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Determinants of Ankle Sprain Among Soccer Players in Hebron Governorate - Case-Control Study

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Dedication

First and foremost, I wish to express my deepest gratitude and dedicate this work to God, Allah, for the guidance, strength, clarity of mind, and the gift of a healthy life that has allowed me to embark on this academic journey.

This study is wholeheartedly dedicated to my cherished family, the cornerstone of my support and the wellspring of inspiration. I extend my dedication to my father, Deyab, and to my beloved mother, Najah, whose boundless and unwavering encouragement sustained me throughout my academic odyssey. Their belief in me has been an enduring beacon of strength.

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Lastly, my heartfelt appreciation goes to the entire Al-Quds University family and esteemed lecturers. Your continuous inspiration and guidance have been instrumental in shaping me as a dedicated researcher and a lifelong learner.

Declaration

This thesis is submitted in partial fulfillment of the requirement for the Master's degree in Physiotherapy.

I declare that the content of this thesis (or any part of the same) has not been submitted for a higher degree to any other University or institution.

Signed: Moath Abu.Skedim

Date: 30/12/2023

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I wish to convey my deepest gratitude to Allah for guiding me through the arduous journey of completing my thesis. My heartfelt thanks go to my esteemed supervisor, Dr. Akram Amro, who has not only served as a mentor but also as an invaluable source of guidance and unwavering support. I appreciate his patience, inspiration, and constructive feedback, which were instrumental in advancing this research.

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Determinants of Ankle Sprain Among Soccer Players in Hebron Governorate - Case Control Study

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Abstract

Background: Chronic ankle sprain is a persistent condition resulting from repeated or improperly healed ankle ligament injuries. It can lead to ongoing pain, instability, and functional limitations, This study's primary objective is to examine the epidemiological aspects of ankle sprains (AS) in Palestinian athletes in Hebron, focusing on incidence, risk factors, and injury patterns.

Methods: The research employed a case-control study design to explore the factors influencing Ankle Sprain (AS) by comparing athletes in the AS case group (n=30) with athletes having no history of AS in the control group (n=30). Data collected included age, weight, height, true limb length, the disparity in muscle bulks (gastrocnemius and quadriceps muscles), proprioception, balance (one-leg stance with eyes open and closed), dominant foot, and history of knee and ankle sprain injuries, were collected from participants. The Y balance test was conducted to assess the impact of determinant factors on both case and control groups. Outcome measures, such as the Cumberland Ankle Instability Tool (CAIT) and Foot and Ankle Ability Measure (FAAM) were calculated.

Results: The control and case groups differ in age and athletic age with p-values 0.00 and 0.00, but not in training hours weekly or BMI. There are statistically significant variations in quadriceps measurements between the case and control groups (P = 0.00). The gastrocnemius and patella epicondylar circumferences were not significantly different (p-values of 0.721 and 0.152). The case and control groups had no statistically significant differences in dorsiflexion, plantarflexion, inversion, or eversion ROM. Athletic age, play to return number of days, and age were predictive factors that contributed 56.8% of the variation in the case group. Also, risk factor analysis found substantial relationships between right and left knee injuries. Positive Single leg stance (OR = 1.522) and Ankle angle reproduction (proprioception) test (OR = 1.385). These factors affected case-control group differences in balancing right and left close eyes and proprioception with p-values of 0.01, 0.00, and 0.005. The Y balancing test influenced right and left posteromedial and posterolateral aspects, with p-values of 0.021 and 0.03 for left and 0.03 and 0.01 for right. CAIT (right and left) and FAAM indicated significant group differences with p-values of 0.00 for outcome evaluations.

Conclusion: The study provides valuable insights into the determinants of ankle sprains among Palestinian athletes, highlighting the importance athletic age, age, Days to play return, and history of previous left and right knee injury. These risk factors may be used in and rehabilitating these injuries, that can be detected by single leg stance with eyes closed and Y balance test, in addition to CAIT and FAAM measurements.

Key words: Ankle sprain, balance, proprioception, Cumberland Ankle Instability Tool, Foot and Ankle Ability Measure, Y balance test

دراسة مقارنة لقياس محددات التواء الكاحل بين لاعبي كرة القدم في محافظة الخليل – دراسة الحالات
إعداد الطالب: معاذ أبو اشحيدم

إشراف الدكتور: اكرم عمرو

ملخص عن الدراسة باللغة العربية:

المقدمة : التواء الكاحل المزمن هو حالة ناتجة عن إصابات أربطة الكاحل المتكررة أو التي تلتئم بشكل غير صحيح. و من الممكن أن يؤدي إلى ألم مستمر وعدم استقرار وقيود وظيفية في الكاحل.

هدف الدراسة: الهدف الأساسي لهذه الدراسة هو فحص محددات التواء الكاحل (AS) لدى الرياضيين الفلسطينيين في محافظة الخليل، مع التركيز على الإصابة وعوامل الخطر وأنماط الإصابة.

المنهج المتبع للدراسة: استخدم الباحث تصميم دراسة الحالات والشواهد لاستكشاف العوامل التي تؤثر على التواء الكاحل (AS)من خلال مقارنة الرياضيين في مجموعة الحالة AS (30) مع الرياضيين الذين ليس لديهم تاريخ من التواء الكاحل في المجموعة الضابطة (30). تضمنت البيانات التي تم جمعها العمر والوزن والطول وطول الطرف السفلي الحقيقي والتفاوت في كتل العضلات (عضلات الساق وعضلات الفخذ)، والتوازن (وضع ساق واحدة مع عيون مفتوحة ومغلقة)، والقدم المهيمنة، وتاريخ إصابات التواء الركبة والكاحل. تم إجراء اختبار التوازن Y لتقييم تأثير العوامل المحددة على كل من الحالة والمجموعات الضابطة. تم حساب مقاييس النتائج، مثل أداة عدم استقرار الكاحل في كمبرلاند (CAIT) ومقياس قدرة القدم والكاحل(FAAM).

نتائج الدراسة: تختلف مجموعات التحكم والحالة في العمر والعمر الرياضي مع قيم ($P < 0.05$) ، ولكن ليس في ساعات التدريب الأسبوعية أو مؤشر كتلة الجسم. هناك اختلافات ذات دلالة إحصائية في قياسات عضلات الفخذ بين الحالة والمجموعات الضابطة ($P < 0.05$) لم يكن محيط الفخذ والساق والرضفة مختلفين بشكل ذو دلالة إحصائية بين المجموعتين .لم يكن لدى مجموعات الحالة والمجموعة الضابطة فروق ذات دلالة إحصائية في مستوى حركة الكاحل. كان العمر الرياضي وعدد ايام العودة للعب والعمر عوامل تنبؤية ساهمت بنسبة 56.8 % من التباين في مجموعة الحالة. أيضا، وجد تحليل عامل الخطر علاقات جوهرية بين إصابات الركبة اليمنى واليسرى. فحص التوازان بالوقوف على ساق واحدة علاقة ايجابية الإيجابية ($OR = 1.522$) واختبار إعادة إنتاج زاوية الكاحل (استقبال الحس العميق).($OR = 1.385$) . أثر اختبار موازنة Y على الجوانب الخلفية والخلفية الجانبية اليمنى واليسرى، مع قيم $p=0.021$. بالإضافة الى الاختلاف ذو الدلالة الاحصائية ما بين المجموعتين في مؤشر CAIT(اليمين واليسار) و FAAM($P < 0.05$)

الاستنتاج: تقدم الدراسة رؤى قيمة حول محددات التواء الكاحل بين الرياضيين الفلسطينيين، وتسلط الضوء على أهمية العمر الرياضي، والعمر، وعدد أيام العودة للعب، وتاريخ إصابات الركبة اليسرى واليمنى السابقة. يمكن استخدام عوامل الخطر هذه في منع الإصابات وإعادة تأهيلها، والتي يمكن اكتشافها عن طريق فحص التوازن بالوقوف على ساق واحدة مع إغلاق العينين واختبار توازن Y ، بالإضافة إلى قياسات CAIT و FAAM.

كلمات مفتاحية: التواء الكاحل، التوازن، استقبال الحس العميق، أداة كمبرلاند لعدم استقرار الكاحل، قياس قدرة القدم والكاحل، اختبار التوازن Y.

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List of Abbreviations

AITFL	Anterior Inferior Tibiofibular Ligament
AS	Ankle Sprain
ATFL	Anterior Talofibular Ligament
ATTL	Anterior Tibiotalar Ligament
CAS	Chronic Ankle Sprain
CDC	Centers For Disease Control and Prevention
CFL	Calcaneo-Fibular Ligament
CFL	Calcaneofibular Ligament
CNS	Central Nervous System
LCL	Lateral Collateral Ligaments
MCL	Medial (Deltoid) Collateral Ligaments
PbbP	Proprioception Balance-Based Program
PITFL	Posterior Inferior Tibiofibular Ligament
PNS	Peripheral Nervous System
PTFL	Posterior Talofibular Ligament
PTTL	Posterior Tibiotalar Ligament
TCL	Tibiocalcaneal Ligament
TNL	Tibionavicular Joint
WHO	World Health Organization
SLS	Single Leg Stance
ART	Ankle Reproduction Test

Chapter one

1.1 Back ground

1.2 Problem statement

1.3 Research objectives

1.4 Research questions

1.5 Research hypothesis

1.6 Study justification

Introduction

1.1 Background

Ankle sprain (AS) is one of the most common injuries among players while performing their various sports exercises, especially football. AS it is caused by an injury of any ligament in the ankle region, including the Calcaneo-fibular Ligament (CFL), Anterior Inferior Tibiofibular Ligament (AITFL), Posterior Inferior Tibiofibular Ligament (PITFL) (Wagemans et al., 2022).

Ankle sprain affects the player's performance in general and increases the possibility of re-injury after athletes return to their usual duties (A. H. Alghadir et al., 2020). Usually treatment options are variant, and it includes medications or drugs, braces, surgical interventions in difficult cases, as well as physiotherapist.

Ankle Sprain can be diagnosed through various tests, including the anterior drawer test (Croy et al., 2013), talar tilt (Guerra-Pinto et al., 2020), Cotton test (Schwieterman et al., 2013), and Squeeze test (Morrey, 2012). AS can be classified into acute and chronic stages. In the acute stage, the patient suffers from a noticeable loss of movement, swelling of the ankle, and redness in the affected area, accompanied by severe pain. In this stage, AS is treated by surgery if the AS is accompanied with a fracture, and in majority cases conservative physiotherapy management is utilized through the common intervention of RICE (rest, Ice. Compression by a brace, and elevation in addition to TENS (Tee et al., 2022). In chronic ankle sprain (CAS), the sprain leads to the loosening of the associated ligaments of the ankle region, which may consequently affect balance and proprioception and muscle strength, which will lead to the inability to fully perform the usual exercises (A. H. Alghadir et al., 2020). Physiotherapy intervenes to reduce these symptoms, by using electrical stimulation, tennis, tapping, directed and non-directed exercise at the ankle joint, as well as Proprioception balance-based program (BBP) (Alahmari et al., 2020)(Brey, 1980).

Proprioception refers to the ability of the body to deal with external conditions (surrounding environment) based on its internal sense. Thus, it can be used to assess the extent of sensation in the different joints of the human body. Perception is concentrated on knowing the body's movement, the amount of its resistance, knowing the movement direction, and the speed of movement. proprioception can be used to treat CAS injuries. It is controlled by the central nervous system (CNS) that integrates visual, vestibular, and proprioceptive information to produce motor commands that coordinate the activation patterns of muscles (Brey, 1980).

During the performance of sports exercises, the proprioceptive information is directed around the surrounding environment on the field, which includes focusing on the opponent, where the ball is located, and on the other team individuals, and not focusing on the balance based on visual integrations. The exercises based on proprioception depend on integrating visual vision with balance on each of the lower limbs, thus the player can avoid any injuries related to AS and achieve the desired aims (Gidu et al., 2022).

1.2 Statement of the problem

Ankle sprain injuries represent a prevalent and debilitating musculoskeletal condition affecting individuals across various age groups, particularly athletes and physically active individuals. These injuries can lead to significant pain, functional limitations, and long-term consequences, such as chronic ankle injury (CAI) and posttraumatic osteoarthritis. In addition to the physical burden, ankle sprains contribute to substantial healthcare costs and economic implications due to medical care, rehabilitation, and time away from sports participation. Despite the considerable impact of ankle sprains on individuals and society, there is a need for comprehensive research to further our understanding of the Determinants of ankle sprains, associated risk factors, and effective preventive strategies (Herzog et al., 2019).

Ankle sprains are among the most common injuries in sports and recreational activities. Beyond the sports domain, they also occur in everyday situations. The prevalence and associated morbidity necessitate a deeper understanding of their Determinants , as well as measures to reduce their incidence and severity (Halabchi & Hassabi, 2020b). A significant portion of athletes who experience ankle sprains go on to develop CAI, which results in persistent pain, recurrent injuries, and decreased quality of life. Investigating the factors that contribute to CAI is essential for early intervention and improved patient outcomes.

The economic burden of ankle sprains includes medical expenses, rehabilitation costs, and lost productivity due to time off work or sports activities. Understanding the economic implications of ankle sprains can inform healthcare policy and resource allocation (Bielska et al., 2019).

Effective strategies for preventing ankle sprains are essential for reducing the injury's impact. By identifying risk factors and evaluating the efficacy of preventive interventions, this research can contribute to the development of evidence-based preventive measures. Ankle sprain is one of the common injuries for soccer players (43%) (Gaddi et al., 2022). Usually, conservative physiotherapy management is one of the major interventions in AS management.

There is few studies about AS in Palestine like (Hamarsheh & Shaheen, 2015), and the less information is known about the longer-term effect of AS on balance and proprioception of Athletes Post AS. This study is investigating the above-mentioned gap, and will help in establishment of a preventive plan based on the results achieved by this determinants study.

Considering the researcher background and experience with sports injuries, particularly in football athletes, ankle sprains emerged as a prevalent issue during both training sessions and actual matches. The standard approach to treating such injuries involved primarily rest, with limited therapeutic input from the patient's physical therapist. The treatment regimen typically encompassed cold compresses, massage, and stretching and strengthening exercises. However, upon the athlete's return from the injury, the rehabilitation routine lacked specificity to address the ankle sprain, and the athlete resumed exercises similar to those of non-injured peers. Consequently, this often resulted in recurrent injuries during subsequent gameplay. Given these challenges, there arose a need for research focused on understanding the causes of ankle sprains, optimizing treatment strategies, and determining appropriate timelines for a safe return to play. This research aims to mitigate the occurrence of such injuries in the future.

1.3 Research objectives

The main objectives of this study are:

- To investigate the Determinants of AS among soccer players in Hebron.
- To highlight the potential proprioceptive dysfunction among athlete with history of AS.
- To highlight the personal variables associated with AS in soccer athletes in Hebron Governorate.

1.4 Research Questions

The main Questions of this study are:

- What are the Determinants of AS among soccer players in Hebron?
- Is there a proprioceptive dysfunction among athlete with history of AS?
- What are the personal variables associated with AS in soccer athletes in Hebron Governorate?

1.5 Research Hypotheses

- Personal variables are associated with higher risk of Ankle sprain
- Proprioceptive dysfunction is associated with athletes with history of AS at the affected side.
- Personal variables are associated with AS in soccer athletes in Hebron Governorate?

1.6 Study Justifications

Football is a widely popular sport in Hebron, with a significant number of individuals actively participating in the game. The results of this study may help the football teams to develop a preventive plan based on the results of this study, in addition to the fact that the results of this study may contribute to the selection criteria between different players based on their potential chance of injury. At the same time the results of this study may contribute to the comprehensive rehabilitation plan performed by physical therapists in terms of the for patients with ankle sprain. Also the results of this study will be beneficial for football players who are concerned with developing personal skills that will lead to decrease the possibilities of them being injured in the field during football playing.

The findings of this research will contribute to the development of targeted injury prevention programs tailored to the specific needs of soccer players in Hebron. Preventive measures informed by local data are more likely to be effective in reducing the incidence and severity of ankle sprains.

While this study is focused on Hebron, its findings can contribute to the global body of knowledge on ankle sprain Determinants, enriching the understanding of these injuries in diverse populations and geographical regions.

1.7 Definition and Terminology

Ankle sprain: is a common injury that occurs when the ligaments surrounding the ankle joint are stretched or torn. Ligaments are tough, flexible bands of tissue that connect bones to each other and provide stability to the joints. Ankle sprains typically happen when the foot is twisted or turned in an awkward manner, causing the ligaments to overstretch or tear.

