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PHYSIOTHERAPY

VZOREC, POJAVNOSTI POŠKODB IN NAPOVEDOVANJE DEJAVNIKOV TVEGANJA ZA POŠKODBE SPODNJIH OKONČIN PRI ELITNIH NOGOMETAŠICAH V KOSOVSKI LIGI

INJURY PATTERN, INCIDENCE, AND PREDICTING OF RISK FACTORS OF LOWER EXTREMITY INJURIES IN ELITE WOMEN'S FOOTBALL PLAYERS IN KOSOVO

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POVZETEK

Uvod: Namen te doktorske disertacije je proučitie različne vrste poškodb spodnjih udov, pogostost poškodb, dejavnike tveganja in napovedne modele med elitnimi nogometašicami kosovske super lige. Poleg tega bo ta disertacija natančno napovedala tveganje in resnost LEI poškodbe.
Metode: V empiričnem delu doktorske disertacije smo izvedli sistematični pregled z metaanalizo in kohortno longitudinalno študijo, v katero je bilo vključenih 142 udeleženk, 12 ženskih klubov na Kosovu v sezoni 2021/2022 , s časom izpostavljenosti 1000/h igranja in treninga.
Rezultati: Skupno je bilo registriranih 84 poškodb s skupnim razmerjem poškodb (IR) 3,21 (CI: 2,56, 3,98) s časom izpostavljenosti 1000/h. V tekmovalni sezoni je vsaka igralka v povprečju utrpela 1,4 poškodbe. IR so bili značilno višji med tekmovanjem (n = 50; IR = 1,57; IC: 1,52, 1,62) v primerjavi s treningom (n = 34; IR = 0,26, IC: 0,25, 0,27). Od skupno 142 igralk , je prišlo do 84 (59,2 %) poškodb igralk, kar se razlikuje od ugotovitev podobnih raziskav.
Zaključek: IR pri kosovskih nogometašicah je nizek, medtem ko je približno 11 % pod mednarodnim povprečjem. Ta primerjava odpira razpravo o specifičnih dejavnikih, ki vplivajo na poškodbe med nogometašicami na Kosovu in morebitnih razlikah v pripravi in izvajanju preventivnih programov. Skoraj 2 od vsakih 4 poškodb sta bili kategorizirani kot travmatski (nezgodni), pri čemer so bili IR več kot 5-krat večji med tekmami kot med treningom.

Ključne besede: Športne poškodbe, pogostost, ženski nogomet, dejavniki tveganja, spodnji ud.

SUMMARY

Background: In this dissertation thesis, it is intended to study the different types of lower extremity injuries (LEI), the incidence of injuries, risk factors and predictive models among the elite women soccer players of the Kosovo Super League. Furthermore, this dissertation will accurately predict the risk and severity of injuries to LEI.
Methods: In the empirical part of the doctoral dissertation, we performed a systematic review with a meta-analysis, and cohort longitudinal study from which 142 participants, 12 women clubs in the Kosovo during the 2021/2022 season. Exposure time for 1000/h of playing and training.
Results: In total, 84 injuries were registered with an overall injury ratio (IR) being 3.21 (CI: 2.56, 3.98) injuries/1000 exposure hours. During the competitive season, each player sustained 1.4 injuries on average. The IRs were significantly higher during competition (n = 50; IR = 1.57; CI: 1.52, 1.62) compared to training (n = 34; IR = 0.26, CI: 0.25, 0.27). Of a total of 142 women players, 84 (59.2%) injuries occurred, players that differed from the findings of similar research.
Conclusion: The IR for women in Kosovo women's soccer players is low while being around 11% below the international average. This comparison opens a discussion about the specific factors that influence injuries among female soccer players in Kosovo and possible differences in the preparation and implementation of prevention programs. Almost 2 out of every 4 injuries were categorized as traumatic, with the IRs being more than 5-fold larger during games than during training.

Keywords: Sport injury, incidence, women's soccer, risk factors, lower extremity.

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1 INTRODUCTION

Injuries sustained by athletes are a long-standing and significant issue in all forms of outdoor sports. The impacts of such injuries on both individual and organizational levels are significant. Sports athletes practice intensive exercise sessions involving high intensity training for prolonged durations. Although strength exercises are important for enhancing athletic functioning (McGuine 2006), they prominently increase the chances of sports concussions (Bunk 2021). Sports players, like football players, undergo completely different types of activities, training, and tricks (Culverhouse 2021). Possibly, it results in different injury rates and different sports injuries.

Such player injuries not only lead to significant financial damages to their respective teams, but also pose major ethical and regulatory concerns to professional sports leagues at large (Walia and Boudreaux 2020). Meanwhile, severe sports injuries can lead to early retirement and long-term health issues in players, as injury rates range from 62%, 38.17%, and 60.83% to 66%, which can result in major negative outcomes related to the physical, mental, and overall well-being of players (Wadey et al. 2018).

Therefore, reducing the prevalence and mitigating the impacts of sport-related injuries is essential for protecting the interests of both players and sports organizations. As a complex contact sport, football is associated with a relatively high risk of injuries.

According to (Forsythe et al. 2022), for every 1000 hours of exposure, professional football players sustain between 4 and 35 injuries. According to epidemiological research studies performed for different sports, football has been related to cain higher injury rates when compared with other contact games (Engebretsen et al. 2010; Junge and Dvorak 2000).

Hence, all organs and bones of the body are exposed to injury in contact sports (Caine et al. 2008). Although numerous findings and facts on contact sports injury incidences have been reported (Annett 1999; Han Yu 2023), some researchers have also observed concussions that occurred between training sessions or competitive classes essential for such sports.

The most common types of injury sustained by football players during the game include adductor strains (7.6%), ankle sprains (8.5%), and hamstring strains (12.3%) (Forsythe et al. 2022), thus suggesting that the majority of injuries are lower extremity injuries (LEI), or injuries affecting parts of the lower extremity of the body (Dempster et al. 2021).

Thus, it can be stated that LEIs are the most prevalent type of injury in football. While such injuries affect both male and female football players, contemporary research has proven that the risk factors and impacts of these injuries differ between these gender groups (Lin et al. 2018). As such, specific research is necessary to identify the risk factors causing LEI in football players of each gender. Moreover, it has also been found that the recovery time and negative career and health impacts of injuries are particularly high in female football players (Lucarno et al. 2021).

Women's professional, amateur, and community-level football games have become the fastest-prevailing sports globally (Martínez-Lagunas et al. 2014). However, the underlying social effects and psychological and physiological factors of sports contribution can be counterbalanced by the chances of concussion incidences (Eime et al. 2013).

The most prevalent football codes involve extremity-related damages (eg, groin, ankle, knee, hip, and hamstring) that are observed repeatedly, continue with ongoing injuries, and become the prominent risk factor for assisting the pre-existing injury (Gulías-González et al. 2014). Anxiety fear of getting injuries, and the absence of physiological strength are blockages to sports and healthy activity contributions in adult females (Fortington and Finch 2016).

However, the necessity to get knowledge about what effective plans aim to limit injury risks in female football becomes mandatory (Smith et al. 2012). When considering football display, females have a contrasting injury incidence profile as compared to the opposite gender.

For instance, the chances of severe knee damage (including ACL damage) are observed to be two times higher in females than in gents, irrespective of disclosure or contribution level. Females have a greater chance of concussion, and knee and ankle deterioration than gents, whereas men show a higher risk of injuries related to hamstring and groin (Toohey et al. 2017).

Moreover, football codes exhibit an increased frequency of ACL damage and related implications, in contrast to further sports. Therefore, it is essential to understand the factors that cause a risk of LEI in female football players, to eliminate those risk factors, and minimize the risk of LEI in female football players.

A considerable body of research has already been conducted to identify and analyse the risk factors of LEI among female football players. However, most of these studies focus either on specific demographics of female football players or on specific types of LEI.

Therefore, further secondary research is necessary to compare the findings of the relevant existing studies to identify the most prominent risk factors of LEI in female football players. Moreover, such a secondary analysis can also lead to potentially novel findings by providing a deeper understanding of how the identified risk factors influence the risk of LEI among female football players.

As mentioned earlier, injuries have profound effects on the career, health, and overall well-being of female football players. Apart from direct negative impacts, football-related injuries have also been observed to cause some important long-term negative outcomes in women football players. Such outcomes include kinesiophobia or the fear of movement, higher anxiety, and depression due to career loss and competition anxiety (Alahmad et al. 2021).

On a physical level, LEI related to sports can result in severe health issues, such as shin splints, stress fractures, and tendonitis, which may significantly deteriorate the health of the affected individuals over time. However, numerous researchers (Randell et al. 2021; O'Kane et al. 2016; Sugimoto et al. 2018) have explored the risk factors of LEI among female football players using different methods and sample demographics.

By combining and comparing the findings of these studies through a systematic literature review, the most prominent risk factors of LEI in female football players can be identified, along with their interactions with the risk of LEI.

These risk factors can then be modified to drastically reduce the risk of LEI in elite women's football (Randell et al. 2021). Thus, it can be stated that the findings of this systematic literature review study can be highly valuable for improving the career and health outcomes of elite women football players.

This study aims to identify and analyse the risk factors of lower extremity injuries in elite women football players. A popular sport around the world is football, so to perform at the levels required by this sport, one must possess both excellent tactical and physiological levels (Strauss et al. 2012).

Women's football is an extremely demanding sport that requires a high level of strength, power, endurance, agility, and change of direction, all while requiring remarkable tactical skill and precision. Football is one of the sports activities where physical activity, dexterity, and multiple movements are performed with high intensities up to the maximum (Bloomfield et al. 2007).

Women's football has recently been growing and day by day the level is increasing, thus reaching new levels with time going by (UEFA 2022). International Federation of Association Football (FIFA) data on the 2019 Women's World Cup in France shows an increase in competitiveness compared to the 2015 World Cup, resulting amongst others in injuries as well (FIFA 2022).

The frequency of injuries in this sport increases due to the great desire for the best performance on the field as well as the contacts that occur during the activity (Ekstrand et al. 2011) . In the last decade, numerous types of empirical studies have been conducted, which present the characteristics, types, and incidence of injuries in many countries of the world (Ekstrand et al. 2011; Waldén et al. 2005; Tegnander et al. 2008; Östenberg and Roos 2000; Nilstad et al. 2014).

Another point of concern is the many disagreements regarding the most significant factors in the incidence of injuries in soccer players, including anatomical characteristics of women players (Q angle), biomechanical factors, muscle disharmony between quadriceps and hamstrings hormonal factors, body mass index (BMI), neuromuscular fatigue and its consequences, repetitions, age and especially a reduction in the range of motion (ROM) lack of flexibility in the muscles involved (Amoako et al. 2017; Eston and Reilly 2009; Hägglund et al. 2006).

Injuries of the lower extremities are very frequent in female players, with roughly 60-80% of all injuries being responsible for keeping them away from exercise and play (Engström et al. 1991; Giza et al. 2005; Faude et al. 2005).

Bottom-extremity concussions happen because of a complex combination of several risks that can be managed by injury preventive training. For this purpose, different preventive programmes have been researched (including, external and insole joint supports), whereas the majority of them are exercise-focused strategies (Bizzini and Dvorak 2015).

These exercise-focused injury protection training sessions commonly aim to increase muscularity, stability, and complete anatomical kinetics during movements homogenous to contact-free anterior cruciate ligament concussion procedures (like alternating direction or aligning for a leap).

Such a series of measures involve the FIFA 11+, Prevent injury and Enhance Performance programme (PEP), Knäkontroll and Footy First. Such activities-focused sessions focus on several training classes, including agility, stability, mobility, jump training, running and robust activities (Hägglund et al. 2009).

Meta-analytical studies give evidence of the potency of associated plans to decrease ACL deterioration, for all populations of participants and game players (OR=0.50; 95% CI 0.41 to 0.59), and women players especially (OR=0.33; 95% CI 0.27 to 0.41) (Donaldson 2015).

None of the evidence-based literature has typically mentioned the studies for women athletes playing football, to identify the effectiveness of injury prevention programmes planned for all injuries, specifically localised concussions (such as sprains in the knee, ankle, ACL, hip, or hamstring).

Whereas, observing the gender-based and game-based effectiveness of injury prevention programmes may deliver individuals, health providers and sports organisations circumstances-based evidence-specific recommendations (Webster and Hewett 2018).

The major types and forms of injuries reported are easily identifiable and almost identically described by many researchers. The most common injuries in sports, qualified as injuries in games or exercises, are either injuries due to trauma (e.g., contact) or overuse (Andersen 2004; Curtis et al. 2021; Dvorak and Junge 2000; Shalaj et al. 2016; "F-MARC Football Medicine Manual 2 Nd Edition" 2009).

The lower extremities are the areas having the highest rate of injuries in elite-level female players, accompanied by knee injuries, ankle, and hip.4−1 Several studies report the incidence of injuries in women's national leagues in Germany, Spain / Netherlands, Norway, and Sweden (UEFA 2022).

In this context, this study aimed to investigate the injury incidence, their types and forms occurring in women's football players from the Elite Division of an upper middle-income European country. The hypothesis was that the occurrence depends on the exposure time, playing position and age of players, with lower limb injuries being the most frequent.

Football is considered to be one of the most popular sports in the world, therefore performance required by this sport must be at high tactical and physiological levels (Strauss et al. 2012; McCrory et al. 2013).

Football is a group sport including increased incidences of injuries. These injuries can be observed commonly among both, professional players, and amateur football participants (Bradley et al. 2014).

However, some individuals experience considerable time loss related to an injury. Mostly, the average duration to join the play is dependent on the pattern of injury. For example, nervus obturator deterioration requires almost 12 days for rehabilitation in professional football-playing individuals to come back to competition (Danielsson et al. 2020).

Whereas, the time required to recover and play football after hamstring injuries has a variable duration, between 14 to 28 days, in case of serious hamstring injuries (Shea et al. 2017). Mostly, almost 8 to 28 days of missed game play were recorded for professional football players belonging to European league teams. The injury time loss was recorded between 1 to 752 days for professional football athletes of Dutch football players, including an average of 8 days (Bahr 2003).

The duration required to join back the sports game included 7 to 24 weeks, 11 weeks mentioned to be the average time span, among experienced football individuals experiencing severe shoulder damage (Lockwood et al. 2015). One of the prominent effects of having a lower figure of injuries has been associated with team success, it is necessary to lessen their rate and reduce the average of wasted playing time (Drevon et al. 2017).

Females playing football has become more popular now than ever, as statistics from a recently published report mentioned a 7.5% rise in the figures of inscribed female sports players and an 11% elevation in the number of registered female football mentors in the time period between 2016 and 2017 (Bradley and Ade 2018). There is also a highlight of a 70% escalation in the number of registered female match management professionals between 2013 and 2017.

There is evidence that the physical activity demands of female football players have increased. Football as a sport is ranked by many authors as among the first five sports where the incidence of injuries is very high. Many studies conducting surveillance have observed the incidence of injuries in play ranging from 12.5 to 55.5/1000 h and the incidence in training ranging from 1.4 to 10.9/1000 h (Meeuwisse et al. 2007; Tegnander et al. 2008; Engström et al. 1991; Ekstrand and Gillquist 1983; Nilstad et al. 2014; Jacobson and Tegner 2007; Faude et al. 2006).

Physical contact between opponent players constitutes the main extrinsic factor, accounting for about 44–74% of these injuries (Arnason et al. 2004; Bahr et al. 2020; Nielsen and Yde 1989). Furthermore, longer career duration (Östenberg and Roos 2000; Dvorak and Junge 2000).

Increased age and a previous history (Ekstrand and Gillquist 1983; Patel et al. 2017; Covassin et al. 2013), seem to increase the risk of injury as well. According to DeLang and colleagues (DeLang et al. 2021), the dominant side with the non-dominant side is more attacked in relation to the presentation of the incidence of injuries.

The lower extremities are the areas with the highest incidence of injury in elite-level female players, with injuries to the knee, ankle, and hip (UEFA 2022). In young football players of both sexes, there is a high incidence of injuries (Zech et al. 2022).

While, in recent years associated risk factors have received widespread scientific attention in northern European countries, no respective data are available from the Kosovarian Women's Football Super League.

To complicate things further, a consensus concerning the general rehabilitation process and protocols is still missing to date ("Elite Ligue – Female 2022/23 – Football Federation of Kosovo" 2023) ("Elite Ligue – Female 2022/23 – Football Federation of Kosovo" 2023). In line with what was mentioned above, it is imperative to conduct an encompassing empirical cohort longitudinal study.

They will shed light on the occurrence of injuries in female elite football players, as well as the underlying factors of such injuries. Additionally, the study will also identify risk factors that significantly contribute to the injury incidence, the most prominent types and forms of such injuries, and the influence of other covariates such as age on the specifics of female biological gender within under-investigated settings, population from a developing country like Kosovo.

It should be noted that in elite women's football, the prevalence of lower extremity injuries (LEI) has become a growing concern for players, coaches, and sports medicine professionals (Ling et al. 2023; Faude et al. 2005).

Understanding the injury patterns, incidence rates, and risk factors associated with LEI is essential for developing further effective injury prevention strategies and enhancing player welfare in this physically demanding sport.

While several studies have examined LEI in football, limited research has focused specifically on elite women's football players (Agustín et al. 2021; Nilstad et al. 2014; Xiao et al. 2021). Some studies even emphasise that female athletes suffer a higher prevalence of specific types of LEI (Such as knee ligament injuries and severe ankle injuries) and are even reported to have considerably higher absences in training sessions due to such injuries. This difference in absence rate can be as high as 21% in some populations (Larruskain et al. 2018).

Due to this reason, developing a better understanding of the patterns and risk factors of LEI in women players is crucial for formulating targeted interventions to reduce the risk of LEI and their outcomes in women players.

In the limited number of studies that have explored this research domain, it has been observed that the incidence risk of LEI in women football players also depends on some regional, settings or population-specific factors, such as training pattern and load (Larruskain et al. 2022; Harøy et al. 2019; Dalen-Lorentsen et al. 2022).

However, there is a considerable lack of dedicated research aiming to identify and analyse these factors in developing countries, such as Kosovo, which hinders the possibility of developing interventions optimised for reducing the risk and impacts of LEI in elite women football players in these countries.

Addressing this research gap is critical to understanding the unique injury patterns and risk factors affecting this population, especially in Kosovo. From the perspective of Kosovo, the lack of scientific data on this matter complicates the situation even further. Identifying research gaps such as the occurrence of injuries in female elite football players, risk factors that significantly contribute to the injury incidence and the most prominent types, and forms of such injuries.

The PRRS questionnaire is a useful tool for improving athlete care and optimizing performance outcomes, even outside of research and clinical contexts. Through the methodical evaluation of players' psychological preparedness for a return to competition, coaches and sports psychologists can customize training plans and interventions to target particular psychological obstacles and promote a more seamless return to the game.

Additionally, the PRIA-RS questionnaire is essential to the measures used by regulatory bodies and sports groups to prevent injuries. Proactive steps can be taken to reduce the likelihood of psychological obstacles preventing athletes from returning to play and to support the long-term well-being of athletes by identifying these athletes.

The PRIA-RS questionnaire has gained popularity as a standard tool for evaluating psychological preparation in athletes across many sports and levels of competition, in light of the growing acknowledgment of the significance of mental health in sports (Brewer et al. 2000). Its extensive use in modern sports medicine practice highlights its applicability and significance.

The PRIA-RS questionnaire continues to be at the forefront of research and practice as our understanding of the psychological components of athlete rehabilitation develops. The efficiency of the questionnaire in promoting athletes' physical and emotional well-being during the recovery process will be further improved by ongoing validation and improvement.

To sum up, the PRIA-RS questionnaire is a vital tool in the field of sports medicine that provides a wealth of information about an athlete's psychological preparedness to resume play following an injury. Its methodical approach to evaluating psychological variables supports both the optimization of athletic performance and holistic care in addition to providing clinical decision-making (Brewer et al. 2000).

This research aims to understand the patterns of different types of LEI in elite women's football players in Kosovo. As such, both the incidence and risk factors of such injuries in the given population are to be studied in this research project. Moreover, the study also aims to develop a predictive model that can accurately predict the risk and severity of LEI in elite women football players in Kosovo.

2 RESEARCH PROPOSALS

2.1 Injury Patterns and Incidence

Any physical part of the players that results in removal from the game or training is defined as an injury, while a repeated injury is considered a new injury according to ("F-MARC Football Medicine Manual 2 Nd Edition" 2009). Injury can be defined as any situation that results in a player being eliminated from a sports game, missing a game, or being unfit to reach the medical shelter (Ardern et al. 2011).

Another definition of injury is receiving wounds or bruises during training sessions or competition and resulting in preventing the affected player from taking part in routine training classes or competitive sessions for more than 2 days, excluding the day of the injury (Bittencourt et al. 2016).

Several studies further elaborated injuries into subdivisions but with a variety of classifications. To avoid confusion, injury subdivisions are defined by using the injury rate and injury percentages (Ardern et al. 2011). Injury frequency is characterised by the count of concussions present in 1000 hours of active performance of performer time, or the count figure of injuries present in 1000 players' exposures (Danielsson et al. 2020).

Athlete-exposure or player-exposure is concluded as one player contributing to one competitive game or one training class where he/she is revealed to the chances of being injured, irrespective of time entangled (Shea et al. 2017). For instance, two competitive sessions having 40 athletes as participants and three training classes consisting of 50 athletes as contributors would conclude among a gross of 230 players display (Bahr and Krosshaug 2005).

As the majority of the population thinks that the injury rate is different for both, competition sessions and during training. Researchers found it to be true as injury rates observed for competition sessions were generally higher than injury rates calculated during training (Lockwood et al. 2015).

The underlying reason may involve the fact that the greater the velocity of play, the higher the rate of accidents. Due to increases in speed and intensity, athletes are inclined to have higher chances of body contact, like gripping and sliding, resulting in more injuries (Dellal et al. 2011). Injury mechanisms are classified according to the variety of injuries. Among these mechanisms, the most frequently observed injury mechanisms were shooting, turning, and twisting, landing, tackling, jumping, and running, and being tackled (Drevon et al. 2017). Tackling is generally observed in football games when athletes intend to get control over the ball.

The lower proximity of the body are commonly injured because athletes are unable to respond quickly and avoid these fast, sudden movements during tackling. The prominent reasons behind injuries associated with turning, running, and twisting, are poor playing surfaces and unsuitable footwear (Falah et al. 2010).

Uneven playing grounds increase the loading force on muscles and ligaments present in the lower extremities. As external pressure increases from the bearable capacity of ligaments and muscles, it results in injury.

Inappropriate footwear may lead to slipping due to a lack of sufficient frictional force (Fuller et al. 2006). On the contrary, extra frictional force results in large torque during movements of twisting and turning, which causes injury. Moreover, athletes playing as defenders occasionally utilise different techniques to stop opponents from accomplishing goals; therefore, serious injury incidences generally occur in the duration of shooting (Hägglund et al. 2005).

Additionally, injuries are also often observed during bouncing and landing, concluded as integral parts of movements such as goalkeeping, heading and shooting. Reasons for these injuries include inaccurate landing styles and smash hitting between players when they initiate and complete the landing movements (Hawkins et al. 2001).

Previous research studies have suggested that reduced body exposure is a basic procedure of injury (Schmidt-Olsen et al. 1985). In support of these findings, researchers reported that reduced body contact (59%) injuries have a greater prevalent rate as compared to body contact (41%) injuries.

Moreover, turning, shooting, running, and jumping account for 39% of all concussions, which were labelled as body-free contact injuries (Kucera 2005). Certain researchers observed adult athletes under 18 years old and documented that running led to 27% of all injuries, which are known as non-body contact injuries (Rahnama et al. 2002). The figure for body contact-free concussions in professional football players was observed to be 58% as compared to body contact injuries which included 38%.

Mostly, hitting (4%), rushing (19%), slipping (4%), and twirling and diverging (8%) comprise among commonly experienced injury mechanisms, which are classified as non-contact injuries(Weightman and Browne 1975). Injuries in the lower extremities are classified into several types like fractures, strain, sprain, contusion, tendinitis, and bursitis (Sullivan et al. 1980).

However, the severeness of the concussions is determined according to the missing days of play due to injury (Nielsen and Yde 1989). Whereas several other classification systems can also be used to identify the severity of injury. For instance, Schmidt Olsen et al determined severity according to various treatments used: general emergency medicine was labelled as acute, medical vigilance as medium, and health center medication as prominent one (Schmidt-Olsen et al. 1985).

Identifying risk factors towards injury outbreaks is a key approach to planning effective prevention strategies (Mechelen et al. 1992; Meeuwisse et al. 2007; Finch 2006; Bahr 2003; Bahr and Krosshaug 2005). To create focused injury prevention methods and maximise player welfare, it is essential to comprehend the specific injury patterns and incidence rates among elite women's football players in Kosovo.

2.2 Predictive Risk Factors

Effective injury prevention strategies must consider the risk variables that predispose athletes to LEI. Age-related factors, previous injury history, training load, muscle imbalances, and playing surface have all been associated with an increased risk of injury in football players (Harøy et al. 2019; Larruskain et al. 2022; Dalen-Lorentsen et al. 2022).

Recognizing possible risk factors and interaction between different injury risk factors involves complex analysis, so, for this purpose, a multivariate model can also be applied (Hawkins and Fuller 1998). Previous studies have mentioned the relationship between injury and age as a main risk factor, and the application of multivariate tests confirmed that although there were a few limitations, both factors affect injury occurrence.

Preceding injury is related to increased age, but several studies also showed it as an independent predictive risk factor for injury. Several researchers have reported variant findings on age as a risk factor including the observations that some older players show higher susceptibility for injury as compared to others (Lewis 2023). Previous studies mentioning injuries of football players have documented different antecedent injuries having a high rate of recurrence (Isla et al. 2021).

Such injuries involve hamstring strains, ankle sprains, as well as groin and ankle sprains. Whereas an earlier sprain or strain was also found to be a strapping predictor for a new injury (Kucera 2005a). In addition, injuries related to hamstring strain or adductor may be a consequence of variations in the bone structure or scar formation occurring at the associated muscle or tendon. Other possible causes involve improper rehabilitation along with early joining of a competitive football game session after the previous strain (Hawkins 2001).

In the case of ligament sprains, previous studies suggest that neuromuscular performance of the ankle joint is affected in athletes who have continuous instability objections after injury (Hägglund et al. 2009).

Moreover, this instability is also observed in the immediate recovery period following an acute injury, but not a complicated situation as it can be restored by board training programmes (Fuller et al. 2006). Other studies have documented a common finding of mechanical instability in ankles after ongoing sprain injuries, most prominently, ankle sprains that occur frequently in athletes showing mechanical instability (Falah et al. 2010). Interestingly, several previous research mentioned, reduced Range of mobility, as a

significant predictive risk parameter for groin strains, since no evidence to be involved in hamstrings (Dellal et al. 2011).
Regrettably, the correlation between hamstrings and quadricep strength ratio along with adductor strength is still not reported. Ekstrand and Gillquist stated that professional athletes with a reduced radius of motion in the hip hinge were more susceptible to adductor muscle damage or at higher risk of adductor muscle ruptures or tendinopathy. Recent studies proved an established relationship between football players and flexibility of hip abduction, knee flexion, and hip extension (Ardern et al. 2013).

The possible determinants of this relationship can be the attributes of football sports as it requires high intensity, sudden movements like rapid turning, short sprints, and increasing or slowing the pattern of speed. These activities require the demand of strong muscles that can facilitate muscle tightness. Moreover, inappropriate flexibility training in football sessions further strengthens the relative risk factors (Söderman et al. 2001).

Player exposure has been considered a predictive risk factor for football injuries, but relatively few studies are available supporting this component (Tysvaer 1992). Researchers found that players having different training exposures incurred different injury rates during football sports (Inklaar 1994). For this purpose, players can be categorised into high and low-exposure groups along with immediate groups. Another contributing factor for such predictive risk factors involves the better health condition of players, as these individuals get more time to play and are encouraged by the coaches (Olsen 2004).

In this situation, it is assumed that the athletes acquire better-playing qualities—tricks, awareness, and anticipation that can provide a better methodology to avoid injuries (Engström and Renström 1998). Some investigators suggested research techniques to identify predictive factors that propose injury occurrence in football players without mentioning injury incidence (Inklaar 1994).

Identifying group variance in retrospective case-control research is one of the techniques that has been used to recognise predictive injury risk factors in the absence of prospective injury incidence (Tucker 1997). Retrospective Injury-prediction studies by consulting case-control research designs facilitate to notice of differences between two groups of individuals involving the injured and uninjured ones (Keller et al. 1987).

Such identified group dissimilarities are used by the researchers to draw inferences about injury risk. These retrospective studies are quite simple and less demanding which can be advantageous, but the inferences about the predictive risk factors are potentially inaccurate and laborious to make (Murphy 2003).

The possible reason behind this setback can be the poor assessment of group differences before the injury incidences (Pritchett 1981). It is not necessary that the dissimilarities existed before the injuries but can also be a response to the injuries (Nielsen and Yde 1989). Irrespective of these limitations, significant information can be collected from these

retrospective studies and final findings help to identify possible injury risk factors that authorize prospective considerations (Sullivan et al. 1980).
Additionally, a process for the identification of predictive risk factors involves finding out factors that predict others, preceding recognized risk factors responsible for injury occurrence (Weightman and Browne 1975). Prediction of possible injury risk factors possibly deals with those risk factors as substitutes responsible for injury, facilitating clinicians to consider the fact that by anticipating risk factors for injury, they can also be able to successfully predict injury (Rahnama et al. 2002).

However, this mechanism is disquieting as it instigates additional faults into the procedure of injury-risk–identification that may affect accuracy and correctness and enhance the chances of uncertainty relevant to predictive injury-risk estimate (Yde and Nielsen 1990). Such reduction in accuracy and elevated uncertainty of a prediction would be manifested in broad confidence intervals. Muscular imbalance is related to unilateral dynamic imbalance, described as an individual's capability to maintain mass center within the body during activities like single leg movements (Schmidt-Olsen et al. 1985).

Hence, unilateral dynamic balance is considered a fundamental capability of an individual to play explosive sports like football, within safe and accurate limits, on a single leg (Drevon et al. 2017). Recent research has reported that unilateral dynamic balance influences football performance as athletes require repetitive unilateral movements including rapid alterations in direction, running, kicking, jumping, landing, and sudden acceleration and acceleration activities (Lockwood et al. 2015).

One-sided dynamic equilibrium comprises a composite capacity consisting of collaboration and correlation among visual, labyrinthine sense, and somatic sense connection and therefore, might be affected, by various parameters of muscular activities including groin and ankle firmness, core stability and bottom extremities joint-related range of motion [ROM] (Inklaar and Krosshaug 2005).

Eventually, according to the applicability of the Y-Balance trial (considered an estimate of one-side dynamic equilibrium) in case of sports activities and injury recovery, it looks mandatory to recognize what parameters of muscular activity participate in Y-Balance performance to plan focused training interventions.(Shea et al. 2017).

