research has shown that they are crucial for identifying athletes who are more likely to have chronic ankle instability while also minimizing the duplication associated with executing all eight SEBT directions (Olmsted et al., 2012; Plisky et al., 2016). The test leg and reach direction for every participant were randomized and similarly, every participant was randomized for both the reach direction and the tests.

3.7 ETHICAL CONSIDERATIONS

The National Commission for Science, Technology, and Innovation (NACOSTI)(Appendix 2) granted the researcher permission to carry out the research after ethical clearance from the University of Witwatersrand Human Research Ethics Committee (Appendix 3). Permission was granted by the Kenya rugby union to conduct the study. Consent was obtained from the management of each club and informed consent (Appendix 5) was obtained from players.

3.8 DATA ANALYSIS

The statistical analysis was performed by a qualified statistician using the IBM Statistical Package for Social Science (SPSS) Version 26. The table below explains how the data will be analysed based on the objectives and specific variables.

Table 3.2: Summary of the Objectives, Variable, and Method Data Analysis

Objective	Variable	Type of Data	Analysis
Describe the demographic profile of rugby player.	Age, weight, height, and position	Nominal and Interval	Frequencies, Mean/median
To screen for chronic ankle instability among rugby Players.	Dependent	Numerical	Descriptive and inferential analysis
To describe differences in demographic characteristics and postural control in rugby players with/without ankle instability	Chronic ankle instability tool, reach distances on anterior, posteromedial, and posterolateral directions.	Nominal	Frequencies, Mean standard deviation, and tables.
To find the association between chronic ankle instability and postural control in rugby players	Chronic ankle instability tool (CAI), and star excursion balance test (SEBT)	Nominal, ordinal, and Correlations	Pearson correlation, T-square (two-tailed test)

3.9 DATA MANAGEMENT

The acquired data was used per the study's objectives. All acquired data was kept in a cupboard with a key and lock, accessible only to the researcher. The raw data remained with the researcher for three years and could be discarded thereafter.

3.10 CONCLUSION

This cross-sectional study recruited a sample of 127 participants with and without chronic ankle injuries. The participants in the study were a CAI group and a non-CAI group of Kenyan rugby players. The assessment tools used to categorise the groups included the Demographic Sports History Questionnaire, CAIT, and SEBT.

CHAPTER FOUR

4. RESULTS

4.1 INTRODUCTION

This chapter contains the results of the study with tables and demographic data as well as findings from the Cumberland ankle instability tool and the three reach directions of star excursion balance test. The results are discussed, compared, and interpreted to other literature in Chapter 5. Section 4.2 summarises the demographics of the participants, section 4.3 the screening of chronic ankle instability among rugby players, section 4.4 the assessment of postural control among rugby players with or without chronic ankle instability and 4.6 is the conclusion of the results.

4.2 DEMOGRAPHIC CHARACTERISTICS

The study participants comprised 127 male rugby players from eight clubs in Kenya. The mean age group of the participants was 23.5 (SD± 5.67) and about 110 (86.6%) of the participants were in the age range of 18 - 29 years, while the modal age group was 18-24 years. Three-quarters (73.3%, n=93) of the participants spent not more than five years in their respective clubs and only 10 (7.6%) spent more than 10 years in the club. The right leg was dominant among 120 (94.5%) participants. (Table 4.2.1).

Table 4.1: Demographics (n=127)

Variable	Frequency	Percentage
Age		
18-24	80	63.0
25-29	30	23.6
30-34	16	12.6
35-39	1	0.8
Team		
Kabras RFC	16	12.6
Nakuru RFC	16	12.6
Oilers RFC	16	12.6

Quinnes RFC	16	12.6
K.U RFC	16	12.6
CUEA RFC	16	12.6
KCB RFC	16	12.6
Strathmore RFC	15	11.8
Time at Current Club		
<1 year	26	20.5
1-5yrs	67	52.8

Variable	Frequency	Percentage
6-10yrs	24	18.9
>10yrs	10	7.9
Dominant leg		
Right	120	94.5
Left	7	5.5
Position played		
Back	64	50.4
Forward	63	49.6

No statistically significant differences were demonstrated among the three groups for their age (p>0.1) and BMI measurements (p>0.22), height (p>0.45), and weight **(**p>0.32).

4.3 CHRONIC ANKLE INSTABILITY

4.4.1 Reach Distance as a % Limb Length (mean ± SD) as a Factor of CAIT Score

When classifying ankles based on the presence of Chronic Ankle Instability (CAI) using a CAIT score threshold (CAIT > 25 vs. CAIT ≤ 25) as shown in Table 4.2, no significant differences were observed in reach directions. However, there were slight positive differences in mean reach distances: anterior reach showed a mean increase of 1.01 cm, and posteromedial reach increased by 1.52 cm. Among the participants, 71 (55%) exhibited CAI, with mean CAIT scores of 76.35 ± 7.29 for anterior reach, 88.86 ± 10.21 for posteromedial reach, and 81.28 ± 9.97 for posterolateral reach.