Balance: involves the integration of sensory information from the eyes (visual input), inner ear (vestibular input), and proprioception (sensory input from muscles and joints). The brain processes these signals to make rapid adjustments in muscle contractions, allowing the body to stay upright and steady.

Proprioception: is the sense that provides information about the position and movement of the body parts. It allows individuals to have an innate awareness of the relative positions of their limbs and other body parts without relying on visual cues.

Cumberland Ankle Instability Tool: The CAIT serves as a questionnaire that comprises questions derived from focus group interviews involving individuals with chronic instability and ankle injuries. A 9-item survey was formulated based on insights gathered from these sources. Each item allowed for a possible response range of 4 or 5, indicating an escalating level of difficulty for the specified task. In the study conducted by Hiller et al. in 2006, the determined threshold CAIT score was 27.5, with corresponding sensitivity and specificity values of 82.9% and 74.7%, respectively.

The Foot and Ankle Ability Measure (FAAM): is a self-reported outcome tool developed to evaluate physical function in individuals facing impairments related to the foot and ankle. Comprising 29 items, this questionnaire is divided into two subscales: the 21-item Activities of Daily Living Subscale and the 8-item Sports Subscale. The Sports Subscale is tailored to assess more challenging tasks crucial for sports performance, making it a subscale specifically designed for athletes, as outlined by R. R. L. Martin et al. in 2005.

Y balance test (YBT): is a clinical assessment tool commonly used in sports medicine and physical therapy to evaluate dynamic balance, functional symmetry, and movement control in individuals. It is designed to assess the stability and neuromuscular control of the lower extremities, particularly the hips, knees, and ankles.

Chapter Two

Review of literatures

2.1 Literature review

2.2 similar studies

2.1 Literature review

2.1.1 Ankle Joint Anatomy

The ankle joint is a synovial hinge type that forms by the component of three bones (tibia, fibula, and talus). It can allow different movements of the foot including dorsiflexion and plantarflexion, inversion, and eversion.

There are two main groups of ankle ligaments divided into the lateral collateral ligaments (LCL), and the medial (deltoid) collateral ligaments (MCL) (Figure 2.1A and B). The LCL contains three different ligaments: the anterior talofibular ligament (ATFL), the posterior talofibular ligament (PTFL), and the calcaneofibular ligament (CFL) (Hockenbury & Sammarco, 2001). While the MCL contains four ligaments: the posterior tibiotalar ligament (PTTL), the tibiocalcaneal ligament (TCL), the anterior tibiotalar ligament (ATTL), and the tibionavicular joint (TNL).

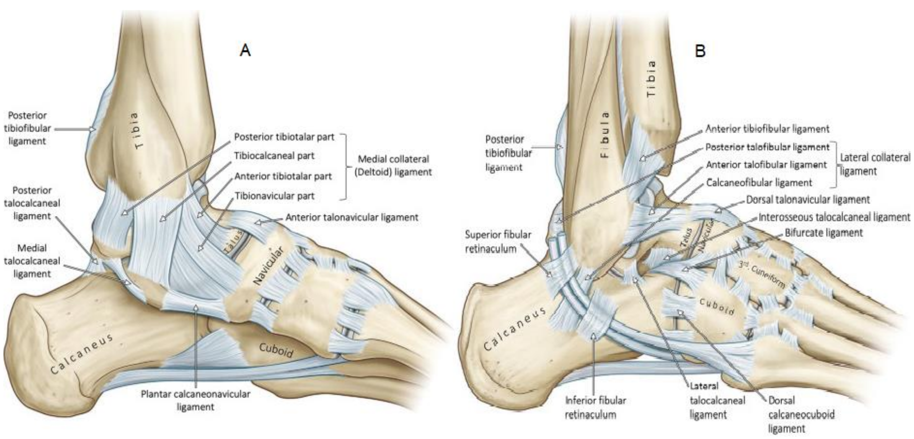

Figure 2. 1.Ankle joint anatomy with ligaments: (A) medial collateral ligament.; (B) lateral collateral ligaments (Jona James & Al-Dadah, 2021).

2.1.2 Ankle Sprain

2.1.2.1 Overall View

An ankle sprain is one of the most common injuries in athletes. It happens when ligaments in ankle joint injuries special lateral ligament and medial ligament complex, it also occurs due to distal tibiofibular syndesmosis. lateral ligament sprains account for 76.7 to 90% of injuries followed by fractures at 16.3% (D. T.-P. Fong et al., 2007). Inversion-plantarflexion and external rotation on a supinated, dorsiflexed, or pronated foot are the typical AS injuries. Radiologic imaging can be used for diagnosing AS especially ultrasound and MRI in the acute stage.

2.1.2.2 Ankle Sprain Injury Incidents

AS injury incidents in the general population are approximately 1 from 10000 daily, while in athletes reaches 9.35 from 10000 during their exercise (O'Loughlin et al., 2009). In the general population, the AS incidence has been reported to be 107–187 per 100 000 person-years (C. W. C. Lin et al., 2010). AS injury occurs in all ages, 60% of all AS injuries occur in patients between 25 and 45 years, also most of the injuries affect men rather than women (Moumeni et al., 2021).

The athletes with AS are varying times to return to do their work, on average between two to three weeks after injury. However, re-injury may occur for them with 12-47% in the different sports games (Herzog et al., 2019).

2.1.2.3 Ankle Sprain Grading and Types

AS has three sprain grades which are: Grade I or Mild, in this grade the fibers of the ligament are slightly stretched or there is a slight tear; in Grade II or Moderate, where the ligament is splitting, without a complete tear; and Grade III or Severe, in this grade the ligament is splitting completely (Gaddi et al., 2022).

There are two types of ankle sprains: Eversion which occurs when the ankle rolls outward and tears the MCL; and Inversion which occurs when you twist your foot upward and the ankle rolls inward and tears the LCL (Adhya et al., 2021).

2.1.2.4 Determinants of Ankle Sprain

Determinants of ankle sprains refers to the study of the occurrence, distribution, and determinants of ankle sprains within a population. Ankle sprains are a common musculoskeletal injury, and understanding their Determinants can help healthcare professionals, researchers, and policymakers develop strategies for prevention and treatment.

2.1.2.5(i) Incidence

Ankle sprains are one of the most common sports-related injuries. They can also occur in non-sporting activities. The incidence varies by age, gender, and activity level. Athletes, particularly those in sports that involve jumping and rapid direction changes, are at a higher risk. The incidence of ankle sprain refers to the frequency or rate at which new cases of ankle sprains occur within a specific population during a defined period of time. This statistic is often expressed as the number of new ankle sprain cases per a certain population or per 1,000 people over a specific time frame, typically one year. The incidence rate is a valuable measure to assess the risk of ankle sprains in a particular group and is useful for public health and sports medicine professionals to understand the burden of this injury (G Javier & Lawrence B, 2021).

2.1.2.5(ii) Age and Gender

The age and gender distribution of ankle sprains is an important aspect to consider when studying the Determinants and risk factors associated with this injury. Ankle sprains are common among children and adolescents, especially those who participate in sports or physical activities. Their still-developing coordination and strength can make them more susceptible to ankle injuries. Ankle sprains are also prevalent in young adults, particularly in sports-related contexts. As individuals engage in recreational and competitive activities, they are at risk of spraining their ankles. While ankle sprains are more common among the younger population, older adults can still experience ankle sprains, often due to factors like reduced balance and mobility. They may also experience more severe complications and longer recovery times (G Javier & Lawrence B, 2021).

Historically, ankle sprains were considered more common in males, especially in high-impact sports. Males often engage in activities with a higher risk of injury, which can contribute to this higher incidence. Recent research has shown that females are also at risk for ankle sprains, especially in sports like basketball, soccer, and volleyball. Anatomical and biomechanical differences, such as wider hips, may play a role in making females more susceptible to ankle injuries. Efforts to study and prevent ankle sprains in female athletes have gained attention (Waterman et al., 2010b).

It's important to note that the prevalence of ankle sprains can vary depending on geographical location, cultural factors, and the level of sports participation in a particular population. Additionally, the availability of preventive measures and rehabilitation programs can influence the incidence and outcomes of ankle sprains in different age groups and genders.

Understanding these patterns can help tailor injury prevention strategies and improve the management of ankle sprains in various populations.

2.1.2.5(iii) Recurrent Ankle Sprains

Recurrent ankle sprains are an important aspect of the Determinants of ankle sprains. Recurrent ankle sprains refer to the occurrence of multiple ankle sprains in the same individual, typically involving the same or both ankles. Understanding the Determinants of recurrent ankle sprains is essential for comprehensive injury prevention and management. People who have experienced an ankle sprain in the past are at a higher risk of experiencing recurrent ankle sprains. This is an important consideration for prevention and rehabilitation (Mugno & Constant, 2023).

2.1.2.5(iv) Risk Factors

Several factors can increase the risk of ankle sprains, including a history of previous ankle sprains, inadequate footwear, and environmental conditions (e.g., uneven terrain). Risk factors for ankle sprains are characteristics or conditions that increase an individual's likelihood of sustaining an ankle sprain. Understanding these risk factors is crucial for injury prevention and developing targeted interventions (D. T. Fong et al., 2009).

Certain anatomical and biomechanical factors can increase the risk of ankle sprains, including a high arch or a foot that pronates excessively. These factors affect foot stability. Moreover, weakness or imbalances in the muscles that support the ankle can impair stability and increase the risk of sprains. Some individuals naturally have looser ligaments, which can make their ankle joints more susceptible to sprains. Also, inadequate footwear, such as shoes without proper ankle support or traction, can contribute to ankle sprains (D. T. Fong et al., 2009).

In addition, unpredictable or uneven playing surfaces, like grass fields with potholes or court surfaces in poor condition, can increase the risk of ankle sprains. Failing to warm up adequately or engage in proper conditioning exercises before physical activity can leave the ankle vulnerable to sprains. Environmental conditions like wet or slippery surfaces can contribute to ankle sprains. Certain sports and activities, such as basketball, soccer, football, and trail running, involve frequent changes in direction, jumping, and quick stops, which increase the risk of ankle sprains. Not completing a full course of rehabilitation after an initial ankle sprain can lead to residual weakness or instability, making the ankle more susceptible to further injury (Bozkurt & Doral, 2006).

2.1.2.5 **Proprioception and Balance and Its Effect On Chronic Ankle Sprain**

Proprioception is defined as any positional, postural, and kinetic information provided to the CNS and peripheral nervous system (PNS), it includes mechanoreception like touch, nociception (pain), equilibrioception, and sense of positioning and movement - through sensory receptors in tendons, skin, joints, and muscles. It is also known as somatosensorial (somatosensory senses) or the sixth sense (Ager et al., 2020)(Verhagen et al., 2004).

In humans, there are three proprioceptive types: muscle spindles or skeletal striated muscles, Golgi tendon organs, and joint receptors or fibrous membrane in joint capsules. The proprioception initiation is an activation in the PNS. The sensation of proprioception starts in sensory neurons in the inner ear which responded to motion and orientation. It is also found in stretch receptors which are located in the joints, ligaments, and muscles. Proprioceptors are sometimes known as adequate stimuli receptors (Tuthill & Azim, 2018). The proprioception is controlled by CNS mainly through the muscle, tendons, and joints or somatosensory system, inner ear canal or vestibular system, and visual system (Mukhopadhyay, 2021). The proprioception is distinguished in the vestibular system in the brain. The proprioception sense into an overall sense of body position, movement, and acceleration. The sensory information for proprioception can occur in two pathways: afferent and efferent pathways. In the afferent pathway, the information comes from sensory receptors in muscles through PNS to the spinal cord and then to the brain, while efferent pathway the information comes from the brain to the spinal cord by PNS to the effector organ or muscles.

The relationship between ankle sprains and the foot longitudinal arch is complex and multifaceted. The foot longitudinal arch consists of the medial longitudinal arch (on the inner side of the foot) and the lateral longitudinal arch (on the outer side). Both arches are supported by ligaments, tendons, and the structure of the foot bones. The height and flexibility of the foot arches can affect the distribution of forces during weight-bearing activities. Individuals with high arches (pes cavus) or low arches (pes planus) may experience altered biomechanics, potentially impacting ankle stability.

The natural rolling motion of the foot, known as pronation (inward roll) and supination (outward roll), plays a role in shock absorption and adapting to uneven surfaces. Abnormalities in these motions can contribute to instability and increase the risk of ankle sprains. Ankle sprains can be influenced by the alignment of the foot. If the foot is positioned in an overly inverted (inward) or everted (outward) manner, it may affect the way forces are transmitted through the ankle joint, potentially increasing the risk of sprains.

Weakness or imbalance in the muscles that support the longitudinal arch and stabilize the ankle can contribute to instability. Strengthening exercises targeting the intrinsic foot muscles and muscles around the ankle may help reduce the risk of ankle sprains. The way a person walks (gait) can impact the forces experienced by the foot and ankle. Abnormal gait patterns, such as excessive pronation or supination, may predispose individuals to ankle sprains. The type of footwear worn can influence foot biomechanics and stability. Supportive shoes with proper arch support may help in preventing excessive pronation and supination, reducing the risk of ankle sprains.

Understanding the interplay between the foot longitudinal arch and ankle sprains requires a comprehensive assessment, considering individual variations in anatomy, biomechanics, and gait. Individuals with a history of ankle sprains or concerns about foot arches should consult with healthcare professionals, such as podiatrists or physical therapists, for a thorough evaluation and appropriate interventions.

2.2 Similar Studies

In a similar study, Herzog et al., 2019 investigated the Determinants of ankle sprains and their link to Chronic Ankle Instability (CAI). Their study aimed to provide a comprehensive analysis of ankle sprains, with a particular focus on the development of CAI. A large sample of 500 participants from diverse age groups and backgrounds were recruited, with the data collected over a two-year period. The researchers examined the incidence of ankle sprains across various activities, such as sports, daily routines, and accidental incidents. This wide-ranging approach allowed for a comprehensive understanding of the prevalence of ankle sprains in the general population.

The study by Waterman et al., 2010 explored age and gender patterns associated with ankle sprains. They conducted a retrospective analysis of hospital records from a major medical center, encompassing a diverse population of patients ranging from pediatric to geriatric age groups. The findings revealed distinct patterns: a higher incidence of ankle sprains in adolescents involved in recreational sports and older adults with age-related balance issues. While it was historically believed that males were more prone to ankle sprains, the study demonstrated that females, especially in sports that demanded sudden directional changes and lateral movements, were equally at risk.

CAI was a key point of interest in the research conducted by C.-I. Lin et al., 2021. Their study followed a cohort of patients with a history of multiple ankle sprains over a ten-year period and its effect on valid and reliable self-reported tools in active populations. The results highlighted the consequences of recurrent ankle sprains, leading to the development of CAI in a significant portion of the population. The study emphasized the importance of early intervention, comprehensive rehabilitation programs, and preventive measures to mitigate the risk of CAI among individuals with a history of multiple sprains.

In line with these findings, C.-W. C. Lin et al., 2010 investigated the various preventive and management strategies available to address ankle sprains and CAI. They conducted a systematic review of the literature, considering both evidence-based and traditional approaches. The study emphasized the significance of educational campaigns to raise awareness about ankle sprains, the role of physical therapists in providing comprehensive rehabilitation, and the utilization of preventive measures such as ankle braces and taping, especially in high-risk sports.

In conclusion, research on the Determinants of ankle sprains, age and gender patterns, and the development of Chronic Ankle Instability is instrumental in devising effective strategies for injury prevention and management. These studies underscore the importance of understanding the multifaceted nature of ankle sprains and their long-term consequences, ultimately aiming to enhance the overall health and well-being of those at risk.

Alghadir et al conducted a study of Effect of chronic ankle sprain on pain, range of motion, proprioception, and balance among athletes in 2020, they aimed to see the effect of chronic ankle sprain on pain, range of motion, proprioception, and, static and dynamic balance among athletes. The participant of this study was 80 athletes, aged 18 to 25 years, involved in track-and-field sports. They were divided into two groups. Athletes with a history of grade 1 or 2 ankle sprain in one group, and healthy athletes without any history of ankle sprain or injury were included in the second group. They found there were no differences in the active ankle joint range of motion ($p > 0.05$) in comparison to the second control, athletes with chronic ankle sprain reported mild pain and statistically significant ($p < 0.05$) deficits in foot proprioception, static and dynamic balance (A. H. Alghadir et al., 2020).