Some research literature has discovered the independent participation of some specific altering parameters of neuromuscular activities on Y-Balance trials in football players, focusing on knee and groin firmness, core strength, leaping capability, and ankle dorsiflexion along with hip flexion ROMs (Danielsson et al. 2020). Several research findings explained similar facts for participants in professional sports like football (Bittencourt et al. 2016).

However, these findings can be extrapolated to other sports but with some limitations. Each sport practices different modalities and competition spirit acquiring various technical skills, training load, specific movements, and physical capacities, which are responsible for the athlete's exposure to independent chronic muscular modifications, thus probably designing several methods according to neuromuscular management along with affecting consequential Y-Balance test scores (Bradley and Ade 2018).

Successively, elite athletes playing football exhibit enhanced unilateral diverse balance capacity as compared to their other colleagues (Webster and Hewett 2018). However, this study was limited to the disproportionation of male players as compared to female participants. Although core stability is considered a mandatory factor for sports like football, recent studies focused on the professional linkage between core strength and female football players performance (Donaldson et al. 2015).

Research studies showed that limitations in core strength, particularly in the front area, possibly result in unconfined displacements of the superior trunk during activities involving single-leg activities, shifting the focal point of mass of the body in the opposite direction from the reinforcing foot, which influences diverse firmness of lower extremity (Hägglund et al. 2009).

Other parameters responsible for maintaining core strength include isokinetic strengthening of the knee glutes and extensors, hip adductors isometric stability and Range of Motion of the groin and knee joints (Mandelbaum et al. 2005). Other than pronounced anatomical differences, female athletes get fewer playing chances and fewer training opportunities than male participants (Bizzini and Dvorak 2015). As football demands highly complex and intensive tasks, highly trained players might encounter a reduced rate of possible risk factors related to coordination and muscular control over the upper body and lower extremity joints (Toohey et al. 2017).

Female football players' performance may be influenced by isolated muscle strength, and core strength and lead to the possible prediction of injury incidences in dynamic tasks.
Football is a rapid-operating game performed on comparatively big playgrounds and demands higher standards for health as well as mechanical, strategic, and mental capabilities (Taylor 2020).

Participants require increased thresholds for expertise and physiological strength in case they become part of a competitive extent. Ideally, training each player in all skills- physical and technical- among playing surroundings involves a complex competition and asks for greater considerations for execution and comprehension by team-leading persons (Chang et al. 2020).

As football is a physiologically challenging play, it pressurises the three energy mechanisms. It has been reported that football is trending to be a faster game due to enhanced playground surfaces, modern training and playing techniques, elevated quantity of reciprocating athletes and non-theoretical schemes (Broglio et al. 2019). The value of players showing high expertise and fitness levels has influenced football clubs to implement challenging training loads approaching elite levels. In the past era, one training class per day was declared to be adequate, whereas, in present times, athletes follow a training session twice a day (Yue et al. 2020).

Expert coaches are facing increased pressure to gain success therefore the limitations are frequently being passed through trials concerning what the athletes can accomplish and what their body structure can resist. Training for success has become a mandatory balance between gaining peak functioning and neglecting the side effects of overtraining (Yue et al. 2020).

Training frequency below what is required to achieve desired optimal results may lead to a position usually known as the 'overtraining syndrome,' 'staleness' or 'burnout' (Yue et al. 2020). Training techniques for collision sports, most prominently football, manifest a balance between two points- the least training load essential to obtain an enhancement in fitness condition and the maximum training load bearable before maintaining marked elevation in injury rates (Akhand et al. 2019).

It depends on the technique of coaching to match the appropriate levels of training without crossing a player's exercise-bearing strength and rehabilitation capacity (Harmon et al. 2019). Additionally, the rehabilitation procedure is also crucially important due to increased demand for the nature of training, performance, and games. Moreover, maintaining an appropriate level between training classes, competition sessions and rehabilitation is necessary to maximise the performance of participating athletes (Isla et al. 2021).

The unavailability of optimum rehabilitation time may affect athletes to follow training sessions required to acquire intensity or accomplish the demanded load for sports, therefore increasing the susceptibility of the participants to concussions (Isla et al. 2021).

Therefore, it is essential to observe the practicing sessions of football athletes to confirm the accurate training loads to be applied and manage both the training load and rehabilitation chances so that positive practicing techniques are provided. So, utilization of these techniques permits minimising the gloomy aspects related to practise and optimum physical health and practice levels that facilitate athletes to contribute at best performance levels.

Several techniques are introduced to examine training load in group sports that include the monitoring of heart beats per minute (Coutts et al. 2009; Esposito et al. 2004; Hoff 2002; Impellizzeri et al. 2004; Impellizzeri et al. 2005; Stagno et al. 2007; Tessitore et al. 2006).

Several techniques applied for the examination of practise sessions include the utilisation of a rating of perceived exertion (RPE) scale. This method involves the approach where subjects are demanded to report the difficulties faced between training once the training session is at the end. A further technique of observing training consists of calculating the training burden (RPE of session × session time), repeatedly reported in previously performed

studies (Foster et al. 2001; Kelly and Coutts 2007; Putlur et al. 2004; Coutts et al. 2009; Anderson et al. 2003).
Results are concluded to examine training load in different playing games and expose the correlation present among illness, training load, and concussions. (Gabbett 2004; Putlur et al. 2004; Anderson et al. 2003).

Noticed training load and the injury occurrence along with disorders in competitive games consisting of women's NCAA Division III Basketball teams and concluded the presence of elevation in injury incidences as training load elevated, whereas no relationship was noticed among training loads and illness (Gabbett 2004; Anderson et al. 2003), stated that in rugby sessions, as the severity, load and time span of the training classes and sports increased, injury incidence also elevated. (Putlur et al. 2004) examined that 53-64% of the illness incidents took place in university-level football performers and related to a continuing spike in elevated training load, strain, and monotony.

The eventual goal of the training session is to develop stamina in athletes for best performance in crucial competitive games (Suzuki et al. 2006). Since the capability of examining training sessions is important for initiating quantifiable training periodicity management (Foster et al. 2001).

Accurate and effective assessment of training sessions allows athletes to achieve the desired training goals and be ready for severe competitive games, whereas reduces possible risks of injury and injury incidences. Injury can happen when physical needs get neglected towards the body's ability to pass through a complete recovery session after training classes and competitive games (Anderson et al. 2003).

Head guides along with coaches and players support the benefits of appropriate training load observations (Coutts et al. 2009). Training Load and Injury associated studies have examined training load and discovered the correlation between incidents and concussions in several playing games (Gabbett 2004; Putlur et al. 2004; Anderson et al. 2003).

Several researchers reported that there was a rise in injury incidence when the training load was enhanced. One of the limitations related to such studies includes low sample size which affected the analytical capacity of the research.

The greater rate of injury occurrence was reported mostly between week three and week twelve of training sessions which correlated with the duration when there was an increased training load. Generally, the initial fourteen days of a season are mostly the most tough and physically challenging duration of the season (Anderson et al. 2003).

Other similar studies also exhibited the absence of any relationship between training loads and illness (Gabbett 2004), noticed the correlation present among frequency, intensity, and load of training in sports games and the concussion incidences in expert rugby athletes.

Further studies showed the increased occurrence of injury incidents (205.6 per 1000 practice session hours) noticed during pre-season termination when the training burden was at its peak. These findings stated that greater training injuries happen during the first session of the game session in comparison to the other half (69.2% vs 30.8%) (Gabbett 2004), stated that there is a correlation between the incidence of training injuries and the severity, frequency, and training load even though the periodized training sessions were then implemented according to game specifications.

Another recent observation presented by researchers explained the correlation among training load, fitness, and injury in elite football sports players. One of the prominent results related to referenced observations concluded that as training load rises, especially before the season starts, a higher risk of injury incidence is present in contact sport participants.

These findings were expanded by reporting that the increased occurrence of overuse, bottom-extremities concussions, and overexertion, before starting training sessions require guidance to the facts that in such sports like contact sport players, elevation in concussion occurrence chances during the practice period before seasons are nearly resembling elevation in training load.

During the era of 1992, the football leagues applied an injury survey application for elite football players known as the AFL Injury Survey. Findings extracted in recent times recommend that concussion incidence at the elite rank is found to be historically less (Taylor 2020).

Every year the Australian Football League notes the findings of a current surveillance document that observes the occurrence of damages in different football groups and tries to recognise any 12 growing trends with reference to injury.

An Injury Report: stated that for that special season, there was less injury rate when compared to the prolonged rate of groin injuries, hamstring damages, knee injuries, anterior cruciate ligament damages, and persistently the most commonly observed injuries. Hamstring strains have been noted to be among the most prevalent injuries in each year of the surveillance report, maintaining records of approximately six of these concussions happening in each club every season.

Furthermore, recent research admitted the better planning and concussion protection movements at club-level sports are appropriate, conclusively affecting the comparatively lower rates of concussions occurring collectively. Such knowledge is precise and deep with reference to injury phases and incidents.

Expert Physiological therapists along with firming and guiding coaches can observe the status of their teams in comparison to the whole occurrence and methods followed for concussions in the AFL. Moreover, the discussed document does not present the correlation between training loads and the rate of concussion incidence or ailments. Artificial ground surfaces prove to be cost-bearing, all-season substitutes to natural grass grounds and are used nowadays for several sports and performances (Smith et al. 2012).

The differing physical parameters of these ground surfaces are reported to have an impact on not merely the speed and pattern of sports but also the monitored injury styles accordingly (Fortington and Finch 2016). Acrylic and clay surfaces were initially used for sports like tennis in the 1940s and 1950s, respectively, and even now trend to be used as a substitute for grass surfaces (López-Valenciano et al. 2020).

An alternative to traditional wooden floors used for sports like basketball and volleyball are referred to as artificial flooring. Almost the most important revolution took place in the 1960s when synthetic turf grounds were first utilised as a substitute for natural grass grounds. Synthetic turf areas have managed to develop over the previous 50 years in a strive to imitate the training parameters of native grass. At present, synthetic tuft has three categories, which are extensively explained by their physical parameters (Eime et al. 2013).

The first category of synthetic turf was discovered in the late 1960s and identified by small pile distance lengthwise, reduced padding and increased coefficients related to friction. Such surfaces were majorly utilized for football and continued to be used as primary synthetic field surfaces till the era of 1980s when another generation, the second-generation ground was discovered, identified as more cushioning with long pile distance lengthwise, sand or rubber filling and elevated padding (Martínez-Lagunas et al. 2014).

Third-generation grounds manifested in the late 1990s and showed improved characteristics related to padding, pile distance lengthwise and filling parameters to serve enhanced cushioning and reduced friction (Annett 1999).

The advancements in alternative playing grounds for field sports, conventionally played on natural grass, have increased the risk related to safety questions. Several peer-reviewed studies presented different surface types and correlations between injury incidences that are sport-specific (Caine et al. 2008).

2.3 Court Surfaces

Games requiring competitive spirit on playing grounds are also exposed to variable grounds. The impact of synthetic courts on injury rates has been noticed by several studies. One such sport involves grass tennis, discovered in the late 19th century, which was initially organised on natural grass(Junge et al. 2006).

Typical surfaces are made up of seeding turf built on a layer of soil. A 2007 research of partial games in Grand Slam professional tennis matches (1978 -2005) lack statistically prominent outcomes, although fragmented plays figures produce three patterns concerning athlete-ground correlation as follows: some impartial games on grass grounds; elevated rates of partial game sessions on Australian hard grounds as compared to other grounds for women players; and an elevated rate of partial sport games on US hard surfaces for gents (McGuine 2006).

Clay courts are famous for utilisation in sports in the 1950s. This clay layer is composed of coverings of suppressed marble covered with ground, gritty clay. The sandy composition of clay grounds generates an increased frictional coefficient when in contact with the ball and minimal frictional resistance when in contact with the athletes (Hawkins and Fuller 1998).

Decreased rates of knee disorders have been examined in senior athletes who played for years and spent their major career years on clay. A study monitoring injury rates in expert male players for a time span of 3 years on clay surfaces, hard grounds, grass surfaces and carpet layers revealed injury management during game sessions of playing was demanded mostly for grass layers, and prominently more abundantly on hard surfaces as compared to clay, considering that the risk of injury is greater on grass and hard ground surfaces than clay (Kucera 2005).

Acrylic or Polyurethane-Acrylic surfaces were discovered in the 1940s to be used for different sports surfaces. These surfaces are composed of an undercover asphalt or concrete support commonly coated with rubber that enhances the capability of elevated shock absorption (Falah et al. 2010).

Acrylic surfaces are both the toughest grounds and the courts with the greater player-ground friction coefficient. A present study of contact sports players revealed that the demand for injury treatment is more likely greater on tough surfaces as compared to clay, describing the increased chances of injury as greater on tough grounds in comparison to clay (Tysvaer 1992). There is an increased rate of matches that ended improperly on Australian and US hard surfaces as compared to other grounds for women and men players, respectively.

2.4 Sport-Specific Surface Comparisons

Along with the surface-specific contradictions, comparable sport-specific injury rates related to surface types have also been reported. The majority of the studies on American football evaluated synthetic field grounds with football data, and the maximum findings of these studies examined the first- and second-generation synthetic surfaces.

Notably, increased rates of injury incidences in football have been documented during comparisons of artificial and natural playing grounds. One of the studies related to high school football athletes found an injury rate that was 1.6 times greater throughout, above an undefined synthetic turf ground during a comparison with natural grass (Engström and Renström 1998).

Lower extremity concussions in football matches are noticed at double the rates as compared to synthetic surfaces, consisting of greater chances of knee strains along with greater chances of ankle sprains when playing on synthetic turf (Tucker 1997).

Scranton et al. also documented the overall Anterior cruciate ligament injury ratio (a combination of training and sports display) in each team on artificial surfaces to be compared with natural grass. These research findings are different from a class of conclusions discovered by Scranton et al., which showed ACL injuries during non-contact sports that were five times greater on grass.

Another separate study evaluated curved and bowel stadiums that showed that the injury risks for bowel synthetic turf stadiums were lesser as compared to domed artificial stadiums, representing a statistically significant decrease in the risk of injury of Anterior Cruciate Ligaments in open synthetic turf stadiums (Keller et al. 1987).

Several studies reviewed the injury incidence frequency of a professional football team (1968 to 1985) and observed dissimilarities in occurrence rate based on the severeness of injury (Murphy 2003). However, these differences between synthetic and natural grass surfaces for injuries were not statistically significant. Other remaining football research revealed greater injury rates on artificial grounds when compared with other grounds like natural grass surfaces (Pritchett 1981).

Turf-coated surfaces mentioned a yield of 35% injury rate before the playing season when compared with a 13% injury rate in the turf conditioning group for pre-season injuries. It has also been concluded that among 10% of injuries that occur due to contact with the playing surface, higher-grade injuries were related to contact with artificial surfaces as compared to natural grass surfaces (Sullivan et al. 1980).

Conjointly, these research studies fail to support a consensus point on the impact of synthetic playing grounds on football injury rates (Rahnama et al. 2002). Whereas most studies illustrate greater injury rates related to synthetic turf surfaces in comparison to natural grass (Schmidt-Olsen et al. 1985).

Prediction of Injury rates is not only dependent on the game surface and can be affected by shoe style, synthetic surface brand, materialistic and environmental parameters (Lockwood et al. 2015).

The conflicting results recorded in several studies identified the varying phases of ground-associated injuries and boosted the requirements for greater extensive research on the impact of synthetic gaming grounds on football concussion incidence rates (Danielsson et al. 2020).

As part of our PhD dissertation, our 1-year cohort study will assess how these risk factors interact and affect the frequency of LEI among top women's football players in Kosovo.

2.5 Biological gender differences in football

According to research evidence, various authors have shown that the level of performance between the two biological genders varies due to various factors (muscle architecture, strength, and body composition) (Garnica-Caparrós and Memmert 2021; Bartolomei et al. 2021).

Furthermore, many other studies have also reported that several factors can contribute to the risk of increasing the occurrence of injuries, including heavy loads and fatigue from high-intensity work (Bowen et al. 2020; Bengtsson et al. 2013; Bacon and Mauger 2017; Windt and Gabbett 2017; Roos et al. 2017; Rahnama and Reilly 2002; Pfirrmann et al. 2016; Li et al. 2020; Inklaar et al. 1996; Hulin et al. 2014; Griffin et al. 2020; Ehrmann et al. 2016; O et al. 2017).

These biological differences are particularly useful for better understanding the differences in sports performance-related capabilities between the two genders (Shalaj et al. 2016; Andersen 2004; Dingenen and Gokeler 2017; Fernandez et al. 2007; Bradley et al. 2014; Curtis et al. 2021; Sokolove 2009; Inklaar 1994; Caine et al. 2008; “F-MARC Football Medicine Manual 2nd Edition” 2009; Junge and Dvorak 2000).

Engagement in physical activity proposes many long-lasting physical and mental advantages for all genders. However, all physical activities offer several risks of injuries that can be gender specific in some cases and require to be managed to enhance the advantages of athletic participation (Bittencourt et al. 2016).

Evaluation of multiple years of studies of incidence records associated with contact sports indicates that female athletes may be more susceptible to injuries than their male counterparts (Lewis 2023).

Incidence records were perceivable in sports having similar equipment and rules like football as well as ice hockey. Another portion of research studies recognized that the mechanism of football injury may also differ by gender (Webster and Hewett 2018).
Distinctively, to date, only a few research fragments predict possible descriptions for gender differences in predicting sports injury (Donaldson et al. 2015). The majority of relevant information has concentrated on nonprofessional individuals including accident sufferers and rodents (Mandelbaum et al. 2005).

However, different approaches such as biomechanical composition and hormonal evidence can describe the mechanism of gender difference (Bizzini and Dvorak 2015). Another possible condition is more culturally dependent, as the honesty and sensitivity related to reporting actual incidents of football injury may be gender-influenced (Smith et al. 2012).
Arguments of gender-specific factors for the prediction of football injuries are referred to as biological differences (Fortington and Finch 2016).

Gender dissimilarities relate to details including hormonal composition, anatomy, or chromosome gene manifestation. Gender is analogous to societal attitudes and cultural components (Eime et al. 2013). In point of fact, it is not possible to distinguish the influence of gender on sports injuries due to inter twisting. So, gender-dependent intrinsic and extrinsic predictive factors for football traumas include the influence of hormones, anatomy, biomechanics, neuromuscular functions, and societal dissimilarities in sports participation (Annett 1999).

Recent studies have investigated the significant rise in female athletes' contribution in the United States, involving the introduction of new Title IX legislation (Caine et al. 2009). For reference, this federal legislation amendment in the United States (1972) demanded equal opportunities for women and men in several progressive educational programs, focusing on sports (Junge et al. 2006).

Due to the increased involvement rate of female athletes in sports, injuries formerly observed in male athletes started to be more prevalent in opposite-gender athletes (Falah et al. 2010).

Damages to the knee, anterior cruciate ligaments, ankle, and head are the major commonly observed injuries in activities like football, but the condition becomes different if we focus on predictive factors that are dominantly gender dependent.

Minor research factors consider females in comparison to men as the former possess certain gender-dependent variables that should be looked at. For instance, women go through a monthly cycle and hormonal release shows fluctuation between two main phases- the follicular and luteal accompanied by ovulation (Ardern et al. 2011).

Oral contraception administration can also influence hormonal production. Additionally, body health and mental fitness matters are an area of concern for all individuals including both gender athletes. However, they can be found more prevalent in females, due to society’s pressure of being perfect. Women, on the other hand, are also making efforts to maintain a body status that is classic for sports performance. Eventually, food recommendations are not similar for males and females along with sports postures within the sport (Söderman et al. 2001)

The awareness of the mind health of Elite Athletes in Contact sports has escalated over the passing years. The majority of prominent nations, including France, have authorised, under law, that mental assessments and identification surveys be performed on elite players.

The chances of mind fitness identification, including psychic issues, may show equal chances when the comparison is drawn among professional athletes and other common populations, but research findings are still somehow constrained regarding this topic. According to previous study reports, elite athletes represented a 4%-60% prevalence rate of depressive symptoms.

A recent systematic literature review strengthening the current discussion of the elevated chance of mind fitness indications in elite performers, as per the common individuals, reported that the incidences of mental health disorders are 34% in elite participants, whereas in common individuals, it is almost 20%. Elite Athletes may also prefer to ignore the condition and not ask for help while facing mental health issues assuming that it is a symptom of weakness. However, sports such as football, which demand equilibrium or body balance in a person, may show an elevated occurrence rate of mental disorder detection.

The possible risk factors may involve expectations of spectators, coaches, media, society, and parents that play an important part in triggering mental health disorders because stress is enhanced on players to appear or contribute with specific high goals. A physical shape that is possibly perfect according to a specific sport, has the chance of not being ideal according to society.

This can result in an inferiority complex and associated brain disorders. Also, different predictive factors related to anxiety indications in elite players involve parents' history, less financial help, associated relations and other environmental parameters, trauma, unsuccessful career, and stop to play sports. A higher risk of injury incidences leads to a decline in athlete performance (Drevon et al. 2017).

Moreover, research planned by Gulliver et al. included 224 elite athletes who participated in a study related to mind fitness. A series of parameters were analysed such as common psychological disturbance, social anxiety, depression symptoms, panic disorder indications, anxiety indications, social fear, eating disorder signs, and help-searching attitude.

The majority of the participants played football and showed symptoms of mental health issues. However, further studies on the association between mental health and possible risk factors leading to injury incidences may be consulted (Taylor 2020).

3 EMPIRICAL PART

3.1 Purpose and objectives of the research

The purpose of this research thesis is to monitor and analyse the types of injuries that occurred in female football players during one season. The aims of the present 1-year long cohort study are twofold.

The documentation of injury occurrences during an entire season will allow us to identify intrinsic risk factors and calculate the injury incidence rate (IR) per 1000 hours of exposure together with the related 95% confidence intervals (CIs). Based on the topic proposed for the research, some specific goals have been set, which the primary objectives of this research are as follows:

- Analysis of injury patterns and incidence rates of LEI in all elite female soccer players in Kosovo during one season.

- Identification and assessment of predictive risk factors associated with LEI in this specific population.

- To provide valuable insights into injury prevention strategies tailored to the needs of elite women's football players in Kosovo.

3.2 Research hypotheses, research questions

3.2.1 Research Hypotheses

To address and understand better the set research questions related to the doctoral thesis, the following hypotheses are:

H1: Elite women's football players in Kosovo are more likely to experience LEI compared to injuries in other body regions (Injury Patterns).

H2: The incidence rate of LEI in elite women's football players in Kosovo is higher during competitive seasons compared to non-competitive periods (Injury Incidence).

H3: Several risk factors, including previous injury history, training load, playing surface, muscular imbalances, and age, will be associated with an increased likelihood of sustaining LEI in elite women's football players in Kosovo (Predictive Risk Factors).

H4: Players with imbalances in strength and flexibility between muscle groups in the lower extremities will have a higher risk of LEI compared to those without imbalances (Muscular Imbalances).

H5: Higher training loads, characterized by frequent intense training sessions and matches, will be positively correlated with the incidence of LEI in elite women's football players in Kosovo (Training Load).

H6: Playing on artificial turf and wearing improper or worn-out footwear will be associated with an increased risk of LEI in elite women's football players in Kosovo (Playing Surface).

H7: According to group division younger players and those with a history of LEI will be more susceptible to sustaining such injuries during the course of the competitive season (Age and Previous Injury History).

3.2.2 Research questions

The main research question is:

What are the injury patterns, incidence rates, and predictive risk factors associated with LEI in elite women's football players in Kosovo?

The other research questions are:

- What are the most common types of LEI observed in elite women's football players in Kosovo, and how do their incidences vary across different playing positions?

- Do elite women's football players in Kosovo experience a higher incidence of LEI during competitive seasons compared to non-competitive periods, and if so, what are the potential contributing factors?

- To what extent do muscular imbalances in the lower extremities contribute to the incidence of LEI in elite women's football players in Kosovo?

- What is the relationship between the intensity and volume of training load and the occurrence of LEI in elite women's football players in Kosovo?

- Are there any significant differences in injury patterns and risk factors between elite women's football players in Kosovo who play on natural grass versus those who play on artificial turf?

- What role do psychological factors play in the occurrence of LEI among elite women's football players in Kosovo?

3.3 Research methodology

3.3.1 Data collection methods and techniques

Our recognized group has included all female football players from the Women's Football League of Kosovo. This league consists of a total of 12 participating teams (the elite division of women's football in Kosovo) with a total number of 286 players.

All active players have been invited and encouraged to participate and contribute to this study. After a detailed description that will be provided by our research team, each participant will sign a participation consent form and a data publication consent form (in accordance with international standards and a good approach to publishing).

We have explained to each player their role in the process and the possibility of withdrawing from the study at any appropriate time (although this is not advisable).

For all players who have refused to give consent, we have not included them as case studies. At the beginning of the season, together with my mentor and the entire medical staff, including the team coaches, we held an informative lecture about the research, where we informed all players about the standardized injury questionnaire.

At the request of our medical staff and team coaches, we have been informed about the occurrence of an injury in one of the clubs, where we have jointly carried out all the procedures for injury registration under the supervision of the mentor and co-mentor, who have always been with me as a team in injury registration.

The exclusion criteria include players under the age of 16.

Prior to this, club managers, agents, and coaches were informed in advance as a way to avoid misunderstandings and to include as many potential participants as possible in the study. Data collection was carried out immediately after obtaining permission to proceed with the research according to the ethical code.

This thesis is designed by two different sub-category studies.

Study I - Systematic review and meta-analysis – Predicting of the risk factor of lower extremity injuries in elite women’s football: systematic review and meta-analysis, Key Words: lower extremity injuries; women; female; elite; soccer; football; players; risk factor to better understand the current state-of-the-art and compare our findings within the existing vast of data **’’Predicting Risk Factors of Lower Extremity Injuries in Elite Women’s Football: Systematic Review and Meta-Analysis. Gashi, F.; Kovacic, T.; Gashi, A.I.; Boshnjaku, A.; Shalaj, I. Predicting Risk Factors of Lower Extremity Injuries in Elite Women’s Football: Systematic Review and Meta-Analysis. Sports 2023, 11, 187. https://doi.org/10.3390/sports11090187 ’’**

Study II - Research study – Documenting the incidence and predicting the risk of injuries. ’’ **Injuries in professional women’s elite soccer players in Kosovo: epidemiological injury study. F.Gashi et al. BMC Sports Science, Medicine and Rehabilitation (2023) 15:131 https://doi.org/10.1186/s13102-023-00746-9 ’’**

3.3.2 Ethical permission

In order to conduct the study research, we have applied for a research permit from the Ethics Commission at the Chamber of Physiotherapy in Kosovo, and it was approved by the commission with the date 17.09.2021 and number 445 of the protocol. The entire process followed local and international criteria for a good scientific approach, data protection standards and the Helsinki Declaration on Human Experiments latest version.

3.3.2.1 Study I

Materials and Methods The study has been conducted using the combined method of systematic review and meta-analysis. The systemic methods provided rigorous identification, and summary of research documentation to answer the abstracted questions. As healthcare providers, patients, research peers, and policy-making authorities rely on distinct systematic reviews for policy advancements, this research method is widely used to explore a research problem using data collected by previous researchers, and their postulations (Ahn and Kang 2018).

Moreover, meta-analysis provided statistical tools to evaluate the mean and variance of empirical studies collected for population effects for the same focused questions. A wide spectrum of data was collected from evidence-based publications possessing information for interventional reviews and a minority of publications based on accurate epidemiological or diagnostic data. In this section, the methods and criteria used to collect, extract, and analyze data in this systematic review and meta-analysis-based study have been described.

Eligibility criteria

To select the studies with relevant sample profiles for the meta-analysis, the PICO (Population, Intervention, Control, and Outcomes) framework was used. Using this framework, the preliminary eligibility criteria for the samples of the studies to be included in this systematic review have been defined below. Population: Elite women football players; Intervention: Risk factors of injury; Control: Elite women football players without lower extremity injury; Outcome: Lower extremity injury. In Table 1, the inclusion and exclusion criteria used to screen academic research articles identified through database searching for this study have been listed in Table 1.

Table 1: Eligibility Criteria for Research Articles.

No.	Inclusion Criteria	Exclusion Criteria
1	The study specifically focused on the factors influencing the risk of lower extremity injuries in women football players.	The study did not focus on the factors influencing the risk of lower extremity injuries in women football players.
2	The study used an appropriate team of specialists to determine the level of injury.	The articles include children below the age of 13 years.
3	As the article was released in 2013 or later, it is not more than ten years old.	The article focuses on other forms of injuries as a main consequence.
4	English is the language of publication for the article.	There is no English version of the article.

Source: Own source 2024.

Search Strategy and Study Selection

The search strategy used in this study has been developed specifically based on the research objectives of this study to identify the most relevant articles for the systematic review. The following databases were searched to identify potentially relevant research articles: MEDLINE, EMBAS, Cochrane, PUMED, Google Scholar, Web of Science, SCOPUS and CINAHL.

Collectively, these databases provide access to a vast body of high-quality research related to the topic of interest. As demonstrated by Snyder et al. (Snyder 2019), the keywords used to search the databases were extracted from the research questions and objectives of the present study. Hence, the keywords "lower extremity injuries", "women", "female", "elite", "soccer", "football", "players", and "risk factor" are used to search the database.

The risk factors of lower extremity injuries in women elite football players were the subject of search queries developed using these keywords. The keywords were joined to form the search queries using the Boolean operators “AND,” “OR,” and “NOT.”

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework was applied to screen the search results and identify the most suitable research articles for this systematic review. In systematic literature reviews, the framework offers a methodical way to screen and eliminate irrelevant search results through a multi-step procedure (Dangouloff et al. 2021).

As such, two consecutive screening techniques were used in this study to identify and eliminate irrelevant literature. In the first step, the titles and abstracts of the articles identified through database searching were screened for relevant keywords and information. The

articles containing such keywords in their abstracts and titles were retained, while the rest were discarded (Gates et al. 2020).
After that, the text of the retained articles was searched similarly to determine whether the articles contained relevant information for this study. The articles found to be relevant in this study were included in the data analysis, and the rest were discarded.

Title/Abstract Screening

After searching the databases, two authors screened the abstracts and titles based on the inclusion and exclusion criteria. A manual approach was instilled towards finding the relevant keywords through reading the titles and abstracts.

Afterwards, a third author went through the screening process again to ensure minimal bias. With the help of this screening method, the researcher was able to quickly limit viable data sources from a large body of evidence (Gates et al. 2020).

Full-text screening

After the initial screening of Title and Abstracts, a full screening was conducted. The author used a manual approach for reading the selected studies manually and studies relevant to the inclusion and exclusion criteria were selected. After the initial screening of Abstracts and Title, a total of 15 articles were selected, out of which 11 were excluded.

Out of these, six took consent after the study, four focused more on systemic injuries rather than lower extremities, and one had paid access only. A total of 4 studies passed the inclusion criteria and were selected for data extraction. The whole screening procedure involved three authors for minimal selection bias.

Data extraction

Relevant data were extracted from the selected research articles using a systematic data extraction method. The data extraction table represented in Table 2 was used for this data extraction. The table has been developed based on the data extraction table used by Ahn et al. (Ahn and Kang 2018) in their study.