Table 4.2: Reach Distance as a % Limb Length (mean ± SD) as a Factor of CAIT Score

Reach Direction		Reach distance
ANT	CAIT > 25 (n = 71)	76.35 ± 7.29
	CAIT ≤ 25 (n = 56)	75.34 ± 7.55
	Mean Difference	1.01
	P-value	0.45
PM	CAIT > 25 (n = 71)	88.86 ± 10.21
	CAIT ≤ 25 (n = 56)	87.34 ± 10.57
	Mean Difference	1.52

	P-value	0.42
PL	CAIT > 25 (n = 71)	81.28 ± 9.97
	CAIT ≤ 25 (n = 56)	81.39 ± 11.42
	Mean Difference	-0.11
	P-value	0.96

Keynote: Ant.- Anterior; PM- Posteromedial; PL- Posterolateral; CAIT- Cumberland ankle instability tool

No significant association between demographic characteristics and CAI (mean=180.73 and SD=7.82) and control groups (Mean=180.96) and SD=6.14).

4.4 POSTURAL CONTROL

For the limbs with CAI, the loading of each reach direction to the 1-factor model revealed that the posterolateral reach was the most strongly related (α = 0.955). However, all directions had alpha values greater than 0.60, suggesting considerable redundancy among the three directions except for the anterior.

For the no CAI, posterolateral reach loaded highest (α = 0.95), followed closely by posteromedial (α = 0.93). For the analysis of all limbs combined, the posterolateral reach again loaded highest (α = 0.96), and all 3 directions had alpha values of greater than 0.8.

Table 4.3: Alpha Values for Each Direction to the Single-Factor Solution Shown for Each of the Factor Analyses

CAI GROUP (N=49)		NO CAI GROUP (N=48)		BILATERAL CAI GROUP(N=30)	
Reach Direction	Alpha	Reach Direction	Alpha	Reach Direction	Alpha
Anterior	0.618	Anterior	0.559	Anterior	0.817
Posteromedial	0.912	Posteromedial	0.931	Posteromedial	0.904
Posterolateral	0.955	Posterolateral	0.936	Posterolateral	0.960

4.5 DEMOGRAPHICS BY CATEGORY CAI AND CONTROLS

Table 4.4 shows demographic characteristics by CAI and healthy groups. The participant's physical characteristics did not differ significantly among the three study groups. No statistically significant differences were shown among the three groups for their age (p>0.1) and BMI measurements (p>0.22), height (p>0.45), and weight (p>0.32).

Table 4.4: Demographics by Category CAI and Controls

Category	CAI group (n=49)		NO CAI GROUP(n=48)		LATERAL CAI (n=30)		P-value
	Mean	SD	Mean	SD	Mean	SD	
Height	180.73	7.82	180.96	6.14	182.23	7.48	0.45
Weight	92.56	20.71	93.22	16.75	90.15	14.87	0.32
BMI	28.43	6.59	28.47	5.05	27.14	4.25	0.22
Age	23.8	4.711	24.3	5.798	22.8	5.731	0.1

There were also no significant mean differences in the control group and CAI group concerning medial and Posterolateral reach distances

There were no significant differences between the involved limbs of the CAI group, bilateral CAI group, and non-CAI for any of the reach directions.

4.6 ASSOCIATION BETWEEN ANKLE INSTABILITY AND POSTURAL CONTROL

The Pearson product-moment relations among the reach directions revealed *r* values between 0.58 and 0.84 for the involved limbs and between 0.6 and 0.84 for the uninvolved limbs (Table 4.6.1). All bivariate correlations were statistically significant (anterior r=1, posteromedial=0.6 and posterolateral r=0.58, posteromedial r=1 and posterolateral r=0.84 and posterolateral r=1 There was a strong correlation between the Unilateral CAI group and all the reach directions.

Table 4.5: Pearson Product-Moment Correlations (r) of Reach Performance (Unilateral CAI Group)

	Anterior	Posteromedial	Posterolateral
Anterior	1	0.6	0.58
Posteromedial		1	0.84

Posterolateral			1

Table 4.6: Pearson Product-Moment Correlations (r) of Reach Performance in the Three Different Directions on the non-CAI, CAI, and Bilateral CAI groups.

	Anterior	**Posteromedial**	**Posterolateral**
Anterior	1	0.45	0.49
Posteromedial		1	0.83
Posterolateral			1

Pearson product-moment correlations (*r*) of reach performance in the 3 different directions for limbs with chronic ankle instability (n = 48). All *r* values are significant (*P*<0.05).

4.7 MEANS AND STANDARD DEVIATIONS OF NORMALISED REACH DISTANCES (REACH DISTANCE IN CM/LEG LENGTH IN CM)

Mean and standard deviations for normalised reach distances are presented in Table 4.7.1. Except for the Anterior reach direction (p= 0.01), there were no significant mean differences in the non-CAI group and the CAI group. Additionally, there were no significant differences between the uninvolved limbs of the CAI group and the uninvolved limbs between the CAI and control groups for any of the reach directions. There were no evident significant main effects between any of the reach directions and the CAI and healthy (control) groups.

Table 4.7: Means and Standard Deviations of Normalized Reach Distances (Reach Distance in cm/Leg Length in cm)

Direction	CAI Group		NO CAI GROUP		Group-Interaction (p-value	Main Effect (p-value)
	Involved limb. Mean (SD)	Uninvolved limb Mean (SD)	volved limb	nvolved limb		
Anterior	77.8(8.5)	77.2(7.5)	75.4(7.3)	76.0(7.5)	0.01	0.18
Posteromedial	82.4(8.5)	82.1(10.0)	83.2(10.1)	83.6(10.2)	0.23	0.45
Posterolateral	76.0(9.8)	76.3(10.0)	75.6(10.7)	75.8(9.9)	0.46	0.51

Paired t-test findings within three groups

Paired t-test analysis in Table 4.8 revealed a significantly greater mean difference in the dominant versus nondominant leg in the CAI group for anterior reach direction (80.30±9.23 vs 75.98±6.61; *p* <0.01), and the non-CAI group (74.84±6.88) vs 75.98±6.61; *p*=0.01) respectively. The CAI group also exhibited a significant mean difference in posteromedial reach distance of the dominant limb vs nondominant limb (73.99±10.12 ± vs 81.67±10.17; *P* =0.01). In contrast, the No CAI group showed no significant difference in this measure (82.72±8.89) vs 83.44 ±9.85; *P* =0.27). No statistically significant differences were found for posterolateral reach distance between groups (*p=0.5*).