Moreover, Verhagen et al conducted in 2004, did the effect of a proprioceptive balance board training program for the prevention of ankle sprains. The participants were 116 male and female volleyball teams. Teams were randomized by 4 geographical regions to an intervention group (66 teams, 641 players) and a control group (50 teams, 486 players). They found significantly fewer ankle sprains in the intervention group were found compared to the control group (risk difference = 0.4/1000 playing hours; 95% confidence interval, 0.1-0.7). A significant reduction in ankle sprain risk was found only for players with a history of ankle sprains. They concluded that the proprioceptive balance board program is effective for the prevention of ankle sprain recurrences (Verhagen et al., 2004).

An unsupervised home-based proprioceptive training study was conducted by Hupperets et al in 2009. The aim of the study was to evaluate the effectiveness of an unsupervised proprioceptive training program on recurrences of ankle sprain after usual care in athletes who had sustained an acute sports-related injury to the lateral ankle ligament. The participants of 522 athletes, aged 12-70, who had sustained a lateral ankle sprain up to two months before inclusion; 256 (120 female and 136 male) in the intervention group; 266 (128 female and 138 male) in the control group. They concluded that the use of a proprioceptive training program after the usual care of an ankle sprain is effective for the prevention of self-reported recurrences (Hupperets et al., 2009).

Chapter Three

Methods and Materials

3.1 Introduction

3.2 Study design

3.3 Study sample

3.4 Tools of data collection

3.5 Data collection procedure

3.6 Statistical analysis

3.7 Ethical considerations

3.1 Introduction

This chapter presents the sampling strategy, sample size, inclusion and exclusion criteria and the research methodology including design, tools of data collection procedure, intervention, and statistical analysis, plus the ethical aspects considered during the process of this research.

3.2 Study design

This research has used a case-control study design. This design has been recognized as the gold standard when investigating the Determinants and risk factors of a health-related issues. Case-control studies are particularly for understanding the underlying causes and risk factors associated with ankle sprain. In this study, the athletes were carefully selected in both cases and controls groups to compare and analyze potential risk factors, exposures, or variables of interest according to ankle sprain.

3.3 Study Setting

The setting for this study was encompassed various soccer club playgrounds located in the city of Hebron and its adjacent villages. These venues included the playgrounds of soccer clubs in Hebron Governorate including Dura, Hebron, Samou', and Thahriya football club. These carefully chosen locations will serve as the primary sites for data collection, observations, and interactions with participants. The geographical diversity of playgrounds may contribute to the comprehensive and representative sampling of the soccer community in this region, allowing for a robust and multifaceted study.

3.4 Sample and population of the study

3.4.1 Sampling Method

The sampling method employed in this study was a non-probability convenient sampling approach. This strategy was used to choose the participants, both those who had a history of ankle sprain and those who did not, with the goal of matching athletes by age , gender and location. Using this strategy, the recruiting process was shortened, which made it more practical and accessible while also guaranteeing that all groups were represented in an equal manner. Using this form of sampling, the researcher was able to investigate the impact of ankle sprains by comparing the risk prevalence in each group.

3.4.2 Sample Size

In the case-control study, a total of 60 players were recruited, 30 players with a history of ankle sprain were recruited with an equal number of participants consisting the control group, comprising 30 athletes matched for age and gender and without any history of ankle sprains, was invited to participate in this study. This sample size has been meticulously chosen to meet the minimum required number for the intended statistical analysis, ensuring the study's statistical rigor and the reliability of its findings.

3.5 Inclusion criteria

In this study, the inclusion criteria for participants encompassed the following: Athletes within the age range of 18 to 40 years were eligible, also This study was exclusively involved male participants only. Only professional soccer players, actively engaged in the sport will be considered for participation. Athletes with a documented history of ankle sprain were included in the case group, which was contrasted with the control group during the study.

3.6 Exclusion criteria

The exclusion criteria for this study were followed for athletes younger than 18 years or older than 40 years, Athletes who have experienced ankle sprains as a result of post-surgical injury, Athletes with ankle sprains associated with a concurrent fracture, or Athletes who have any other medical conditions, such as osteoarthritis or rheumatoid arthritis were excluded from the study to ensure that the research findings are not confounded by additional medical variables. The number of excluded athletes was two due to acute ankle sprain.

3.7 Study methodology

3.7.1 Data collection tools

The researcher used different data collection methods, that included

A. Data Collection Sheet

This data collection sheet included personal variables, injury history, and further management variables, Demographic and Personal data like age, athletic age, Anthropometric variables like weight, Height, and BMI, Dominant leg, Number of injuries in right and left, Hours of training, History of injury, (e) Balance test (single leg stance) in open eyes.

B. Clinical Tests

1. Ankle angle Reproduction Test

Ankle Proprioception Measurement to assess joint proprioception of the ankle. Participants were instructed to sit in a raised position with their eyes closed. The foot was then moved to a specified dorsiflexion angle (for example 15 degrees), and the participants before returning to the neutral position. Subsequently, participants actively brought the foot back to the target angle. Three consecutive trials were conducted for each angle. The result values were negative or positive through the observational were utilized for the analysis of both target positions (Willems et al., 2002). The positive results mean there is different between referral and repeated position with standard deviation more than 2 degrees (Willems et al., 2002;Mukhopadhyay, 2021).

2. Single Leg Stance Closed Eyes

This test is designed to evaluate an individual's ability to maintain balance and proprioception while standing on one leg with their eyes closed. It is commonly used in clinical settings, sports medicine, and rehabilitation to assess the integrity of the proprioceptive system, which is responsible for the body's awareness of its position in space see Figure 3.1.

The Procedure of this test included: the individual stands on one leg, then the eyes are closed to remove visual input, challenging the reliance on proprioceptive and vestibular input, and finally the duration of the stance and the individual's ability to maintain balance are observed (A. Alghadir et al., 2020).

If the individual can maintain balance for an extended period with minimal sway more than 20 sec, it suggests good proprioceptive function and balance control and this result was normal or negative. Swaying or difficulty maintaining balance may indicate challenges in proprioception or vestibular function with less than 20 sec durations and its called abnormal or positive result (Tao et al., 2020).

Figure 3. 1. Single Leg Stance Closed Eyes.

3. **Single leg stance opened eyes**

This test is designed to assess an individual's ability to maintain balance and proprioception while standing on one leg with their eyes open same figure 3.1. It provides insight into the integration of visual input with proprioceptive and vestibular cues for balance control. The individual stands on one leg, then the eyes remain open, allowing the use of visual input, and finally the duration of the stance and the individual's ability to maintain balance are observed and seconds of the test while the person did not lose his balance is recorded, and cutoff point of 20 seconds is a considered a proper threshold of stable balance (A. Alghadir et al., 2020).

Successful completion of the test suggests effective integration of visual, proprioceptive, and vestibular inputs for balance. Difficulty in maintaining balance may indicate challenges in the integration of these sensory inputs or weakness in the lower extremities. Visual input is an essential component of balance, especially during activities that require postural control. This test provides information about the individual's ability to use visual cues to adjust and maintain balance.

4. **Y balance test**

The Y Balance Test is a dynamic assessment commonly used to evaluate a person's functional balance, proprioception, and neuromuscular control. It is often employed in sports medicine, physical therapy, and fitness settings to assess lower extremity stability and identify potential asymmetries or deficits.

The Y Balance Test aims to measure an athlete's ability to reach in three different directions while standing on one leg. This test provides valuable information about dynamic stability, weight distribution, and neuromuscular control. Figure 3.2 shows the Y test balance examination. The participant stands at the center of a Y-shaped line or platform, typically marked on the floor. While balancing on one leg, the participant reaches as far as possible with the opposite foot in three directions: anterior (forward), posteromedial (backward and to the side), and posterolateral (backward and to the other side). The maximal reach distance (in meter) in each direction is measured and recorded (Plisky et al., 2009). The posterior pipes are situated at an angle of 135 degrees from the anterior pipe, with a 90-degree separation between the posterior pipes. Each pipe is labeled in 5-millimeter increments for accurate measurement.

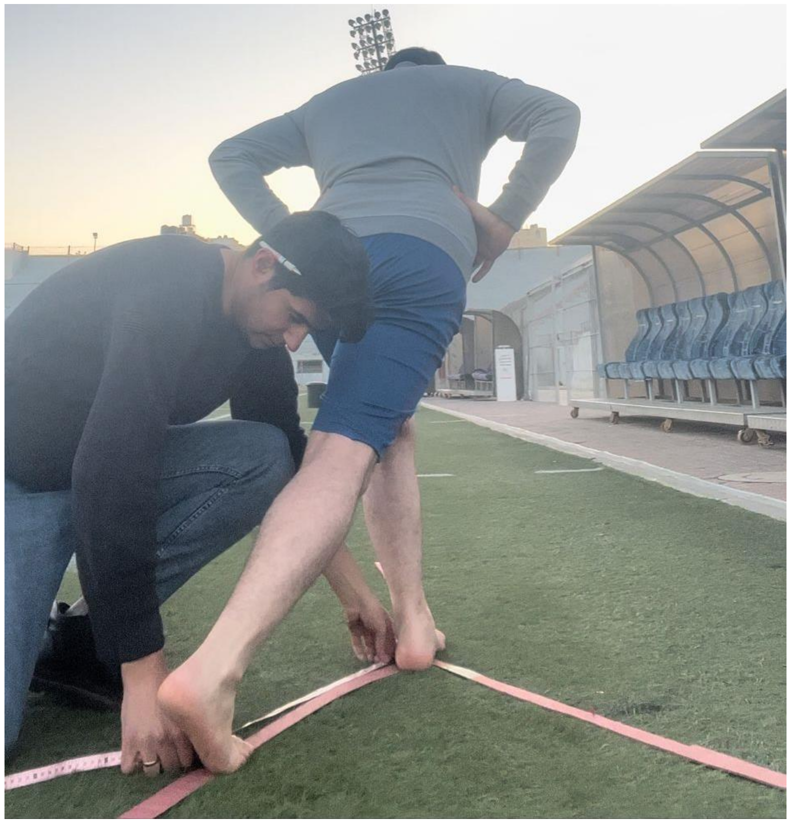

Figure 3. 2.Y balance test techniques.

For Anterior Reach, the measures the participant's ability to reach forward while maintaining balance on one leg with a sensitivity of 87.50% and specificity of 71.43%. For posteromedial Reach, the assesses the ability to reach backward and to the side with a sensitivity of 90.62% and specificity of 57.14%. The While posterolateral Reach, evaluates the ability to reach backward and to the other side (Alkhathami, 2023).

The Y Balance Test is often used in injury prevention and rehabilitation settings to identify asymmetries and weaknesses that may contribute to the risk of injuries, especially in athletes. It provides a functional assessment of balance and proprioception, which are critical for various activities, including sports performance and daily living.

Physical therapists may use the Y Balance Test to design targeted interventions for individuals with lower extremity injuries or imbalances. Researchers may employ the test to investigate the effectiveness of training programs or interventions aimed at improving balance and neuromuscular control.

5. **True Leg Length**

Measure real leg length in clinical examinations, especially for ankle sprains. Bony alignment, joint health, and muscular tension affect leg length. There are many ways to measure leg length. Distance in centimeters from one bony landmark on one side of the body to another on the other see Figure 3.3. Measure leg length from the ASIS to the medial malleolus using a tape measure (Sabharwal & Kumar, 2008).

Figure 3. 3.True Leg Limb Length Measurements.

6. Circumference of the Lower Extremity

Measuring the circumference of the lower extremity can be a useful clinical test, especially in the context of ankle sprain injuries. Changes in circumference may indicate swelling, a common symptom associated with ankle sprains.

Using the flexible measuring tape, measure the circumference at each marked reference point. The first reference point is the epicondyles from medial to lateral epicondyles. The second point is 10 cm above the epicondyles to measure the quadriceps muscle circumference see Figure 3.4. The third point is to measure the gastrocnemius muscles circumference using 10 cm lower than epicondyles. The last pint is measuring the circumferences from medial malleolus.

The circumference measurements around the epicondyles (medial and lateral) are typically not taken in a routine clinical setting. Physiotherapist may focus on specific clinical tests for, assessing the knee joint or surrounding structures for range of motion assessments. For Measuring the circumference of the quadriceps muscles can be a useful clinical assessment, especially in cases of muscle injuries, atrophy, or strength imbalances. Moreover, Measuring the circumference of the gastrocnemius muscles, which are the prominent muscles in the calf, can be a valuable clinical assessment, particularly in cases of muscle injuries, strains, or imbalances. Finally, Measuring the circumference around the medial malleolus (the bony prominence on the inner side of the ankle) can be a useful clinical assessment, especially in cases of ankle injuries or conditions where swelling is a concern (Kruse et al., 2021). The standing position was used to measure the muscle circumference because the ankle sprain injuries occur with the tension is exist in both leg for the athletes.

Figure 3. 4. Circumference of Lower Extremity: the right side for Gastrocnemius and the left side for epicondyles

7. **Range of Motion (ROM)**

The range of motion (ROM) assessment for an ankle sprain involves evaluating the extent to which the ankle joint can move in different directions. Range of motion testing is commonly used in clinical settings to assess joint flexibility, function, and to identify any limitations or abnormalities (A. Alghadir et al., 2020).

Range of Motion Assessment for Ankle Sprain using Goniometer (a device used to measure joint angles), and examination table or plinth. The patient typically sits or lies down comfortably with the affected leg exposed. Dorsiflexion (Upward Movement), to do that, ask the patient to bring their toes toward their shin (point the foot upward), then use the goniometer to measure the angle formed between the shin and the top of the foot. Plantarflexion (Downward Movement), the patient asks to point their toes away from the shin (point the foot downward), and then use the goniometer to measure the angle formed between the shin and the top of the foot. Inversion (Inward

Movement), Ask the patient to turn the sole of their foot inward and then use the goniometer to measure the angle formed between the long axis of the foot and the lower leg. Finally, Eversion (Outward Movement) though Asking the patient to turn the sole of their foot outward, and then use the goniometer to measure the angle formed between the long axis of the foot and the lower leg (G Javier & Lawrence B, 2021).

Normal ranges of motion for inversion between 14.5-22 degrees, eversion from 10-17 degrees, dorsiflexion from 20-30 degrees, and plantarflexion 37-45 degrees (Shahrol Aman et al., 2015). It can vary among individuals, but significant limitations or differences between the affected and unaffected sides may indicate issues related to the ankle sprain, such as ligament damage, muscle tightness, or joint stiffness. ROM assessments help physiotherapist understand the functional status of the ankle joint, and Tracking changes in range of motion over time can guide treatment decisions and rehabilitation.

8. True Leg Length

Measure real leg length in clinical examinations, especially for ankle sprains. Bony alignment, joint health, and muscular tension affect leg length. There are many ways to measure leg length. Distance from one bony landmark on one side of the body to another on the other. Measure from the ASIS to the medial malleolus. Measure leg length from the ASIS to the medial malleolus using a tape measure (Sabharwal & Kumar, 2008).

C. Outcome Measures

The researcher used a 4 valid and reliable outcome measures to measure the functional outcome of the AS on affected players group, and they included

1. Cumberland Ankle Instability Tool (CAIT)

CAIT is a tool that asks questions. The questions came from focus group interviews with individuals with chronic instability as well as an ankle injury. A 9-item survey was created using these sources. There was a possible response range of 4 or 5 for each item, signifying an increasing level of difficulty for the task in question. The threshold CAIT score was 27.5; the sensitivity and specificity were 82.9% and 74.7%, respectively (Hiller et al., 2006) (Appendix 3).

2. Foot and Ankle Ability Measure (FAAM)

(FAAM) is a self-report outcome instrument developed to assess physical function for individuals with foot and ankle-related impairments. The Foot and Ankle Ability Measure is a 29-item questionnaire divided into two subscales: The Foot and Ankle Ability Measure, 21-item Activities of Daily Living Subscale, and the Foot and Ankle Ability Measure, 8-item Sports Subscale. The Sports subscale assesses more difficult tasks that are essential to sport, it is a population-specific subscale designed for athletes (R. R. L. Martin et al., 2005). (Appendix 4).