However, the table has been customized to collect specific data related to this study. As a result, Table 2 has been designed to collect the most relevant data to understand the risk factors of LEI in elite women football players.

Table 2: Format of the Data Extraction Table.

Author(s)	Year of Publication	Sample Population	Number of Participants	Type and Prevalence of Lower Extremity Injury	Risk Factor Identified and Odds Ratio (OR)/ Risk Ratio (RR)	CASP Score (Out of 10)

Source: Own source 2024.

Risk of Bias Assessment and Quality Assessment

The CASP (Critical Appraisal Skills Programme) checklists were used to assess the calibre of the contained literature. These checklists make use of a series of closed-ended questions to evaluate the calibre of various research study kinds in relation to their methodology, data collection methods, and research designs (Long et al. 2020).

Different CASP checklists apply to different types of studies, including randomized controlled trials (RCT), cross-sectional studies, and qualitative studies. Based on the number of CASP criteria satisfied by each of the included studies, the studies have attributed a score out of 10. This led to an objective and accurate assessment of the quality of the included studies.

Statistical analysis

As mentioned in Table 2, the Odds Ratio (OR) or Risk Ratio (RR) of each risk factor has been extracted from the included articles. The OR and RR values provide an accurate understanding of the statistical significance of each of the risk factors, while also enabling relative prioritization of the risk factors identified in this study (Schuh-Renner et al. 2017).

3.3.2.2 Study II

Study population

A total of 286 female soccer players out of 12 participating teams from the Kosovo Women's Soccer League (The elite division of women's soccer in Kosovo) were invited to participate in the study. Every active and officially registered player, from all the playing positions (goalkeepers, defenders, midfielders, and strikers) being part of any of the competing teams within this league was eligible to participate. For statistical issue 142players from 12 teams agreed to participate and signed informed consent.

Data collection

Data collection was performed on a weekly basis during the competitive season 2021/2022. Exposure time of playing and training were recorded by a member of the team's medical staff or the coach of the team after baseline characteristics of the players (including anthropometric data, playing position, and prior injury history) during the end of the season, practice, and match.

The exact type of injury, severity, and post-injury recovery time, as well as the circumstances surrounding the injuries, were recorded. The self-reported dominant, non-dominant or bilateral sites of players were recorded. Specific injury report forms in accordance with the FIFA Medical Assessment and Research Center Consensus FIFA (F-MARC) (Fuller et al. 2006), were applied for this reason.

All conditions that prevented a player from participating completely in practice or games were noted. According to this questionnaire the injuries were classified as minor, mild, moderate, and severe for absences from play of 1-3 days, 4–7 days, 8–28 days, and more than 28 days, respectively (Fuller et al. 2006).

The severity of injuries was reported based on this instrument (F-MARC). Teams received a comprehensive information through the study handbook that included examples to help teams understand how to record data (Shalaj et al. 2016). The study employed translated versions of the F-MARC forms and adhered to their recommendations on definitions and data gathering methods in soccer injury studies (Fuller et al. 2006).

3.3.2.3 Data analysis

The typical characteristics of our study population, including all the data collected from the used assessment instruments, are described using descriptive statistics (means and standard deviation for continuous variables and frequencies for categorical variables).

The injury incidence rate (IR) per 1000 hours of exposure and the related 95% confidence intervals (CIs) was determined using Poisson regressions with generalized estimating equations to assess the risk of injury across matches and training. (Dahmen and Ziegler 2004) as an increasingly used approach in cohort longitudinal study related to sports injuries (Clausen et al. 2014).

The IRs will evaluate the impact of age where it has been separately estimated for players assigned to the younger (under 24), middle (24-29), or older (>30) age groups.

Age was included in the Poisson regression as a continuous covariate variable to compensate for any bias associated to age differences between goalkeepers, defenders, midfielders, and strikers for the comparison of injury IRs in all playing positions.

The statistical software program IBM SPSS Statistics for Windows, Version 25.0 (Armonk, NY: IBM Corp) was used to conduct all statistical analyses.

Data was processed on Microsoft Office (Microsoft Corp., Redmond, Washington), using a Macintosh computer (Apple Computer, Cupertino, California). The statistical analysis was applied utilizing Stat View (version 4.5; SAS Institute, Cary, North Carolina) and SPSS (version 25.0; SPSS Inc., Chicago, Illinois).

The major methods used to document collected data were frequencies, descriptives, tabulation forms, and means.

Dissimilarities between injured and non-injured groups were analysed using approaches like multivariate analysis, Player's *t*-test, regression analysis, and chi-square analysis. Other than exceptions, mere values showing a 5% difference were considered statistically significant.

The Critical Appraisal Skill plan was assessed to analyse the standard of past issues in systematic studies. However, modifications were performed to filter the relevant research question. For appropriate processing of data provided, Complete Meta-analysis Version 2.0 (Bio Stat, Englewood, New Jersey, USA) technology was utilised to monetize meta-analysis of predictive risk characteristics for injury incidences.

To maintain methods of heterogeneity of data, an abrupt effect pattern was applied. Whereas I2 statistics were used to process heterogeneity. Heterogeneity values were characterised as 100% to be a completely heterogeneous sample, less than 25% to be at lower levels of heterogeneity, and 0% to be no observation of heterogeneity.

3.3.3 Instrumentation description

General anthropometric data (weight and height) will be collected using international standards for anthropometric assessments (Eston and Reilly 2009).

Injury patterns and incidence data will be collected using a combination of observational and data-keeping techniques throughout the competitive season, where this cohort longitudinal study will use standardised methods and techniques from previous studies.

Playing Surface

Information about the playing surface, whether the players have developed a game or training on natural or artificial grass.

Functional tests

Functional tests primarily analyse athletes' fitness level and readiness to come back to the football game. Functional tests will be performed to assess strength, stability, and movement patterns of the lower extremities.

A functional test is considered an assessment tool that imitates a particular movement or sports activity. As a result of this mimicking capability, functional tests offer information related to a participant's preparedness level that is difficult to identify with typical manual assessments. These tests will be: Y-Balance Test and Single Leg Squat Test.

Y-Balance Test

Evaluates dynamic balance and lower extremity control. Players will be standing on one leg and using the opposite leg to reach as far as possible in three directions: anterior, posteromedial, and posterolateral (Plisky et al. 2006, Guo et al., 2021).

The players have always performed the test in the three directions three times, as well as all the players, the leg length assessment has been carried out and after the results have been completed, we have performed the calculation according to the formula (Table 3).

We have also identified a difference between the left leg and the left. The Y-balance test measures postural control, a major predictive factor associated with lower extremities injuries in expert players.

The purpose of this test is to identify the hip muscle strength related to the stability of the lower extremities.

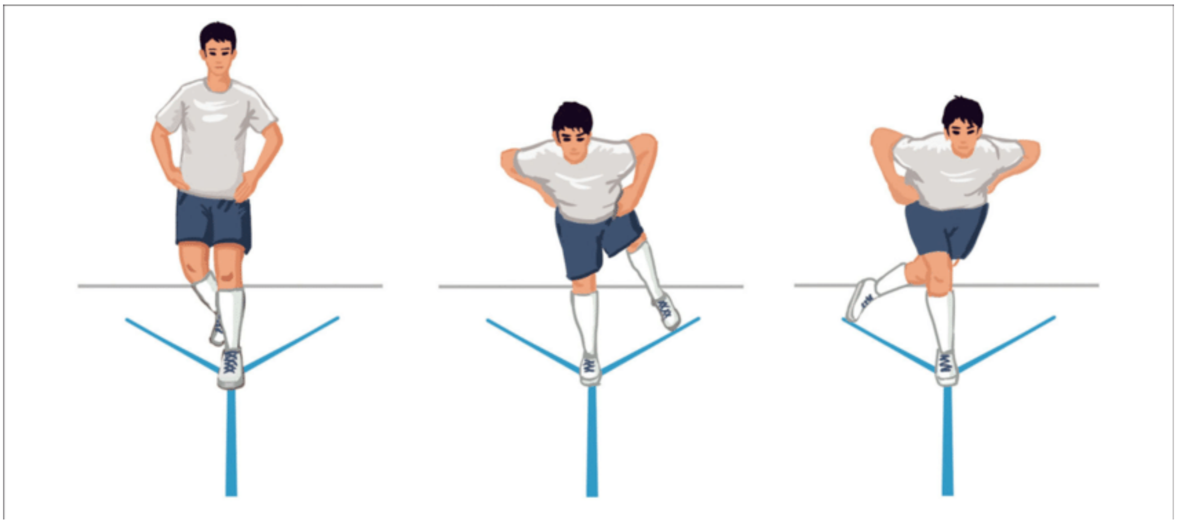
The greatest stretching distance will be calculated by using the tape measurement at the end of the reach marker where the lateral portion of the participant's foot approached. If the contributor: (1) fails to maintain one leg balance while reaching the platform (2) will be unable to sustain the contact of foot reach as compared to the reach marker of the target area (3) approach the reach marker to maintain balance, (4) fail to point the reaching foot back on initial position, will make the test to be disposed of and perform again.

Table 3: Calculation formula for evaluating the Y balance Test.

	Right Leg	Left Leg
Direction 1	Reach1+Reach2+Reach3 / 3	Reach1+Reach2+Reach3 / 3
Direction 2	Reach1+Reach2+Reach3 / 3	Reach1+Reach2+Reach3 / 3
Direction 3	Reach1+Reach2+Reach3 / 3	Reach1+Reach2+Reach3 / 3
Average distance in each direction / leg length*100		

Source: Own source 2024.

Picture 1: The Y-Balance Test.



Source: Guo et al. 2021.

Single Leg Squat Test

Reaching distances in foot lengths: the single-leg squat test will evaluate participants' stability (Earl et al. 2007). Players will be standing on one leg while slowly performing controlled squats, aiming to maintain proper balance.

Participants will perform a single leg squat test with 90° of knee flexion on each side leg while standing on a metal plate.

All the players have performed the test 5 times and have been scored with 15 points, where in the case of not performing well, it has been stopped and considered as not having reached the maximum points.

A test will be distorted if (1) the participants put their opposite leg in the forward direction (2) if the participants touch their opposite leg to the stance leg (3) If the participants touch the ground with their opposite leg (4) if participants are unable to maintain the body balance or if they remove their hands from sides. Both legs' performance scores will be recorded separately, while the right leg will be measured first.

Picture 2: Single Leg Squat Test.

Source: Earl et al. 2007.

Muscular Imbalances

To assess muscular imbalance, we will perform strength and flexibility tests to compare the strength of opposing muscle groups quadriceps vs hamstrings and identify potential imbalances. The tests we will include in this study are: Sit and Reach Test and Countermovement Jump Test.

Sit and Reach Test

Therefore, the flexibility of the hamstring and lower back muscles will be assessed by the Sit and Reach Test.

To perform the SRT, the athlete sits on the floor with the legs fully extended and the soles of the bare feet resting against a purpose-made sit and reach box. The athlete places one hand on top of the other, slowly bends forward and reaches forward along the measuring line as far as possible.

The distance reached by the athlete's finger tips (cm) is recorded and the average of three trials is calculated for further analyses (Mayorga-Vega et al. 2014).

Picture 3: Sit and Reach Test.

Source: Mayorga-Vega et al. 2014.

Countermovement Jump Test

Countermovement jump performance will additionally be assessed as representative measure of leg muscle power. Starting from an upright standing position, participants squat down to a knee angle of approximately 90 degrees before jumping up vertically as explosively as possible. Making use of the Leonardo Mechanograph® ground reaction force plate, jump heights and indices of movement efficiency and symmetry are calculated automatically (Chelly et al. 2010).
The subject will perform the test three times and the best result will be used for further analyses.

Picture 4: Countermovement jump teste.

Source: Chelly et al. 2010.

Psychosocial Factors

We will administer psychological questionnaires to assess stress levels and psychological readiness for competition. Psychological Readiness of Injured Athletes to Return to Sport (PRIA-RS) Questionnaire (Gómez-Piqueras et al. 2020) will be used to measure the perceived psychological readiness levels of the subjects.

The level to which people regard their readiness to rejoin practice after an injury is gauged by this 10-item self-report questionnaire. Responses are given on a Likert-type scale with a 0 (Never) to 4 (Very often) rating range, while the total score of the questionnaire is 50.

The PRIA-RS Questionnaire examines several areas, such as mental readiness, confidence, and attention, to provide a thorough assessment of an athlete's psychological condition before returning to sports-related activities. A Likert scale is used to record responses to this questionnaire, allowing athletes to properly convey their feelings and opinions about their preparedness to return to the playing field.

The scale is not only a relatively new one but is also designed specifically for football players, rendering it even more suitable for this study. Moreover, recent studies have also proven that the scale demonstrates a high level of accuracy and validity in assessing the psychological readiness of football players.

Fitness tests

Fitness tests related to soccer performance, such as the Aerobic Fitness Test - 20-meter shuttle run test, we also performed to assess aerobic capacity, all players were included in the multiphase 20-meter Fitness Test (20 -MMFT), also known as the "Beep Test" or the "Progressive Aerobic Cardiovascular Endurance Run (PACER)," is a widely used assessment tool in the field of physical fitness and exercise physiology.

This standardized maximal aerobic capacity (VO2 max) test is designed to measure an individual's cardiovascular fitness and endurance. The primary objective of the Multiphase 20m Fitness Test is to assess participants' maximal aerobic capacity and endurance through a progressive and maximal aerobic exercise protocol.

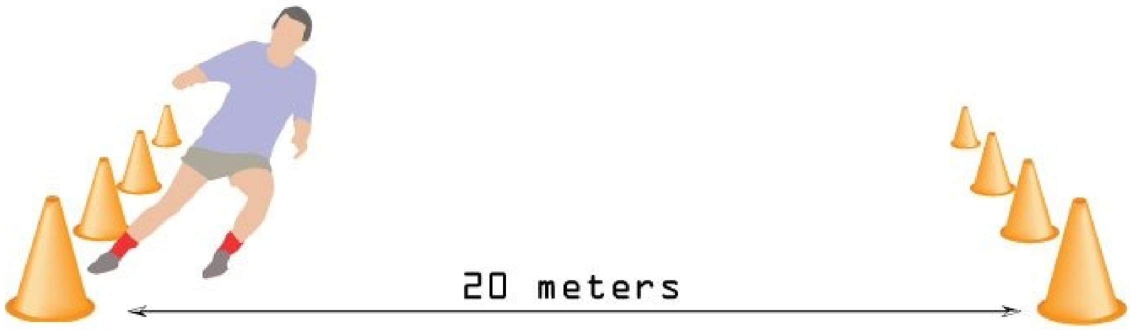
The test was performed on a flat, non-slip surface with two parallel lines located 20 meters apart. We have placed cones or markers at each end to indicate turning points. Participants start in one of the lines and run to the opposite line following an audio signal. The initial running speed of 8.5 km/h increases by 0.5 km/h every minute.

The running speed is initially set at a moderate pace and gradually increases with each phase. Participants reached the opposite line before the next beep to continue the test. The test is terminated when a player fails to reach the line in time for the beep twice in a row and the number of successfully completed transfers is recorded (Ahmaidi et al. 1992).

The time between beeps is reduced with each phase, requiring an increasingly faster pace. We have always taken care to ensure the safety of every soccer player, including proper warm-up and cool-down procedures.

Based on this score as well as the age of the player, maximal oxygen consumption can be estimated by linear and univariate regression analysis to identify any association with injury risk.

Picture 5: Aerobic Fitness Test - 20-meter shuttle run test.



Source: Ahmaidi et al. 1992.

3.3.4 Description of the sample

Information on injuries occurring during the observation period will be documented using an Albanian translation of the Injury Report Form provided by Injury Consensus Group established by the FIFA Medical Assessment and Research Centre (Fuller et al. 2006), and the Oslo Sport Trauma Research Centre (Clarsen et al. 2014), where according to the injury report form, we will receive information on the position of the game (Goalkeeper, defender, striker, and midfielder), the dominant side (Left, right or both), the injured body part, the type of injuries, previous injuries, the cause of the injury (Trauma or overuse), the place of the injury (Training or game), contact with other players and time to return to the game.

Injury classifications will be conducted following for classification in minor, mild, moderate, and severe for absences from play of 1-3 days, 4–7 days, 8–28 days, and more than 28 days by (Clarsen et al. 2014). We will aim for age differences to divide players into three age groups: Group 1: Young participants (up to 24 years of age), group 2: middle-aged participants (25 – 29 years of age), group 3: older participants (30 years and above).

Exposure to training loads and match playing times will additionally be recorded using the Exposure Report Form proposed by the same group (Fuller et al. 2006). In testing predictive risk factors for LEI in elite female football players, we will use a combination of physical assessments, surveys, and performance measures.

3.3.5 Description of data processing

Have use different statistical tests and analytical approaches, which are: **Descriptive statistics** (means and standard deviation for continuous variables and frequencies for categorical variables) have used to describe the typical characteristics of our study population, including all the gathered data from used assessment instruments. If the outcomes result to be non-parametric data, descriptive statistics for non-parametric data will be used (median and 25^{th} to 75^{th} percentile).

Continuous variables calculated for the subjects of this study include age, height, weight, BMI, and sustained multistage fitness. However, these variables were documented, explained, and compared according to physical performance and physical characteristics. **Statistical comparisons** among mean values calculated for non-injured and injured teams were completed with a t-test and Chi-square trials.
The Chi-square trial was applied to analyse injury incidence according to game duration or practice sessions. The impact of **potential predictor test v**ariance on the chances for possible LEI injury was analysed by mean values of logistic regression (Hosmer, Jr., and Lemeshow 2004). Firstly, the values for each potential predictor variable were calculated in univariate logistic regression analyses.

Those values which manifested a P-value<0.20 were considered for further multivariate analysis. Afterwards, statistically significant predictors were extracted by employing backward elimination. An optimum correlation between a continuous predictor and the risk of injuries was analysed based on model assumption; classification of a continuous predictor was reviewed. Logistic regression analysis shows an estimation of the predictor variable impact on the injury risk by odds ratio.

Chi-Square Test: To test H1, Have use chi-square test to determine if there is a significant relationship between injury patterns and LEI compared to injuries to other body regions, i**ncidence rate calculations**: We will calculate the injury incidence rate per player per 1000/h of time matches and training to test H2, **logistic regression analysis**: Have use it to examine the relationship between potential risk factors (e.g., previous injury history, training load, playing surface, muscle imbalance, age) H3, **muscle imbalance tests**: Have use the most appropriate statistical test, such as t-tests or analysis of variance (ANOVA) for parametric data, to compare strength and flexibility measurements between different groups to test H4, **correlation analysis**: Have use correlation analysis Pearson correlation to assess the relationship between training load and the incidence of to test H5, **comparative analysis**: Have use comparative analysis t-tests, chi-square tests to compare injury rates and risk factors between players playing on artificial turf and natural grass and between players H6, **age-related analysis**: t-tests, chi-square tests to compare injury rates and risk factors

between different age groups to examine H7, **multivariate analysis**: Have use multivariate analysis, multiple logistic regression to assess the combined effects of multiple risk factors on the occurrence of LEI, **time Series Analysis**: For longitudinal data, we will use time series analysis to examine trends and patterns of injuries during the competitive season.
To compare the likelihood between matches and training, the injury IR per 1000/h of exposure and the corresponding 95% CIs will be calculated using Poisson regressions with generalised estimating equations (Gail and Benichou 1998; Dahmen and Ziegler 2004; Rabe-Hesketh et al. 2005) as an increasingly used approach in epidemiological studies related to sports injuries (Clausen et al. 2014).

The influence of the age will be assessed by the IRs, where it has been independently calculated for players assigned to youth (≤24), middle age (25–29), or older age groups (≥ 30) years of age. For the comparison of injury IRs in all playing positions, age will be included in the Poisson regression as a continuous covariate variable to control for bias related to age differences between goalkeepers, defenders, midfielders, and strikers.

All statistical analyses will be performed using the SPSS statistical software package SPSS 25.0 (Edward and Using 2019). Further complicating factors include a widespread agreement on the rehabilitation process. When p-values are lower than the predetermined significance level (alpha) for hypothesis testing (for example, = 0.05), the results are deemed statistically significant. For developing the LEI prediction model, a neural network has trained using machine learning (ML) methods to formulate an algorithm that can accurately forecast the risk and severity of LEI. To train this model, the risk factors identified from the collected data have used. Meanwhile, the frequency of LEI and the severity of injuries (in terms of number of days of training missed due to injuries) have used as outcome measures in the model.

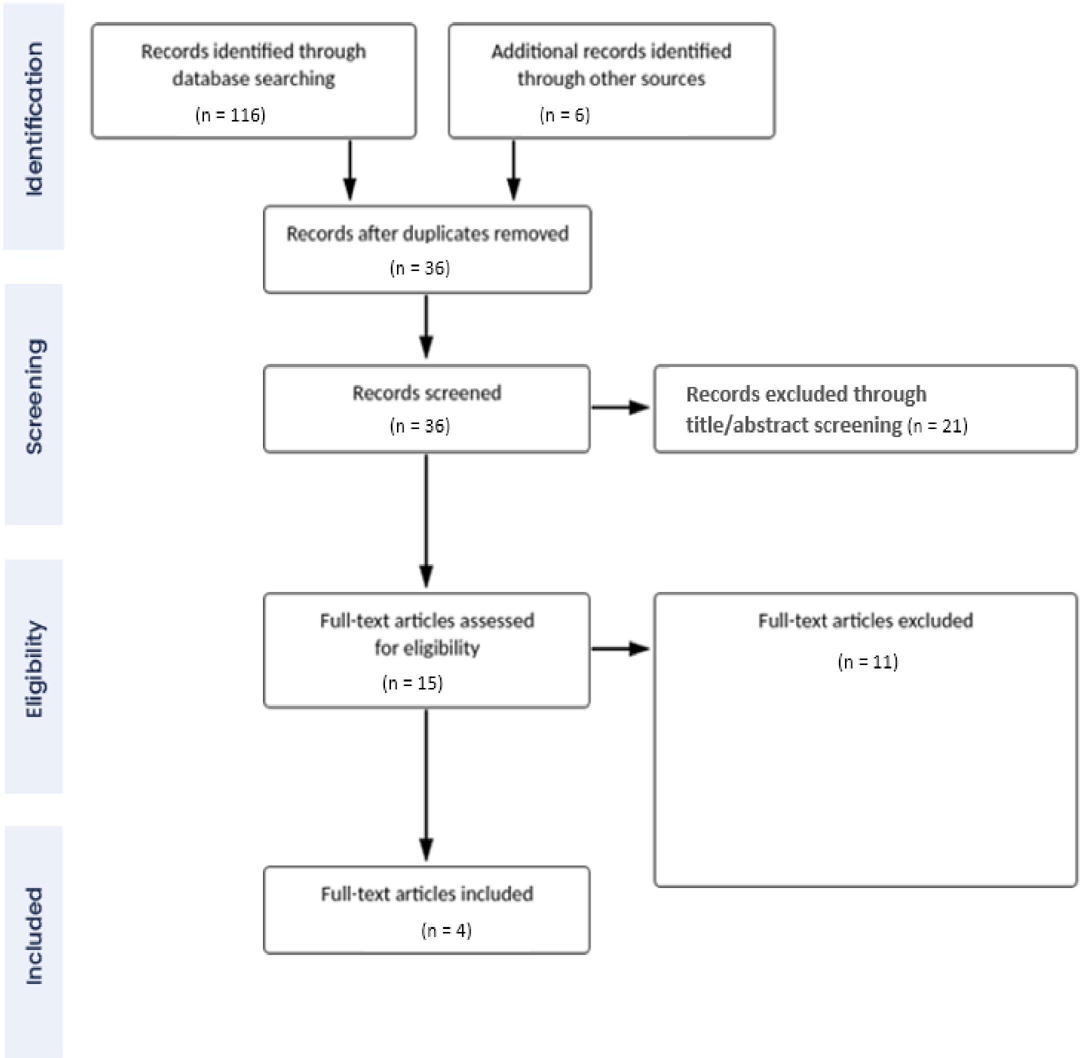
4 RESULTS

4.1 Study I

Descriptive Characteristics of the Studies

As depicted in Figure 1, a total of 4 research articles were included in this study through systematic screening of the database search results. In total, these studies recruited 895 elite female football players. The prevalence of LEI in the studies varied significantly (from 38.17% to 66%). Among the four studies, two were prospective cohort studies, one was a cross-sectional cohort study, and one was a longitudinal cohort study. Finally, the average CASP assessment score of the included studies was 9.25 (between 9 and 10). Therefore, it can be stated that a set of high-quality data has been included in the present study.

Figure 1: PRISMA Flow Diagram of Study Selection.



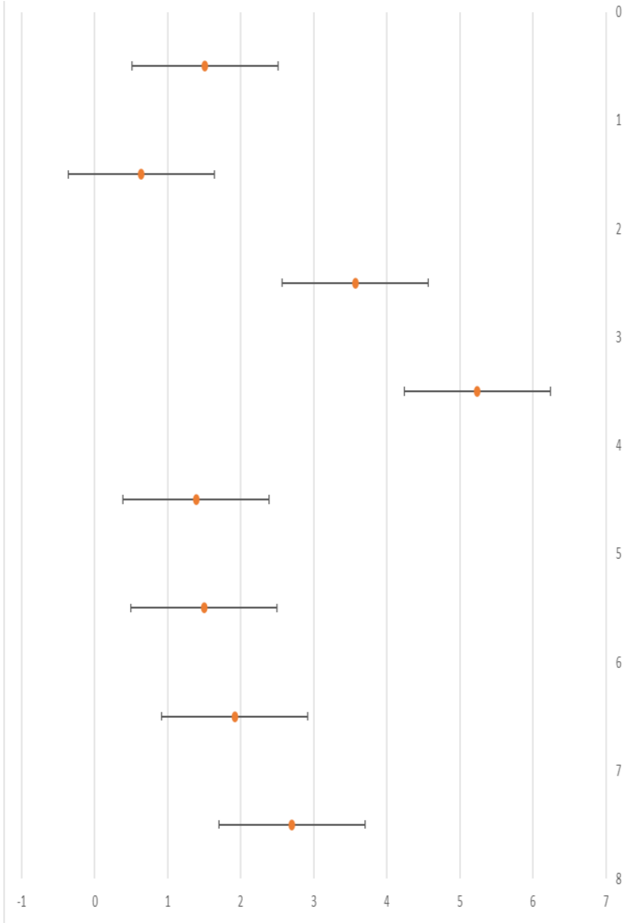
Source: Own source 2024.

Table 4: Is the data extraction table that.

Author(s)	Type of Study	Sample Population	Number of Participants	Type; Prevalence of Lower Extremity Injury	Risk Factor Identified	CASP Score (Out of 10)	Notes
(Nilstad et al. 2014)	Cross-sectional cohort study	Elite female football players	173	All types of lower extremity injuries; 62%	Higher body mass index (BMI); lower knee valgus angle in a drop-jump landing; previous knee injury	9	
(Faude et al. 2006)	Prospective cohort study	Elite female football players from the German national league	143	All types of lower extremity injuries; 60.83%	Previous injury (anterior cruciate ligament rupture, ankle sprain, knee sprain)	9	Though the researchers aimed to identify the risk factors of injuries in elite female football players, all injuries included in the study were LEI.
(O'Kane et al. 2017)	Longitudinal cohort study	Female elite youth football players	351	All types of lower extremity injuries; 38.17%	Low normalized knee separation (≤10th percentile)	10	
(Hägglund, et al. 2006)	Prospective cohort study	Female Swedish Premier League football players	228	All types of lower extremity injuries; 66%	Previous injury in the lower body	9	Though the researchers explored the risk factors of injuries in both men and women elite football players, the data related to only elite women football players have been included in this meta-analysis

Source: Own source 2024.

Table 5: Findings.

Author(s)	Number of Injuries	Risk Factor	Forest Plot	OR/RR/HR (95%CI)
(Nilstad et al. 2014)	171	Higher BMI		1.51 (1.08-2.11)
		Lower knee valgus angle in a drop-jump landing		0.64 (0.41-1.00)
		Previous knee injury		3.57 (1.27-9.99)
(Faude et al. 2006)	176	Previous ruptures 1.anterior cruciate ligament rupture risk		5.24 (1.42-19.59)
		2.ankle sprain risk		1.39 (0.62-3.10)
		3. knee sprain risk		1.50 (0.61-3.72)
(O'Kane et al. 2017).	134	Low normalized knee separation during takes off		1.92 (0.84-4.37)
(Hägglund, et al. 2006)	1189	Previous injury in the lower body		2.7 (1.70-4.30)

Source: Own source 2024.

Findings

Table 4 is used to extract relevant data and derive the findings of this study. Meanwhile, Table 5 reports the statistical findings of the included studies.

From Table 4 and Table 5, it can be observed that a total of six factors have been identified to influence the risk of LEI among women football players. These factors are higher body mass index (BMI) (OR 1.51, 95% CI); lower knee valgus angle in a drop-jump landing (OR 0.64, 95% CI); previous knee injury (OR 3.57, 95% CI); Low normalized knee separation (≤10th percentile) (RR 1.92, 95% CI); previous injury (anterior cruciate ligament rupture: OR 5.24, 95% CI; ankle sprain: 1.39, 95% CI; knee sprain: 1.50, 95% CI); and previous injury in the lower body (OR 2.97, 95% CI). Different characteristics were studied in all four studies differently, as BMI was identified as a risk factor in only one study, while two studies identified previous injury as a risk as high risk. This resulted in heterogeneity between the characteristics of the selected studies.

Based on the influence of the factors on the risk of LEI in elite women football players, and the nature of the factors, the identified risk factors have been categorized into different groups in Table 6. From Table 6, it can be observed that one of the six factors (Lower knee valgus angle in a drop-jump landing) identified in this study reduces the risk of LEI among elite women football players, whereas the rest effectively increase the same.

Table 6: Categorization of the Identified Factors.

Influence of the Factor	Category	Factors
Factors Increasing the Risk of LEI	Physical characteristics	High BMI Low normalized knee separation (≤10th percentile)
	Present characteristics and history	Previous knee injury History of LE injury Previous ruptures 1. anterior cruciate ligament rupture risk 2. ankle sprain risk 3. knee sprain risk
Factors Decreasing the Risk of LEI		Lower knee valgus angle in a drop-jump landing

Abbreviations: LEI, lower extremity injuries.
Source: Own source 2024.

4.2 Study II

Anthropometric data

In this research, all elite female players of the Kosovo Football Super League were invited to participate, where only 142 players from all invited teams accepted. The average age of the players was 20.39 ± 3.4 years, and the height of the players was 1.66 ± 0.06 m, with an overall body weight for all players of 58.49 ± 6.02 kg.

Table 7: Anthropometric data.

	Mean	Median	Minimum	Maximum	Std. Deviation
Age (years)	20.39	19.5	16	30	3.4
Height (m)	1.66	1.65	1.5	1.86	0.06
Weight (kg)	58.49	58	45	73	6.02

Source: Own source 2024.