While there was no significant difference in postural control between the CAI and control groups (p > 0.05), the differences were notably higher in the CAI group compared to controls for the anterior reach (mean difference = 2.36) and for both limbs in the CAI group (mean difference = 2.67) than for posterolateral and posteromedial reach in the involved limbs, which predominantly exhibited negative deviations in means.

Table 4.8: Paired t-test Findings within Three Groups

Direction	Leg	CAI Group		Bilateral CAI groups		No CAI group healthy	
		M p-value		M p-value		M p-value	
A p-value	Dominant	80.30(9.23)	<0.01	73.87(10.64)	0.57	74.84(6.88)	0.01
	Non dominant	75.98(6.61)		74.50(8.70)		76.07(6.43)	
Pm p-value	Dominant	73.99(10.12)	<0.01	81.74(11.10)	0.53	82.72(8.89)	0.27
	Non dominant	81.67(10.17)		82.25(11.05)		83.44(9.85)	
Pl p-value	Dominant	75.98(6.61)	0.52	77.58(11.75)	0.5	75.16(9.53)	0.5
	Non-dominant	74.86(9.77)		78.33(11.15)		75.67(9.65)	

4.8 ASSOCIATION BETWEEN CHRONIC ANKLE INSTABILITY AND POSTURAL CONTROL

The results of the Tukey post hoc test are presented in Table 4.9. There were no significant differences among the three groups regarding scores in the anterior, posteromedial, and posterolateral reach directions. However, the mean differences were notably higher in the CAI group compared to the healthy group for the anterior reach (2.36) and for both limbs in the CAI group (2.67). In contrast, the posterolateral and posteromedial reach distances in the involved limbs exhibited negative deviations in their means.

Table 4.9: One-Way ANOVA Tukey Post Hock Test for Maximum Reach Distances between the Three Groups

Direction	Group	Mean difference	p-value	95% c. i
Anterior	CAI vs Control	2.36	0.43	-1.53, 6.25
	CAI vs Both limbs	2.67	0.44	-1.77, 7.11
	Controls vs Both limbs	0.31	1.00	-4.14, 4.77
Posteromedial	CAI vs Control	-0.82	1.00	-5.56 ,3.92
	CAI vs Both limbs	-0.17	1.00	-5.58, 5.24
	Controls vs Both limbs	0.65	1.00	-4.79, 6.08
Posterolateral	CAI vs Control	0.35	1.00	-4.78 ,5.47
	CAI vs Both limbs	-3.75	0.37	-9.6 -,2.1
	Controls vs Both limbs	-4.10	0.28	-9.97, 1.78

4.9 SUMMARY OF RESULTS

The study included 127 male participants, comprising both the CAI and control groups. A majority (86.6%) were aged between 18 and 29 years, with the modal age group being 18 to 24 years. The analysis of the anterior reach direction revealed significant differences between involved and uninvolved limbs in both the CAI ($p = 0.01$) and control (healthy) groups ($p = 0.01$). Additionally, the study found a strong correlation between postural control and ankle stability.

CHAPTER FIVE

5. DISCUSSION

5.1 INTRODUCTION

In this chapter, we will thoroughly examine the results presented in chapter four. Our focus will be on providing a detailed description of the demographic profile of 15's players. Additionally, we conduct a comprehensive screening for CAI (Chronic Ankle Instability) among the players. Furthermore, us

objective was to determine and establish whether there is a discernible relationship and association between CAI and postural control among the 15's rugby players.

5.2 DEMOGRAPHIC

The Kenya 15s clubs consist of 12 clubs located in Nairobi County, Kakamega County, Nakuru County, and Kisumu County. The players come from diverse backgrounds and different ethnicities, including university students, college students, and others from the physical environments bordering the rugby-playing counties. In this sample, the average age was 23.5 years but ranged from 18-29 years (86.6%). The average age is normal for club rugby because the feeding grounds for clubs are post-secondary school players. As players age, their level of fitness and other risks must be considered as they could play a part in injuries (Gabbet, 2004). The players' height ranged from 155 cm to 201 cm, and the weight ranged from 65 kg to 138 kg. The right leg was dominant among the participants, accounting for 94.5% (120) of the participants. The physical characteristics didn't differ much between the CAI group and the non-CAI group, and there were no significant differences among the groups regarding height and weight.