Test-retest reliability is the consistency of a score over time when measurements are repeated. When a person's condition is expected to remain stable, it is evaluated by having them complete the instrument two or more times. To measure test-retest reliability, SEM values and the intraclass correlation coefficient are frequently used. Using the group that was anticipated to remain stable, evidence for reliability was produced (R. L. Martin & Irrgang, 2007).

The specific items on the instrument and what they measure determine the evidence that is based on content. The International Classification of Functioning, Disability and Health model can be used to define item content. According to this model, items can potentially measure the domains of (1) body structure and function and (2) activity and participation. For the development of the FAAM (Eechaute et al., 2008).

3.7.2 Data collection procedure

Ethical approval for this study was sought from the Al-Quds University Ethical Committee. All research activities adhered to ethical guidelines and regulations. Before data collection, contact was established with the targeted soccer clubs. Approval for the study was obtained from these clubs. Permission to access and engage with their players for the research was sought. Soccer players from the selected clubs who meet the study's inclusion criteria were invited to participate in the analysis.

This included athletes within the specified age range, male gender, and professional soccer players. All potential participants who meet the inclusion criteria were provided with an information sheet (Appendix 1) that details the research objectives, procedures, potential risks, and benefits. Participants had an opportunity to review this information and ask any questions. Participants who wish to proceed with the study were requested to sign a consent form in the Appendix 2. This consent form confirms their voluntary participation and understanding of the research's purpose and requirements. They were informed of their right to withdraw from the study without consequences.

Once informed consent is secured, a data collection sheet is used to gather participant demographic data, injury history, and relevant details. This form ensured systematic data collection and record-keeping. Baseline assessments included physical examinations, self-report questionnaires, and objective assessments of balance, proprioception, and ankle function. These assessments served as a foundation for the study's analysis.

The collected data were organized, coded, and entered into a secure database. Data analysis was conducted using appropriate statistical techniques to address the research objectives. All the collected data was treated with the utmost confidentiality. Personal identifiers were removed or anonymized to protect participant privacy. Research findings were reported and disseminated by ethical standards and data protection regulations. The researcher ensured that results were communicated in a manner that preserved the anonymity of participants. Upon completion of data collection, participants were thanked for their contributions to the study, and any inquiries or concerns they may have will be addressed.

3.7.3 Statistical analysis

The SPSS 22 software (Statistical Package for Social Sciences) was used to study the difference in groups and within groups. Descriptive and frequency statistics was used to study the main characteristic of the sample. Means, standard deviation, and percentages. Continuous variables were given as mean ± standard deviation while categorical variables were given as number and percentage. Shapiro-Wilk test was used to study the normality of demographic data between groups. Odd ratios were used to identify the significant risk factors associated with ankle sprain and their magnitude for nominal variables. Levene's Test for Equality of Variances was used to find the p-value between normal distribution variables, while Mann-Whitney U test was used to investigate the difference of in outcome measures between the 2 groups.

3.8 Ethical considerations

All participants were requested to assign a consent form, prior to being enrolled in the study. The consent form was written in the Arabic language to be understood easily by all participants (appendix 2). The form was contained all details of the study. Each participant was handled an information sheet (Appendix 1) that included all the studies details and the researcher contact details. With all his rights being informed in Arabic, including anonymity and confidentiality, and that no names will be used in analysis. Ethical clearance was requested from Al-Quds University Ethical Committee, which is followed the Declaration of Helsinki.

Chapter four

Results

4.1 Results

4.2 Discussion

4.1 Introduction

This chapter presents the study findings, data will be presented using tables, charts, graphs, and descriptive narratives.

4.2 Sample and recruitment

The researcher screened 85 players for the participation in this study, of whom 60 were recruited as they have fit the inclusion and exclusion criteria of this research.

4.3 Demographic Data

4.3.1 Descriptive Statics

The average age among these individuals stood at 26.12 years. The standard deviation of 4.892 suggests that the ages in this dataset exhibit moderate variability. The age range extends over 19 years, from a minimum of 19 years to a maximum of 38 years. This data provides a comprehensive overview of the age distribution within the sample, highlighting the average age.

Table 4.1 shows the sample characteristics distribution for Case and Control groups. The criteria include BMI, Club Name, and Age Group. In the Case group, 53.3% of Athletes are Healthy with BMI 18.5-24.9 and 46.7% are Overweight with 25-29.9. In the Control group, 90% of athletes are healthy and 10% are overweight. Current studies athletes play for Dura, Hebron, Samou', and Thahriya. Athletes were most common in Dura (20.0%), followed by Hebron (50.0%), Samou''' (13.3%), and Thahriya (16.7%). Dura is 26.7%, Hebron 36.7%, Samou’ 20.0%, and Thahriya 16.7% in the Control group. The Case group's age distribution is 19-23.9 (16.7%), 24-27.9 (40.0%), 28-31.9 (13.3%), and >32 (30.0%). The Control group's age distribution is 19-23.9 (36.7%), 24-27.9 (33.3%), 28-31.9 (23.3%), and >32 (6.7%).

Table 4. 1. Demographic data for Athletes in case and control groups.

Factor		Category	Frequency	Percent		Category	Frequency	Percent
BMI	Case	Healthy weight 18.5-24.9	16	53.3	Control	Healthy weight 18.5-24.9	27	90
		overweight 25-29.9	14	46.7		overweight 25-29.9	3	10
club name		Dura	6	20.0		Dura	8	26.7
		Hebron	15	50.0		Hebron	11	36.7
		Samou'	4	13.3		Samou'	6	20.0
		Thahriya	5	16.7		Thahriya	5	16.7
Age group		19-23.9	5	16.7		19-23.9	11	36.7
		24-27.9	12	40.0		24-27.9	10	33.3
		28-31.9	4	13.3		28-31.9	7	23.3
		>32	9	30.0		>32	2	6.7
total			30	100			30	100

4.3.2 Test of Normality for Demographic Data

Table 4.2 shows that Age, Athletic Age, and Training Hours Weekly do not follow a normal distribution since their p-values are below 0.05. In comparison, BMI looks to be more normal, although the significance correction highlights some ambiguity.

Table 4. 2. Test of Normality for Demographic data.

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Age	.140	60	.005	.934	60	.003
Athlete’s age	.232	60	.000	.878	60	.000
Training hours weekly	.118	60	.038	.938	60	.004
BMI	.098	60	.200*	.971	60	.168
*. This is a lower bound of the true significance.						
a. Lilliefors Significance Correction						

Table 4.3 shows the p-values for different Case-Control factor differences. The Cases average 27.93± 5.349 years old, whereas the Controls average 24.30 ± 3.64. A significant difference in mean ages across groups is 3.63 (Mann-Whitney U test, p=.009). Case sample mean Athletic Age is 12.83 ± 4.136. Control group mean athletic age was 7.83 ± 2.00. At the 5 level of significance, the Mann-Whitney U test shows that the mean Athletic Age difference between the two groups is statistically significant with p-value 0.00. Cases had an average BMI of 24.3 ± 1.87. The Control group averaged 23.62 ± 1.02 BMI. Levene's Test for Equality of Variances shows no significant difference in mean BMI of 0.7056 across groups (p=.076). The Case group trains 13.63 ± 4.582 hours each week. The Control group averages 15.27 ± 4.502. The Mann-Whitney U test shows that the Control group averaged 1.63% less training hours, but the p-value is more than 0.05 (p= 0.128).

Table 4. 3. The differences between case and control groups in age athletic age, BMI, and training hour weekly.

	Case Group		Control Group		Differences	p-value
	Mean	SD	Mean	SD		
Age	27.93	5.34	24.30	3.64	3.63	0.009
Athlete’s age	12.83	4.13	7.83	2.00	5	0.000
BMI	24.33	1.87	23.62	1.02	0.70	0.076
Training hours weekly	13.63	4.58	15.27	4.50	-1.63	0.128

Figure 4.1 shows Case and Control Group age distributions. The data shows that these two groups have different age distributions. Specifically, The Case group range is 16.7% and the Control Group 36.7% in the 19-23.9 age range. The 24-27.9 age group had 40.0% Case and 33.3% Control group. The Case group range makes up 13.3% of the 28-31.9 age range, whereas the Control Group makes up 23.3%. The Case Group contains 30.0% of participants over 32, whereas the Control Group has 6.7%.

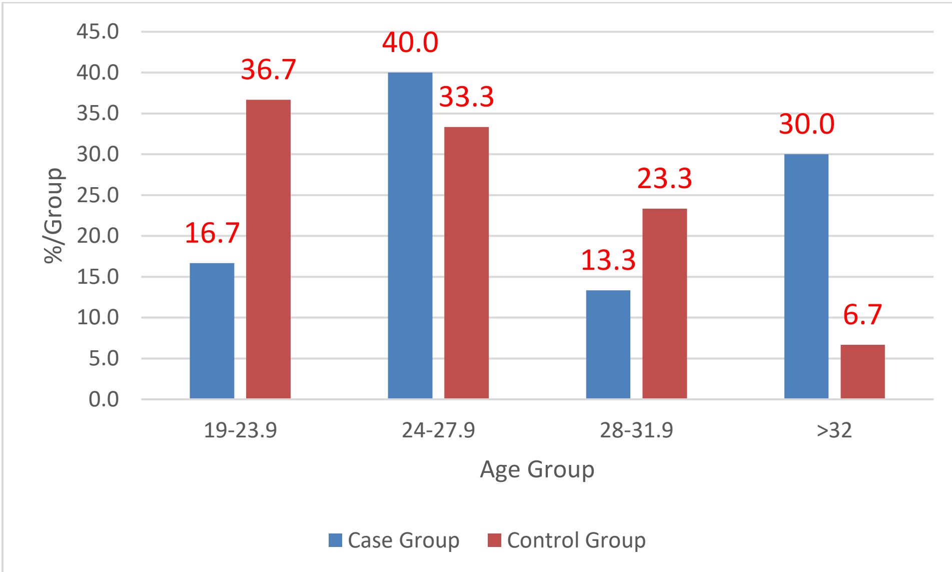

Figure 4. 1. Age group distribution in the sample between both case and control groups.

Figure 4.2 shows the Case and Control Groups' athlete age distributions. These two groups have different age distributions. In the Case Group, no athletes are 1-7 years old. In this age group, 43.3% of participants are from the Control Group. In the Case Group, 60.0% of athletes are 7-14 years old. 46.7% of Control Group participants are this age. This shows the Case Group has more 7-14-year-old athletes. In the 14-21 age range, the Case range (36.7%) had more athletes than the Control Group (10.0%). This suggests the Case Group has more 14-21-year-old athletes. Both classes have few over-21 athletes. This category has 3.3% in the Case Group and none in the Control Group.

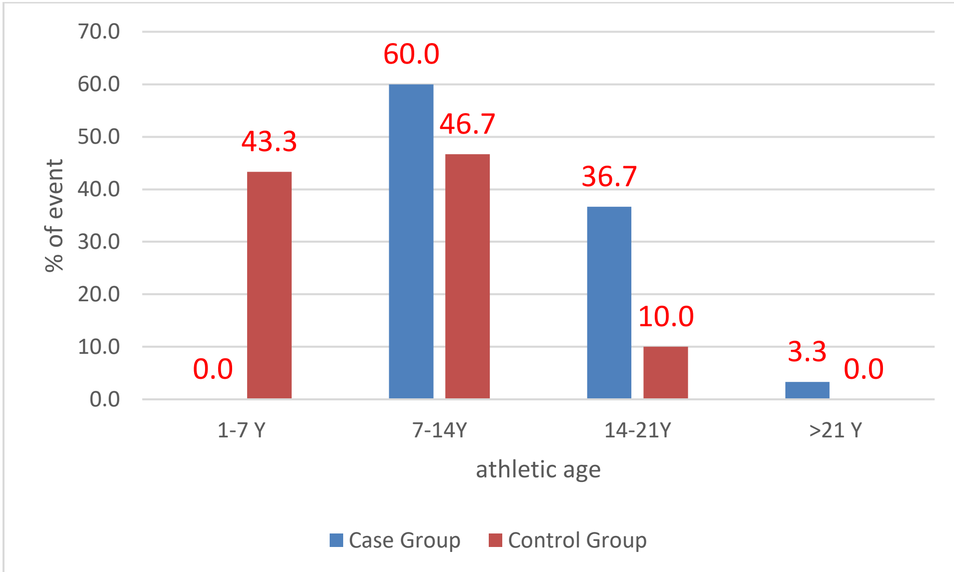

Figure 4. 2. Distribution of athletes' age groups within Case and the Control Groups.

4.4 Lower Limb Measurements

4.4.1 Test of Normality for Measurement Data

Table 4.4 shows Kolmogorov-Smirnov and Shapiro-Wilk test results for different body measures on the right (Rt) and left (Lt) sides. Significant deviations from a normal distribution are evident in both right and left measurements, as shown by low p-values ($p < 0.05$). The analysis used Significance Correction. These findings show that these measures may not follow a normal distribution, which is crucial for statistical studies which mainly left limb length measurement, right circumference medial malleolus, left circumference medial malleolus, right circumference patella epicondyle, left circumference patella epicondyle, right Quadriceps measurement, left Quadriceps measurement.

Table 4. 4. Tests of Normality for Limb Length Measurements, Circumferences, and Muscle Measurements in the Sample.

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Right circumference medial malleolus	.265	60	.000	.733	60	0.000
Left circumference medial malleolus	.260	60	.000	.749	60	0.000
Right circumference patella epicondylar	.173	60	.000	.916	60	0.001
Left circumference patella epicondyle	.171	60	.000	.901	60	0.000
Right Gastrocnemius measurement	.125	60	.020	.969	60	0.126
Left Gastrocnemius measurement	.113	60	.054	.982	60	0.502
Right Quadriceps measurement	.172	60	.000	.924	60	0.001
Left Quadriceps measurement	.179	60	.000	.882	60	0.000
a. Lilliefors Significance Correction						

4.4.2 Descriptive Statistics

Table 4.5 and Figure 4.3 provide insights into the differences in various lower limb measurements between the Case and Control Groups. Notably, height and Quadriceps measurements show statistically significant differences, while other measurements do not exhibit significant differences at the standard significance level. Moreover, the there is no differences between Gastrocnemius circumference patella epicondylar measurement in both legs where P-values >0.05. However, the differences between circumference medial malleolus in right and left leg was 0.064 and 0.047 which indicates right have not difference between legs while left have a difference between both legs where case group have larger mean with 28.43 cm comparing with control group with value reaches to 25.54 cm.

Table 4. 5. Differences in Lower Limb Measurements between Case Group and Control Group.

	Case Group		Control Group		Differences	P-value
	Mean	SD	Mean	SD		
Athletic Height	177.37	5.46	172.03	4.7	5.34	0.00
Right circumference medial malleolus	28.43	5.720	25.49	2.745	2.94	0.064
Left circumference medial malleolus	28.43	5.409	25.54	2.719	2.90	0.047
Right circumference patella epicondylar	34.56	2.927	35.58	2.560	-1.02	0.152
Left circumference patella epicondyle	34.39	2.934	35.46	2.590	-1.07	0.111
Right Gastrocnemius measurement	34.41	3.130	34.16	2.281	0.25	0.721
Left Gastrocnemius measurement	34.17	3.216	33.95	2.210	0.22	0.755
Right Quadriceps measurement	49.00	4.598	45.27	4.589	3.73	0.001
Left Quadriceps measurement	48.67	4.277	44.97	4.382	3.69	0.000

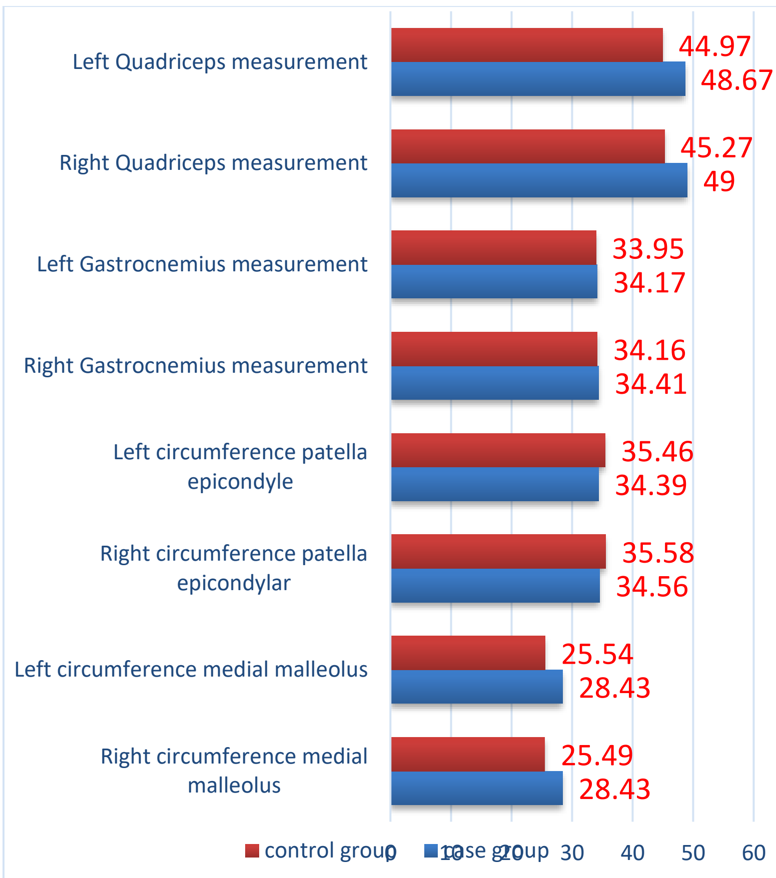

Figure 4. 3. Differences in Lower Limb Measurements between Case Group and Control Group.