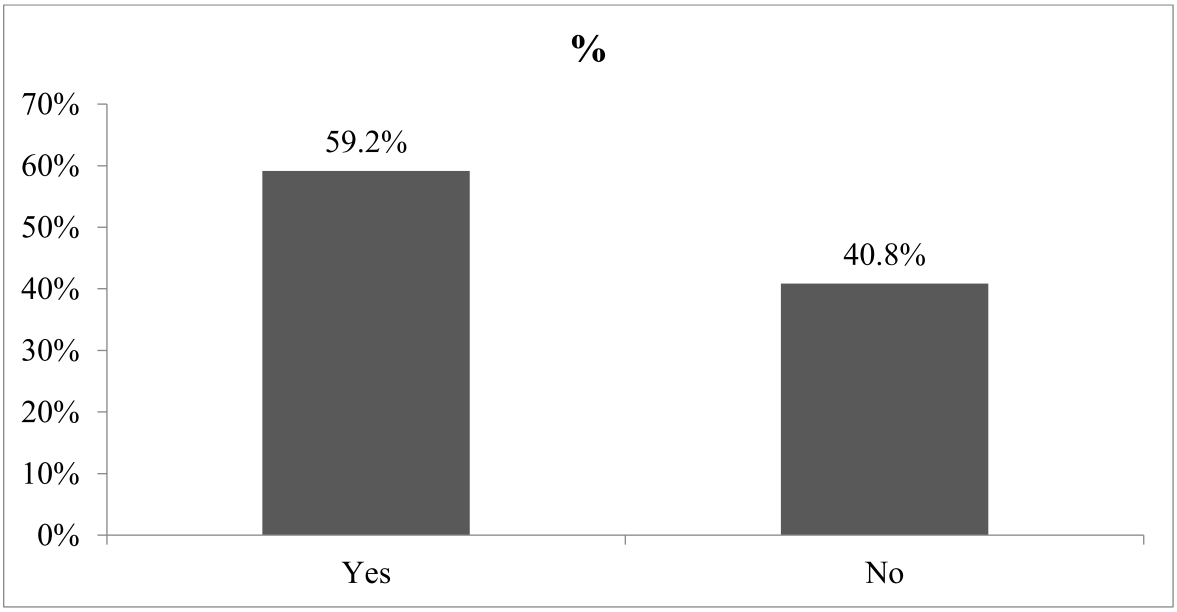
The results reveal that among the participants, 59.2% have experienced injuries, while 40.8% report no injuries. This finding indicates that injuries are relatively common in the studied population, with a majority of individuals having encountered some form of injury. Understanding the prevalence of injuries is crucial for the development of effective injury prevention strategies, rehabilitation programs, and for promoting overall well-being among individuals involved in sports or physical activities.

Table 8: Injury players

Injured players	N	%
Yes	84	59.2%
No	58	40.8%

Source: Own source 2024.

Figure 2: Injury players.



Source: Own source 2024.

During the 2021–2022 season's observation period, 84 injuries were reported. The injury rate ratio (IRR) after adjusting for total exposure time was 3.21(CI: 2.56, 3.98) injuries per 1000 exposure hours. On average, each player suffered approximately 1.69 injuries during the competitive season. Injury IRRs were significantly higher (n = 84; IRR = 11.39; CI: 7.14, 17.96; $p < 0.001$) during competition (n = 50; IRR = 13.34; CI: 9.90, 17.59) compared to training (n = 34; IRR = 1.52, CI: 1.05, 2.12). Out of a total of 142 women players, 84 (59.2%) injuries occurred, and no injuries were recorded in 58 (40.8%) players.

Injuries depending on age.

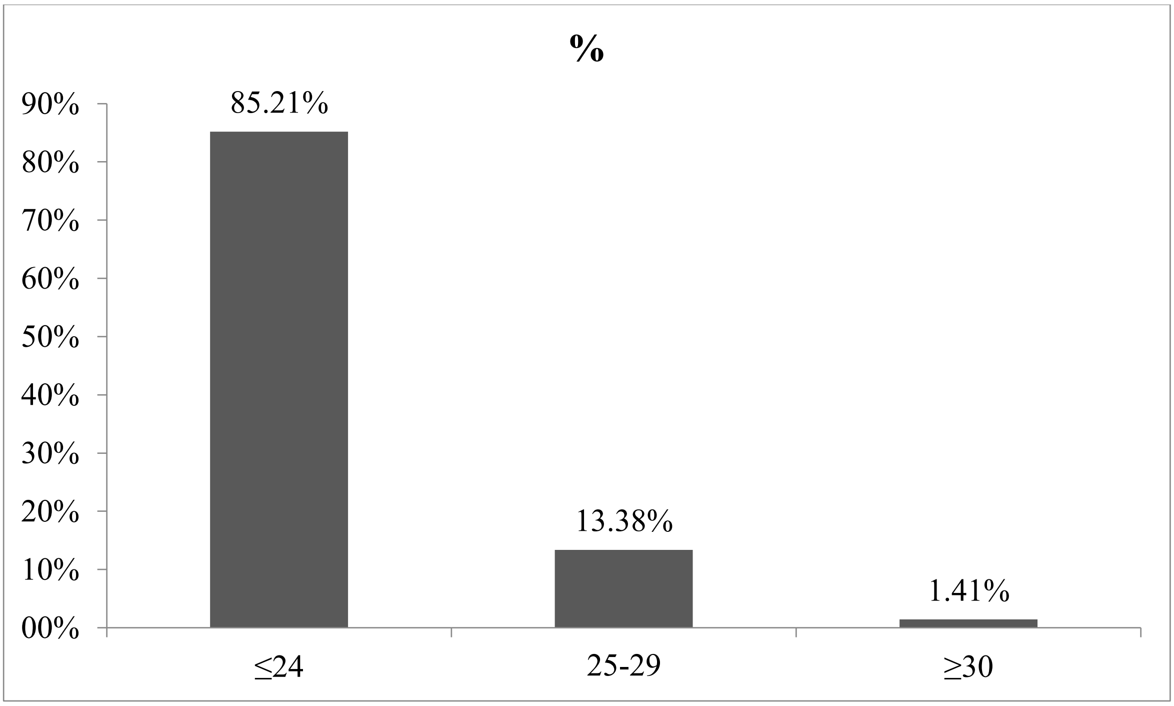
The results indicate a distribution of individuals across three age groups. The largest group consists of individuals aged 24 years or younger, comprising 85.2% of the sample, followed by the age group 25-29, representing 13.4% of the population. A smaller portion, estimated at 1.4%, falls into the age group 30 or above. These data provide a brief overview of the age demographics within the studied population.

Table 9: Age by group.

Age by group	**N**	**%**
≤24	121	85.2%
25-29	19	13.4%
≥30	2	1.4%

Source: Own source 2024.

Figure 3: Age by group.



Source: Own source 2024.

Players were divided into groups according to their ages: young (< 24 years n = 72, 85.7% IR = 8,57; CI = 6,70, 10.79), middle (24–29 years; n = 11, 13.1% IR = 1,31; CI = 0,65, 2.34) or old (> 29 years older; n = 1, 1.2%).

The major findings observed in this context were the significantly higher number of injuries occurring amongst younger women soccer players (IRR = 6.54, CI = 3.43, 13.69 ($p < 0.001$) in comparison to the "middle" age group (Table 10).

Table 10: Injuries depending on age.

Age & Injuries		N Injuries	%
Age	<24	72	85.7%
	24-29	11	13.1%
	≥30	1	1.2%
Total		84	100%

Source: Own source 2024.

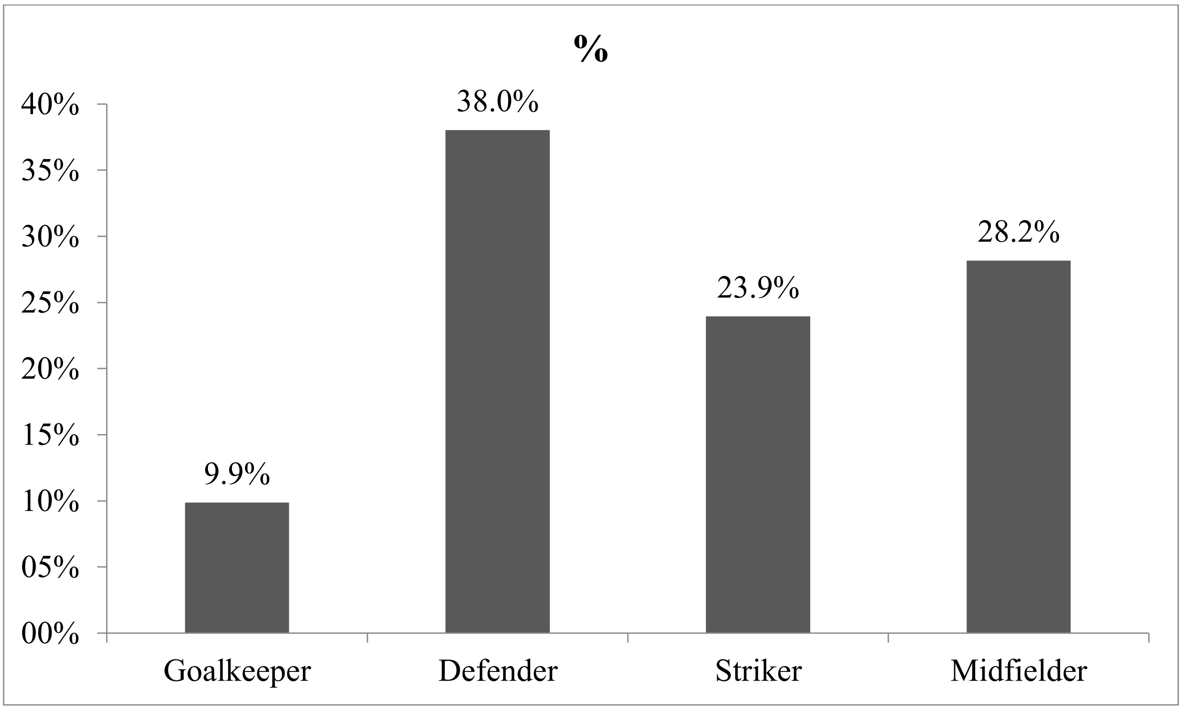
The results present a distribution of individuals based on their positions on the field. The goalkeeper position is composed of 14 individuals, representing 9.9% of the total sample. Defenders constitute the largest segment, with 54 individuals, accounting for 38.0%. Forwards closely follow, comprising 23.9% of the population, with a total of 34 individuals. Midfielders, with 40 individuals or 28.2%.

Table 11: Position on the field.

Position on the field	N	%
Goalkeeper	14	9.9%
Defender	54	38.0%
Striker	34	23.9%
Midfielder	40	28.2%

Source: Own source 2024.

Figure 4: Position on the field.



Source: Own source 2024.

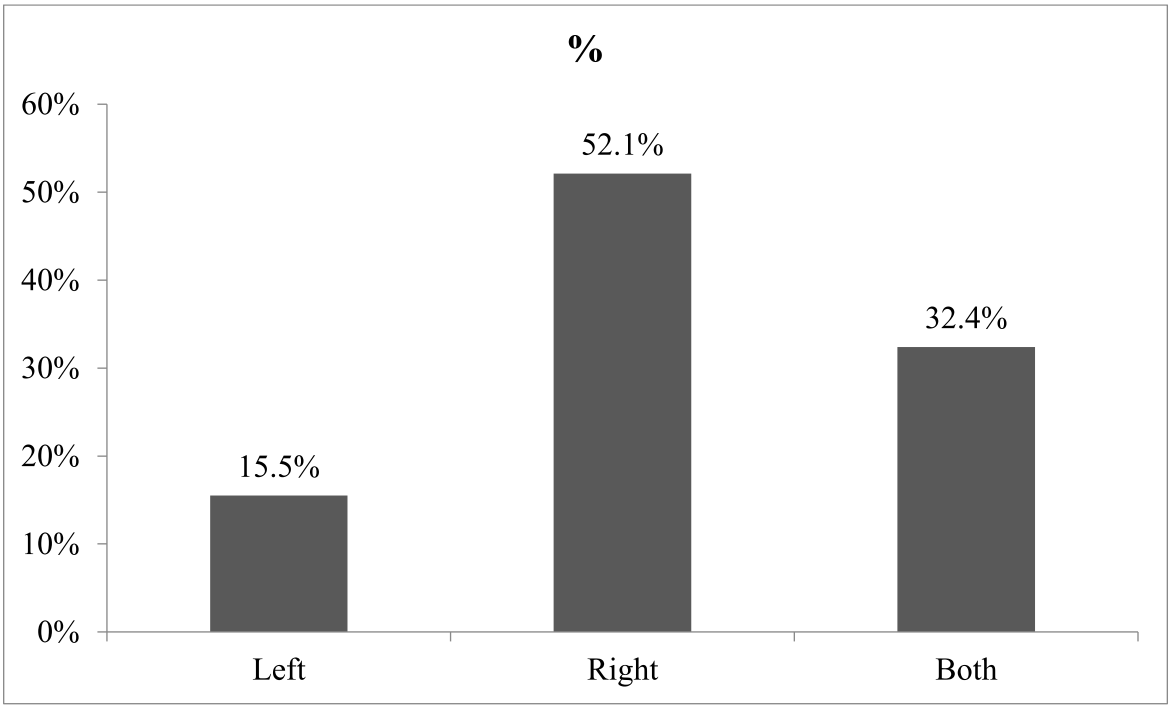
The results describe the distribution of individuals based on their dominant leg. Among the participants, 15.5% exhibit a dominant left foot, totalling 22 individuals. The majority, comprising 52.1%, demonstrate a dominant right foot, represented by 74 individuals. Interestingly, a significant portion of the population, estimated at 32.4%, possesses strength in both feet. These results represent a diverse range of preferences for dominant foot within the studied group, with a slight inclination towards individuals with a dominant right foot, closely followed by those exhibiting strength in both feet, and a smaller portion favoring the left foot.

Table 12: Dominant leg.

Dominant leg	**N**	**%**
Left	22	15.5%
Right	74	52.1%
Both	46	32.4%

Source: Own source 2024.

Figure 5: Dominant leg.



Source: Own source 2024.

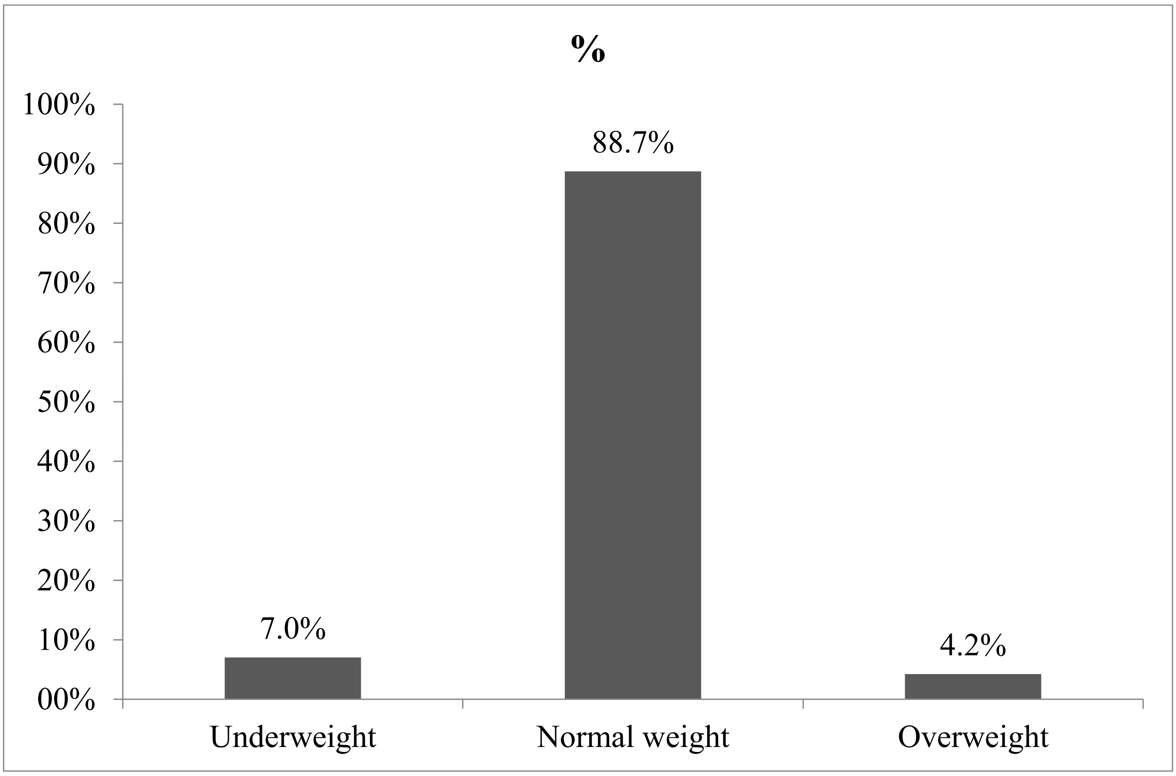
The results provide an overview of the distribution of individuals within the studied population based on the Body Mass Index (BMI) classification. Among the participants, 7.0% fall into the underweight category, 88.7% are classified as normal weight, and 4.2% are categorized as overweight. These BMI classifications offer insights into the overall body composition of the population, indicating a significant presence of individuals with normal weight, while a smaller portion falls into the underweight and overweight categories. Understanding BMI distributions is valuable for assessing overall health, nutritional status, and potential implications for performance in sports and physical activities.

Table 13: Classification of BMI.

Classification of BMI	N	%
Underweight	10	7.0%
Normal weight	126	88.7%
Overweight	6	4.2%

Source: Own source 2024.

Figure 6: Classification of BMI.



Source: Own source 2024.

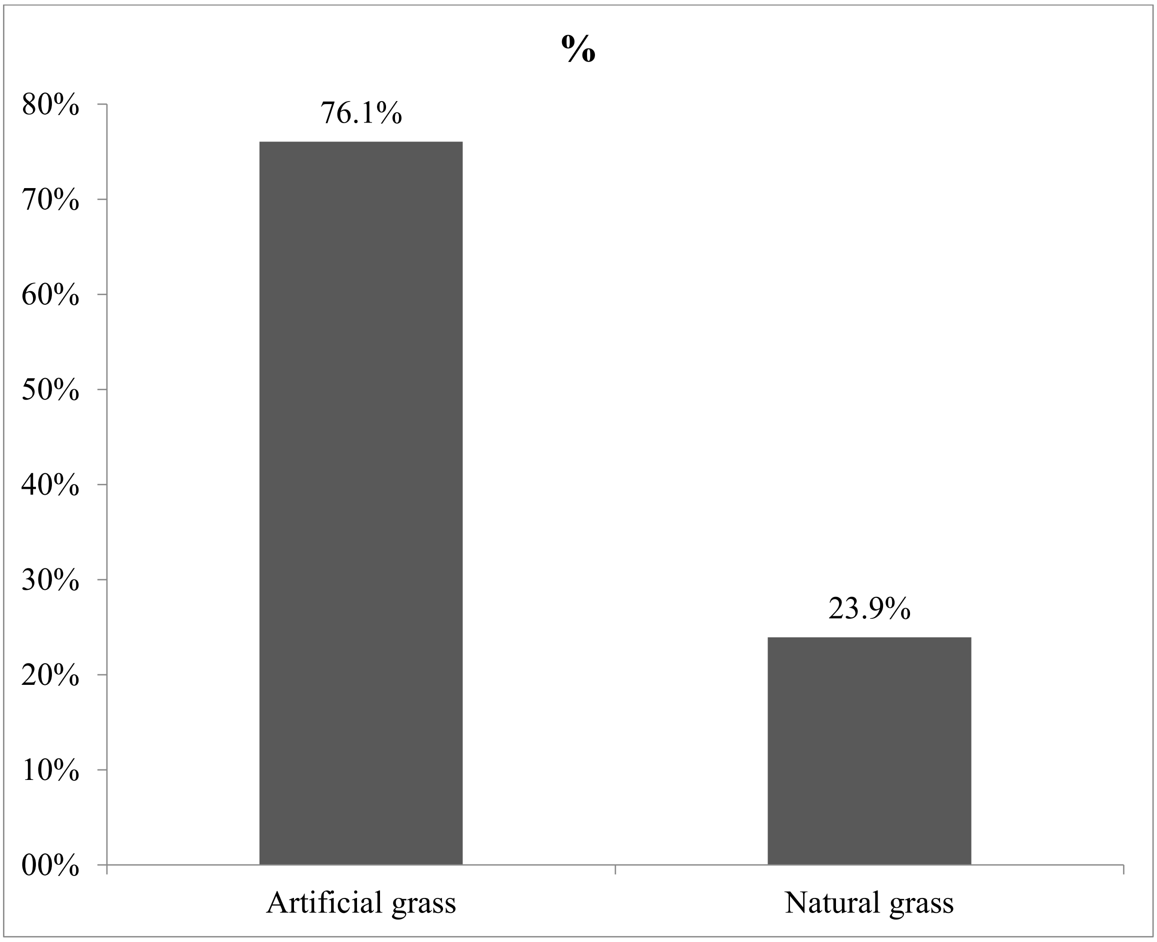
The results indicate the distribution of individuals within the studied population based on the playing surface. Among the participants, 76.1% report playing on artificial turf, while 23.9% play on a natural turf. This finding provides insight into the primary playing surface for individuals in the study, suggesting that a considerable majority participate in sports or activities on artificial turf. Understanding the playing surface is important, as different surfaces may have an impact on the risk of injuries and can influence training conditions and performance for athletes.

Table 14: Playing Surface.

Playing Surface	N	%
Artificial grass	108	76.1%
Natural grass	34	23.9%

Source: Own source 2024.

Figure 7: Playing Surface.



Source: Own source 2024.

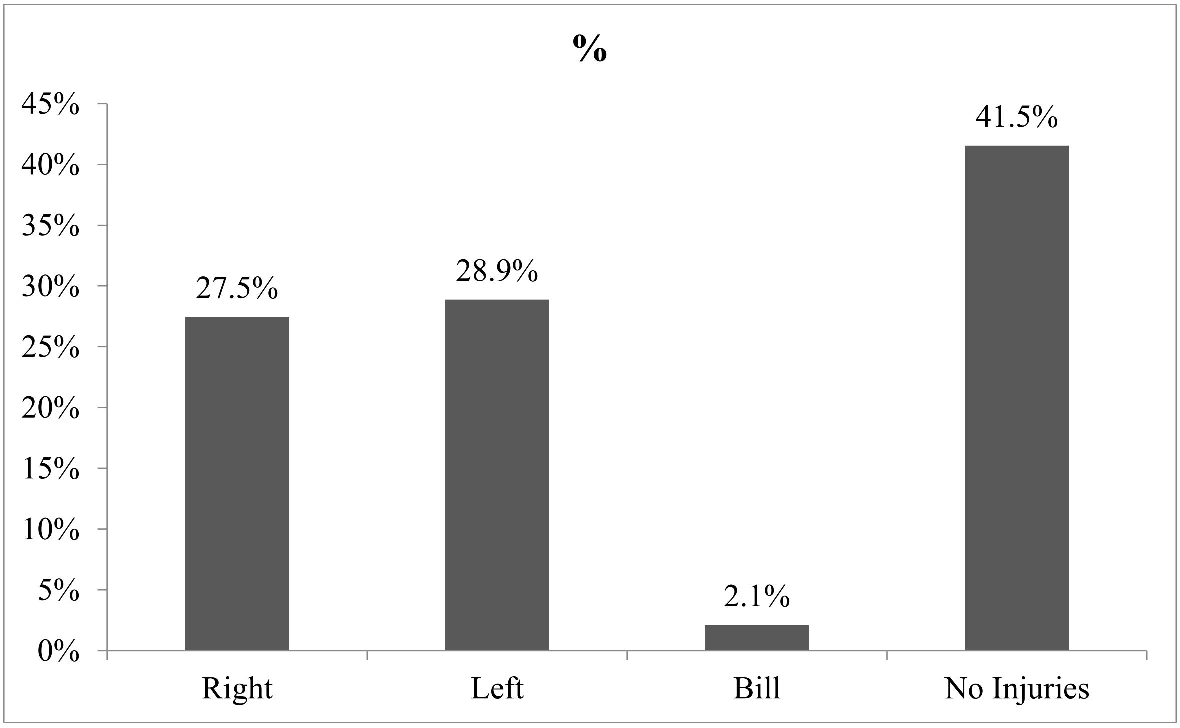
The results depict the distribution of injuries based on the affected side. Among the participants, 27.5% report injuries on the right side, totalling 39 individuals, while 28.9% show injuries on the left side, represented by 41 individuals. Interestingly, a small portion of individuals (2.1%) mention injuries on both sides (bilateral). The majority of the population (41.5%) reports having no injuries. These findings highlight a relatively balanced distribution of injuries between the right and left sides, with a notable proportion experiencing injuries on both sides. Understanding the prevalence and location of injuries is crucial for rehabilitation and injury prevention strategies in sports and physical activities.

Table 15: Injured Side.

Injured Side	N	%
Right	39	27.5%
Left	41	28.9%
Bill	3	2.1%
No Injuries	59	41.5%

Source: Own source 2024.

Figure 8: Injured Side.



Source: Own source 2024.

The results indicate that all individuals in the studied population, encompassing 100.0%, report that they do not consume alcohol. This fact suggests a consistent pattern of alcohol abstinence within the group, which may be important for understanding lifestyle choices, potential health considerations, or adherence to training and competition guidelines. The absence of alcohol consumption in this population provides a unique characteristic that could contribute to the overall health and fitness profile of the individuals involved in this study.

Table 16: Use of Alcohol.

Use of Alcohol	N	%
No	142	100.0%

Source: Own source 2024.

The results indicate that every individual in the studied population, reaching 100.0%, reports not smoking tobacco. The absence of cigarette use in this population may contribute to a healthier lifestyle and could be important in understanding factors influencing sports performance and overall well-being.

Table 17: Use of Cigarette.

Cigarette	N	%
No	142	100.0%

Source: Own source 2024.

The results indicate that all individuals in the studied population, representing 100.0%, report not using any stimulant substances.

Table 18: Use of Stimulus Substance.

Stimulus Substance	N	%
No	142	100.0%

Source: Own source 2024.

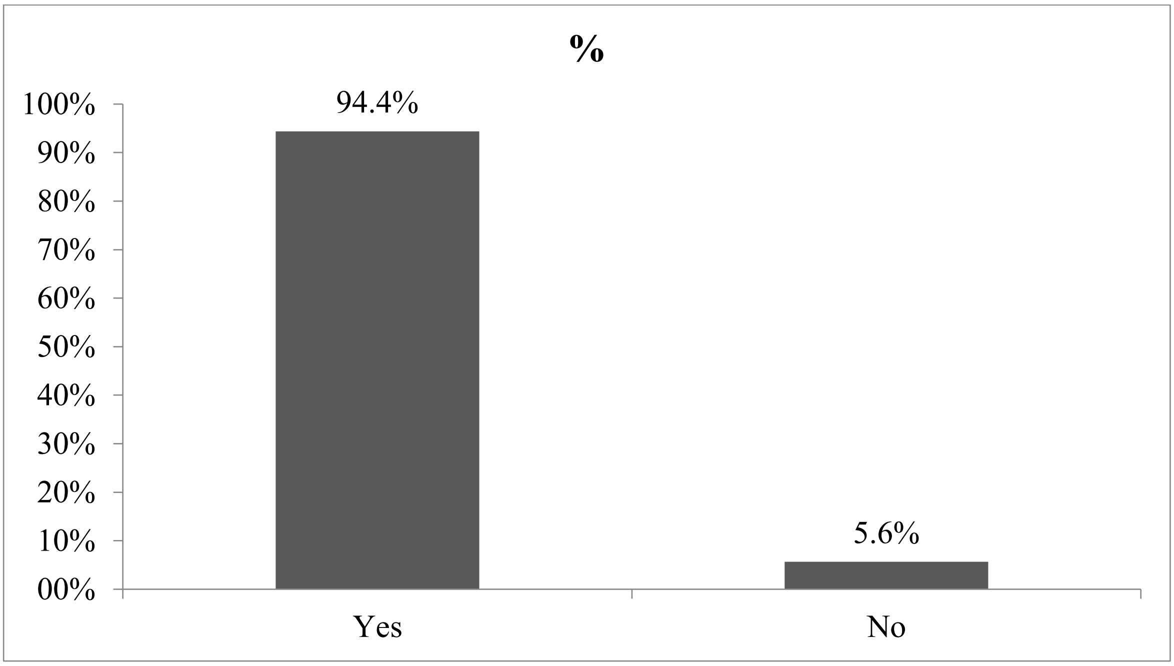
The results depict the distribution of players based on whether they have experienced a previous injury in the same area and of the same type. A significant majority of players, constituting 94.4%, do not report any previous history of an injury in the same area and of the same type. On the other hand, a small percentage, 5.6% of players, indicate that they have experienced a previous injury in the same area and of the same type. These results suggest that the majority of players have not encountered repeated injuries in specific areas or types, emphasizing the potential effectiveness of preventive measures or successful rehabilitation efforts in this population.

Table 19: Previous injury.

Previous injury of the same location and type	N	%
No	134	94.4%
Yes	8	5.6%

Source: Own source 2024.

Figure 9: Previous injury.



Source: Own source 2024.

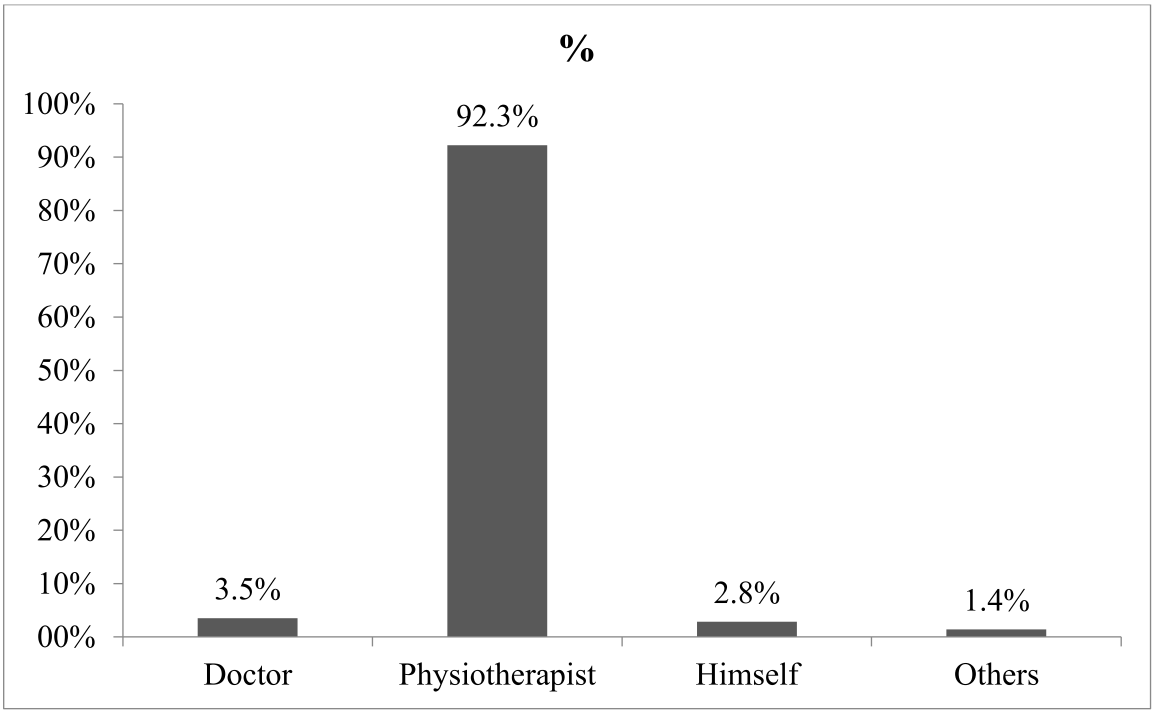
The results present the sources of medical assistance sought by individuals within the studied population for the management of their injuries. Among the participants, 3.5% have consulted a physician, 92.3% have sought the expertise of a physiotherapist, 2.8% have self-treated their injuries, and 1.4% have sought assistance from other unspecified sources. These results underscore the prominent role of physiotherapists in injury management within this population, suggesting that a significant majority prefer or utilize the specialized skills of physiotherapy professionals for their recovery. The use of various sources for injury management highlights the diverse approaches individuals follow based on their preferences and the nature of their injuries.