5.2 Screening for CAI among the 15's rugby players

The study involved 127 rugby players who were assessed using the CAIT technique. They were divided into two groups: those with CAI (55%) and those without CAI (45%). The percentage of players with CAI was higher across all clubs. The distribution of CAI was similar for forward and back players, consistent with previous findings. The high incidence of CAI among Kenyan rugby players may be attributed to poor pitch conditions, inadequate pre-match warm-up, poor conditioning, and inappropriate footwear. These predisposing conditions lead to ankle ligament stress, which can cause long-term damage. Brooks and Kemp (2008) identified factors such as the demands of the rugby game, inadequate injury care, outdated training methods, and diminishing postural control as contributors to the prevalence of injuries in club rugby players. Wright et al. (2014) suggested that a cut-off score of 25 or higher improves the test's accuracy in distinguishing between individuals with and without CAI. Hiller et al. (2006) discovered that the test-retest reliability of ICC 2.1 was 96%, with a sensitivity of 82.9% and specificity of 74.7%. CAIT is more reliable than the FAO outcome measure questionnaire in analyzing ankle instability complaints, as it contains fewer items (Vuurberg et al., 2018). The study's findings revealed that more than half of the participants were classified as having CAI, while 45% with no CAI, which is greater than previously reported globally (42.5 per 10,000 gamers). Despite the study's findings, the CAI individuals actively participated in training and match-day activities. The greater number (55%) of CAI individuals in the study compared to global data (42.5 per 10,000).

5.3 POSTURAL CONTROL

There were marginally significant changes in the star excursion balance test for the rugby players with chronic ankle instability group compared to players with no CAI, specifically in the anterior direction only. In the current study, the Star Excursion Balance Test (SEBT) was used to assess dynamic postural stability in three different directions for both individuals with Chronic Ankle Instability (CAI) and healthy participants. Among the ankles with CAI, 55% had mean CAIT scores of 76.35± 7.29 for anterior (ANT) reach, 88.86± 10.21 for posteromedial (PM) reach, and 81.28± 9.97 for posterolateral (PL) reach. There was a slight positive difference in anterior reach (1.01) and posteromedial (1.52) reach distance as an indicator of CAIT score. The main finding of this study was a lower ANT score in CAI participants compared to the non-CAI group. These results were consistent with a previous study by Jabber et al. (2018), which also found differences in mean reach distance in the anterior direction across the three study groups. Additionally, a study by Chaiyakul et al. (2022) reported that the posteromedial direction in the SEBT was lower in the CAI group compared with no CAI group.

The recent study found that there was a shorter reach distance in the anterior direction (P = 0.01), followed by the posteromedial direction (P = 0.23), and the posterolateral direction (P = 0.46) when compared to the no CAI group. An ankle sprain could potentially damage the mechanoreceptors of joints, muscles, and ligaments, affecting the afferent impulses to the central nervous system and lower extremity motor control (Mohamadi et al., 2022). In addition to losing proprioception in the ankle joint, participants were unable to use their ankle joint to control their posture. According to Susco et al. (2004), impairments in the entire kinetic chain can affect a player's performance in postural control tests, including the ankle test. According to Gibble et al. (2004), chronic ankle instability (CAI) and tiredness can cause a postural control deficit, but conversely, a postural control deficit can also affect ankle joint stability.

The mean and standard deviation of normalized reach distances in this study suggest changes in sensory and neuromuscular kinematics at the ankle, as well as impaired dynamic stability during SEBT reach directions. The study is consistent with previous research, which found that the loading of each reach direction to the 1-factor model indicated that the posterolateral reach distance was most strongly related (a = 0.955). However, all directions had alpha values greater than 0.60, showing considerable redundancy among the three directions except the anterior direction compared to the non-CAI group (a > 0.8). Witter (2012) also reported similar results, showing the effect of CAI patients on lower extremity frontal plane kinematics such as plantar pressure during dynamic postural control. Delahunt et al. (2006) found that participants with CAI exhibited more ankle inversion and less peroneus longus EMG during the jump-landing phase. Palmieri-Smith et al. (2009) demonstrated that reduced dynamic peroneal activity may contribute to these findings. Hoch et al. (2011) found that a decrease in anterior reach distance performance could indicate reduced ankle dorsiflexion and sagittal plane motion at the hip, knee, and ankle.

In SEBT reach directions, ankle dorsiflexion ranges of motion have a stronger impact on anterior reach direction performance. Teralda et al. (2017) found that dorsiflexion of the ankle is somewhat linked with the anterior reach direction but not with the posterior reach directions (posteromedial and posterolateral) of the SEBT. When compared to the control group, the CAI group had a lower anterior reach distance and a higher posteromedial reach distance. The study also suggests that the anterior reach distance is best suited for detecting postural control deficiency among rugby players with CAI. It supports the hypothesis that the CAI group of rugby players had shorter reach distances in the anterior and posteromedial directions than the non-CAI group.

Based on the findings from the study on Kenya rugby players, the anterior reach direction seems to be the most indicative of overall SEBT reach direction performance, followed by the posteromedial and posterolateral reach distances. According to Hertel et al. (2006), the posteromedial reach direction best represents overall SEBT reach direction performance. The results reported by Hertel et al. were partially replicated in the current investigation, with the CAI (Chronic Ankle Instability) group performing significantly worse in the anterior and posteromedial reach directions compared to the control group. However, there are some discrepancies between this study and previous research.

The participants with chronic ankle instability (CAI) showed better performance in the posteromedial and posterolateral reach directions compared to other studies. For instance, the composite reach score for the uninjured limb was 75.34 +/- 7, which was significantly lower than the CAI group's score of 80.12 (Hertel et al., 2006). Reduced dorsiflexion range of motion contributed to poorer performance in the anterior reach direction in the Star Excursion Balance Test (SEBT). This suggests a connection between hip, knee, and ankle joint movements in the total ratio of flexion-dorsiflexion displacement of the lower limb during the anterior reach direction, resulting in altered motor control strategies (David et al., 2003). Riemann et al.