4.5 Range of Motion

4.5.1 Test of Normality for Range of Motion Data

The table 4.6 presents the results of normality tests, specifically the Kolmogorov-Smirnov and Shapiro-Wilk tests, for various range of motion (ROM) measurements in both right (Rt) and left (Lt) sides. The findings reveal that all the ROM measurements significantly depart from a normal distribution, as indicated by the very low p-values ($p < 0.05$) across the board. The Significance Correction was applied to the analysis, which reinforces the non-normality of these data.

Table 4. 6. Tests of Normality for Range of Motion (ROM) Measurements in the Sample.

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Right Dorsiflexion ROM	.382	60	.000	.626	60	.000
Left Dorsiflexion ROM	.434	60	.000	.586	60	.000
Right Plantarflexion ROM	.458	60	.000	.552	60	.000
Left Plantarflexion ROM	.450	60	.000	.564	60	.000
Right Inversion ROM	.467	60	.000	.539	60	.000
Left Inversion ROM	.497	60	.000	.471	60	.000
Right Eversion ROM	.512	60	.000	.427	60	.000
Left Eversion ROM	.505	60	.000	.450	60	.000
a. Lilliefors Significance Correction						

4.5.2 Descriptive Statics

The table 4.7 compares the mean values of dorsiflexion, plantarflexion, inversion, and eversion range of motion (ROM) measurements between the Case Group and Control Group. For each measurement, both right (Rt) and left (Lt) sides are assessed. The results indicate that there are no statistically significant differences between the Case and Control Groups for any of these ROM measurements, as all p-values exceed the common significance level of 0.05. This suggests that, in this sample, the ROM measurements do not significantly differ between the two groups, and both groups exhibit similar ROM patterns in the assessed joint movements.

Table 4. 7. Comparison of Range of Motion (ROM) Measurements in the Case Group and Control Group Using Mann-Whitney U Test

	Case Group		Control Group		P-value using Mann-Whitney U
	Mean	SD	Mean	SD	
Right Dorsiflexion ROM	25.11	0.498	25.21	0.504	0.795
Left Dorsiflexion ROM	23.31	0.466	23.85	0.479	0.783
Right Plantarflexion ROM	39.97	0.430	42.24	0.466	0.563
Left Plantarflexion ROM	41.26	0.450	42.24	0.466	0.776
Right Inversion ROM	17.49	0.407	19.43	0.466	0.375
Left Inversion ROM	17.49	0.379	17.94	0.407	0.741
Right Eversion ROM	13.5	0.407	12.37	0.305	0.282
Left Eversion ROM	13.83	0.430	12.37	0.305	0.169

4.6 Determinants factors

4.6.1 Leg Injuries and Return to Play

Figure 4.4 presents the percentages injuries in right and left legs in both groups. In the Case Group, 86.7% of individuals experienced abnormal (positive) injuries in the right leg, while 13.3% of the Case Group had normal (negative) right leg condition. The left leg injury distribution shows a higher percentage of positive injuries in the Case Group 56.7% while 43.3% had negative injury in left leg conditions.

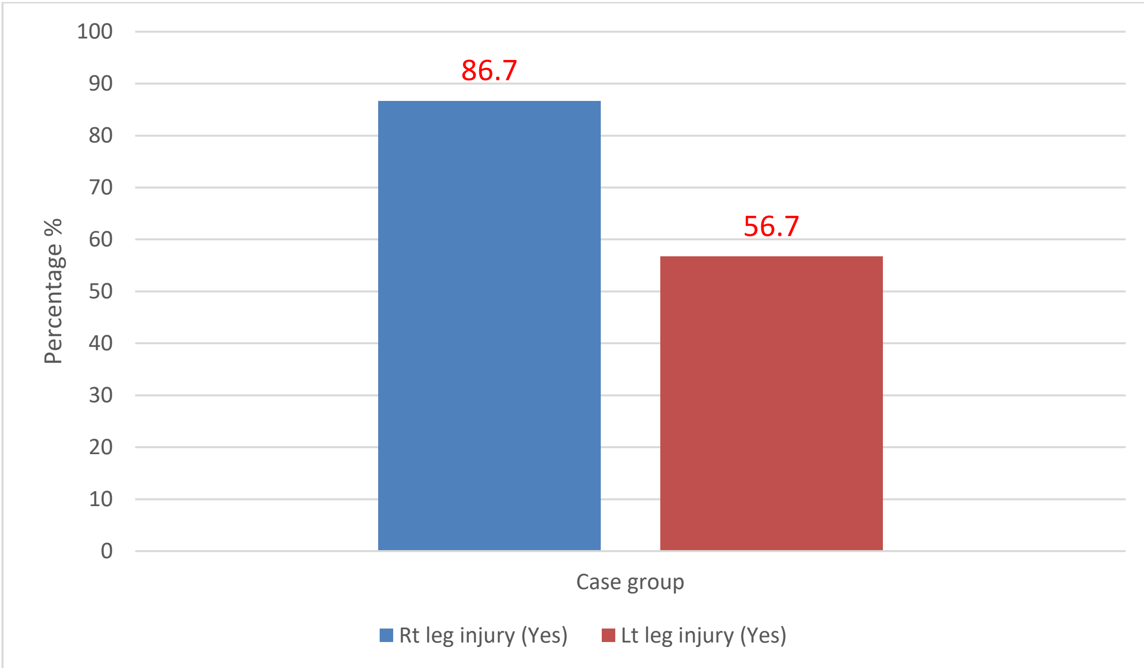

Figure 4. 4.Distribution of Injury Time for Right and Left Leg in Case Group.

These results provide insights into the distribution of dominant legs in both groups, Figure 4.5 showing that the majority of individuals in both the Case and Control Groups have their right leg as the dominant leg. The comparison between the two groups allows for an understanding of potential differences in dominant leg prevalence between the cases and controls.

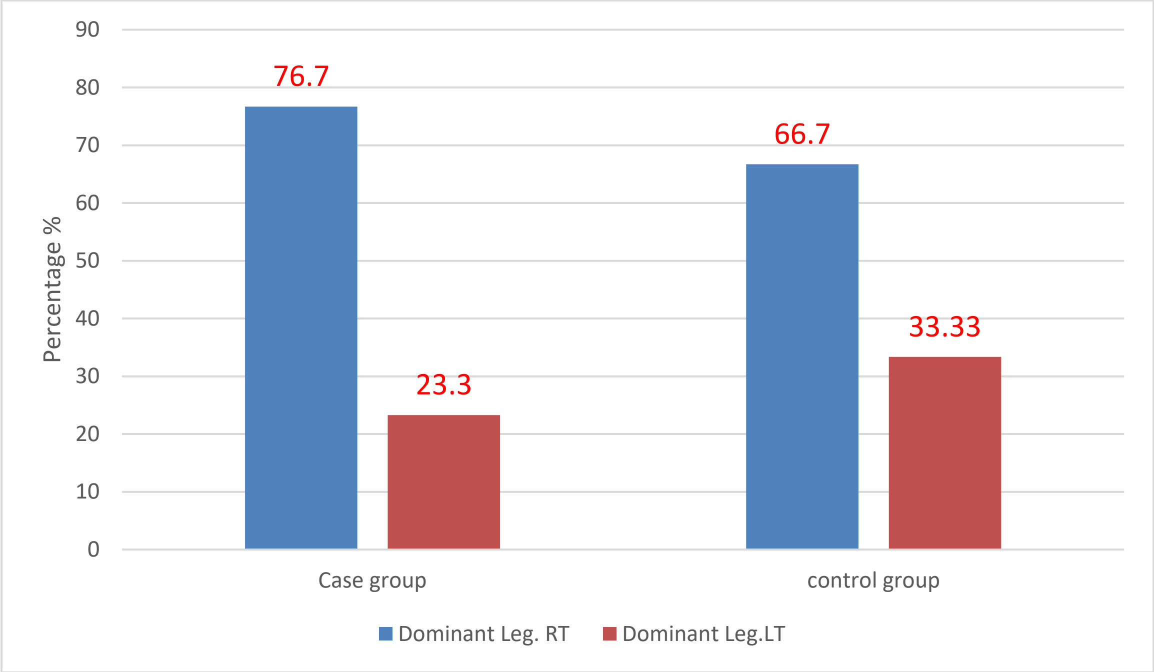

Figure 4. 5. Dominant Leg distribution in both groups.

Figure 4.6 presents Return to Play Duration Following the ankle sprain Injury in Case Group. The majority (56.7%) of cases had a longer recovery period and returned to play after more than 4 weeks (Grade 3). These results provide insights into the duration of return to play following injury in the Case Group, with a notable portion experiencing longer recovery periods (Grade 3). The comparison allows for understanding the impact of injury severity on duration of the return to play in the Case Group.

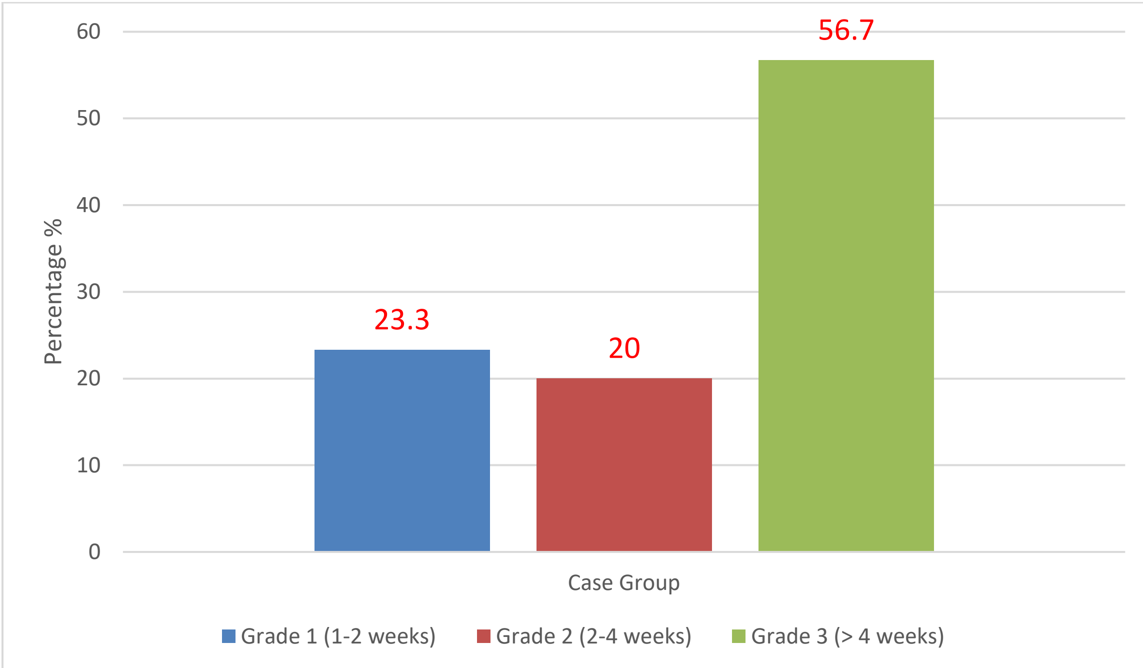

Figure 4. 6. Return to Play Duration Following Injury in Case Group.

4.6.2 Predictive Factor for Ankle Sprain Injury

Table 4.8 displays the descriptive statics for variables which included in the stepwise regression for predictive ankle sprain injury and the dependent variables (Right and Left limb length measurement, Right and Left circumference medial malleolus, Right and Left circumference patella epicondylar, Right and Left Gastrocnemius measurement, Right and Left Quadriceps measurement, age, athletic age, Training hours weekly, BMI, and Play return day).

Table 4. 8.Descriptive Statistics for all predictive variables for ankle sprain injuries.

	Mean	Std. Deviation	N
Rt circumference medial malleolus	27.09	4.875	60
Lt circumference medial malleolus	27.12	4.655	60
Rt circumference patella epicondylar	34.91	2.886	60
Lt circumference patella epicondyle	34.75	2.900	60
Rt Gastrocnemius measurement	34.29	2.816	60
Lt Gastrocnemius measurement	34.09	2.839	60
Rt Quadriceps measurement	47.61	4.741	60
Lt Quadriceps measurement	47.28	4.485	60
Age	26.30	5.086	60
Athletic age	10.70	4.195	60
Training hours weekly	14.08	4.376	60
BMI	23.9825	1.61743	60
Play return day	26.43	42.237	60

The table 4.9 displays the results of the stepwise regression model for predicting ankle sprain injury. The model includes three steps. The variable entered into the model is athletic age, play return day, and the age. All of the Stepwise with the criteria that the Probability-of-F-to-enter is less than or equal to 0.050, and the Probability-of-F-to-remove is greater than or equal to 0.100. The model which used in the regression is dependent on age variable due to its highest R-square which is 56.8% shown in table 4.10.

Table 4. 9. Stepwise Variable Selection for Dependent Variable in both case and control groups.

Model	Variables Entered	Method
	Age	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
a. Dependent Variable: Group name (case or control)		

The coefficient of determination, or R-Square, indicates how much of the variability in the dependent variable (case and control group) can be accounted for by changes in the independent variable which is age.

Table 4.10 also shows the regression model in for age is significant ($p < 0.000$), indicating that the predictors in the model contribute significantly to the prediction of ankle sprain injury. The F-value is 21.74.

Table 4. 10. Model Summary for Predicting case and control group with Selected Predictors.

Model		R	R Square	Adjusted R Square	Std. Error of the Estimate
		.754c	.568	.541	.339
	Sum of Squares	df	Mean Square	F	Sig. (ANOVA)
	7.394	3	2.465	21.470	.000

Table 4.11 provides a summary of the coefficients for different regression models used to predict the dependent variable case and control groups. The table includes unstandardized coefficients, standardized coefficients (Beta), t-values, and significance levels (Sig.) for each predictor in the models.

The predictive ankle sprain injury in case and control group = 1.405 - 0.101 * athletic age -0.005 * play return day + 0.048 *age. The signification was found in all variables athletic age, play return day, and age with p-values = 0.000, 0.000 and 0.006, respectively.

Table 4. 11. Coefficient Analysis for Regression Models Predicting case and control group.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	1.405	.291		4.826	.000
	Ath.age	-.101	.020	-.849	-5.030	.000
	Play return day	-.005	.001	-.450	-4.511	.000
	Age	.048	.017	.484	2.848	.006
a. Dependent Variable: Group name						

4.6.3 Odd ratio

Table 4.12 presents the odds ratios and their 95% confidence intervals for various groups and conditions, comparing "positive" or "abnormal" cases to "negative" or "normal" cases. The odds ratio for having a right knee injury in the case group is 22.176. This indicates that individuals with a right knee injury have 22.176 times higher odds of being in the case group compared to the control group. The 95% confidence interval for this odds ratio ranges from 2.661 to 184.79, which suggests a significant association between right knee injury and the case group.

The odds ratio for having a left knee injury in the case group is 7.25. This indicates that individuals with a left knee injury have 7.25 times higher odds of being in the case group compared to the control group. The 95% confidence interval for this odds ratio ranges from 0.815 to 64.457, suggesting no significant association between left knee injury and the case group.