Table 20: Treatment of injuries that occurred.

Treatment of injuries that occurred	N	%
Doctor	5	3.5%
Physiotherapist	131	92.3%
Himself	4	2.8%
Others	2	1.4%

Source: Own source 2024.

Figure 10: Treatment of injuries that occurred.



Source: Own source 2024.

Match and training exposure

A total of 26,123 hours of exposure were logged during the course of the whole season, including 3,748 hours of played matches and 22,375 hours of training. Players attended 157.45 ± 31.60 training sessions and took part in 26.20 ± 6.37 matches on average. 183.96 ± 31.47 hours were the resultant mean exposure time.

The results provide insights into the causes of injuries related to contact with other players within the studied population. Among the participants, 30.3% report having no injuries, while 40.8% have no reported injuries. For those with reported injuries, 28.9% indicate that their injuries were caused by contact with another player.

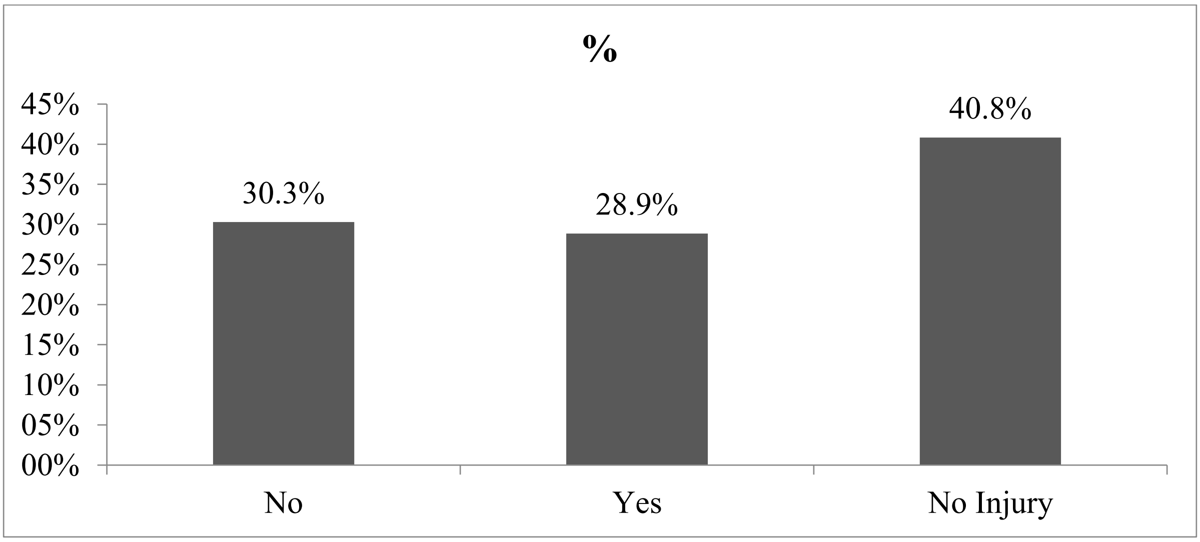
These data suggest that, while a significant portion of injuries occurs independently of contact with other players, a substantial proportion is linked to interactions with other players during matches or training sessions. Understanding the role of contact with other players in injuries is crucial for developing strategies to reduce the risk of such incidents and enhance player safety in sports and physical activities.

Table 21: Injuries caused by contact with another player.

Injuries caused by contact with another player	N	%
No	43	30.3%
Yes	41	28.9%
No Injury	58	40.8%

Source: Own source 2024.

Figure 11: Injuries caused by contact with another player.



Source: Own source 2024.

In this study, a total of 142 women players of the elite league were included, from which anthropometric assessments of the players, such as the players' age, weight, height, and BMI were 20.39 ± 3.44 years, 58, 49 ± 6.02 kg, 1.65 ± .06 m, and 21.2 ± 1.8 kg/m^2. The basic characteristics of the players were composed of 14 goalkeepers (9.9%), 54 defenders (38%), 40 midfielders (28.2%), and 34 forwards (23.9%). The dominant leg was determined in 74 players (52.1 %), the left one in 22 (155 %) players, and both legs in 46 (32.4 %) cases Table 22.

Table 22: Descriptive analysis.

	Mean			GK (N = 14)			DF (N = 54)			MDF (N = 40)			ST (N = 34)		
Age (years, SD)	20.39 ± 3.44			19.93 ± 3.14			20.41 ± 3.51			21.13 ± 3.86			19.68 ± 2.82		
Height (m, SD)	1.65 ± 0.6			1.67 ± 0.05			1.66 ± 0.63			1.64 ± 0.003			1.65 ± 0.071		
Weight (kg, SD)	58.49 ± 6.02			61.86 ± 6.10			58.76 ± 6.05			57.78 ± 5.71			75.53 ± 6.04		
BMI (kg/m^2)	21.20 ± 1.8			21.97 ± 2.35			21.29 ± 1.67			21.29 ± 1.95			20.98 ± 1.87		
Dominant leg (n, %)	R	L	Bil	R	L	Bil	R	L	Bil	R	L	Bil	R	L	Bil
	74 52.1 %	22 15.5 %	46 32.4 %	7	1	6	28	11	15	18	6	16	21	4	9

BMI, body mass index; GK, goalkeeper; DF, defender; MDF, midfielder; ST, strikers; R, right; L, left; Bil, bilateral; SD, standard deviation.
Source: Own source 2024.

Injuries depending on the position playing.

A total of 84 injuries were recorded. Amongst those, goalkeepers (n = 9, 10.7%, IR = 1.07; CI = 0.49, 2.03), strikers (n = 17, 20.2%; IR = 2.02; CI = 1.18, 3.24), midfielders (n = 23, 27.4%; IR = 2.74; CI = 1.74, 4.11) represented the most frequently affected groups, followed by defenders (n = 35, 4.17%; IR = 2.47; CI = 1.72, 3.43 of all injuries). Defenders, on average, were the group's youngest members 20.4 ± 3.52 years, while midfielders were the oldest 20.9 ± 3.56 years. Forwards 20.24 ± 2.70 years old, goalkeepers 20 ± 3.16 years old. Injury IRRs were significantly higher (IRR = 25.71, CI = 10.87, 54.57, $p < 0.001$) in goalkeepers (n = 9, 10%.7) comparing to defenders (n = 35, 41.7%). Yet this was not the case in between strikers (n = 17, 20.2%) and midfielders (n = 23, 27.4%), where no observable differences were significant (IRR = 1.35, CI = 0.69, 2.69 (p = 0.349).

Injuries by location and severity

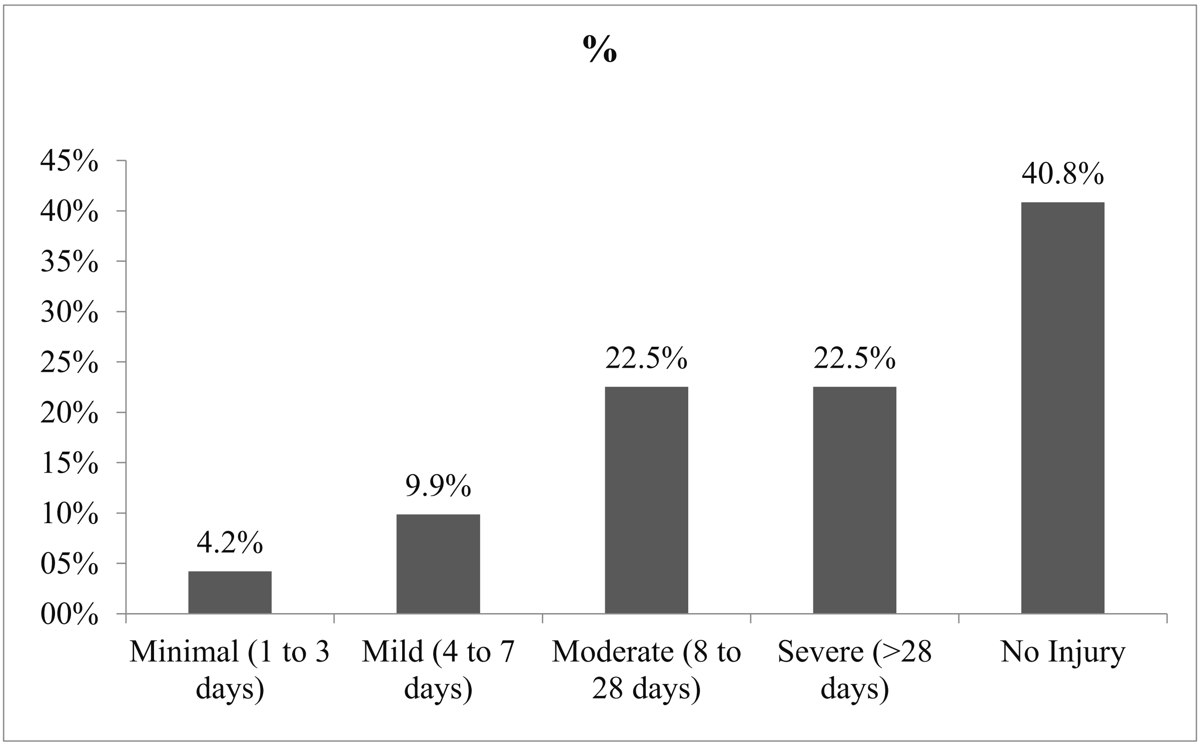
The results categorize the importance of injuries based on the recovery time in days within the studied population. Among the participants, 40.8% report having no injuries. For those with reported injuries, the distribution of importance is as follows: 4.2% have experienced minimal injuries (lasting from 1 to 3 days), 9.9% have had mild injuries (lasting from 4 to 7 days), 22.5% have faced moderate injuries (lasting from 8 to 28 days), and an equal percentage (22.5%) have dealt with severe injuries (lasting over 28 days). These results offer a nuanced understanding of the extent of injury severity in the population, with a substantial number of individuals experiencing injuries with varying durations. Classification into categories is important for tailoring rehabilitation and recovery plans based on the nature and extent of the observed injuries.

Table 23: Severity of injury in days.

Severity category Severity of injury in days	N	%
Minimal (1 to 3 days)	6	4.2%
Mild (4 to 7 days)	14	9.9%
Moderate (8 to 28 days)	32	22.5%
Severe (>28 days)	32	22.5%
No Injury	58	40.8%

Source: Own source 2024.

Figure 12: Severity category.



Source: Own source 2024.

Incidence rate of overall injury

While 60 (42.3 %) the single body parts most frequently injured by injuries in the lower extremities were the knee, thigh, and ankle, whereas joint injuries in the upper extremities and trunk made for 24 (16.9%) of all registered injuries. In addition, the majority of injuries were categorized as mild (absence from play between 1 and 3 days, n-6; 4.2%), moderate (absence from play between 4 and 7 days, n-14; 9.9%), or severe (absence > 28 days, n-32; 22.5%). Smaller groups were categorized as minimal (absence from play between 1 and 3 days, n-6; 4.2%) and medium (absence from play between 4 and 7 days, n-14; 9.9%).

When analysing the injury occurrence based on the body region (Table 24), it can be observed that the majority of injuries are with in the lower extremities (n = 58, 69.2%), including knee (n = 21, 25.0%), ankle (n = 10, 11.9%) and foot (n = 7, 8.3%) as the three most common sites.

It should be highlighted that shoulder injuries were the most common type of injury to the upper extremities (7.1%), whereas the dispersion of injuries within the trunk was rather equal in between lumbar (n = 2, 2.4%), pelvis/sacrum (n = 2, 2.4%) and cervical spine (n = 1, 1.2%).

Another interesting finding that was observed in table 24 was the fact that moderate and severe injuries made up the bulk of the total number of injuries (n = 64, 76.2%), with an equal dispersion in between these two groups (n = 32, 38.1% each).

Table 24: Injuries by location and severity.

Severity category					
Injured body part	Minimal (1 to 3 days)	Mild (4 to 7 days)	Moderate (8 to 28 days)	Severe (>28 days)	**Total**
Head/Face	-	1 (7.1%)	1 (3.13%)	-	2 (2.4%)
Neck / Cervical Spine	-	1 (7.1%)	-	-	1 (1.2%)
Lumbar Spine	-	1 (7.1%)	-	1 (3.1%)	2 (2.4%)
Pelvis / Sacrum	1 (16.7%)	-	1 (3.13%)	-	2 (2.4%)
Shoulder	-	1 (7.1%)	2 (6.25%)	3 (9.4%)	**6 (7.1%)**
Elbow	-	-	-	1 (3.1%)	1 (1.2%)
Lower Arm	-	-	1 (3.13%)	-	1 (1.2%)
Wrist	-	1 (7.1%)	1 (3.13%)	3 (9.4%)	5 (6.0%)
Hand	-	-	1 (3.13%)	-	1 (1.2%)
Finger / Thumb	-	1 (7.1%)	1 (3.13%)	1 (3.1%)	3 (3.6%)
Hip	-	1 (7.1%)	-	-	1 (1.2%)
Groin	-	-	1 (3.13%)	-	1 (1.2%)
Musculus adductor	-	-	2 (6.25%)	1 (3.1%)	3 (3.6%)
Hamstring	-	1 (7.1%)	3 (9.38%)	1 (3.1%)	5 (6.0%)
Quadriceps	-	-	1 (3.13%)	-	1 (1.2%)
Thigh	-	-	1 (3.13%)	-	1 (1.2%)
Knee	1 (16.7%)	1 (7.1%)	5 (15.63%)	14 (43.8%)	**21 (25.0%)**
Lower Leg	1 (16.7%)	-	1 (3.13%)	1 (3.1%)	3 (3.6%)
Achilles Tendon	-	2 (14.3%)	2 (6.25%)	1 (3.1%)	5 (6.0%)
Ankle	1 (16.7%)	-	5 (15.63%)	4 (12.5%)	**10 (11.9%)**
Foot	2 (33.3%)	2 (14.3%)	2 (6.25%)	1 (3.1%)	7 (8.3%)
Toe	-	1 (7.1%)	1 (3.13%)	-	2 (2.4%)
Total	6 (7.1%)	14 (16.7%)	32 (38.1%)	32 (38.1%)	84 (100%)

Source: Own source 2024.

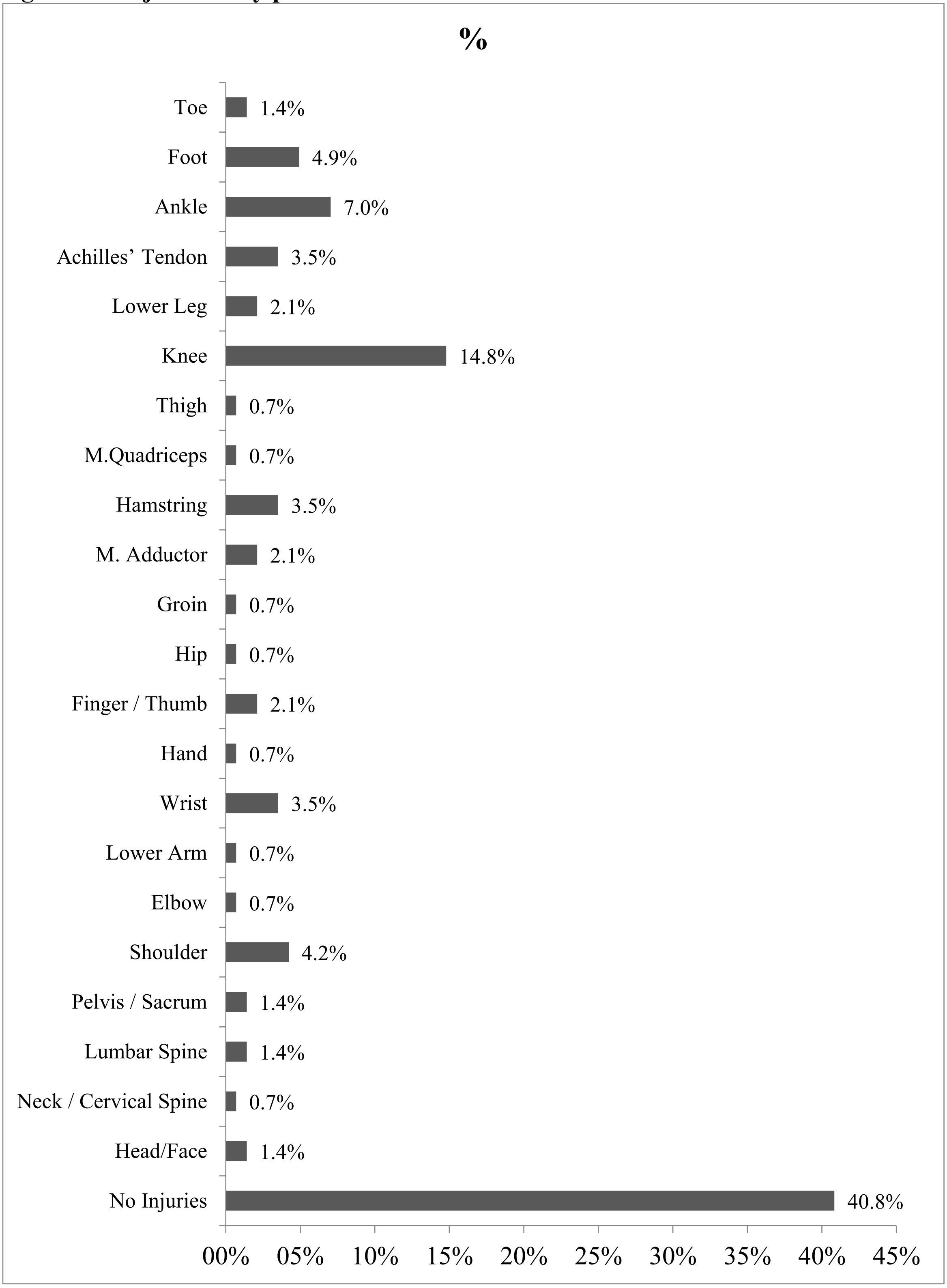
The results provide a comprehensive overview of the distribution of injuries across different parts of the body within the studied population. The majority of individuals, accounting for 40.8%, report having no injuries. Among those with reported injuries, the most frequently affected areas include the knee (14.8%), the leg (7.0%), and the head/face (1.4%). Other significant injury zones include the spine (4.2%), the hand (3.5%), and the Achilles tendon (3.5%). These findings highlight the diversity of injuries, with a varied range of body parts affected, underscoring the importance of monitoring, and addressing injuries in different areas to ensure the overall well-being of individuals involved in the study.

Table 25: Injured body part.

Injured body part	N	%
No Injuries	58	40.8%
Head/Face	2	1.4%
Neck / Cervical Spine	1	0.7%
Lumbar Spine	2	1.4%
Pelvis / Sacrum	2	1.4%
Shoulder	6	4.2%
Elbow	1	0.7%
Lower Arm	1	0.7%
Wrist	5	3.5%
Hand	1	0.7%
Finger / Thumb	3	2.1%
Hip	1	0.7%
Groin	1	0.7%
M. Adductor	3	2.1%
Hamstring	5	3.5%
M.Quadriceps	1	0.7%
Thigh	1	0.7%
Knee	21	14.8%
Lower Leg	3	2.1%
Achilles' Tendon	5	3.5%
Ankle	10	7.0%
Foot	7	4.9%
Toe	2	1.4%
Total	84	100%

Source: Own source 2024.

Figure 13: Injured body part.



Source: Own source 2024.

Table 26 highlights the distribution of injuries by type and severity. Contusions (n = 15, 17.9%), sprains (n = 12, 14.3%), fractures (n = 8, 9.5%) and dislocations (n = 8, 9.5%) injuries that occurred most frequently, representing more than half of all injuries combined (n = 43, 51.2%). The most frequent injuries requiring minimal recovery time were contusions (n = 4, 66.7%), whereas for a mild period of time (4-7 days) the most frequent ones were lacerations / abrasions (n = 3, 21.4%) and tendonitis (n = 3, 21.4%). The most prominent injuries requiring moderate (8 to 28 days) and severe (> 28 days) recovery time were sprains (n = 7, 21.9%), strains (n = 6, 18.8%) and lacerations (n = 4, 12.5%), as well as fractures, dislocations, and ligamentous ruptures with or without instability (n = 5, 15.6% in all cases).

Table 26: Injuries by type and severity.

Severity category					
Type of injury	Minimal (1-3days)	Mild (4 - 7 days)	Moderate (8 to 28 days)	Severe (>28 days)	Total
Fracture	-	1 (7.1%)	2 (6.3%)	5 (15.6%)	**8 (9.5%)**
Dislocation	1 (16.7%)	-	2 (6.3%)	5 (15.6%)	**8 (9.5%)**
Rupture of muscle	-	-	-	1 (3.1%)	1 (1.2%)
Ligamentous rupture with instability	-	-	-	5 (15.6%)	5 (6.0%)
Ligamentous rupture without instability	-	-	1 (3.1%)	5 (15.6%)	6 (7.1%)
Lesion of meniscus	-	-	-	1 (3.1%)	1 (1.2%)
Sprain	-	2 (14.3%)	7 (21.9%)	3 (9.4%)	**12 (14.3%)**
Strain	-	2 (14.3%)	3 (9.4%)	2 (6.3%)	7 (8.3%)
Contusion	4 (66.7%)	1 (7.1%)	6 (18.8%)	4 (12.5%)	**15 (17.9%)**
Tendonitis / Bursitis	-	3 (21.4%)	3 (9.4%)	-	6 (7.1%)
Dental Injury	-	1 (7.1%)	-	-	1 (1.2%)
Deep wound	-	1 (7.1%)	1 (3.1%)	-	2 (2.4%)
Laceration / Abrasion	1 (16.7%)	3 (21.4%)	4 (12.5%)	-	**8 (9.5%)**
Others Diagnosis	-	-	3 (9.4%)	1 (3.1%)	4 (4.8%)
Total	6 (7.1%)	14 (16.7%)	32 (38.1%)	32 (38.1%)	84 (100%)

Source: Own source 2024.

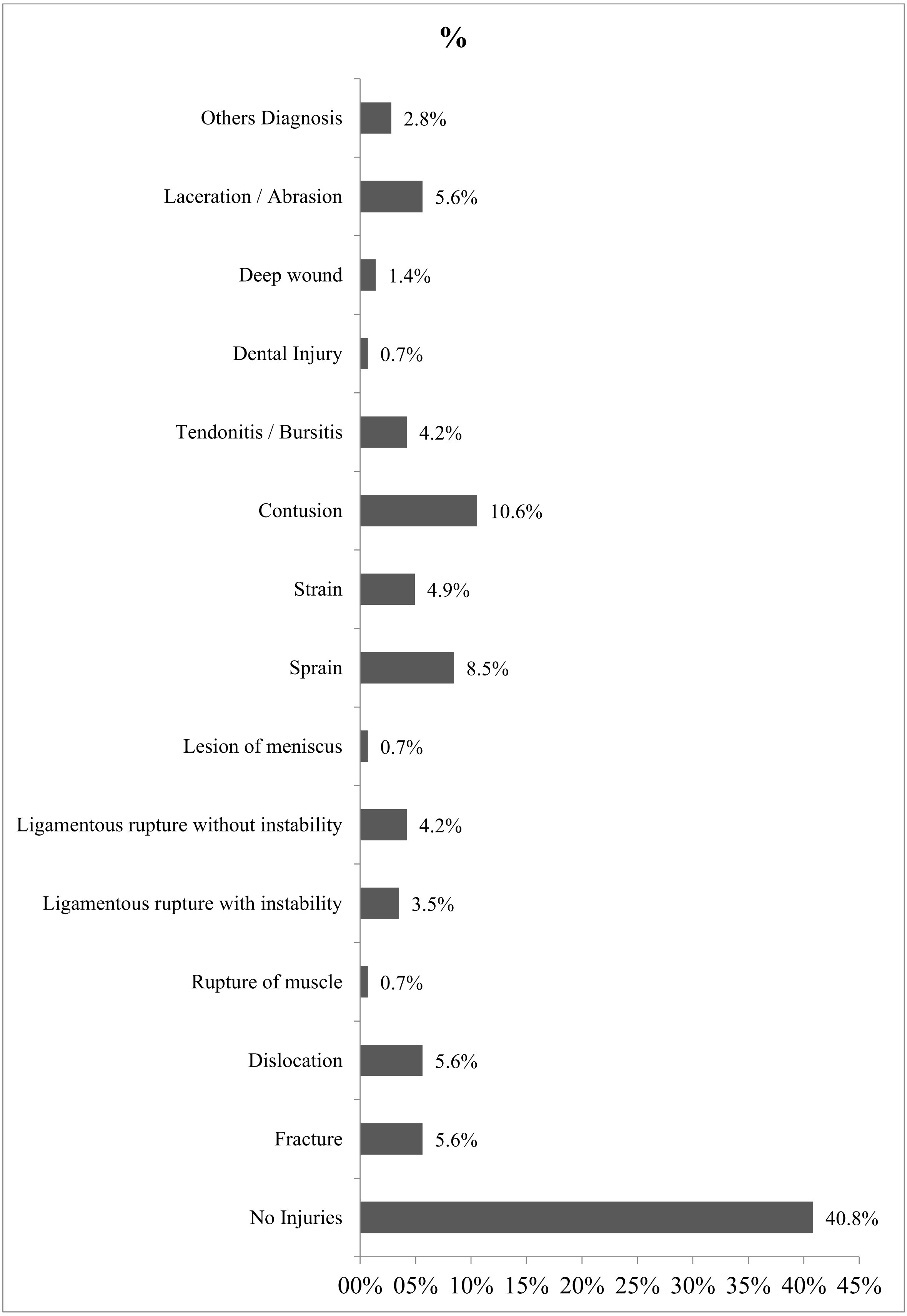
The results present the types of reported injuries within the studied population. The majority of players, comprising 40.8%, do not report any injuries. Among those with reported injuries, the most frequent types include contusions (10.6%), sprains (8.5%), and fractures (5.6%). Ligamentous tears and sprains, both with and without instability, each account for 5.6% of the reported injuries. Less common injury types encompass strains (4.9%), tendonitis/bursitis (4.2%), and lacerations/abrasions (5.6%). Additionally, there are isolated cases of muscle strain, meniscus damage, dental injuries, deep wounds, and other diagnoses, each representing smaller percentages. These data provide a comprehensive overview of various injury types faced by the studied population, emphasizing the need for diverse approaches in injury management and prevention.

Table 27: Type of injury.

Type of injury	N	%
No Injuries	58	40.8%
Fracture	8	5.6%
Dislocation	8	5.6%
Rupture of muscle	1	0.7%
Ligamentous rupture with instability	5	3.5%
Ligamentous rupture without instability	6	4.2%
Lesion of meniscus	1	0.7%
Sprain	12	8.5%
Strain	7	4.9%
Contusion	15	10.6%
Tendonitis / Bursitis	6	4.2%
Dental Injury	1	0.7%
Deep wound	2	1.4%
Laceration / Abrasion	8	5.6%
Others Diagnosis	4	2.8%
Total	142	100%

Source: Own source 2024.

Figure 14: Type of Injury.



Source: Own source 2024.

Traumatic vs. overuse injuries

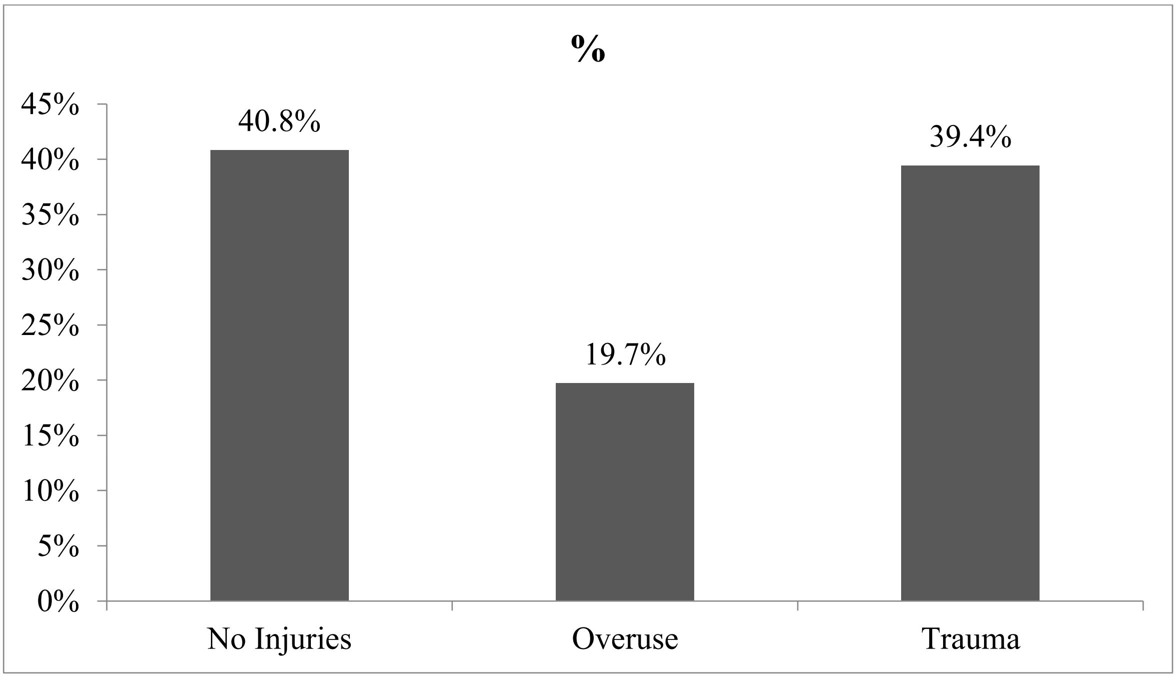
The results describe the causes of injuries within the studied population. Among the participants, 40.8% do not report any injuries. For those with reported injuries, 19.7% attribute the injury to overuse, while a larger proportion, 39.4%, attribute the injury to trauma. These findings highlight the significance of both overuse and traumatic factors in injury occurrences, with a substantial portion resulting from unexpected external forces or impacts (trauma), and a considerable portion associated with repeated stress or strain (overuse). Understanding the causes of injuries is crucial for developing effective preventive strategies tailored to the specific nature of observed injuries in the population.