(2002) attributed the reduced performance in the anterior reach direction to compromised visual and somatosensory inputs, which are essential for maintaining postural stability. Additionally, Wikstrom et al. (2012) found that subjects performed better in the posteromedial and posterolateral reach directions when their visual awareness was reduced compared to the anterior reach direction.

Olmsted et al. (2002) found similar results when comparing participants with chronic ankle instability (CAI) to those in the SEBT reach directions. According to Razeghi et al. (2016), the modified SEBT showed no significant difference in either direction between the CAI group and the no CAI group. The post hoc test results revealed no significant differences in scores between the three groups, but the mean difference was higher in CAI vs. no CAI (2.36) and CAI in both Ankles vs. no CAI group (2.67) for anterior reach than for both posterolateral and posteromedial reach CAI group, which had predominantly negative deviations in means. The post-hoc test for maximum reach distances was not significant in all three groups ($p > 0.05$). Finally, the anterior reach direction was most typical of the CAI group and indicated postural control deficiency among rugby players in Kenya.

5.4 ASSOCIATION BETWEEN ANKLE INSTABILITY AND POSTURAL CONTROL

The study's primary findings were:

1. No significant differences were demonstrated among the three groups for age, height, and weight
2. The proportion of rugby players with CAI was 55% (71) and 45% with no CAI were screened using the CAIT questionnaire.
3. The alpha value was greater than 0.60, indicating redundancy except the anterior reach and the anterior reach direction had a p-value of 0.01 among the CAI group and no CAI group.
4. The mean anterior reach direction between the dominant and non-dominant legs differed substantially between the CAI and no CAI group.
5. The mean anterior reach direction between the dominant and non-dominant legs differed substantially between the CAI and no CAI groups ($p = 0.01$).

The study conducted in Kenya and the East African region is the first of its kind. The main finding of the study was that the group with chronic ankle instability (CAI) had a shorter reach distance in the anterior direction and a shorter reach in the posteromedial direction on the SEBT reach test compared to the group without CAI.

The star excursion balance test (SEBT) was used to assess postural control by measuring subjects' ability to maintain stability while reaching as far as possible without losing their balance (Hertel et al., 2006). Olmsted et al. (2002) discovered that individual ankle instability (CAI) exhibits poorer postural control when tested using the SEBT. Gibble et al. (2004) studied the performance of CAI individuals in different reach directions during the SEBT to assess their dynamic postural control in lower limb movements. When reaching, individuals tend to focus on their performance on each trial (Riemann et al., 2002), which may explain why the anterior reach distance differs significantly from the other reach distances. The study concluded that the CAI group achieved the shortest anterior reach distance compared to the non-CAI group, indicating a postural control impairment among rugby players with CAI in Kenya.

In each of the three-factor studies, the anterior reach direction was most strongly associated with the calculated factor, resulting in a one-factor answer. In the study sample of the three SEBT reach directions, the anterior reach direction was reflective of CAI performance. All the reach directions' alpha values (r) ranged from 0.618 to 0.955 regarding the CAI group's single-factor solution. The combination of 1-factor strength and the solution of each reach direction on the SEBT must be used to determine the CAI group's postural control performance deficit. There was a significant association between unilateral and all reach distances ($P < 0.05$). Rugby players with CAI demonstrated poor balance on their stance limb and performed worse on SEBT reach directions than those with no CAI.

The results of the one-way ANOVA Turkey post-hoc test indicate a significant interaction for anterior, posteromedial, and posterolateral reach directions. The groups had shorter reach distances than the control group. The mean difference between the unilateral CAI
The mean difference between the CAI group and the no CAI group was significant. between the CAI group and the no CAI group was 2.36, while the bilateral CAI group had a mean difference of 2.67. The mean differences were greater in the anterior reach direction than in the posteromedial and posterolateral reach directions, which showed negative deviations in means. When compared to participants without CAI, the anterior reach direction was the most sensitive in detecting dynamic balancing performance with unilateral and bilateral CAI. The difference in magnitude between the anterior and posteromedial reach directions can be used clinically to assess postural control impairments associated with CAI in rugby players in Kenya using the SEBT reach direction.

The one-way ANOVA Turkey Hock test for maximum reach distances showed no significant difference between the three groups (unilateral CAI, bilateral CAI, and no CAI group) in terms of anterior, posteromedial, and posterolateral reach direction scores. Khuman et al. (2014) found that the CAI group had significantly shorter reach distances than no CAI Ankles ($p = 0.00$). The study also found no significant difference ($p > 0.05$) in reach distance between the injured dominant and non-dominant limbs of the CAI group. The study revealed that the CAI group had a significantly higher mean difference in anterior reach direction (80.30±9.23 vs 75.98±6.61; $p<0.01$) compared to the non-CAI group (74.84±6.88 vs 75.98±6.61; $p=0.01$), as well as a significant difference in posteromedial reach distance of the dominant leg vs non-dominant leg (73.99±10.12 vs 81.67±10.17; $p=0.01$) compared to the non-CA group. The difference between dominant and non-dominant limbs has a probability of less than 1% due to sampling error, as indicated by $p<0.01$.