The odds ratio for having balance issues with closed eyes in the case group is 1.522. This indicates a slightly higher likelihood of balance issues in the case group compared to the control group, but the association is not as strong as in the previous examples. The 95% confidence interval ranges from 0.423 to 5.472, indicating some uncertainty in the association.

The odds ratio for having right proprioception issues in the case group is 1.385. This suggests a modestly higher likelihood of proprioception issues in the case group compared to the control group. The 95% confidence interval ranges from 0.282 to 6.796, indicating some uncertainty in the association.

The odds ratio is 1.000, which suggests no difference in the odds of having balance issues with open eyes between the case and control groups. Both case and control groups have similar proportions of individuals with this condition (3.3% in case group and 3.3% in control group). The odds ratio for having balance issues with closed eyes in the case group is 0.172. This indicates a substantially lower likelihood of balance issues in the case group compared to the control group.

Table 4. 12. the odds ratios, confidence intervals, and the distribution of cases and controls for different conditions and groups within the study.

	Odds Ratio for group (case / control)	95% Confidence Interval		case group		control group	
		Lower	Upper	positive (abnormal)	negative (normal)	positive (abnormal)	negative (normal)
Right Knee injury	22.176	2.661	184.79	13 (43.3%)	17 (56.6%)	1 (3.3%)	29 (96.7%)
Left Knee injury	7.25	0.815	64.457	6 (20%)	24 (80%)	1 (3.3%)	29 (96.7%)
Right SLS close eye	1.522	0.423	5.472	7 (23.3%)	23 (76.7%)	5 (16.7%)	25 (83.3%)
Right SLS open eye	1.000	.060	16.763	1 (3.3%)	29 (96.7%)	1 (3.3%)	29 (96.7%)
right ART	1.385	0.282	6.796	4 (13.3%)	26 (86.7%)	3 (10.0%)	27 (90.0%)
Left ART	0	0	0	0	30 (100%)	0	30 (100%)
Left SLS close eye.	0.172	.019	1.576	1 (3.3%)	29 (96.7%)	5 (16.7%)	25 (83.3%)
Left SLS open eye	0	0	0	1 (3.3%)	29 (96.7%)	0	30

Figures 4.7, Figure 4.8, Figure 4.9 present the results of a study comparing two groups: the Case Group and the Control Group, across different measures related to balance and proprioception. The data is presented in terms of percentages for each group and condition.

From Figure 4.7, the majority of both groups had normal (negative) results, with 80.0% in the Case Group and 100.0% in the Control Group through the left balance test with eyes closed, 20.0% of the Case Group had abnormal (positive, which means the athletic fall down before 20 second) results. The majority in left balance open eye of the Case Group (96.7%) had normal results while 3.33% had abnormal results. However, all of the left balance of open eye in control group was normal. The Chi-Square Tests in table 4.13 shows there is significant differences between both groups in close eye with p-value equals to 0.01, while the open eye no differences with p-value equals to 0.313.

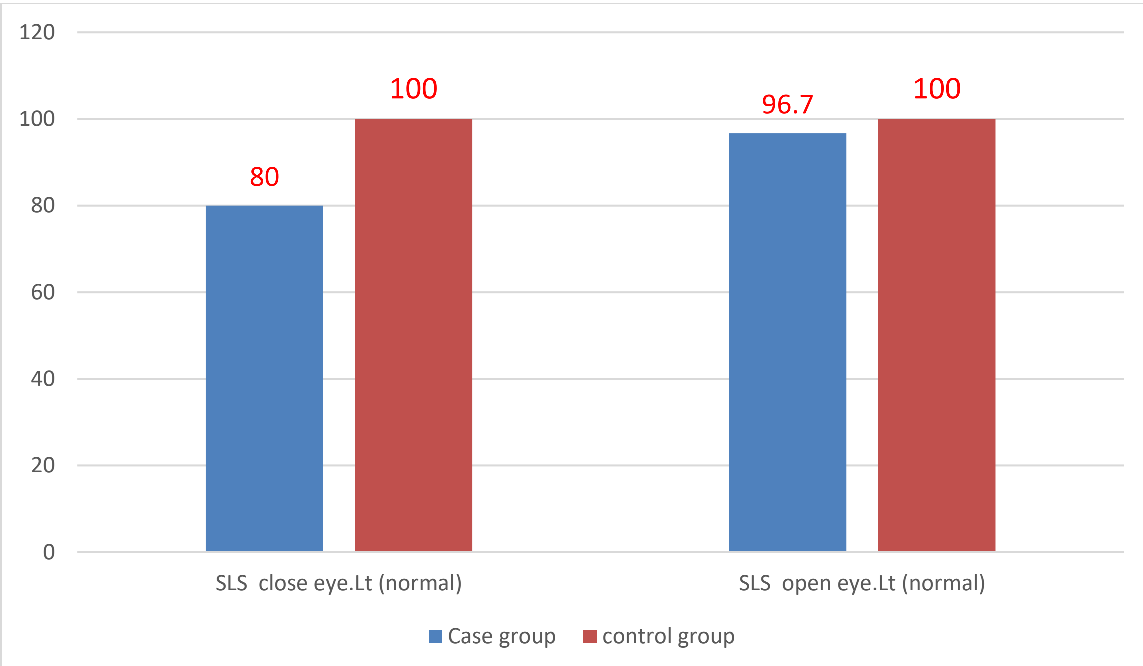

Figure 4. 7. Left Single Leg Stance with close and open eyes between both groups.

Table 4. 13. Chi-Square Tests for Lt Single Leg Stance with close and open eyes between both groups.

Chi-Square Tests for Lt balance close eyes				**Chi-Square Tests for Lt balance open eyes**			
	Value	df	Asymptotic Significance (2-sided)		Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.667[a]	1	0.010	Pearson Chi-Square	1.017[a]	1	0.313

From Figure 4.8, in the balance test with eyes closed on the right side, a higher percentage (43.3%) of the Case Group exhibited abnormal results compared to the Control Group (0.00%). The majority of both groups had normal results, with 56.7% in the Case Group and 100.0% in the Control Group. In the balance test with eyes open on the right side, 6.7% of the Case group is abnormal while the Control Groups exhibited no abnormal results. The vast majority of both groups had normal results with 93.3% and 100.0% in case and control groups, respectively. The Chi-Square Tests in table 4.14 shows there is significant differences between both groups in close eye with p-value equals to 0.00, while the open eye no differences with p-value equals to 0.15.

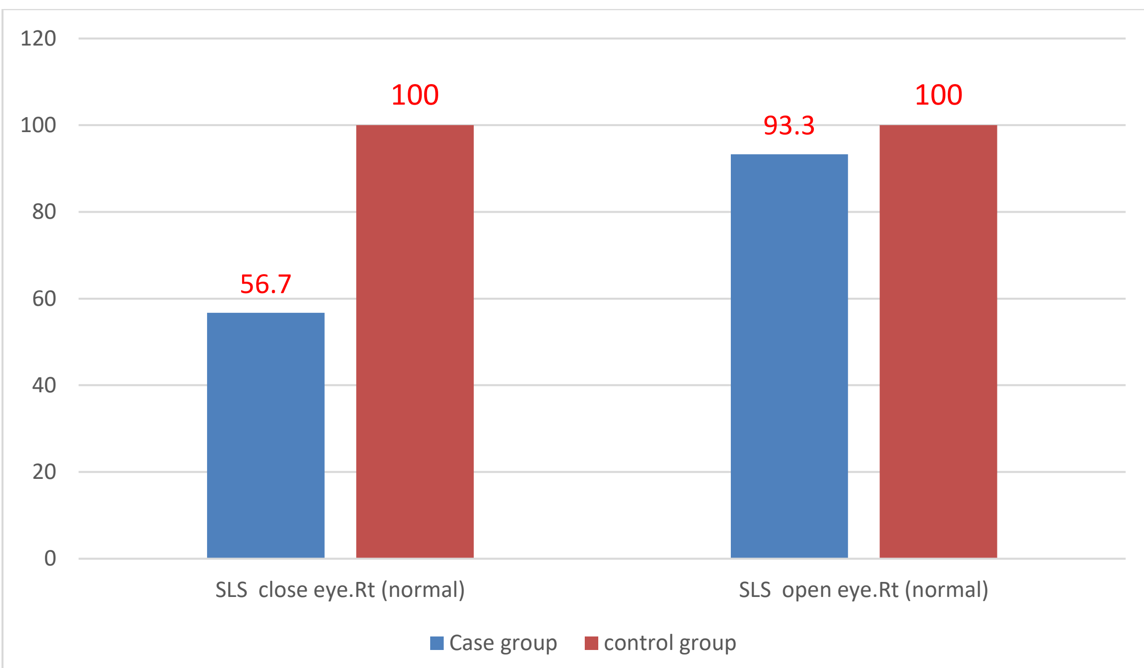

Figure 4. 8. Right Single Leg Stance with close and open eyes between both groups.

Table 4. 14. Chi-Square Tests for Rt Single Leg Stance close and open eyes between both groups.

Chi-Square Tests for Rt balances close eye				Chi-Square Tests for Rt balance open eye			
	Value	df	Asymptotic Significance (2-sided)		Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	16.596[a]	2	0.000	Pearson Chi-Square	2.069[a]	1	0.150

From Figure 4.9, in the proprioception test on the right side, the difference of mean between two groups was 23.3% of the Case Group and 0.00% of the Control Group exhibited abnormal which have a positive result. The majority of both groups had normal proprioception, with 76.7% in the Case Group and 100.0% in the Control Group. None of the individuals in either the Case or Control Group exhibited abnormal results in the proprioception test on the left side. The cut point of normality of ankle proprioception was 2 degrees more or less than origin position was normal while the degree more or less than 5 degrees was considered as abnormal. The Chi-Square Tests in table 4.15 shows there is significant differences between both groups in right Proprioception with p-value equals to 0.005.

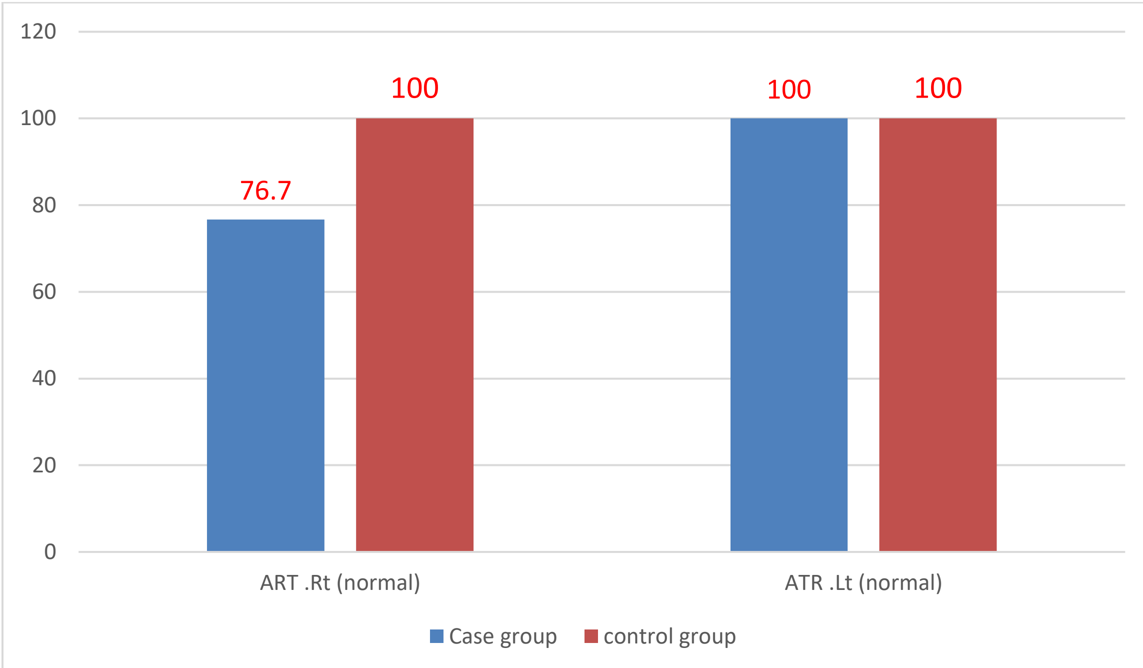

Figure 4. 9. Proprioception for right and left legs in both groups.

Table 4. 15. Chi-Square Tests for Rt ART between both groups.

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.925[a]	1	0.005

4.7 Y TEST

Table 4.16 compares anterior, posterior-medial, and posterior-lateral Y balance test for a Case Group and a Control Group. Mean anterior left was 0.87 meter (87 cm). for Case Group and

0.887 meter for Control Group. Between groups, T-test was -0.46 and p-value was 0.64. Case and control groups have similar standardized anterior left leg length measures. For left posterior-mediolateral, the Case Group had a significantly lower standardized posterior medial left leg length than the Control Group (with mean 0.81 meter vs. 0.86-meter, t-test -2.36, and p-value 0.02). The left posterior-lateral test showed that the case group had a significantly lower standardized posterior lateral left leg length than the control group (mean = 0.86-meter, t-test = -2.20, p-value = 0.03).

The mean for right anterior aspect was 0.87 meter for Case Group and 0.89 meter for Control Group, with t-test -1.13 and p-value 0.26. Standardized anteroposterior right leg length measures indicate no statistically significant difference between case and control groups. In the right posterior-medial aspect, the Case Group had a significantly lower standardized posterior medial right leg length than the Control Group (mean = 0.82 meter, t-test = -2.14, p-value = 0.036). Finally, the right posterior-lateral aspect showed a statistically significant difference between the case and control groups: the case group had a significantly shorter standardized posterior lateral right leg length.

Table 4. 16. Comparative Analysis of Y balance test for Anteroposterior (Ant), Posterior Medial (PM), and Posterior Lateral (PL) aspects in Case and Control Groups.

Group name		N	Mean	Std. Deviation	t test	p. value
STD.Ant.let	Case Group	30	0.8797	0.06083	-0.46	0.64
	Control Group	30	0.8870	0.06109		
STD.PM.Lt	Case Group	30	0.8143	0.10843	-2.36	.021
	Control Group	30	0.8680	0.06054		
STD.PL.LT	Case Group	30	0.8673	0.06554	-2.20	0.03

	Control Group	30	0.9033	0.06076		
STD.Ant.Rt	Case Group	30	0.8750	0.06208	-1.13	0.26
	Control Group	30	0.8933	0.06299		
STD.PM.Rt	Case Group	30	0.8250	0.07295	-2.14	0.03
	Control Group	30	0.8613	0.05722		
STD.PL.Rt	Case Group	30	0.8663	0.06749	-2.41	0.01
	Control Group	30	0.9070	0.06287		

4.8 Outcome Measurement

4.7.1 Test of Normality for Range of Motion Data

The Kolmogorov-Smirnov and Shapiro-Wilk normality tests for assessment and balancing test variables are shown in the table 4.17. All variables do not follow a normal distribution, as seen by the very low p-values ($p < 0.05$). The Lilliefors Significance Correction validates data non-normality.

Table 4. 17. Tests of Normality for outcome measurement CAIT and FAAM.

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CAIT/RT/100	.194	60	.000	.806	60	.000
CAIT/LT/100	.215	60	.000	.724	60	.000
FAAM/100	.288	60	.000	.707	60	.000
a. Lilliefors Significance Correction						

4.7.2 Descriptive statics

Table 4.18 compares various assessment scores and balance test results between the Case Group and Control Group, providing means and standard deviations for each variable. The results indicate statistically significant differences ($p < 0.05$) between the two groups for all variables, including CAIT in right and left and FAAM. Specifically, the Case Group tends to exhibit lower mean values in these variables compared to the Control Group. These findings suggest that there are substantial differences in assessment scores and balance test results between the two groups, with the Case Group generally performing less favorably than the Control Group.