Table 28: Injuries caused by overuse or trauma.

Injuries caused by overuse or trauma	N	%
No Injuries	58	40.8%
Overuse	28	19.7%
Trauma	56	39.4%

Source: Own source 2024.

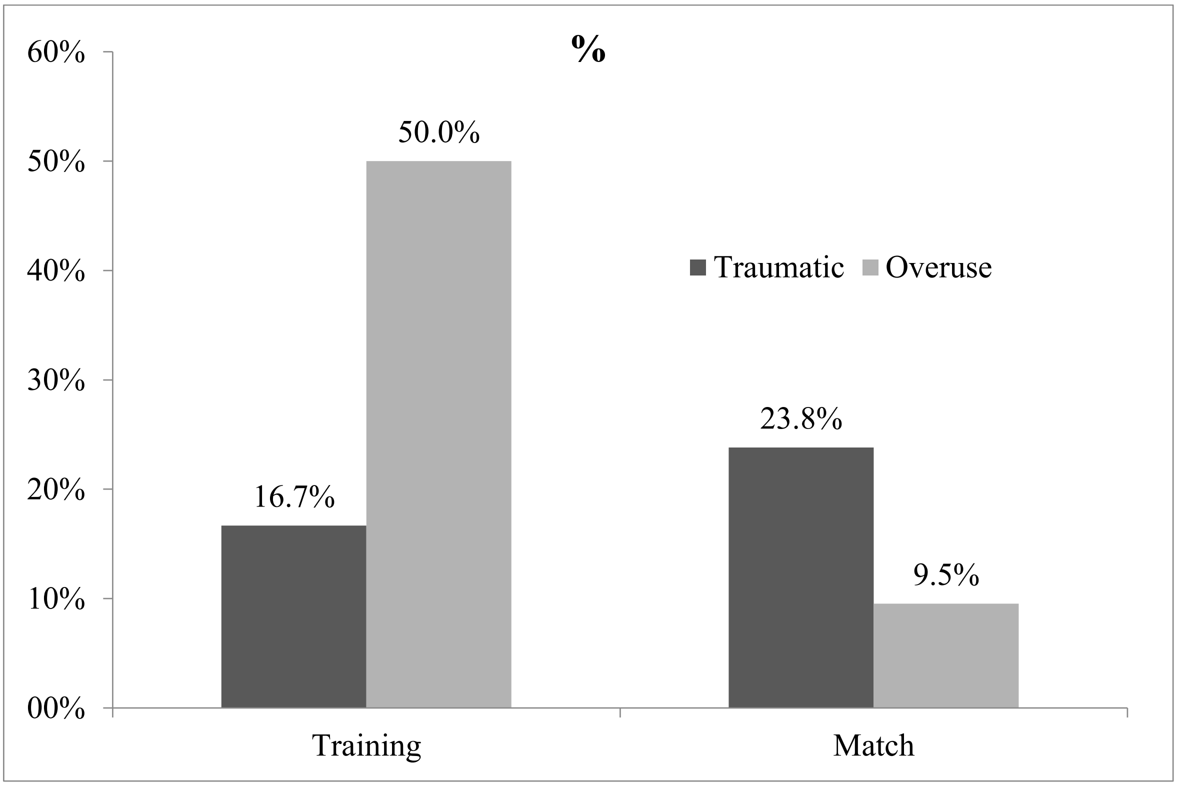
Figure 15: Was the injury caused by overuse or trauma.



Source: Own source 2024.

From the total injuries (n = 84; IR = 2.00; CI: 1.24, 3.27), traumatic and overuse ones (n = 56; IR = 2.14; CI: 1.61, 2.78) were the majority (66.7%) and significantly higher ($p < 0.05$) than the overuse injuries (33.3%; n = 28; IRR = 1.07; CI: 0.71, 1.54), as observed in figure 16.

Figure 16: Traumatic and overuse injuries that occur most frequently during training and match.



Source: Own source 2024.

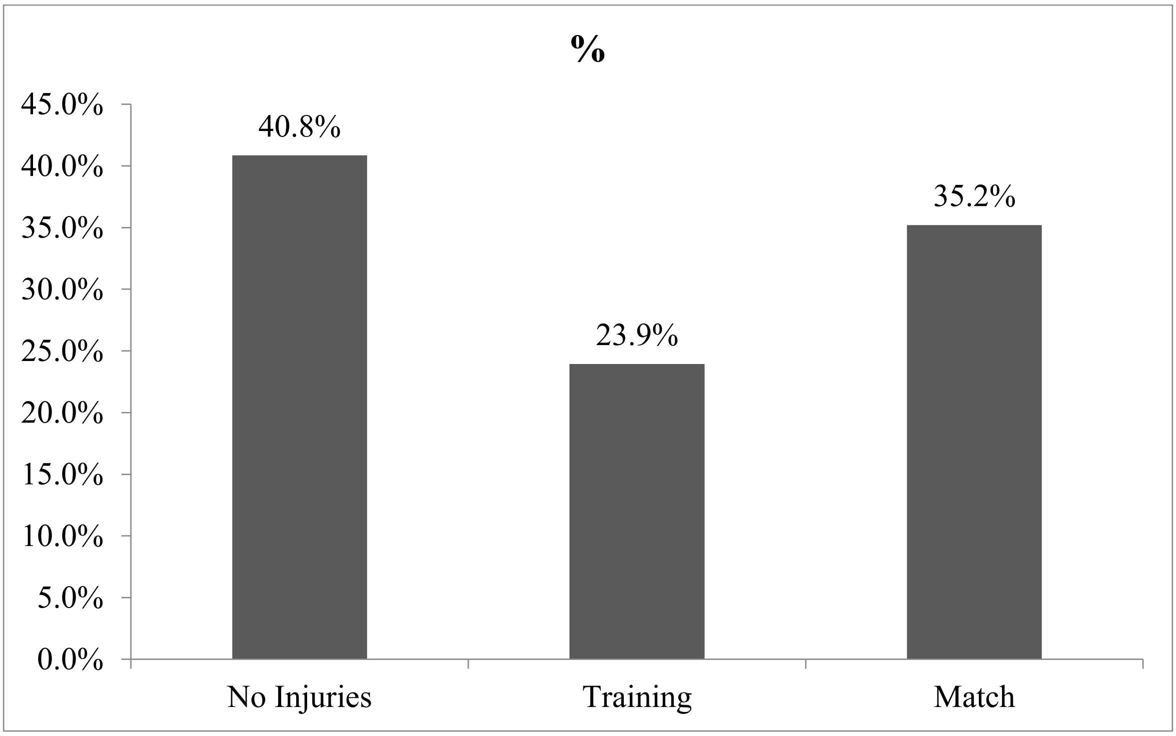
The results describe the timing of injuries within the studied population. Among the participants, 40.8% do not report any injuries. For those with reported injuries, 23.9% have experienced injuries during training sessions, while a larger proportion, 35.2%, have encountered injuries during competitive matches. These results highlight that a considerable number of injuries occur during competitive matches, emphasizing the high risk that athletes face in game situations. Additionally, a significant portion of injuries occurs during training, underscoring the importance of injury prevention measures during both training sessions and competitive play to ensure the overall well-being of individuals involved in the study.

Table 29: Injuries occurred.

Injuries occurred	N	%
No Injuries	58	40.8%
Training	34	23.9%
Match	50	35.2%

Source: Own source 2024.

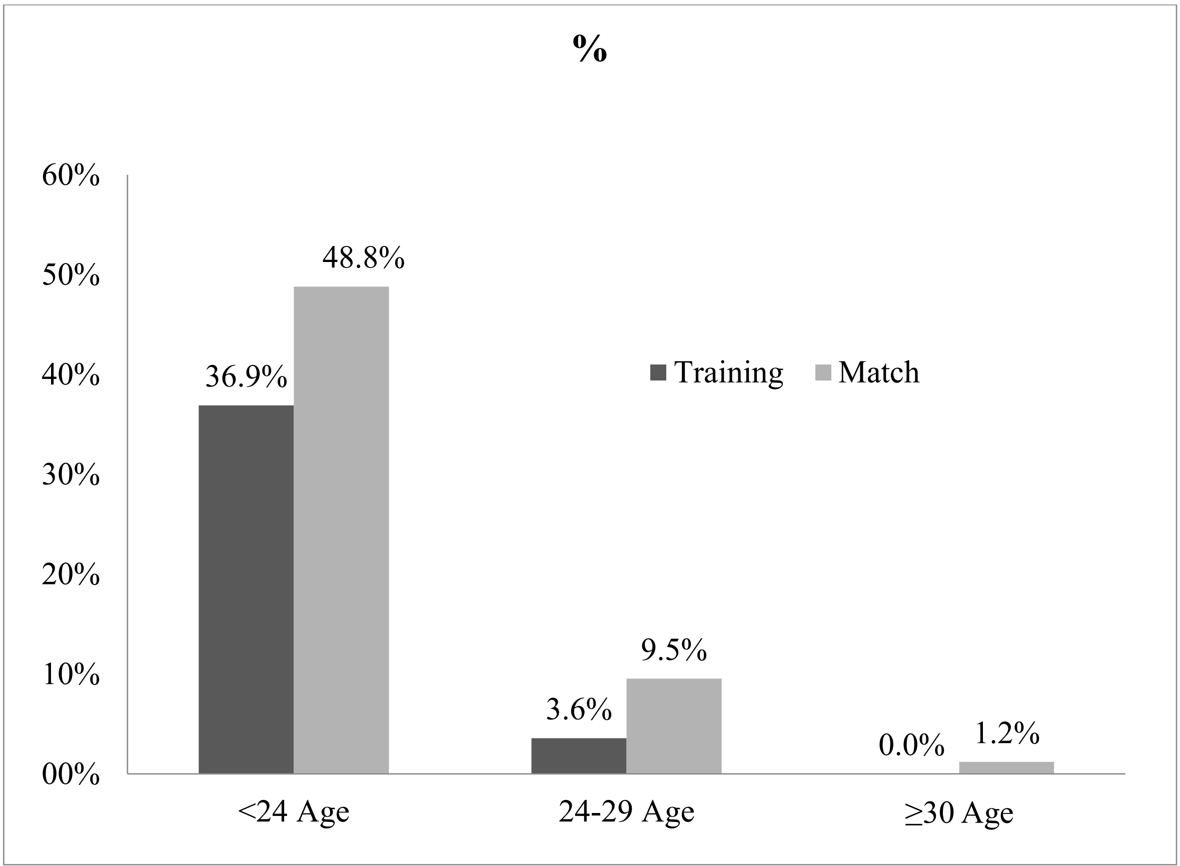
Figure 17: When did the injury occur.



Source: Own source 2024.

Overall number of injuries differed between those occurring in training and those in match (34 versus 50), declining from 36.9% and 48.8% (31 and 41 players respectively) amongst players aged 24-year-old and younger, 3.57% and 9.52% (3 and 8, respectively) in those aged between 25 and 29, and 0% and 1.2% (0 and 1, respectively) in athletes aged 30 years and older (figure 18).

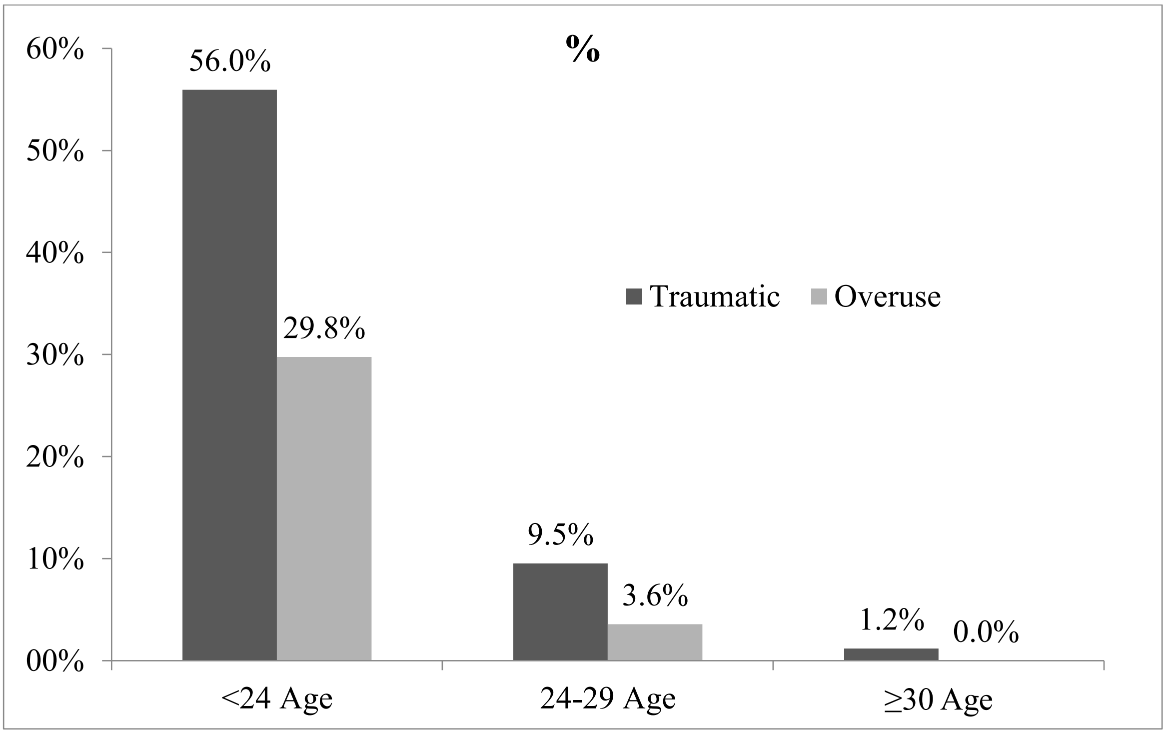
Figure 18: Relative numbers of injuries occurring during training and matches separated by age.



Source: Own source 2024.

Additionally, the number of injuries (both from overuse and traumatic origins) declined from 29.8% and 56.0% (25 overuse and 47 traumatic injuries, respectively) in the age group of 24 years old and below, to 3.6% and 9.5% (3 and 8, respectively) in the 25 – 29-year-old group, and no injuries and 1.19% (0 and 1, respectively) in the above age group of 30 years and above (figure 19).

Figure 19: Relative numbers of traumatic and overuse injuries separated by age.



Source: Own source 2024.

Comparative Results

Comparison between age and other parameters - The comparison data that follow demonstrate that there were no statistically significant variations in height (P = 0.136). Weight, however, showed a significant difference between the groups (P = 0.040), with the average weight of the ≥30 age group being greater at 73.00 ± 5.44 kg.

There were no discernible variations in body mass index (BMI) (P = 0.181). There were no statistically significant variations in exposure time metrics (matches, training, and total) between age groups. In particular, there was a significant difference (P = 0.016) in the Lift and Reach Test results, demonstrating different levels of flexibility between the age groups.

The Aerobic Fitness Test also revealed a significant variation (P = 0.009), indicating that various age groups had varying aerobic capacity. There were no discernible changes between the age groups for other measures, such as the incidence rate, Y-Balance Test, and Squat Jump Test outcomes.
Each age group's mean values and standard deviations for every parameter are provided, offering information on the physical traits and performance indicators of the population under study.

Table 30: Comparison between age and other parameters.

	≤24		25-29		≥30		
Age by grope	Mean	Std	Mean	Std	Mean	Std	P-value
Age (years)	1.66	0.05	1.64	0.08	1.77	*	0.136
Height (m)	58.83	5.44	59.73	5.87	73.00	*	**0.040****
Weight (kg)	21.34	1.60	22.25	2.74	23.30	*	0.181
BMI (kg/m^2)	1453.75	325.26	1456.36	408.12	1710.00	*	0.752
Exposure time of match / h	8696.25	1703.78	9065.45	1134.21	7200.00	*	0.511
Exposure time - Training / h	10150.00	1651.88	10521.82	1159.19	8910.00	*	0.563
Exposure time Total /h	24.23	5.42	24.27	6.80	28.50	*	0.752
Match/h	144.94	28.40	151.09	18.90	120	*	0.511
Training /h	169.60	27.56	175.73	19.37	149.00	*	0.568
Match and Training h	16.96	2.76	17.57	1.94	14.90	*	0.568
Incidence rate	84.71	3.27	85.28	1.99	85.07	*	0.848
Y Balance Test Right (cm)	82.31	2.74	81.82	2.84	80.21	*	0.657
Y Balance Test Left (cm)	3.72	1.95	4.24	2.35	4.86	*	0.631
Y Balance Test Difference %	12.65	5.71	17.91	4.41	16.00	*	**0.016 ** **
Sit and Reach Test (cm)	41.97	5.66	40.36	6.87	42.00	*	0.695
Countermovement Jump Test (cm	10.59	2.10	8.49	1.92	9.40	*	**0.009***

Source: Own source 2024.

Comparison between Position of Play and other factors.

There was a significant difference in weight (P = 0.032) between the examination of many factors for the goalkeeper, defender, forward, and midfielder positions on the field. Goalkeepers weighed 64.22 ± 5.42 kg on average, Defenders weighed 58.17 ± 5.57 kg, Forwards weighed 59.24 ± 5.56 kg, and Midfielders weighed 58.48 ± 5.19 kg on average.

There appears to be a statistically significant variation in weight between the four places, as indicated by the p-value of 0.032. The results of the Y-Balance Test, Lift and Reach Test, Squat Jump Test, and 20-Meter Aerobic Fitness Test, as well as height, Body Mass Index (BMI), exposure time metrics (matches, training, and total), match and training hours, incidence rate, and other measures did not show statistically significant differences across various playing positions on the field.

The study population's physical attributes and performance metrics are revealed through the reporting of mean values and standard deviations for every parameter for every playing position.

Table 31: Comparison between Position of Play and other factors.

Position on the field	Goalkeeper Mean	Std	Defender Mean	Std	Striker Mean	Std	Midfielder Mean	Std	P-value
Age (years)	1.701	.046	1.66	.067	1.652	.072	1.644	.042	.128
Height (m)	64.22	5.42	58.17	5.57	59.24	5.56	58.48	5.19	**.032****
Weight (kg)	22.23	2.20	21.08	1.58	21.71	1.97	21.63	1.78	.296
BMI (kg/m^2)	1350.00	324.500	1427.14	350.03	1598.82	253.62	1440.00	351.72	.229
Exposure time of match / h	8440.00	1735.72	9133.71	1585.72	8899.41	1795.76	8092.17	1432.54	.106
Exposure time -Training / h	9790.00	1716.96	10560.86	1497.09	10498.24	1853.47	9532.17	1306.73	.068
Exposure time Total /h	22.50	5.40	23.79	5.83	26.65	4.22	24.00	5.86	.229
Match/h	140.67	28.92	152.23	26.42	148.32	29.92	134.87	23.87	.106
Training /h	163.67	28.60	176.40	25.07	175.35	30.95	159.35	21.68	.071
Match and Training h	16.37	2.86	17.64	2.51	17.54	3.10	16.93	2.17	.071
Incidence rate	84.80	3.17	85.48	2.57	85.22	3.06	83.41	3.61	.086
Y Balance Test Right (cm)	81.77	3.92	81.83	2.39	82.83	2.78	82.54	2.72	.552
Y Balance Test Left (cm)	3.62	2.56	4.16	1.95	4.19	1.69	3.02	1.92	.143
Y Balance Test Difference %	12.33	6.52	13.66	5.06	11.06	6.53	15.07	5.72	.167
Sit and Reach Test (cm)	39.56	5.61	52.54	5.72	41.411	5.33	41.70	6.34	.576
Countermovement Jump Test (cm	10.94	1.39	10.44	2.21	10.24	2.30	9.90	2.31	.647

Source: Own source 2024.

Comparison between weight categories and other factors.

Statistically significant differences were observed when various factors from the four Body Mass Index (BMI) categories—Underweight, Normal weight, Overweight, and Obesity—were analyzed. In particular, there were notable variations in body mass index (BMI) (P = 0.000) and weight (P = 0.000) within BMI groups.

The average weight of those who were categorized as underweight was 50.75 ± 2.22 kg with a BMI of 17.97 ± 0.40, whereas the average weight of people who were classified as normal weight was 59.01 ± 5.09 kg with a BMI of 21.40 ± 1.37.

The average weight of those who were categorized as overweight was 67.40 ± 5.03 kg, and their BMI was 25.48 ± 0.47. Individuals who were obese had high BMI and weight numbers. The results of the Y-Balance Test, Lift and Reach Test, Squat Jump Test, and 20-Meter Aerobic Fitness Test, as well as age, height, exposure time metrics (matches, training, and total), match and training hours, incidence rate, and other parameters did not demonstrate statistically significant differences among the various BMI categories. Each BMI category's mean values and standard deviations for every parameter are provided, offering information on the physical traits and performance indicators of the population under study.

Table 32: Comparison between BMI categories and other factors.

BMI	Underweight Mean	Underweight Std	Normal weight Mean	Normal weight Std	Overweight Mean	Overweight Std	Obese Mean	Obese Std	P-value
Age (years)	19.75	2.50	20.33	3.28	23.20	3.56	*	*	.155
Height (m)	1.68	0.02	1.66	0.06	1.63	0.07	*	*	.390
Weight (kg)	50.75	2.22	59.01	5.09	67.40	5.03	*	*	**.000***
BMI (kg/m^2)	17.97	0.40	21.40	1.37	25.48	0.47	*	*	**.000***
Exposure time of match / h	1395.00	363.73	1455.6	340.10	1530.00	246.48	*	*	.831
Exposure time - Training / h	8752.80	1669.4	8752.8	1669.45	8316.00	1660.25	*	*	.849
Exposure time Total /h	10147.50	1040.2	10208.4	1614.53	9846.00	1828.57	*	*	.887
Match/h	23.25	6.06	24.26	5.67	25.50	4.11	*	*	.831
Training /h	145.88	20.32	145.88	27.82	138.60	27.67	*	*	.849
Match and Training h	169.50	17.41	170.56	26.94	164.60	30.48	*	*	.890
Incidence rate	16.95	1.74	17.06	2.69	16.46	3.05	*	*	.890
Y Balance Test Right (cm)	83.73	2.55	84.86	3.22	84.62	1.78	*	*	.777
Y Balance Test Left (cm)	80.26	0.91	82.32	2.70	82.26	3.88	*	*	.340
Y Balance Test Difference %	3.47	1.67	3.84	2.05	3.44	1.64	*	*	.864
Sit and Reach Test (cm)	16.38	5.76	13.07	5.81	15.60	5.46	*	*	.368
Countermovement	44.75	4.43	41.79	5.71	39.00	7.52	*	*	.334

Jump Test (cm									
Aerobic Fitness Test – 20-Meter (levels)	11.50	0.54	10.34	2.15	8.76	2.74	*	*	.153

Source: Own source 2024.

Comparison between Dominant leg and other factors.

Most of the parameters did not exhibit statistically significant changes when analyzed based on dominant leg (left, right, or both). In particular, there were no statistically significant variations between the dominant leg groups in terms of age, height, weight, Body Mass Index (BMI), match and training hours, incidence rate, exposure time metrics (matches, training, total), Squat Jump Test, Lift and Reach Test, and the 20-Meter Aerobic Fitness Test.

On the other hand, there was a possible tendency towards statistical significance ($P = 0.072$) in the Y-Balance Test along the right leg. For the left-dominant group, the average results for the Y-Balance Test along the right leg were 85.40 ± 2.35, for the right-dominant group, 85.31 ± 2.75, and for the both-dominant group, 83.69 ± 3.72.

With the exception of a possible trend in the Y-Balance Test along the right leg, the findings generally show that there are no significant changes in most parameters dependent on the dominant limb.

Table 33: Comparison between Dominant leg and other factors.

Dominant leg	Left Mean	Std	Right Mean	Std	Both Mean	Std	P-value
Age (years)	19.75	2.35	20.90	3.68	20.29	3.22	.472
Height (m)	1.65	0.06	1.67	0.06	1.65	0.06	.562
Weight (kg)	58.13	5.04	59.80	4.88	58.71	6.95	.550
BMI (kg/m^2)	21.25	1.66	21.56	1.89	21.50	1.80	.846
Exposure time of match / h	1434.38	317.72	1473.75	344.49	1446.43	337.58	.906
Exposure time - Training / h	8949.38	1498.79	8703.00	1653.65	8633.57	1734.46	.824
Exposure time Total /h	10383.75	1444.82	10176.75	1609.24	10080.00	1687.48	.833
Match/h	23.91	5.30	24.56	5.74	24.11	5.63	.906
Training /h	149.16	24.98	145.05	27.56	143.89	28.91	.824
Match and Training h	173.44	24.15	170.00	26.90	168.50	28.07	.841
Incidence rate	17.34	2.42	17.00	2.69	16.85	2.81	.841
Y Balance Test Right (cm)	85.40	2.35	85.31	2.75	83.69	3.72	.072
Y Balance Test Left (cm)	82.97	2.46	81.90	2.95	85.24	2.55	.423
Y Balance Test Difference %	3.60	1.77	3.84	2.08	3.85	2.05	.912
Sit and Reach Test (cm)	12.81	5.42	14.08	5.47	12.70	6.48	.577
Countermovement Jump Test (cm	40.25	6.29	42.53	5.59	41.54	5.76	.404
Aerobic Fitness Test – 20-Meter (levels)	11.19	1.82	10.07	2.07	10.13	2.42	.192

Source: Own source 2024.

Comparison between the Injured Side and other factors.

The examination of many factors according to the side of injury (Right, Left, or Both) found notable variations in multiple variables. In particular, there was a significant difference in the groups' exposure times throughout training (P = 0.050), with the Both sides group having a lower mean exposure duration than the Right and Left sides.

For both the left and right groups, the exposure time during training had mean values of 9059.27 ± 1649.19 hours, 7110.00 ± 1061.08 hours, and 8436.92 ± 1535.25 hours, respectively. Furthermore, there was a significant difference (P = 0.005) in the Y Balance Test Right across the groups; the Both sides group had a lower mean Y Balance Test Right than the Left and Right sides. For the Y Balance Test Right, the groups on Both sides were 86.51 ± 0.32, the Left side group was 85.73 ± 2.89, and the Right-side group was 83.62 ± 3.11.

Significant differences (P = 0.001) were also seen in the Aerobic Fitness Test - 20-Meter, where the Both sides group's mean was lower than that of the Left and Right sides. The Aerobic Fitness Test - 20-Meter mean scores for the Left side group were 10.80 ± 1.81, the Right-side group was 10.07 ± 2.17, and the Both sides group was 6.07 ± 2.51.

A number of other parameters did not show statistically significant differences between the various categories of injured sides, including age, height, weight, Body Mass Index (BMI), exposure time of match, exposure time total, hours of training and matches, incidence rate, Y Balance Test Left, Y Balance Test Difference %, Sit and Reach Test, and Countermovement Jump Test.

The mean and standard deviation values for each parameter are presented for each damaged side group, offering insights into the physical attributes and performance measures within the investigated population.

Table 34: Comparison between the Injured Side and other factors.

Injured Side	Right Mean	Std	Left Mean	Std	Both Mean	Std	P-value
Age (years)	21.05	3.57	20.12	3.05	18.33	2.51	.239
Height (m)	1.65	.006	1.66	0.06	1.67	0.04	.849
Weight (kg)	58.13	5.50	60.24	5.67	59.67	4.73	.240
BMI (kg/m^2)	21.21	1.98	21.75	1.63	21.50	1.90	.413
Exposure time of match / h	1497.69	295.26	1389.51	363.39	1770.00	137.48	.087
Exposure time - Training / h	8436.92	1535.25	9059.27	1649.19	7110.00	1061.08	**.050****
Exposure time Total /h	9934.62	1501.68	10448.78	1613.34	8880.00	1054.70	.124
Match/h	24.96	4.92	23.16	6.06	29.50	2.29	.087
Training /h	140.62	25.59	150.99	27.49	118.50	17.68	**.050****
Match and Training h	166.00	25.02	174.56	26.94	148.33	17.21	.123
Incidence rate	16.60	2.50	17.46	2.69	14.83	1.72	.123
Y Balance Test Right (cm)	83.62	3.11	85.73	2.89	86.51	0.32	**.005***
Y Balance Test Left (cm)	82.49	2.86	81.75	2.60	84.83	1.39	.118
Y Balance Test Difference %	3.79	1.95	3.97	2.05	1.68	1.16	.161
Sit and Reach Test (cm)	13.94	4.93	12.44	5.92	18.00	13.00	.192
Countermovement Jump Test (cm	42.74	5.74	41.34	5.57	37.33	5.75	.212
Aerobic Fitness Test – 20-Meter (levels)	10.07	2.17	10.80	1.81	6.07	2.51	**.001****

Source: Own source 2024.

The comparison between the place where the injury was done and other factors.

The majority of the variables did not show statistically significant variations when the different metrics depending on the incidence of injury during training or match sessions were analyzed. Age, height, weight, Body Mass Index (BMI), exposure time metrics (match, training, total), hours spent during matches and training, incidence rate, results of the Y Balance Test, Sit and Reach Test, Countermovement Jump Test, and the Aerobic Fitness Test - 20-Meter did not differ significantly between injuries sustained during training and those sustained during matches. The two injury incidence groups' mean and standard deviation values for every parameter were similar, indicating that the occurrence of injuries during practice or competition had no effect on the population under the study's measured variables.

Table 35: The comparison between the injured occur and other factors.

	Training		Match		P-
Injured Occur	Mean	Std	Mean	Std	value
Age (years)	20.26	3.14	20.62	3.43	0.626
Height (m)	1.66	0.06	1.66	0.06	0.801
Weight (kg)	59.88	5.10	58.60	6.00	0.296
BMI (kg/m^2)	21.81	1.41	21.26	2.01	0.147
Exposure time of match / h	1500.88	363.20	1427.40	312.30	0.340
Exposure time -Training / h	8782.94	1874.04	8688.60	1474.62	0.806
Exposure time Total / h	10283.82	1798.00	10116.00	1449.04	0.652
Match/h	25.01	6.06	23.79	5.21	0.340
Training /h	146.38	31.23	144.81	24.58	0.806
Match and Training h	171.79	29.99	169.04	24.19	0.657
Incidence rate	17.18	3.00	16.90	2.42	0.657
Y Balance Test Right (cm)	85.01	3.41	84.63	2.91	0.599
Y Balance Test Left (cm)	82.03	2.61	82.35	2.83	0.589
Y Balance Test Difference %	3.93	1.94	3.71	2.05	0.624
Sit and Reach Test (cm)	13.40	6.46	13.36	5.35	0.978
Countermovement Jump Test (cm)	40.79	6.82	42.42	4.91	0.237
Aerobic Fitness Test – 20-Meter (levels)	10.28	2.18	10.32	2.19	0.926

Source: Own source 2024.

Comparative results LEI vs no Injury.