Please remember the following information:

Several studies have found a connection between ankle dorsiflexion range of motion and lower limb movement patterns. Lima et al. (2018) suggested that limited ankle dorsiflexion may lead to detrimental lower limb movement patterns. Moreno-Perez et al. (2020) linked reduced ankle dorsiflexion range of motion to injuries such as hamstring injuries, Achilles/patella, ACL, and ankle injuries. On the other hand, Burns et al. (2017) proposed that increased ankle dorsiflexion could help prevent injuries and improve dynamic postural control. Howe et al. (2019) found that decreased ankle dorsiflexion range of motion was associated with reduced joint displacement in the lower limb joints. Kang et al. (2015) discovered a strong correlation between poorer postural control and decreased weight bearing using the lower-quarter Y-balance test. Additionally, Olmsted et al. (2012) reported a significant decrease in reach distances for individuals with chronic ankle instability (CAI) compared to those without CAI. Hertel et al. (2006) concluded that functional deficits related to CAI can be tested using three reach directions (anteromedial, medial, and posterior). However, the current study contradicts these findings and suggests that the three reach orientations of the Star Excursion Balance Test (SEBT) are more suitable for assessing postural control among players with or without CAI and contradicts Hertel’s (2006) prior findings. Finally, there is a link between ankle instability and postural control, with or without ankle injury.

5.5 CONCLUSION

The results from Chapter 4 demonstrated a correlation between CAI and postural control. The anterior reach direction showed a statistically significant difference compared to the posteromedial and posterolateral reach directions. The study results confirmed that the anterior reach direction can be utilized to identify postural control deficits in individuals with chronic ankle instability.

CHAPTER SIX

6. CONCLUSIONS, RECOMMENDATIONS, LIMITATIONS

6.1 CONCLUSION

The study aimed to determine whether there is a relationship between CAI and postural control among 15's rugby players with or without ankle injury in Kenya. In the answer to the objectives, it can be concluded:

The demographic profile of the rugby players in the study was as follows: the age range was 18 to 29 years, the weight range was 65 to 138 kg, and the height range was 155 cm to 201 cm. The study concluded that most of the players participating in 15-a-side rugby are below 30 years old.

The screening of CAI in the 15's club rugby players in Kenya was derived using the CAIT tool that reported 55% of CAI and 45% with no CAI, which is slightly higher than reported in the literature.

The study found a correlation between chronic ankle instability (CAI) and postural control among 15s rugby players in Kenya. Rugby players with CAI tended to score less distance in the anterior reach compared to those without CAI. This suggests a relationship between chronic ankle instability and postural control in the Kenyan context.

6.2 RECOMMENDATIONS

The study found that 55% of 15's rugby players in Kenya experienced CAI (chronic ankle instability), which is a high percentage compared to existing literature. The Kenya Cup clubs should consider implementing policies to address CAI among their rugby players. The Kenya Rugby Union should encourage clubs and universities to prioritize and conduct more research on chronic ankle instability and postural control. They should also develop a program to address individuals with chronic ankle instability and create preventive programs for those without it.

6.3 LIMITATIONS

There have been no previous studies conducted on chronic ankle instability and postural control among 15's rugby players in Kenya. There is no available data or literature in Kenya to compare the findings with. The researcher was unable to obtain the intended sample size of 161 subjects and only managed to recruit 127 due to school and work commitments during the data collection period.

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APPENDIX 1

- **SAMPLE SIZE CALCULATOR BY RAOSOFT**

Sample size calculator.

.

What margin of error can you accept? 5

5% is a common choice

%

The margin of error is the amount of error that you can tolerate. If 90% of respondents answer *yes*, while 10% answer *no*, you may be able to tolerate a larger amount of error than if the respondents are split 50-50 or 45-55.

A lower margin of error requires a larger sample size.

What confidence level do you need? 95

Typical choices are 90%, 95%, or 99%.

%

The confidence level is the amount of uncertainty you can tolerate. Suppose that you have 20 yes-no questions in your survey. With a confidence level of 95%, you would expect that for one of the questions (1 in 20), the percentage of people who answer *yes* would be more than the margin of error away from the true answer. The true answer is the percentage you would get if you exhaustively interviewed everyone.

A higher confidence level requires a larger sample size.

What is the population size?

If you don't know, use 20000

What is the response distribution? Leave this as

50%

20000	How many people are there to choose your random sample from? The sample size doesn't change much for populations larger than 20,000.	each question, what do you expect the results will be? If the sample is skewed highly one way or the other, the population probably is, too. If you don't know, use 50%, which gives the largest sample size. See below under **More information** if this is confusing.
50 %	For	

161 Your recommended sample size is	This is the minimum recommended size of your survey. If you create a sample of this many people and get responses from everyone, you're more likely to get a correct answer than you would from a large sample where only a small percentage of the sample responds to your survey.

Online surveys with Vovici have completion rates of 66%!

Alternate scenarios							
With a sample size of	100	200	300	With a confidence level of	90	95	99
Your margin of error would be	**7.84%**	**3.64%**	**0.00%**	Your sample size would need to be	**137**	**161**	**196**

Save effort, save time. Conduct your survey online with Vovici.

More information

If 50% of all the people in a population of 20000 people drink coffee in the morning, and if you were to repeat the survey of 377 people ("Did you drink coffee this morning?") many times, then 95% of the time, your survey would find that between 45% and 55% of the people in your sample answered "Yes".

The remaining 5% of the time, or for 1 in 20 survey questions, you would expect the survey response to be more than the margin of error away from the true answer. When you survey a sample of the population, you don't know that you've found the correct answer, but you do know that there's a 95% chance that you're within the margin of error of the correct answer.