Table 4. 18.Comparison of outcome measurement between Case and Control Groups using Mann-Whitney U Test

Group name	Case Group		Control Group		P-value using Mann-Whitney U
	Mean	Std. Deviation	Mean	Std. Deviation	
CAIT/RT/100	53.83	24.357	94.07	3.973	0.000
CAIT/LT/100	45.20	36.271	94.07	3.973	0.000
FAAM/100	84.91	15.627	97.00	7.812	0.000

4.9 Discussion

The control group had 16.7%, and the case group had 36.7% in 19–23.9 years, while the case group had 30.0%, and the control group had 6.7% in athletes over 32 years. Results may explain why 19–24-year-old athletes have the least ankle sprain injury. They have better muscles, bones, and connective tissues, with more blood flow and tissue regeneration. Younger athletes may handle minor ankle sprain injuries and stress better. Younger athletes also have better cardio and conditioning. More typically, they do injury-prevention strength and conditioning. Younger athletes may not overtrain as much as older ones. Senior athletes may suffer more overuse injuries. Lastly, age-related physiological changes such as muscle loss, bone density, and flexibility may increase athlete injury risk. The Mann-Whitney U test showed a P-value of 0.009 between the case and control groups. Several studies support this results as shown in Saki et al., 2021 study, and Prieto-González et al., 2021 study. However, Waterman et al., 2010 study showed that ankle sprain injury occurs in males in age between 19-24 years old more than in other categories. This result may occur because his study takes all populations rather than athletic persons.

Athletes aged 7-14 are predominantly found in the Case Group, while the Control Group includes a significant number of athletes in the 1-7 years age group. Additionally, the Case Group has a higher proportion of athletes aged 14-21, whereas athletes over 21 are rare in both groups. These differences in age distribution are essential for understanding the characteristics of athletes in both groups and may have implications for the study or research being conducted. These results improved by P-value which have a result of 0.00 between case and control groups.

Several studies have linked greater BMI to ankle sprains. High-BMI athletes may have more weight to support, which may strain the ankle joint and ligaments and increase the risk of sprains. Heavy weight, frequently linked with increased BMI, might compromise ligament function and lower extremity mechanics. This reduces ligaments' capacity to support the ankle, making it more susceptible to injury (Bi et al., 2023). The present analysis indicates no BMI changes between the case and control groups with p-value a 0.076 improvement. Most athletic have healthy or overweight BMIs, which explains the lack of distinctions.

Training hours per week and ankle sprain risk are complicated and may not always be linked. Training hours are crucial, but so is quality. Technique, strength, fitness, and injury prevention are essential. Regardless of training hours, high-intensity, quality exercise may reduce injury risk. Quick changes in direction, contact with other players, or the playing surface may cause ankle sprains in several sports. Overtraining without rest may cause weariness and overuse problems. Fatigued athletes have worse coordination and proprioception, which increases ankle sprain risk. However, Research on the relationship between training hours and ankle sprain injuries may vary in terms of sample size and research design. Small sample sizes or study limitations can impact the ability to detect significant associations. Further investigation should be achieved this complicated relationship.

There has been no conclusive research that demonstrates a direct link between an increase in limb length measurement and an increased likelihood of ankle sprain injuries. Sprains of the ankle are often brought on by a combination of internal and external causes that are connected to the ankle joint and the tissues that surround it, as well as motions or forces that bring about the injury. However, longer limbs may have the ability to change an athlete's center of gravity as well as their balance; however, this effect is often rather minor (Halabchi & Hassabi, 2020a).

There was a significant difference of length between the Case and control groups, the case Group's average length was 177.37, while the Control Group's is 172.03. This difference suggests a distinction between the two groups. However, it's crucial to note that this dissimilarity in limb length does not directly imply an increased likelihood of ankle sprain. Subsequently, the Y balance test was conducted to further explore this relationship. The movement of the body may be altered by having longer limbs, but this does not always result in an increase in the number of ankle sprains. There is a possibility that it may alter gait patterns in certain circumstances, but this will not be the case for the vast majority of athletes. Although the size or strength of the quadriceps muscle group may have an effect on joint stability, it is not a direct indication of an individual's likelihood of sustaining an ankle sprain (Kwak & Kim, 2017).

The quadriceps have a more significant role in maintaining knee stability than they do ankle stability, and their effect on ankle stability is mainly indirect. Although having strong quadriceps may help improve general lower limb stability, the direct influence that they have on ankle sprains is not significant. Strength training that focuses on the lower limbs as a whole may enhance overall joint stability and perhaps minimize the chance of AS injury because the quadriceps are powerful muscles involved in various activities such as walking, running, jumping, and squatting. Strengthening exercises for the quadriceps are often a part of rehabilitation programs for knee injuries and are also essential for maintaining overall leg strength and function. These muscles affect on the stability of ankle joint accordingly. This evidence was shown in case control with high Quadriceps measurement in both sides with difference between 3.73 and 3.69 in right and left leg respectively. J et al., 2021 conducted a study of association between lower extremity muscle strength and ankle injury in youth team-sports athletes, they found that association between lower extremity muscle strength and ankle injury in youth team-sports where athletes with maximal quadriceps strength increased the risk of any type of ankle injury in youth male athletes.

Athletes have the ability to reduce their risk of injury by engaging in activities such as performing an appropriate warm-up, engaging in strength and balance training (Abernethy & Bleakley, 2007). By doing these steps, you may improve the general stability of your lower limbs and reducing the AS injuries. There have not been a lot of studies done on the influence that limb length and quadriceps measurement have on the risk of ankle sprains, and there is not a lot of information that can be considered definitive in this area. At this stage, we need to have completed further investigations.

The medial malleolus provides the support needed for weight bearing. When in the standing, walking, or running posture, it shares the ankle's stress and weight and aids in joint activities during any weight-bearing action. Such a balance of assistance is crucial. Stability and medial malleolus alignment are essential for balance (Manganaro & Alsayouri, 2023).

The medial malleolus is a spot where muscles, tendons, and ligaments were attached. These support structures can also be affected depending on changes that occur with athlete's position. The medial malleolus provides the biomechanics of the ankle joint. Instability and balance concerns may be due to misalignment or anatomical abnormality of malleolus.

The balance and ankle stability depend on the medial malleolus. It protects the ankle joint, prevents over movement, and helps in the weight-bearing workout. Disorders in the medial malleolus can affect the balance and stability of the ankle, a significant factor in health and function. The medial malleolus of the tibia bone forms the medial ankle joint. It limits ankle inversion and eversion. Supporting at either side of the ankle, the medial and lateral malleolus prevent ankle sprains (R. L. Martin et al., 2013).

Range of motion (ROM) refers to the extent of movement that a joint or a combination of joints can move in various directions. It is an important aspect of musculoskeletal health and is often assessed and measured in clinical settings. The ROM can be influenced by factors such as the structure of the joint, the flexibility of the surrounding muscles and tendons, and the presence of any injuries or conditions affecting the joint. ROM measures do not directly influence the likelihood of sustaining an ankle sprain. The ROM of a joint is measured to determine how flexible and mobility of the ankle joint. However, the most common causes of ankle sprains are the rupture of one or more of the ankle's ligaments, a loss of proprioception (the sensory knowledge of where a joint is located), or the application of force from outside (Roos et al., 2017).

Sprains of the ankle often take place when the ligaments that are responsible for stabilizing the ankle joint get stretched or torn as a result of excessive stress or movement that is not normal. The ROM of an athletic does not have an effect on the amount of ligament damage in chronic stage that occurs; instead, the mechanism that caused the injury does. Furthermore, ankle stability, which is essential for avoiding sprains, is more closely tied to proprioception and the capacity of the muscles and ligaments around the joint to retain control. This is the case because proprioception is a critical component of management. An athletic with adequate proprioception can better recognize and react to changes in the position of their joints, which helps them avoid harm (Al-Mohrej & Al-Kenani, 2016). However, there is no direct correlation between the range of motion and the likelihood of spraining an ankle. Some individuals may have a restricted range of motion yet still be susceptible to ankle sprains owing to other contributing variables. In contrast, others with a more excellent range of motion may not be affected by this condition.

Ankle sprains are caused by sports which involve sudden changes of directions and intense jumping activities using the dominant foot. The athlete’s dominant limb is used for stability and power so that it is subjected to intense pressure. The study done by Pashak, 2019 reported increased incidences of ankle sprains for athletes who used their dominant foot as support during high impact movements. Injury risk can be increased by more dependence of the dominant leg for stability and power. Moreover, our studies show that right leg injury is more than left with 86.7% and 56.7% respectively, and the dominant leg on the right was 76.7% while on the left was 23.3%. These results indicate the right leg injury more than the left due to the dominant leg accordingly. It should make a training for those athletic people with take into account the dominant leg. The training for athletes should focus on the different legs rather than the dominant to help the dominant leg in their work and share the bearing on both legs so the AS injury will decrease accordingly.

The number of days it takes for an athlete to return to play after an ankle injury (often referred to as "return to play" or "RTP" duration) can have an impact on ankle sprain injuries. The duration of time an athlete takes to RTP can be indicative of the severity of the ankle injury. An athlete who RTP too soon, before the ankle has fully treated, may be at a higher risk of re-injury.

Conversely, an athlete who takes longer to RTP may have allowed the ankle to treat properly and undergo rehabilitation, reducing the risk of re-injury (D'Hooghe et al., 2020).

Return to play (RTP) before the ankle has fully recovered can lead to residual weaknesses or imbalances in the injured ankle, which can increase the risk of another ankle sprain or related injuries. Athletes may compensate for the injured ankle by altering their gait or movement patterns. This compensation can lead to overuse injuries in other areas of the body, including the opposite ankle, knees, or hips. A longer RTP duration often allows for more comprehensive rehabilitation and strengthening of the injured ankle. This can help restore the athlete's balance, proprioception, and strength, which are essential for preventing future ankle sprains. Also, Athletes who are mentally and physically prepared to RTP are less likely to experience anxiety or hesitation, which can lead to injuries. Rushing back to competition without adequate psychological readiness can contribute to injury risk. Moreover, A longer RTP duration may involve more thorough evaluation and medical guidance, which can help ensure that the athlete is physically and psychologically ready to return to competition safely by physiotherapists (Clanton et al., 2012).

Our study shows that 56.7% of the case group RTP after 4 weeks (grade 3), those athletic reduce the re-injury more than athletic who RTP after 1-2 weeks (grade 1) (Wilmoth et al., 2021). The duration required for RTP in ankle sprains is influenced by various factors, such as the severity of the injury, and the available rehabilitation features. In amateur and professional football players, the reported RTP ranges from 15-19 days, with no detailed documentation on injury gradation (Waldén et al., 2013). In a case series involving professional athletes who underwent surgical ligament repair, the median RTP was 77-105 days for those with concurrent injuries (Pearce et al., 2016).

In the predictive factors which are effect on ankle sprain injury, the equation indicates that athletic age and play to return decreasing the probability of AS injury while the age increasing the AS injury. Athletic age decreasing the likelihood of ankle sprain injury could be attributed to several factors and may not be a direct cause-and-effect relationship, but rather a correlation or observation. Athletes with a higher athletic age typically have more experience and skill development in their sport. They may have better control over their movements, balance, and training proprioception, which are essential for avoiding injuries like ankle sprains. Over time, athletes may improve their physical conditioning, including strength, flexibility, and endurance. Better physical conditioning can reduce the risk of injuries, as stronger and more flexible muscles and ligaments are better equipped to support and protect the joints, including the ankles (Fulton et al., 2014).

Moreover, experienced athletes may have been exposed to injury prevention programs and strategies. These programs often include exercises and drills that focus on strengthening the ankle and improving stability and balance, which can reduce the risk of ankle sprains. Athletes with a higher athletic age may be more aware of the risks associated with their sport and take steps to minimize those risks. They may use appropriate protective gear and follow safety guidelines. Also, with more years of athletic experience, individuals are more likely to have learned from past injuries, including ankle sprains. They may take precautions to avoid repeating similar injuries in the future (Al Attar et al., 2022).

However, as athletes mature, ankle sprains increase due to playing a long time which may injury during exercises or competition more than low-age athletes. Ankle sprains decrease with athlete age owing to biological, physiological, and lifestyle variables. Older athletes age should be aware of these hazards and take actions to avoid them, including regular strength, balance specific training, good warm-up and stretching, suitable footwear, and injury prevention methods to reduce ankle sprains (Vuurberg et al., 2019).

Biomechanical and training variables complicate athletes' knee and ankle sprain injuries. Athletes and sports medical experts should examine the interconnectedness of these injuries and apply knee and ankle joint prevention, early intervention, and rehabilitation measures. Ankle sprains may increase with knee biomechanics changes, such as gait patterns or landing mechanics after a knee injury. Athletic with weak or damaged knees may depend more on their ankles for support, increasing the risk of ankle sprains. Athletic may change their motions to compensate for knee discomfort or instability, which might increase ankle load. To perform, athletes with knee ailments may avoid bending the knee and abuse the ankle. Anatomical variables, injury history, and susceptibility may increase the incidence of knee and ankle problems in athletes (Räisänen et al., 2020). Cumps et al., 2007 reports that ankle sprains associated with overuse knee injuries.

Balance is an essential part of Proprioception, and an ankle sprain is the result of the sum of several factors, including Proprioception, visual, vestibular, and somatosensory systems. Athletes' training must include these main factors to avoid ankle sprains. The lack of equal balance may be the result of the injury itself, especially since the tendons contain mechanoreceptors, and these tendons can be affected after the injury, so rehabilitation is essential for an ankle sprain (Han et al., 2015).

Athletes vary in their natural mobility, a capacity intricately governed by the coordination of limb muscles orchestrated by the central nervous system (CNS). The preservation of balance and spinal stability hinges on sensory inputs derived from the visual, vestibular, and somatosensory systems. The nervous system seamlessly combines these peripheral afferent signals to uphold postural control during periods of stance. The control of balance and proprioception is overseen by the central nervous system, relying on three primary subsystems: the somatosensory system (comprising nerves in joints, tendons, and muscles), the vestibular system (residing in the inner ear canals), and the visual system. Disruption or malfunction in any of these subsystems can lead to imbalances and functional issues and therefore increase the ankle sprain injury. Fortunately, balance and proprioception can be effectively trained and incorporated into workouts for individuals of diverse ages and skill levels (Zemková & Zapletalová, 2022).

When an individual closes their eyes and stands on one leg, the proprioceptive system plays a crucial role in maintaining balance. Proprioception refers to the body's ability to sense its position in space and the relative position of body parts without relying on visual input. It involves information from sensory receptors in muscles, tendons, and joints. Closing the eyes eliminates visual input, placing a greater reliance on proprioception. Standing on one leg further challenges the proprioceptive system because it requires continuous adjustments in muscle activity to maintain stability (Mukhopadhyay, 2021).

Closing the eyes reduces reliance on visual cues, forcing the body to depend more on proprioceptive information. Standing on one leg increases the difficulty by limiting the base of support and requiring constant adjustments to maintain equilibrium. Proprioceptive receptors in the muscles, tendons, and joints provide real-time feedback about the position of the body in space. The body must adjust muscle activation and joint position continually to prevent swaying or falling while standing on one leg with closed eyes (Gaerlan, 2010).

Proprioception is closely tied to neuromuscular control, involving the coordination of muscles and the nervous system. The brain receives feedback about body position and uses this information to adjust muscle tone and contraction to keep the body balanced. Practicing balance exercises with closed eyes and single-leg stance can enhance proprioceptive awareness and improve neuromuscular control. Enhanced proprioception contributes to better joint stability, reduced risk of injury, and improved overall balance and coordination. Strong proprioception is essential for various daily activities, sports, and injury prevention. Improved proprioception can positively impact activities that involve uneven or unstable surfaces, sudden changes in direction, or tasks that require precise control of movement (Tuthill & Azim, 2018).

Finally, closing the eyes while standing on one leg challenges the proprioceptive system, which, in turn, enhances the body's ability to sense and control its position in space. This type of balance exercise can have positive effects on proprioception, leading to improved stability and coordination. The relationship between closing eyes, single-leg balance, and ankle sprain risk is rooted in the reliance on proprioception for maintaining stability. While these exercises can enhance proprioceptive awareness, they should be approached thoughtfully to mitigate the risk of injury, especially for individuals with pre-existing balance issues or a history of ankle sprains. Therefore, the study showed that there are differences between the groups in the case of closing the eyes on proprioceptive, controversy to perception when the eyes are open.

The Y Balance Test (YBT) is a functional movement assessment designed to evaluate an individual's dynamic balance, proprioception, and neuromuscular control. It involves reaching in three directions (anterior, posteromedial, and posterolateral) from a central starting point, creating a Y-shaped pattern. Specifically, your question focuses on the posteromedial (PM) and posterolateral (PL) directions and their potential effects on ankle sprains. The YBT assesses an individual's ability to maintain balance and control while reaching in different directions. The posteromedial and posterolateral directions involve movements that challenge the stability of the ankle joint, as the body weight shifts over the supporting leg (A. Alghadir et al., 2020).