Many statistically significant differences were found when those with and without injuries (the injured group and the non-injured group) were compared. In comparison to the Non-injured Group, the Injured Group exhibited significantly reduced exposure times during training sessions (P = 0.000), matches (P = 0.000), and overall exposure (P = 0.000). In the injured group, the occurrence rate was significantly greater (P = 0.000). In terms of Match/h (P = 0.000), Training/h (P = 0.000), and Match and Training/h (P = 0.000), the Non-injured Group had better values. A significant difference (P = 0.002) was found between the groups in the right single leg hop test, with the non-injured group having a higher average value. There was also a significant difference (P = 0.000) in the left single leg hop test, with a higher average in the Non-injured Group. The findings of the Y-Balance Test, Flexion and Extension Test, High-Number Bounce Test, and 20-Meter Aerobic Fitness Test did not reveal statistically significant differences between the two groups, nor did other characteristics such as age, height, weight, or Body Mass Index (BMI). According to these results, people with injuries may differ from those without injuries in terms of exposure duration, occurrence rate, and performance on particular functional tests.

Table 36: In comparison to the Non-injured Group.

	No Injury (n = 58)		Injury (n = 84)		P-value
	Mean	Std	Mean	Std	
Age (years)	20.26	3.65	20.48	3.30	.718
Height (m)	1.65	0.06	1.65	0.06	.743
Weight (kg)	57.59	6.46	59.12	5.65	.147
BMI (kg/m^2)	21.00	1.95	21.48	1.80	.139
Exposure time of match / h	1737.93	389.65	1457.14	333.68	**.000***
Exposure time -Training / h	10489.66	1766.46	8726.79	1637.76	**.000***
Exposure time Total / h	12227.59	1625.50	10183.93	1591.15	**.000***
Match / h	28.97	6.49	24.29	5.56	**.000***
Training /h	174.83	29.44	145.45	27.29	**.000***
Match and Training h	203.97	27.13	170.15	26.54	**.000***
Incidence rate	20.39	2.71	17.01	2.65	**.000***
Y Balance Test Right (cm)	85.48	2.43	84.78	3.11	.135
Y Balance Test Left (cm)	81.92	2.63	82.22	2.73	.524
Y Balance Test Difference %	3.55	1.91	3.79	1.99	.472
Right Single Leg Squat Test (reps)	4.76	0.57	5	0	**.002***
Left Single Leg Squat Test (reps)	4.71	0.59	5	0	**.000***
Sit and Reach Test (cm)	14.06	4.67	13.38	5.78	.438
Countermovement Jump Test (cm)	41.36	5.88	41.76	5.77	.689
Aerobic Fitness Test – 20-Meter (levels)	10.66	1.76	10.30	2.17	.275

Source: Own source 2024.

The opinion of footballers who were injured during the game or training.

The findings show a generally favourable trend in participants assessments of their development over the rehabilitation/sport functional recovery phase following their injury. A sizable majority—64.3%—said their improvement was "Very good," while another 32.1% thought it was "Good." This implies that they are quite satisfied with their rehabilitation efforts and that they believe they have improved. In a similar vein, the respondents' emotions were overwhelmingly positive, with 70.2% saying they were feeling "Very good" and 27.4% saying they were "Good."

In reference to his possible return to the squad, 54.8% of respondents rated his physical condition as "Very good," and 36.9% as "Good." Positive assessments were given to the damaged area's functioning state, with 79.8% classifying it as "Very good" or "Good." When performing physical activities in the wounded region, participants felt safe overall—60.7% reported feeling "Very good" and 38.1% reported feeling "Good." Regarding a possible return to full training, the majority of respondents—56 percent—rated their general state as "Very good," while 42.9% thought it was "Good." Overall, these findings show that the participants who were polled had a good attitude and were satisfied with their rehabilitation and recovery procedures. According to the survey's findings, the majority of participants—72.6%—reported experiencing discomfort or limits that make it difficult for them to work out regularly.

No participant said they felt no discomfort. A sizeable percentage, 27.4%, said they were unsure or didn't know if they faced these restrictions. When it came to their anxiety over going back to the team's normal training, 46.4% of the participants were close to 100%. Conversely, 23.8% of respondents were unclear or gave a negative response, while 29.8% of respondents indicated that they do feel frightened.

The results indicate a noteworthy degree of unease and uncertainty among the participants in the survey, underscoring the necessity for more investigation into the elements influencing these perceptions about their recuperation and possible resumption of team exercises. Regarding the participants' assessments of the chance of suffering a repeat of the injury shortly, the survey findings show an unsettling pattern.

Remarkably, every responder in every category—80–100%, 40–60%, 20–40%, or 0–20%—stated that there was a 100% chance of a recurrence. This widespread worry about the possibility of an injury recurrence among the surveyed persons is indicated by the fact that all levels of estimated percentages show the same concern.

The high levels of perceived risk, even in situations when the calculated chance is less than 100%, highlight the necessity of comprehensive injury prevention techniques as well as psychological support to address and lessen participant anxiety during the rehabilitation process.

Table 37: Opinion according to the questionnaire (PRIA-RS).

	Very bad		Bad		Neither good nor bad		Good		Very good	
	N	%	N	%	N	%	N	%	N	%
How do you evaluate the progression you have experienced during the rehabilitation/sport functional recovery period since your injury	0	0.00%	0	0.00%	3	3.60%	27	32.10%	54	64.30%
How is your mood?	0	0.00%	0	0.00%	2	2.40%	23	27.40%	59	70.20%
What is your physical state in view of a potential return to the team?	0	0.00%	0	0.00%	7	8.30%	31	36.90%	46	54.80%
How do you evaluate the functional status of your damaged area?	0	0.00%	0	0.00%	2	2.40%	15	17.90%	67	79.80%
How secure do you feel when performing physical actions or movements in the injured area?	0	0.00%	0	0.00%	1	1.20%	32	38.10%	51	60.70%
How would you evaluate your overall condition in view of a potential return to full training?	0	0.00%	0	0.00%	1	1.20%	36	42.90%	47	56.00%
	Yes				Don't know				No	
Do you feel any discomfort or limitations that prevent you from training as normal?	0	0.00%			23	27.40%			61	72.60%
Are you feeling nervous about returning to regular training with the team?	25	29.80%			20	23.80%			39	46.40%
	80-100%		60-80%		40-60%		20-40%		0-20%	
Give an estimated percentage of how likely you are to experience a recurrence of the injury soon	1	1.16%	0	0.00%	10	11.90%	25	29.76%	48	57.14%
	Excessive		High		Normal		Low		None	

What level of pressure do you feel in your surroundings to return to training with the team?	0	0.00%	13	15.50 %	21	25.00%	13	15.50%	37	44.00%

Source: Own source 2024.

The questionnaires that evaluated the progress made during the rehabilitation/sport functional recovery period yielded mean scores of 4.61, 0.560; 4.68, 0.519; 4.46, 0.648; 4.77, 0.475; and 4.45, 0.897; these mean scores all demonstrate high levels of satisfaction and positive perceptions. The also measured physical state for a potential return to the team, and the functional status of the damaged area. The mean score of the respondents regarding their level of anxiety on the return to regular team training was comparatively lower (Mean = 3.33, Std. Deviation = 1.724), indicating a degree of fear. Overall, nonetheless the participants showed confidence in their general state for a prospective return to full training (Mean = 4.55, Std. Deviation = 0.524) and felt comfortable when conducting physical activities in the damaged region (Mean = 4.60, Std. Deviation = 0.518). Together, these results show that participant attitudes and general well-being improved throughout the course of the rehabilitation procedure.

Table 38: (PRIA-RS) Questionnaire description.

	N	Minimum	Maximum	Mean	Std. Deviation
How do you evaluate the progression you have experienced during the rehabilitation/sport functional recovery period since your injury	84	3	5	4.61	.560
How is your mood?	84	3	5	4.68	.519
What is your physical state in view of a potential return to the team?	84	3	5	4.46	.648
How do you evaluate the functional status of your damaged area?	84	3	5	4.77	.475
Do you feel any discomfort or limitations that prevent you from training as normal?	84	3	5	4.45	.897
Are you feeling nervous about returning to regular training with the team?	84	1	5	3.33	1.724
How secure do you feel when performing physical actions or movements in the injured area?	84	3	5	4.60	.518
Give an estimated percentage of how likely you are to experience a recurrence of the injury soon	84	1	5	4.42	.795
What level of pressure do you feel in your surroundings to return to training with the team?	84	2	5	3.88	1.145
How would you evaluate your overall condition in view of a potential return to full training?	84	3	5	4.55	.524
Valid N (listwise)	84				

Source: Own source 2024.

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy analysis yielded a value of 0.595, indicating a moderate degree of sampling adequacy for the variables included in the study. However, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy was significant at $p < 0.001$ level. Out of 10 questions analyzed through factor analysis only 4 of them were included in the model explaining altogether 61.2% of the variance.

Component 1 alone as shown in table x explained 23.7% of the variance. When component 2 was included in the model the variance explanation increased to 38.6%. In addition, component 3 further improved the variance explanation to 51.2%.

Table 39: Rotated factor matrix (Varimax with Kaiser normalization).

Question	Factor 1	Factor 2	Factor 3	Factor 3
How would you evaluate your overall condition in view of a potential return to full training?	0.737			
How is your mood?	0.599			
What is your physical state in view of a potential return to the team?	0.563	0.448		
What level of pressure do you feel in your surroundings to return to training with the team?	0.509			
Give an estimated percentage of how likely you are to experience a recurrence of the injury soon		0.782		
How do you evaluate the progression you have experienced during the rehabilitation/sport functional recovery period since your injury		0.664		0.415
Are you feeling nervous about returning to regular training with the team?			0.791	
Do you feel any discomfort or limitations that prevent you from training as normal?			0.737	
How do you evaluate the functional status of your damaged area?	0.423	0.414	-0.493	
How secure do you feel when performing physical actions or movements in the injured area?				0.901

Source: Own source 2024.

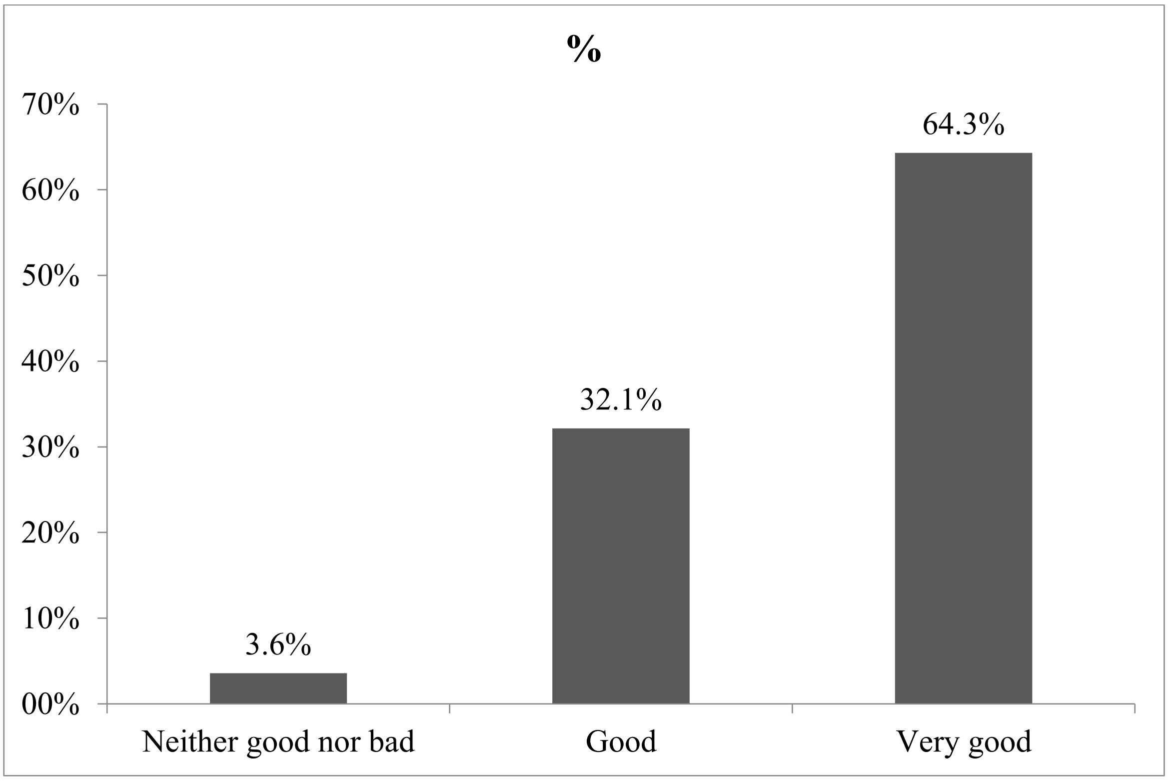
Evaluation of the progression from the injury during the rehabilitation or sport functional recovery period shows promising results: 32.1% are satisfied with a "Good" progression, 3.6% report no outcome at all, and an overwhelming 64.3% describe their experience as "Very good." The majority of people have reported good to exceptional gains in their functional recovery or sports-related rehabilitation after their injury, according to the collective replies, which point to a largely favourable trend in the rehabilitation process.

Table 40: Question 1 (PRIA-RS).

How do you evaluate the progression you have experienced during the rehabilitation/sport functional recovery period since your injury	N	%
Neither good nor bad	3	3.6%
Good	27	32.1%
Very good	54	64.3%

Source: Own source 2024.

Figure 20: Question 1 (PRIA-RS)



Source: Own source 2024.

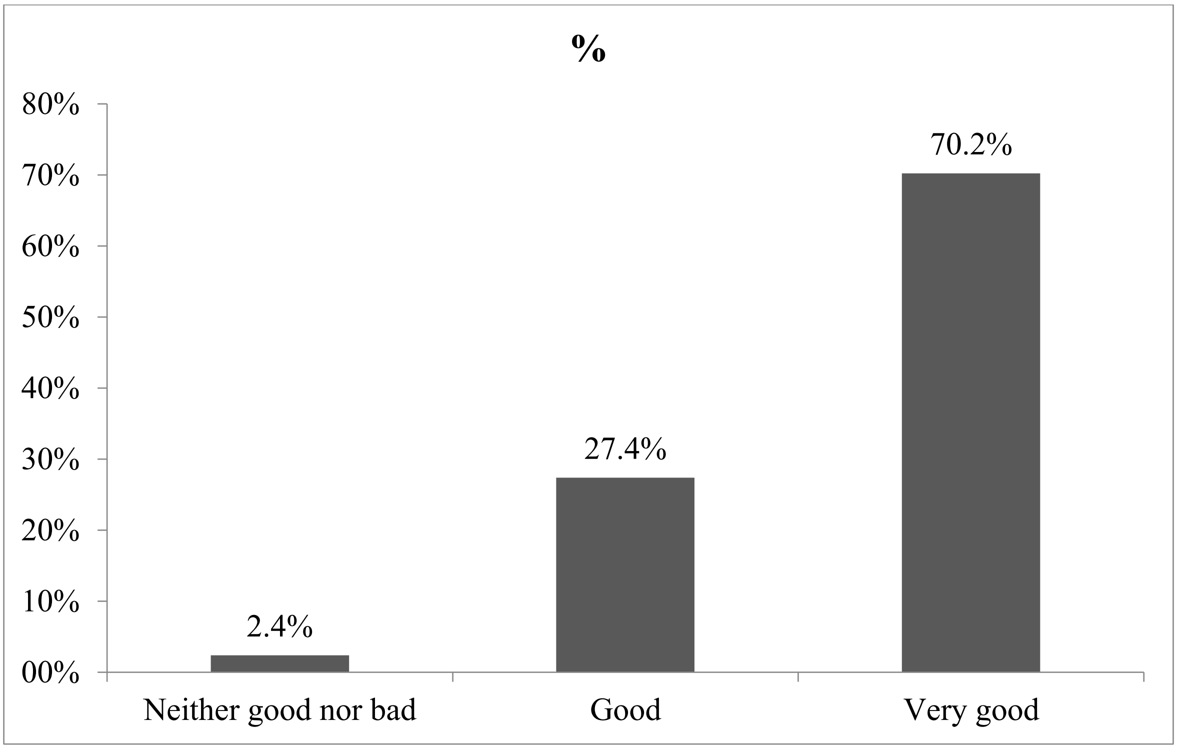
The mood evaluation's findings show that most respondents had good feelings. Of all the participants, 2.4% said they were indifferent, and a sizable 27.4% said they were in a good mood. Seventy-two percent of the responders said they felt extremely well. These results imply that most respondents had a generally happy attitude, with a sizable percentage reporting a very pleasant mood.

Table 41: Question 2 (PRIA-RS).

How is your mood?	N	%
Neither good nor bad	2	2.4%
Good	23	27.4%
Very good	59	70.2%

Source: Own source 2024.

Figure 21: Question 2 (PRIA-RS).



Source: Own source 2024.

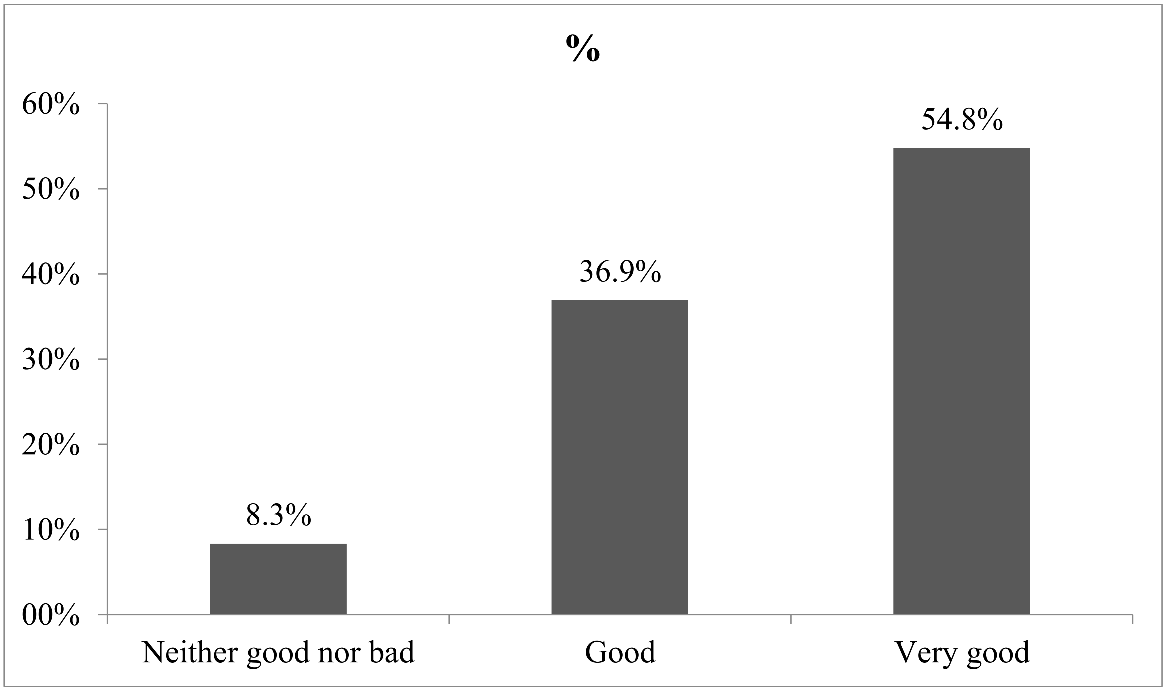
Positive findings emerge from the evaluation of participants' physical conditions with regard to a possible return to the team: only 8.3% of them indicate neither excellent nor terrible conditions. Notably, 36.9% of respondents said they were in good physical health, while 54.8% said they were in very good physical health. With a sizable percentage of participants evaluating their physical condition as either good or very good, these results point to an overall upward trend in the participants' preparedness for a prospective return to the team. The majority's propensity for being in good physical health suggests that their chances of being reintegrated into team activities are favourable.

Table 42: Question 3 (PRIA-RS).

What is your physical state in view of a potential return to the team?	N	%
Neither good nor bad	7	8.3%
Good	31	36.9%
Very good	46	54.8%

Source: Own source 2024.

Figure 22: Question 3 (PRIA-RS).



Source: Own source 2024.

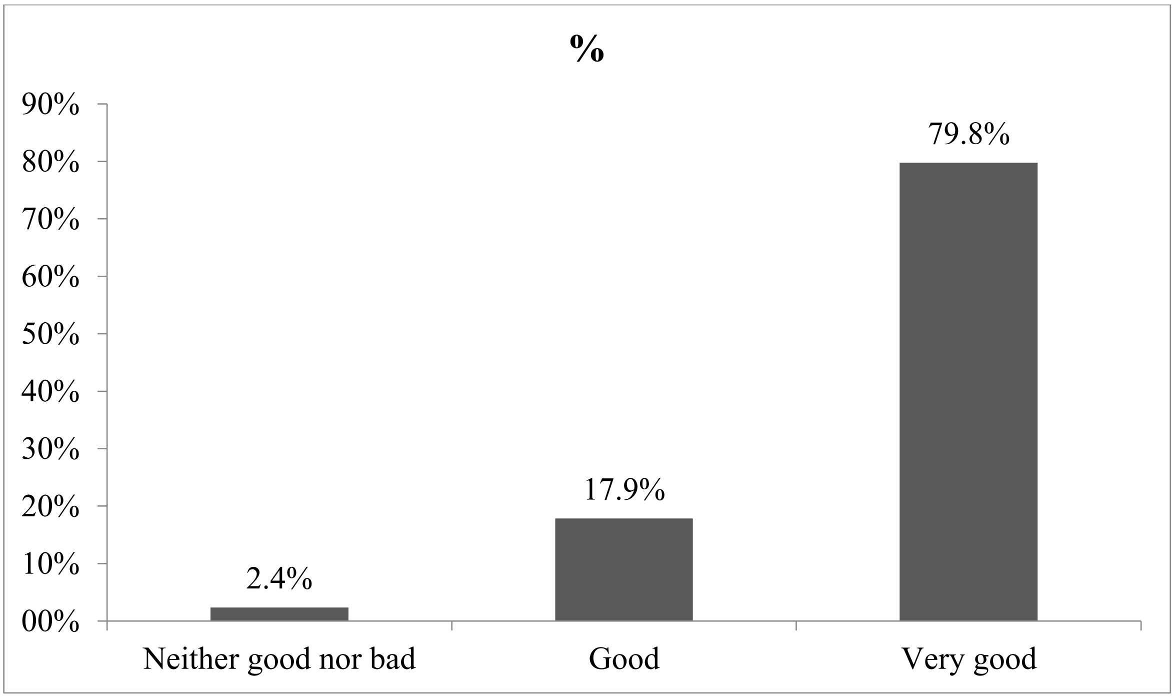
Participants' assessments of the affected area's functioning state are predominantly favourable, with only 2.4% expressing neither excellent nor terrible circumstances. Significantly, 17.9% of respondents reported having an excellent functional status, and an astounding 79.8% said they felt very good. These results provide a strikingly bright view for the affected area's functional recovery, with a sizable majority reporting high levels of pleasure and good development. The large majority of respondents who gave their functional state a very satisfactory rating, indicating successful functional recovery and rehabilitation in the evaluated areas.

Table 43: Question 4 (PRIA-RS).

How do you evaluate the functional status of your damaged area?	N	%
Neither good nor bad	2	2.4%
Good	15	17.9%
Very good	67	79.8%

Source: Own source 2024.

Figure 23: Question 4 (PRIA-RS).



Source: Own source 2024.

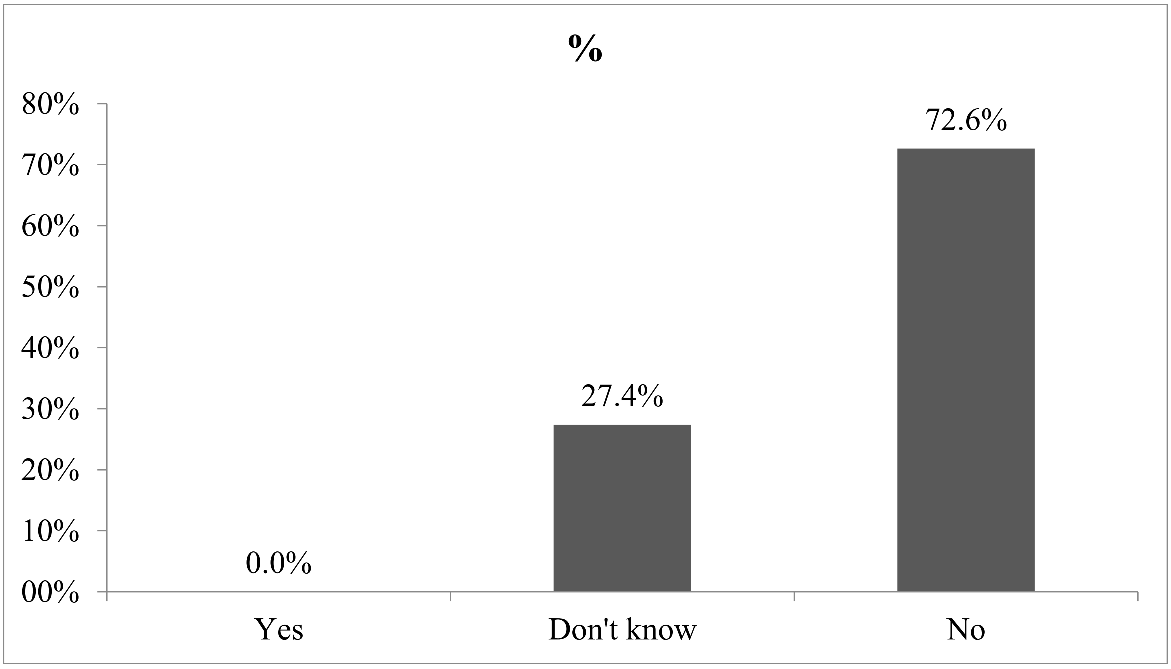
The results of the survey regarding discomfort or limitations hindering normal training indicate that a substantial majority, comprising 72.6% of respondents, reported no such hindrances. Conversely, 27.4% expressed uncertainty, stating they don't know if they feel any discomfort or limitations that might impede their regular training. These findings suggest that a significant portion of participants does not perceive any hindrance to their normal training routines, while a notable proportion remains uncertain about the presence of such limitations. The results underscore the importance of further assessment and communication to clarify the nature of potential discomfort or restrictions that individuals might be experiencing during their training activities.

Table 44: Question 5 (PRIA-RS).

Do you feel any discomfort or limitations that prevent you from training as normal?	N	%
Don't know	23	27.4%
No	61	72.6%

Source: Own source 2024.

Figure 24: Question 5 (PRIA-RS).



Source: Own source 2024.

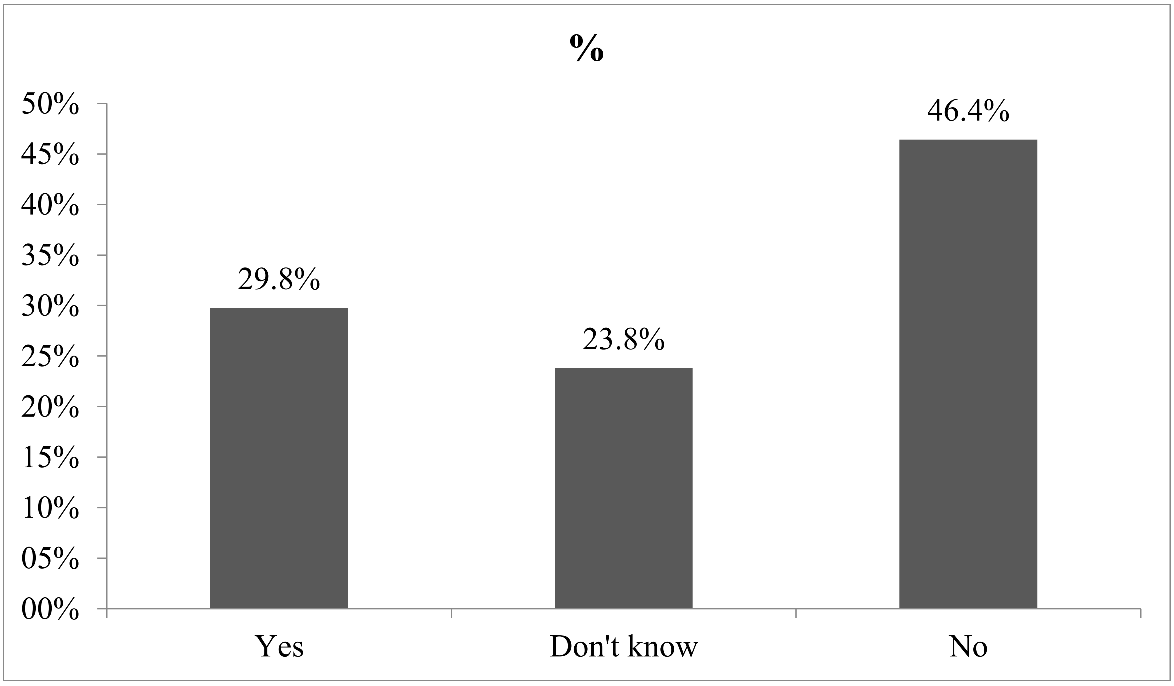
The survey findings indicate that participants' levels of anxiety about going back to regular team training are not all the same. Notably, 29.8% of respondents said they were anxious to return, while 23.8% answered "Don't know" to show hesitation. Positively, 46.4% of respondents said they don't feel anxious about starting up regular training sessions with the team again. These results show that people experience a wide variety of emotions, and a sizable percentage of them expressed anxiety or doubt about the idea of going back to team training. Addressing issues and promoting a more seamless return to routine training activities may need clear communication and assistance.

Table 45: Question 6 (PRIA-RS).

Are you feeling nervous about returning to regular training with the team?	N	%
Yes	25	29.8%
Don't know	20	23.8%
No	39	46.4%

Source: Own source 2024.

Figure 25: Question 6 (PRIA-RS).



Source: Own source 2024.