Try changing your sample size and watch what happens to the *alternate scenarios*. That tells you what happens if you don't use the recommended sample size, and how M.O.E and confidence level (that 95%) are related.

To learn more if you're a beginner, read **Basic Statistics: A Modern Approach** and **The Cartoon Guide to Statistics**. Otherwise, look at the **more advanced books**.

In terms of the numbers you selected above, the sample size *n* and margin of error *E* are given by

$X = Z(^{c}/100)^{2} r(100-r)$ $N = {}^{N\,x}/((N\text{-}1)\ E\ + x)$

2

$$E = \text{Sqrt}\,[^{(N\,-\,n)\,x}/_{n(N-1)}]$$

where *N* is the population size, *r* is the fraction of responses that you are interested in, and *Z*(*c*/100) is the critical value for the confidence level *c*.

If you'd like to see how we perform the calculation, view the page source. This calculation is based on the Normal distribution, and assumes you have more than about 30 samples.

About **Response distribution**: If you ask a random sample of 10 people if they like donuts and 9 of them say, "Yes", then the prediction that you make abo ut the general population is different than it would be if 5 had said, "Yes", and 5 had said, "No". Setting the response distribution to 50% is the most conservative assumption. So just leave it at 50% unless you know what you're doing. The sample size calculator computes the critical value for the normal distribution. Wikipedia has good articles on statistics.

How do you like this web page? Good as-is Could be even better.

APPENDIX 2

- NACOSTI LICENCES

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APPENDIX 3

- **ETHICAL CLEARANCE CERTIFICATE**

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Mr Joseph Kolii

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL) CLEARANCE

CERTIFICATE NO. M221137 MED22-10-107

NAME: (Principal Investigator) Mr Joseph Kolli

DEPARTMENT: Physiotherapy Kenya

PROJECT TITLE: A comparison between chronic ankle instability and postural control in rugby players with/without ankle injuries in Kenya

DATE CONSIDERED: 25/1 1/2022

Approved unconditionally

DECISION: CONDITIONS:

SUPERVISOR: Dr. S. Kunene

APPROVED BY:

DATE OF APPROVAL: 25/04/2023 EXPIRY DATE: 25/04/2028

This clearance certificate is valid for 5 years from the date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and ONE COPY returned to the Research Office Secretary on the

Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and [I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. I agree to submit a yearly progress report. The date for annual re-certification will be one year after the date of the convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in November and will therefore be due in November each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature   Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX 4

- **STUDY INFORMATION SHEET**

Study Title: A comparison between chronic ankle instability and postural control among rugby players with or without ankle injury.

Greetings: Hello everyone, welcome to this information sheet.

Introduction:

My name is Joseph Kolli, I am currently enrolled for a master's degree in physiotherapy at the University of Witwatersrand, Johannesburg. The research report is one of the requirements for completion of the degree. Research is a process used in seeking new knowledge. I am researching "A comparison between chronic ankle instability and postural control among the rugby players with or without ankle injury in Kenya.

Invitation to Participate

I am inviting you as a male rugby player who is over 18 years old and actively playing at the Kenya Cup to participate in this study. I am targeting a total of 161 participants to take part in this study.

What is involved in the study?

This quantitative design study tends to compare the attributes of rugby players with chronic ankle instability and those without ankle injury using the postural control tool (Reach distances, anterior, posteromedial, and posterolateral directions). Some researchers have proposed that chronic ankle instability tends to lower once postural control. Others also observe that chronic ankle instability has a direct negative effect on one's postural control. The purpose of this research is to find a relationship between chronic ankle instability and postural control among rugby players with or without ankle injury in Kenya. The study will involve the researcher visiting you at your rugby club place. If you decide to take part in the study, you will be given a hard copy questionnaire for you to fill in your demographic details and answer the Cumberland ankle instability tool yourself. Then the principal investigator will distribute, collect, and measure your leg length, height, weight, and reach distances in three directions namely

Anterior, posterolateral, and posteromedial for each leg and reach. But before commencement, you will be asked to warm up for 15 minutes and have four trials in three directions, and rest in between them. Then three different reach distances will be recorded in each direction and an average will be taken. This will be done to all the participants taking part in the study. The whole procedure will take approximately one hour if it is okay with you.

Risks of being involved in the study.

There are no obvious risks in taking part in the study, although am asking you to give up some of your time. In case other unforeseen risks may affect the participant, the researcher will organize free professional counselling or treatment during the study.

Benefits of being in the study.

There will be no direct benefit in participating in the study, but the results of the research may benefit the rugby clubs and unions and researchers in addressing chronic ankle instability injuries and postural control.

Costs and payment

There is neither cost nor payment involved in participation.

Participation is voluntary.

Participation in the study is voluntary and you are free to withdraw at any stage of the study. You will not be victimized or penalized for not participating in the study.

Results

I will be pleased to provide a result summary free of charge to any participant upon request.

Confidentiality

The normal information obtained will be treated with confidentiality and will only be available to the principal investigator and supervisor. All data will be retained by the principal investigator for two years if a publication comes out of the study, otherwise for six years.

APPENDIX 5

- **CONSENT**

If you agree to participate, I will ask you to sign a consent sheet to record that fact.

Enquiries

For any inquiries, please contact:

Researcher: Joseph kolli kollijoseph@gmail.com +254713886561 Supervisor: Dr. Siyabonga Kunene Siyabonga.kunene@gmail.com +27719049819

This study has been approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg("committee"). A principal function of this committee is to safeguard the rights and dignity of all human subjects who agree to participate in a research project and the integrity of the research.