The test helps identify asymmetries in dynamic balance and weight distribution between the legs. Asymmetries may indicate weaknesses, imbalances, or deficits in neuromuscular control that could contribute to an increased risk of ankle sprains. The posteromedial and posterolateral reaches specifically target movements that involve ankle stability. Ankle sprains often occur due to insufficient neuromuscular control and stability, leading to the ankle rolling or twisting beyond its normal range of motion. Weakness or imbalances in the muscles surrounding the ankle can contribute to instability and increase the risk of sprains (Manoel et al., 2020).

By identifying weaknesses or imbalances in the PM and PL directions, the YBT can inform targeted rehabilitation programs. Strengthening exercises and neuromuscular training focused on the muscles involved in these movements may be prescribed to improve ankle stability and reduce the risk of sprains. The YBT is part of a broader approach to functional movement screening, providing insights into how individuals move during dynamic activities. Understanding how individuals perform in the PM and PL directions helps clinicians and trainers tailor interventions to address specific movement patterns that may contribute to ankle sprains. A. H. Alghadir et al in 2020 found even there were no differences in the active ankle joint range of motion ($p > 0.05$) in comparison between case and control, athletes with chronic ankle sprain reported mild pain and statistically significant ($p < 0.05$) deficits in foot proprioception, static and dynamic balance (A. H. Alghadir et al., 2020).

The CAIT is a self-reported questionnaire that assesses ankle instability and perceived functional limitations. The results show statistically significant differences ($p < 0.05$) between the Case Group and Control Group for both the right and left ankles.

The Case Group has lower mean values in CAIT scores, indicating that individuals with ankle injuries perceive their ankle stability and function as worse than those in the Control Group. This suggests that ankle injuries have a substantial impact on self-reported ankle stability. Injuries to the ankle, such as sprains, often cause damage to the ligaments that are responsible for stabilizing the ankle joint. Injury to the ligaments may result in joint laxity as well as a reduction in the ankle's mechanical stability, which some people may interpret as a loss of ankle stability. The CAIT is a test that measures how a person feels about their ankle's degree of stability, thus it may record these sentiments. In addition, injuries to the ankle might interfere with proprioception, which is the body's capacity to detect the position and movement of joints. An impaired sense of proprioception after an ankle injury may make a person feel less confidence in their joint's stability, even if the ligaments have healed. This can happen even if the accident did not include a fracture. The CAIT evaluates how people feel they have lost proprioceptive control of their bodies (Shao et al., 2023).

Athletes who have already had ankle injuries often develop a dread of sustaining another one in the future. Because of this phobia, both their sense of self-confidence and their ankle stability may suffer dramatically. The CAIT takes into consideration these psychological elements in the form of an evaluation of the individual's impression of their ankle's instability (Suttmiller, 2022).

Injuries to the ankle may cause muscular weakness, especially in the muscles that surround the ankle and those that are found in the lower leg. Individuals with weakened muscles have less dynamic joint support, and as a result, they may feel less stable when walking on a wounded ankle. The CAIT scores demonstrate the degree to which this muscle instability exists. In addition, injuries to the ankle may result in functional restrictions, which can hinder a person's ability to participate in a variety of activities. These constraints may lead to a feeling of diminished stability, and the CAIT evaluates how a person is affected by these limits. In addition, injuries to the ankle may create changes in the biomechanics of the joint, which makes the ankle joint less stable when the body is in motion. Individuals are able to better explain how these biomechanical alterations impact their perceived ankle stability with the use of the CAIT (Jeon et al., 2021).

Injuries to the ankle joint almost always result in a diminished range of motion and mobility in that joint. Balance and an individual's impression of their own stability might be negatively impacted by limited movement. These facets are subjected to evaluation by the CAIT as part of the overall assessment.

Ankle injuries might impair every day and sports activity, which can influence FAAM outcomes. Ankle injuries cause pain, swelling, and discomfort during weight-bearing activities. This discomfort severely impairs every day and athletic activities that require ankle mobility and stability. Pain also causes activity avoidance, lowering FAAM scores. Functional restrictions from ankle injuries include difficulties walking, running, leaping, or changing directions (Kaminski et al., 2013).

Limitations might hinder a person's capacity to play sports or conduct everyday tasks, affecting FAAM ratings. Injury to the ankle limit joint mobility. Limited ankle mobility make squatting, leaping, and rotating difficult in everyday life and sports. Weakened ligaments and proprioception affect balance and coordination after ankle injuries. These variables impair stability, making a person less confident in their abilities to play sports or walk on uneven ground. Psychological repercussions of ankle injuries include low self-esteem and long-term worries. Psychological variables may cause perceived restrictions and alter FAAM ratings (Punt & Allet, 2016).

Ultimately, our present investigation is constrained by certain limitations, as it neglects to consider the specific domain and its nature in relation to the severity of players' injuries. Additionally, it is advisable to select a cohort of players within a homogeneous age bracket, such as 19-24 years, and scrutinize the factors influencing them on a more protracted timescale.

Chapter Five

5.1 conclusion

5.2 Recommendations

5.1 Conclusion

In conclusion, the information that has been presented offers a detailed investigation into the many elements that influence the possibility of athletes suffering from ankle sprain injuries. The present investigation takes into account a broad variety of factors, including statistical analysis and the testing of hypotheses, as well as age, body mass index (BMI), limb length, quadriceps strength, range of motion, and self-reported questionnaires like the CAIT and FAAM . These factors are all considered. Additionally, it dives into the interconnection of knee and ankle problems, highlighting how important it is to have a firm grasp on biomechanics, gait patterns, and landing mechanics.

In addition, the research investigated the connection between body mass index (BMI) and ankle sprains, drawing attention to the influence that an increased BMI may have on the likelihood of sustaining an ankle injury. However, the investigation did not identify any significant variations in BMI between the case and control groups, which suggests that other variables may play a more substantial role than was first thought.

In addition, the function of total training hours was investigated, with an emphasis placed on the significance of both the amount and quality of training with regard to the prevention of injuries. Overtraining and weariness have been recognized as significant risk factors, highlighting the need of maintaining a healthy and well-rounded approach to one's workout routine.

According to the findings of the research that investigated the link between ankle sprain risk and parameters such as limb length and quadriceps strength, both of these aspects seem to have a less direct bearing on the risk than do other components.

It was discovered that ankle-specific tests such as the CAIT and FAAM were helpful in measuring ankle instability and functional limits in those who had sustained ankle injuries. The results of these tests revealed insights into the psychological and physical elements of the function and stability of the ankle.

The current study discuss about how the medial malleolus affects the stability and balance of the ankle, and we emphasized how important a function it plays in limiting excessive movement and helping with weight bearing.

In conclusion, the information presented here offers a complete summary of the many elements that play a role in the development of ankle sprain injuries in sports. This demonstrates the need of having a comprehensive approach to the prevention of injuries, one that takes into consideration the myriad of physiological, biomechanical, and psychological factors. It is strongly recommended that further study be conducted in this area so that a more in-depth knowledge of the factors that put athletes at risk for ankle sprains and the preventative methods that are most likely to be successful can be obtained.

5.2 Recommendation

Based on the results and discussion presented in earlier chapters the researcher recommends the following

Recommendation for players and team

1. To respect the resting time of the player after injury to prevent further injuries
2. To consider the Y test and single stance balance test, in variation between different players, in training, and in decision of return to play for players with ankle sprain
3. To consider the importance of younger age as longer athletic age as priority in decreasing the potential of AS injury
4. To include angle reproduction test in decision of proprioception decision after injury and during training
5. To emphasize the importance of balance and proprioception treatment as part of the rehabilitation process of the ankle sprain injuries

Recommendation for further research

1. To conduct this research in a cohort study that will investigate better the concurrent risks with the potential injury development.
2. To use more objective assessment tools for measuring balance and proprioception
3. To consider a continuous level of measurement in analysis and data capture regarding the single leg stance test so that specific correlation van be mad in future

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Appendixes

Appendix 1: Ethical Consideration form

جامعة القدس \ ابو ديس

كلية المهن الصحية

العلاج الطبيعي والتأهيل

نموذج موافقة على المشاركة في بحث علمي:

وبائيات التواء الكاحل وفعالية التدريب الادراكي على النتائج الوظيفية للاعبي كرة القدم في الخليل

أنا الموقع\ة أدناه ....

أوافق عل المشاركة في البحث العلمي الذي سيقوم به أخصائي العلاج الطبيعي معاذ أبو شخيدم، ضمن برنامج الماجستير في العلاج الطبيعي - جامعة القدس.

لقد قامت الباحث بشرح مفصل عن أهداف الدراسة واليه البحث حيث أنني سأشارك في دراسة تهدف لدراسة **وبائيات التواء الكاحل لاعبي كرة القدم في الخليل،** علماً أنني استطيع الانسحاب من الدراسة متى شئت واعلم أن المعلومات الخاصة بي لن تستعمل إلا لغرض البحث العلمي.

طريقة التواصل مع الباحث:

للاستفسار يمكنكم التواصل مع (معاذ دياب أبو شخيدم)عن طريق (رقم الهاتف 00972597274021) أو عنوان البريد (mouzdeab7@gmail.com) إذا كانت لديك بعض الأسئلة عن الدراسة.

التوقيع التاريخ

Appendix 2: Ethical Consideration form

جامعة القدس \ ابو ديس

كلية المهن الصحية

العلاج الطبيعي والتأهيل

معلومات عن بحث علمي:

يقوم الباحث معاد أبو شخيدم بأجراء بحث علمي، ضمن برنامج الماجستير في العلاج الطبيعي - جامعة القدس .و يهدف هذا البحث الى معرفة أسباب التواء الكاحل لدر الرياضيين , علما ان الفحوصات لا تشتمل على أي خطر او ضرر للاعب و ان اشتراكك الطوعي في هذا البحث يسهم في البحث العلمي

ان اشتراكك في هذا البحث يتضمن الحفاظ على سرية المعلومات الخاصة بك , و لن يتم استخدام الأسماء في التحليل , و ان اشتراكك هو بشكل طوعي تام ولن يتم الاضرار باي من مصالحك,

إذا كان لديكم أي تساؤلات او استفسارات ارجوا التواصل على الأرقام المعلنة ادناه

طريقة التواصل مع الباحث:

للاستفسار يمكنكم التواصل مع (معاذ دياب أبو شخيدم)عن طريق (رقم الهاتف 00972597274021) أو عنوان البريد (mouzdeab7@gmail.com) إذا كانت لديك بعض الأسئلة عن الدراسة.

التوقيع : التاريخ :

Appendix 3: Data collection form

جامعة القدس \ ابو ديس

كلية المهن الصحية

العلاج الطبيعي والتأهيل

نموذج الفحص السريري

وبائيات التواء الكاحل وفعالية التدريب الادراكي على النتائج الوظيفية للاعبي كرة القدم في الخليل.

Participant Name:

Participant Code:

Date of Signature:

Section I: Demographic Data

1. **Name of participant: ……………………………………………………..**
2. **Phone number: ……………………………………………………………**
3. **Date of birth: ……………..**
4. **The name of the sports club**
    a. Hebron
    b. Dura
    c. Samou
    d. Dhahiriya
5. **Athletic age (year): …………….**
6. **Weight (Kg)**: …………….
7. **Height (cm): ……………..**
8. **Hours of training (hours weekly): ……………..**
9. **Dominant leg:**
    a. Right
    b. Left
10. **The number of injury times: ………………..**
11. **Time to return to play (days): ....**

Section II: Proprioception parameters

1. **Time of Balance test (single leg stance) in open eyes:**
    a. Right (sec)…..……
    b. Left (sec) ………..
2. **Time of Balance test (single leg stance in a closed eyes)**:
    a. Right (sec)…..……
    b. Left (sec) ………..
3. **Proprioception test:**
    a. Right (negative/ positive) …..……
    b. Left (negative/ positive)) ………..

Section III: Measurements

	Right (cm)	Left (cm)
Apparent Limb length measurements		
Difference between muscles circumference from medial malleolus:		
Difference between muscles circumference from patella epicondyles		
Gastrocnemius muscles circumference measurements		
Quadricep muscles circumference measurements		

Range of motion (ROM)

	Right (degree)	Left (degree)
Dorsiflexion		
Plantarflexion		
Inversion		
Eversion		

Section IV: Outcome Measures

Outcome measures Score

1. Cumberland Ankle Instability Tool (CAIT)
2. Foot and Ankle Ability Measure (FAAM)

Appendix 3: CAIT Questionnaire

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

	LEFT	RIGHT	Score
1. I have pain in my ankle			
Never	◻	◻	
During sport	◻	◻	
Running on uneven surfaces	◻	◻	
Running on level surfaces	◻	◻	
Walking on uneven surfaces	◻	◻	
Walking on level surfaces	◻	◻	
2. My ankle feels UNSTABLE			
Never	◻	◻	
Sometimes during sport (not every time)	◻	◻	
Frequently during sport (every time)	◻	◻	
Sometimes during daily activity	◻	◻	
Frequently during daily activity	◻	◻	
3. When I make SHARP turns, my ankle feels UNSTABLE			
Never	◻	◻	
Sometimes when running	◻	◻	
Often when running	◻	◻	
When walking	◻	◻	
4. When going down the stairs, my ankle feels UNSTABLE			
Never	◻	◻	
If I go fast	◻	◻	
Occasionally	◻	◻	
Always	◻	◻	
5. My ankle feels UNSTABLE when standing on ONE leg			
Never	◻	◻	
On the ball of my foot	◻	◻	

With my foot flat	□	□	
6. My ankle feels UNSTABLE when			
Never	□	□	
I hop from side to side	□	□	
I hop on the spot	□	□	
When I jump	□	□	
7. My ankle feels UNSTABLE when			
Never	□	□	
I run on uneven surfaces	□	□	
I jog on uneven surfaces	□	□	
I walk on uneven surfaces	□	□	
I walk on a flat surface	□	□	

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

Immediately	□	□	
Often	□	□	
Sometimes	□	□	
Never	□	□	
I have never rolled over on my ankle	□	□	

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

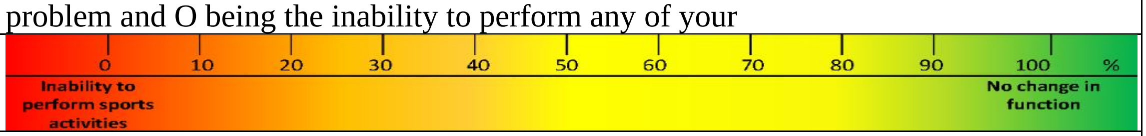
Almost immediately	□	□	
Less than one day	□	□	
1–2 days	□	□	
More than 2 days	□	□	
I have never rolled over on my ankle	□	□	

NOTE. The scoring scale is on the right. The scoring system is not visible on the subject's version.

Appendix 4: FAAM form

1. Running					
No Difficult at all	Slightly Difficult	Moderate Difficult	Extremely Difficult	Unable to do	N/A
• +4	• +3	• +2	• +1	• 0	• X
2. Jumping					
No Difficult at all	Slightly Difficult	Moderate Difficult	Extremely Difficult	Unable to do	N/A
• +4	• +3	• +2	• +1	• 0	• X
3. Landing					
No Difficult at all	Slightly Difficult	Moderate Difficult	Extremely Difficult	Unable to do	N/A
• +4	• +3	• +2	• +1	• 0	• X
4. Starting and Stopping Quickly					
No Difficult at all	Slightly Difficult	Moderate Difficult	Extremely Difficult	Unable to do	N/A
• +4	• +3	• +2	• +1	• 0	• X
5. Cutting lateral movement					
No Difficult at all	Slightly Difficult	Moderate Difficult	Extremely Difficult	Unable to do	N/A
• +4	• +3	• +2	• +1	• 0	• X
6. Ability to perform activity with your normal technique					
No Difficult at all	Slightly Difficult	Moderate Difficult	Extremely Difficult	Unable to do	N/A
• +4	• +3	• +2	• +1	• 0	• X
7. Ability to participant in your desired sport as you would like					
No Difficult at all	Slightly Difficult	Moderate Difficult	Extremely Difficult	Unable to do	N/A
• +4	• +3	• +2	• +1	• 0	• X

8. How would you rate your current level of function during your sports related activities from 0 to 100with 100 being your level of function prior to your foot and ankle problem and O being the inability to perform any of your



How wold you rate your current level of function?

Normal	Nearly Normal	Abnormal	Severly Abnormal
•	•	•	•