If you have any concerns over the way the study is being conducted, please contact the Chairperson of this committee, Dr. Clement Penny, who may be conducted by telephone number 011 7172301, or by e-mail at Clement.Penny@wits.ac.za. The telephone numbers for the committee secretariat are 011 717 2700/1234 and the e-mail addresses are Zanele.Ndlovu@wits.ac.za and Rhulani.Mukans@wits.ac.za.

Thank you for reading this study information sheet. January 2023

CONSENT FORM

Title of the study: A comparison between chronic ankle instability and postural control among rugby players in Kenya

I understand the language that has been used in describing the study and I voluntarily and freely agree to participate. My questions/concerns about the study have been answered. I am assured that my identity will not be disclosed and that free to withdraw from participation without giving a reason at any time and this will not affect me negatively.

Participant's name : ***Participant's signature*** : ***Witness***:

Date : ______________________________

Should you wish to report any problems, or any questions related to the study, please contact the principal researcher.

Mr. Joseph Kolli Physiotherapy Department,
School of Therapeutic Sciences, Faculty of Health Sciences,
The University of the Witswaterands Johannesburg, South Africa
Cell: +254 713886561

APPENDIX 6

- **QUESTIONNAIRE**

PART A: DEMOGRAPHIC INFORMATION

1. What is your age?

   18-24 years [] 25-29 years [] 30-34 years [] 35-39 years [] 40 years and above []

2. Which Kenya Cup team do you play for?

   ……………………..…………….

3. For how long have you played in the Kenya Cup competitions? Less than 1 year [] 1-5 years []
   6-10 years [] Over 10 years []

PART B: HEIGHT andWEIGHT MEASUREMENT, DOMINANT LEG, LEG LENGTH AND POSITION OF PLAY

4. Height (cm) …………... Weight (kg) …………….

5. Which is your dominant leg? Right [] Left []

6. Leg length (in cm):

   Right leg …………… Left leg ………………….

7. What is your position of play in a rugby match? Back [] Forward []

PART C: THE CUMBERLAND ANKLE INSTABILITY TOOL

Please tick the ONE statement in EACH question that BEST describes your ankles.

	eft	**ight**	**core**
. I have pain in my ankle			
ever			
uring sport			

Running on uneven surfaces	□	□	3
Running on level surfaces	□	□	2
Walking on uneven surfaces	□	□	1
Walking on level surfaces	□	□	0

2. My ankle feels UNSTABLE

	Left	Right	Score
Never	□	□	4
Sometimes during sports (not every time)	□	□	3
Frequently during sport (every time)	□	□	2
Sometimes during daily activity	□	□	1
Frequently during daily activity	□	□	0

3. When I make SHARP turns, my ankle feels UNSTABLE

Never	□	□	3
Sometimes during running	□	□	2
Often when running	□	□	1
When walking	□	□	0

4. When going down the stairs, my ankle feels UNSTABLE

Never	□	□	3
If I go fast	□	□	2
Occasionally	□	□	1
Always	□	□	0

5. My ankle feels UNSTABLE when standing on ONE leg

Never	□	□	2
On the ball of my foot	□	□	1

With my foot flat	□	□	0

6. My ankle feels UNSTABLE when

Never	□	□	3
I hop from side to side	□	□	2
I hop on the spot	□	□	1
When I jump	□	□	0

7. My ankle feels UNSTABLE when

Never	□	□	4
I run on uneven surfaces	□	□	3
I jog on uneven surfaces	□	□	2
I walk on uneven surfaces	□	□	1
I walk on a flat surface	□	□	0
Left		**Right**	**Score**

8. TYPICALLY, when I start to roll over (or "twist") on my ankle, I can stop it

Immediately	□	□	3
Often	□	□	2
Sometimes	□	□	1
Never	□	□	0
I have never rolled over on my ankle	□	□	3

9. After a TYPICAL incident of my ankle rolling over, my ankle returns to "normal"

Almost immediately	□	□	3
Less than one day	□	□	2
1–2 days	□	□	1

More than 2 days □ □ 0

I have never rolled over on my ankle □ □ 3

PART D: ANTERIOR, POSTEROMEDIAL, AND POSTEROLATERAL REACH DISTANCES

The participant will need to do unilaterally squats with both the controlling and non-dominant foot, extending the non-stance foot as far as they can in three predetermined orientations - In a grid defined by a centre point where the approaching foot is located, the terms front, posteromedial, and posterolateral all originate from that point. The participant must switch from a double to a single- legged posture without falling while stretching the contralateral side as far as they can along the three indicated directional lines and softly pushing down on a tape measure only with the distal end of the reaching leg.

Fig Y- balance tests. Courtesy of Google images.

	Direction	**Number of trials**	**Reach measurements (cm)**	
			Right leg	**Left leg**
Maximal reach	Anterior	1st		
		2nd		
		3rd		
	Posteromedial	1st		
		2nd		

		3rd		
Maximal reach distance	Posterolateral	1st		
		2nd		
		3rd		
The average reach of 3 trials	Anterior			
	Posteromedial			
	Posterolateral			

Thank you for your participation.

APPENDIX 7 TURN-IT-IN REPORT

A comparison between chronic ankle instability and postural control among rugby players with or without ankle injury in Kenya

Press Esc to exit full screen

ORIGINALITY REPORT

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