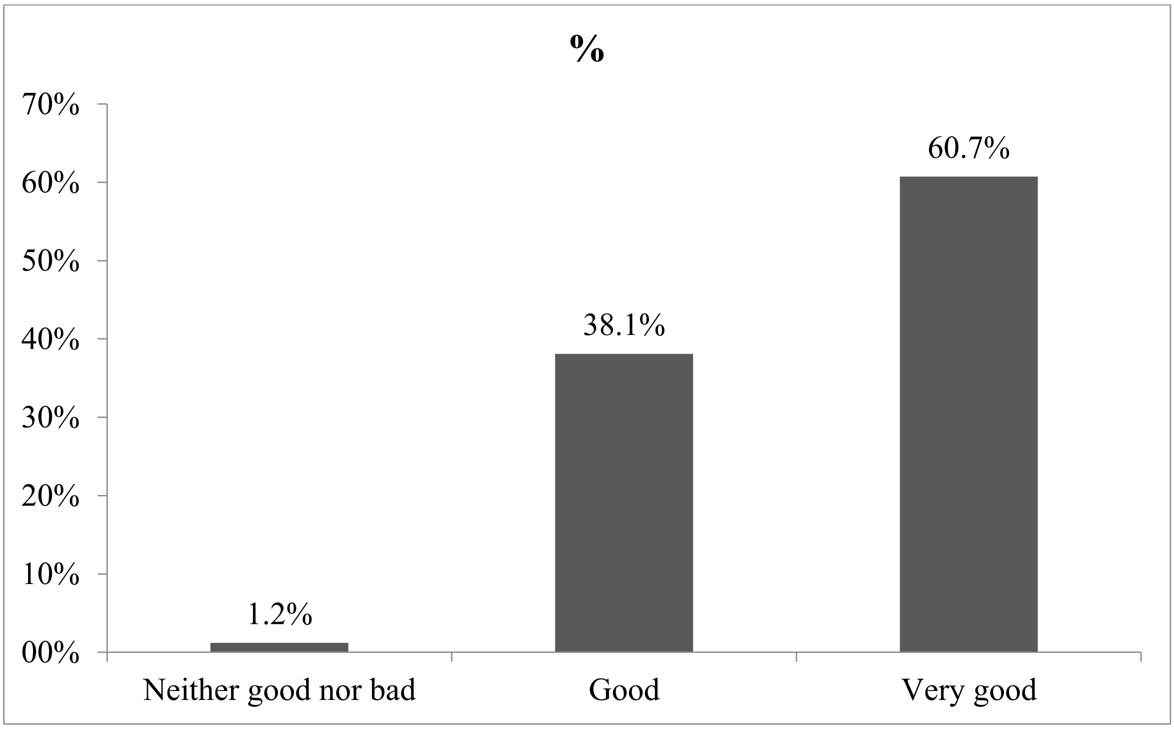
When participants are asked to assess their level of security when moving or acting in the damaged region, the results are overwhelmingly favourable. Just 1.2% of respondents said they had a neutral impression regarding their sense of security. Significantly, 38.1% of respondents said they felt good about the acts they were conducting, and an even bigger majority—60.7%—said they felt very good about it. These results imply that respondents felt quite secure and confident when moving or doing physical activities in the area where they had previously been hurt. The overwhelmingly favourable replies reflect effective rehabilitation and recovery efforts and show a good growth in the sensation of security throughout such acts.

Table 46: Question 7 (PRIA-RS).

How secure do you feel when performing physical actions or movements in the injured area?	N	%
Neither good nor bad	1	1.2%
Good	32	38.1%
Very good	51	60.7%

Source: Own source 2024.

Figure 26: Question 7 (PRIA-RS).



Source: Own source 2024.

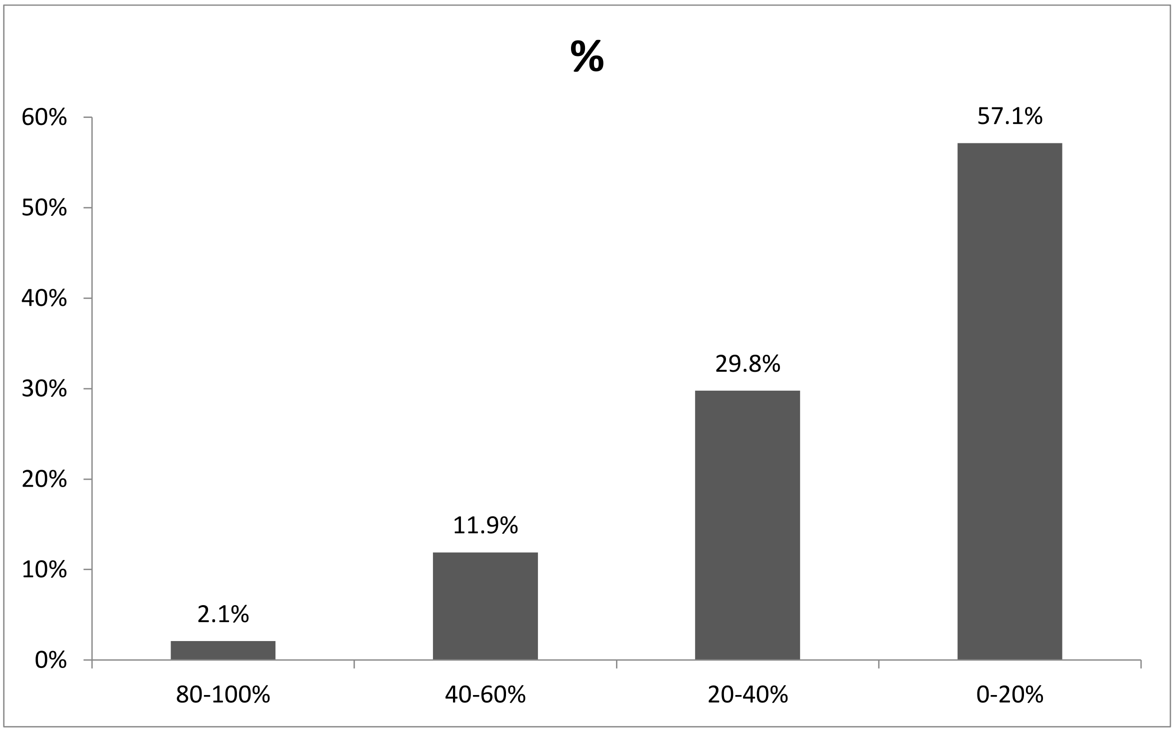
The hopeful perspective among respondents is evident from the survey findings on the predicted chance of having a recurrence of the injury shortly. Just 1.2% of respondents indicated a high probability of recurrence (80–100%), whilst 11.9% indicated a moderate probability (40–60%). Most participants—29.8%—said they were more likely (20–40%), and a much higher percentage—57.1%—said they were less likely (0–20%) to have a repeat of the injury in the near future. All of these results point to a general level of confidence among those polled about the injury's possible recurrence, with a sizable majority indicating that they believe the likelihood of a recurrence is low in the near future.

Table 47: Question 8 (PRIA-RS).

Give an estimated percentage of how likely you are to experience a recurrence of the injury soon	N	%
80-100%	1	1.2%
40-60%	10	11.9%
20-40%	25	29.8%
0-20%	48	57.1%

Source: Own source 2024.

Figure 27: Question 8 (PRIA-RS).



Source: Own source 2024.

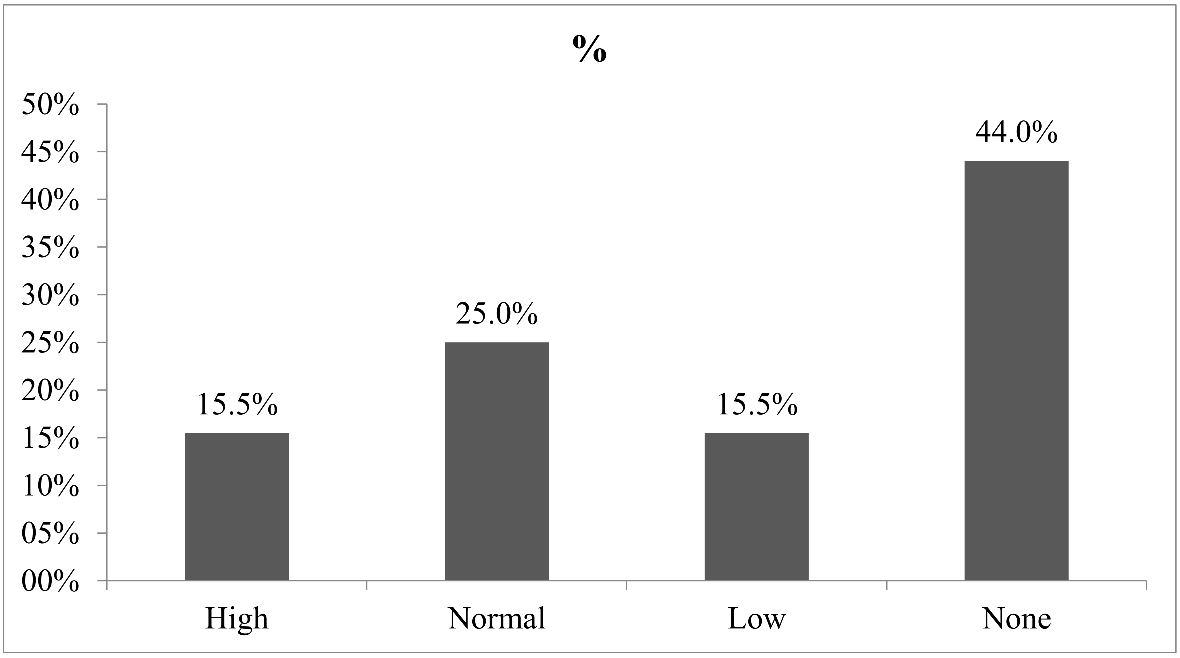
There is a wide range of replies in the survey findings on the amount of pressure people feel in their environment to resume team training. Notably, 15.5% of respondents said they felt under pressure, while an equivalent number said they felt under pressure. 25.0%, a somewhat greater percentage, said they were feeling typical pressure. On the other hand, a noteworthy 44.0% said they felt absolutely no pressure to resume team training. These results point to a wide variety of outside expectations and influences, with a significant percentage of participants reporting little to no pressure to continue training with the team. The findings highlight how crucial it is to take into account each person's unique situation and preferences while readjusting to team activities.

Table 48: Question 9 (PRIA-RS).

What level of pressure do you feel in your surroundings to return to training with the team?	N	%
High	13	15.5%
Normal	21	25.0%
Low	13	15.5%
None	37	44.0%

Source: Own source 2024.

Figure 28: Question 9 (PRIA-RS).



Source: Own source 2024.

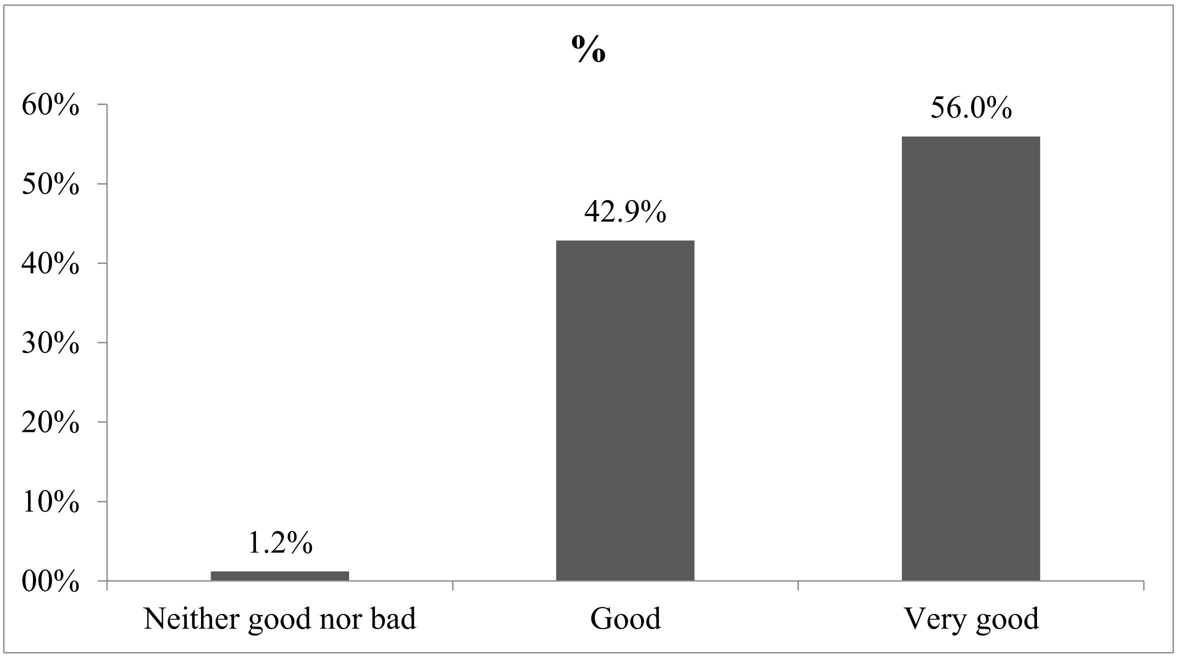
An assessment of the general state of the participants ahead of a possible return to full training yields overwhelmingly good feedback. Just 1.2% of respondents said they were in neither good nor terrible circumstances, however a sizable 42.9% said they were confident in their general state of being good. 56.0% of the participants expressed that they were feeling really good about their general health in light of maybe returning to full training. These results highlight the questioned persons' strong feeling of well-being and good advancement, which bodes well for their preparedness to participate in extensive training activities. The noteworthy proportion of individuals who rated their condition as very excellent suggests a successful recovery and a promising prospect for going back to full training.

Table 49: Question 10 (PRIA-RS).

How would you evaluate your overall condition in view of a potential return to full training?	N	%
Neither good nor bad	1	1.2%
Good	36	42.9%
Very good	47	56.0%

Source: Own source 2024.

Figure 29: Question 10 (PRIA-RS).



Source: Own source 2024.

H1: Elite women's football players in Kosovo are more likely to experience LEI compared to injuries in other body regions (Injury Patterns).

Chi-square test

The relationship between the damaged body part and the incidence rate (Incidence rate) as determined by the Chi-square test. The top 84 injuries female football players in Kosovo produced a two-sided asymptotic significance of .245 and a Pearson Chi-Square value of 59.718 with 53 degrees of freedom. A value of 65.544 with 53 degrees of freedom and an asymptotic significance of.116 was obtained using the Likelihood Ratio test. With one degree of freedom, the Linear-by-Linear Association test yielded a value of .250 and an asymptotic significance of .617. Consequently, the chi-square test indicates that there is not enough data to draw the conclusion that injuries to the lower extremities (LEI) are more common among top women's football players in Kosovo than injuries to other body parts.

Table 50: The relationship between the damaged body part and the incidence rate.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	59.718[a]	53	.245
Likelihood Ratio	65.544	53	.116
Linear-by-Linear Association	.250	1	.617
N of Valid Cases	84		

a. 108 cells (100.0%) have expected count less than 5. The minimum expected count is .23.

Source: Own source 2024.

Independent Sample T-test

The incidence rate among elite women's football players in Kosovo, classified by damaged body part, is computed as (Match and Training h/1000 h) *100%. The group data provide the mean, standard deviation, and standard error mean for this incidence rate. The findings indicate that while players with injuries to other body parts have a slightly lower mean incidence rate of 16.7474 (Std. Deviation = 3.28166, Std. Error Mean = 0.75286), those with lower extremity injuries (LEI) have a mean incidence rate of 17.0938 (Std. Deviation = 2.46633, Std. Error Mean = 0.30591).

Table 51: Incidence rate vs Injured body part.

Group Statistics

	Injured body part	N	Mean	Std. Deviation	Std. Error Mean
Incidence rate = (Match and Training h/1000 h) *100%	LEI	65	17.0938	2.46633	.30591
	Other body parts	19	16.7474	3.28166	.75286

Source: Own source 2024.

The independent samples t-test was conducted to compare the mean incidence rates between players with LEI and those with injuries in other body parts. Levene's test for equality of variances showed no significant difference in variances (F = 3.367, Sig. = 0.070), and assuming equal variances, the t-test indicated a non-significant result (t = 0.498, df = 82, Sig. = 0.620). When assuming unequal variances, the t-test also revealed a non-significant result (t = 0.426, df = 24.248, Sig. = 0.674). The mean difference was 0.34648, with a 95% confidence interval ranging from -1.03706 to 1.73002.
Finaly, the results of the independent samples t-test do not provide sufficient evidence to reject the null hypothesis. Therefore, based on this analysis, there is no significant difference in the mean incidence rates of lower extremity injuries (LEI) compared to injuries in other body regions among elite women's football players in Kosovo.

Table 52: Incidence rate vs Injured body part (Independent Samples Test).

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Incidence rate = (Match and Training h/1000 h) *100%	Equal variances assumed	3.367	.070	.498	82	.620	.34648	.69548	-1.03706	1.73002
	Equal variances not assumed			.426	24.248	.674	.34648	.81264	-1.32982	2.02278

Source: Own source 2024.

H2: The incidence rate of LEI in elite women's football players in Kosovo is higher during competitive seasons compared to non-competitive periods (Injury Incidence).

The Chi-square test was conducted to test the hypothesis that the incidence of Lower Extremity Injuries (LEI) among the highest women's football players in Kosovo is greater during competitive seasons compared during non-competitive periods. Two variables were examined: "LEI - Other body parts" and "When did the injury occur.
The Pearson Chi-square value was 59.718 for "LEI - Other body parts," with a matching p-value of 0.245. The Pearson Chi-square score was 57.021 for "When did the injury occur," with a p-value of 0.328. However, both p-values exceeded the usually accepted significance level of 0.05.

Table 53: LEI and Other body parts * Incidence rate.

Chi-square test	Pearson Chi-square	p-value
LEI – Other body parts * Incidence rate	59.718	.245
When did the injury occur * Incidence rate	57.021	.328

Source: Own source 2024.

Therefore, based on these findings, there is insufficient evidence to reject the null hypothesis. It means that there was no statistically significant variation in the incidence rate of LEI between competitive and non-competition seasons among top women's football players in Kosovo, as demonstrated by the variables "LEI - Other body parts" and "When did the injury occur. The Chi-square test findings do not support the hypothesis, showing that the incidence rate of LEI has no significant relationship with competitive vs non-competitive seasons in the context of the research.

Independent sample t-test
The Independent Sample t-tests, which tested the hypothesis that the incidence rate of Lower Extremity Injuries (LEI) among top women's football players in Kosovo is greater during competitive seasons than during non-competition times, found no statistically significant differences.
In a comparison of affected body parts (LEI vs. Other body parts), the mean incidence rate for LEI was 17.0938, while for Other body parts it was 16.7474, with a non-significant mean difference of 0.346 and a p-value of 0.674. Similarly, when comparing when the injury occurred (Training vs. Match), the mean incidence rate for Training was 17.1794, while for Match it was 16.9040, yielding a non-significant mean difference of 0.275 and a p-value of 0.657.

Table 54: LEI and Other body parts * Incidence rate / Independent Sample T-test.

Independent Sample T-test	Injured body part	N	Mean	Mean difference	P-value
Incidence rate	LEI	65	17.0938	.346	.674
	Other body parts	19	16.7474		
	When did the injury occur	N	Mean	Mean difference	P-value
Incidence rate	Training	34	17.1794	.275	.657
	Match	50	16.9040		

Source: Own source 2024.

These data indicate that, based on the variables studied, there is insufficient evidence to support the hypothesis that the incidence rate of LEI is considerably greater during competitive seasons compared to non-competition periods among top women's football players in Kosovo.

H3: Several risk factors, including previous injury history, training load, playing surface, muscular imbalances, and age, will be associated with an increased likelihood of sustaining LEI in elite women's football players in Kosovo (Predictive Risk Factors).

The case processing summary shows that 84 experiences were included in the study, with no missing data. The study sought to identify predictive risk variables linked to a higher chance of Lower Extremity Injuries (LEI) among top women's football players in Kosovo, such as previous injury history, training load, playing surface, muscle imbalances, and age. However, the presented material does not provide particular statistical statistics or clear findings about the correlations between these risk variables and LEI occurrence.
The study examined predicted risk variables for Lower Extremity Injuries (LEI) in top women's football players in Kosovo, such as prior injury history, training load, playing surface, muscle imbalances, and age. The dependent variable was encoded, with LEI allocated an internal value of zero and injuries to other body parts assigned a value of one. However, the available data lacks definitive statistical conclusions or relationships between these risk variables and an increased chance of LEI.
The categorization chart for elite women's football players in Kosovo predicted Lower Extremity Injuries with an accuracy of 77.4%. However, worries emerge because to the lack of projections for other body parts.

Table 55: Classification table for LEI and other body parts.

Classification Table[a,b]

			Predicted		
Observed			Injured body part		Percentage
			LEI	Other body parts	Correct
Step 0	Injured body part	LEI	65	0	100.0
		Other body parts	19	0	.0
	Overall Percentage				77.4

a. Constant is included in the model.
b. The cut value is .500
Source: Own source 2024.

The logistic regression analysis found a significant constant term (-1.230, $p < 0.001$) that predicts the risk of Lower Extremity Injuries (LEI) among elite female football players in Kosovo. The constant has an odds ratio (Exp(B)) of 0.292, suggesting that for every one-unit increase in the predictor, the odds of LEI fall by 70.8%. However, the published data does not include detailed details on the coefficients and significance levels for the particular risk variables (prior injury history, training load, playing surface, muscle imbalances, and age).

Table 56: The logistic regression for LEI and other body parts.

Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-1.230	.261	22.241	1	.000	.292

Source: Own source 2024.

The Omnibus Tests of Model Coefficients for the logistic regression evaluating predicted risk variables for Lower Extremity Injuries (LEI) among top women's football players in Kosovo generated a chi-square value of 58.248 with 50 degrees of freedom in Step 1. However, the corresponding p-value of 0.198 indicates that the total model, which included factors such as past injury history, training load, playing surface, muscle imbalances, and age, failed to attain statistical significance at the 0.05 alpha level. The current information does not give specific data on the significant levels and coefficients of various risk variables.

Table 57: The logistic regression Tests of Model Coefficients.

Omnibus Tests of Model Coefficients				
		Chi-square	df	Sig.
Step 1	Step	58.248	50	.198
	Block	58.248	50	.198
	Model	58.248	50	.198

Source: Own source 2024.

The logistic regression Model Summary for elite women's football players in Kosovo shows that the -2 Log likelihood in Step 1 is 31.570. The Cox and Snell R Square is 0.500, whereas the Nagelkerke R Square is 0.762. However, the estimate ended prematurely at iteration 20 after reaching the maximum limit, raising worries regarding model convergence. Specific information on the importance of particular risk factors is not provided.

Table 58: The logistic regression Model Summary.

Model Summary			
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	31.570[a]	.500	.762

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Source: Own source 2024.

In predicting Lower Extremity Injuries (LEI) among elite women's football players in Kosovo, the logistic regression model at Step 1 achieved 90.8% accuracy for LEI and 68.4% for other body parts, producing an overall prediction rate of 85.7%.

Table 59: The logistic regression for LEI.

Classification Table[a]

			Predicted		
			Injured body part		
	Observed		LEI	Other body parts	Percentage Correct
Step 1	Injured body part	LEI	59	6	90.8
		Other body parts	6	13	68.4
	Overall Percentage				85.7

a. The cut value is .500

Source: Own source 2024.

When examining risk factors for Lower Extremity Injuries (LEI) among elite women's football players in Kosovo, logistic regression at Step 1 indicated many indicators. Notably, past injury history, training load, playing surface, age, Sit and Reach Test, and Countermovement Jump Test were all significant predictors of LEI, although no particular coefficients were reported. The constant term also proved significant. These findings highlight the diverse nature of the risk variables impacting LEI.

Table 60: Logistic regression at Step 1 indicated many indicators.

		B	S.E.	Wald	df	Sig.
Step 1[a]	Has the player had a previous injury of the same location and type? (1)	-.583	2.417	.058	1	.809
	Match/h			3.665	13	.994
	Match/h (1)	-72.881	44387.392	.000	1	.999
	Match/h (2)	-53.928	18835.225	.000	1	.998
	Match/h (3)	-47.763	59880.844	.000	1	.999
	Match/h (4)	-71.555	31294.750	.000	1	.998
	Match/h (5)	-50.924	18835.226	.000	1	.998
	Match/h (6)	-72.370	44387.392	.000	1	.999
	Match/h (7)	-51.447	18835.226	.000	1	.998
	Match/h (8)	-49.378	18835.226	.000	1	.998
	Match/h (9)	-53.578	18835.226	.000	1	.998
	Match/h (10)	-73.066	27912.502	.000	1	.998
	Match/h (11)	-50.087	18835.226	.000	1	.998
	Match/h (12)	-73.891	21712.996	.000	1	.997
	Match/h (13)	-22.974	519138.930	.000	1	1.000
	Training /h			2.492	21	1.000
	Training /h (1)	36.572	21528399.875	.000	1	1.000
	Training /h (2)	70.377	50247.737	.000	1	.999
	Training /h (3)	16.001	40192.970	.000	1	1.000

Training /h (4)	66.905	367597.709	.000	1	1.000
Training /h (5)	-.743	3.600	.043	1	.837
Training /h (6)	-1.702	32316.185	.000	1	1.000
Training /h (7)	-.305	33576.691	.000	1	1.000
Training /h (8)	2.567	45144.236	.000	1	1.000
Training /h (9)	1.033	3.273	.100	1	.752
Training /h (10)	1.539	4.447	.120	1	.729
Training /h (11)	-23.557	17551.042	.000	1	.999
Training /h (12)	20.134	520399.859	.000	1	1.000
Training /h (13)	-2.373	3.227	.541	1	.462
Training /h (14)	-20.471	18211.919	.000	1	.999
Training /h (15)	-.612	3.670	.028	1	.867
Training /h (16)	71.966	50247.737	.000	1	.999
Training /h (17)	-.349	3.188	.012	1	.913
Training /h (18)	-24.700	40192.970	.000	1	1.000
Training /h (19)	-.936	2.874	.106	1	.745
Training /h (20)	-15.348	9745.613	.000	1	.999
Training /h (21)	47.636	203694.841	.000	1	1.000
Playing Surface (1)	1.872	2.464	.577	1	.447
Age			3.030	12	.995
Age (1)	29.978	21528390.062	.000	1	1.000
Age (2)	-46.281	45823.998	.000	1	.999
Age (3)	23.237	40193.071	.000	1	1.000
Age (4)	27.260	40193.071	.000	1	.999
Age (5)	22.750	40193.071	.000	1	1.000
Age (6)	24.122	40193.071	.000	1	1.000
Age (7)	25.961	40193.071	.000	1	.999
Age (8)	24.156	40193.071	.000	1	1.000
Age (9)	4.537	523027.512	.000	1	1.000
Age (10)	-19.105	523494.960	.000	1	1.000
Age (11)	24.652	40193.071	.000	1	1.000
Age (12)	5.992	41780.732	.000	1	1.000
Sit and Reach Test	.040	.277	.021	1	.886
Countermovement Jump Test	.022	.180	.015	1	.902
Constant	24.997	44387.512	.000	1	1.000

Source: Own source 2024.

In Step 1, the logistic regression analysis produced predicted probabilities for Lower Extremity Injuries (LEI) and other body parts. The cut value was set at 0.50, which is the threshold for categorizing instances. The graph clearly distinguishes between LEI (represented by 'L') and other body parts (represented by 'O'). The estimated probabilities are consistent with the hypothesis, demonstrating a link between risk variables and an elevated risk of LEI among top women's football players in Kosovo.

H4: Players with imbalances in strength and flexibility between muscle groups in the lower extremities will have a higher risk of LEI compared to those without imbalances (Muscular Imbalances).

The research study, which was meant to explore the relationship between muscle imbalances and the risk of Lower Extremity Injuries (LEI) among elite women's football players, discovered no significant variations in several parameters.

When examining exposure time during matches, training, and overall exposure time, there were no statistically significant mean differences between players with LEI and those with other body component injuries. The p-values for these parameters were 0.280, 0.656, 0.554, and 0.674, suggesting that the mean values did not differ statistically significantly on the independent sample t-test.

Table 61: The explore the relationship between muscle imbalances and the risk of LEI.

	Injured body part	N	Mean	Mean Difference	P-value
Exposure time of match/h	LEI	65	1438.62	-81.911	.280
	Other body parts	19	1520.53	301.919	.554
Exposure time -Training	LEI	65	8795.08	220.008	.656
	Other body parts	19	8493.16	-1.365	.280
Exposure time -Training/h	LEI	65	10233.69	5.032	.554
	Other body parts	19	10013.68	3.465	.674
Match/h	LEI	65	23.98	.34648	.674
	Other body parts	19	25.34	-.02614	.973
Exposure time Total/h	LEI	65	146.58	-.63246	.398
	Other body parts	19	141.55	-.26643	.642
Match and Training h	LEI	65	170.94	-.842	.506
	Other body parts	19	167.47	1.597	.272
Match/h	LEI	65	17.09	.5574	.398
	Other body parts	19	16.74	-81.911	.280
Y Balance Test Right %	LEI	65	84.78	301.919	.554
	Other body parts	19	84.80	220.008	.656
Training /h	LEI	65	82.07	-1.365	.280
	Other body parts	19	82.71	5.032	.554
Y Balance Test Difference %	LEI	65	3.73	3.465	.674
	Other body parts	19	4.00	.34648	.674
Match and Training h	LEI	65	5.00	-.02614	.973
	Other body parts	19	5.00	-.63246	.398
Left Single Leg Squat Test	LEI	65	5.00	-.26643	.642
	Other body parts	19	5.00	-.842	.506
Incidence rate = (Match and Training h/1000 h) *100%	LEI	65	13.18	1.597	.272
	Other body parts	19	14.03	.5574	.398

Countermovement Jump Test	LEI	65	42.12	-81.911	.280
	Other body parts	19	40.53	301.919	.554
Y Balance Test Right (cm)	LEI	65	10.43	220.008	.656
	Other body parts	19	9.87	-1.365	.280

a. t cannot be computed because the standard deviations of both groups are 0.
Source: Own source 2024.

The research study, which was meant to explore the relationship between muscle imbalances and the risk of Lower Extremity Injuries (LEI) among elite women's football players, discovered no significant variations in several parameters. When examining exposure time during matches, training, and overall exposure time, there were no statistically significant mean differences between players with LEI and those with other body component injuries. The p-values for these parameters were 0.280, 0.656, 0.554, and 0.674, suggesting that the mean values did not differ statistically significantly independent sample t-test.

Anova

The study, which aimed to examine the relationship between muscle imbalances in the lower extremities and the likelihood of Lower Extremity Injuries (LEI) in elite women's football players, produced fascinating results. Players with LEI on the right side had an average exposure duration of 1497.69 minutes in matches, compared to those with injuries on the left side, who had an average of 1389.51 minutes.

The p-value for this comparison was 0.087, indicating a slightly insignificant difference. Similarly, the p-value for exposure duration during training on the right side (mean: 8436.92 minutes) against the left side (mean: 9059.27 minutes) was 0.050, showing a marginally significant difference.

Table 62: Relationship between muscle imbalances in the lower extremities (Anova).

Injured side		N	Mean	Std. Deviation	P-value
Exposure time of match/h	Right	39	1497.69	295.256	.087
	Left	41	1389.51	363.387	
	Bill	3	1770.00	137.477	
	Total	83	1454.10	334.537	
Exposure time -Training/h	Right	39	8436.92	1535.246	.050
	Left	41	9059.27	1649.188	
	Bill	3	7110.00	1061.084	
	Total	83	8696.39	1623.698	
Exposure time Total/h	Right	39	9934.62	1501.681	.124
	Left	41	10448.78	1613.337	
	Bill	3	8880.00	1054.704	
	Total	83	10150.48	1570.842	

Match/h	Right	39	24.96	4.921	.087
	Left	41	23.16	6.056	
	Bill	3	29.50	2.291	
	Total	83	24.23	5.576	
Training /h	Right	39	140.62	25.587	.050
	Left	41	150.99	27.486	
	Bill	3	118.50	17.685	
	Total	83	144.94	27.062	
Match and Training h	Right	39	166.00	25.019	.123
	Left	41	174.56	26.935	
	Bill	3	148.33	17.214	
	Total	83	169.59	26.196	
Incidence rate = (Match and Training h/1000 h) *100%	Right	39	16.6000	2.50189	.123
	Left	41	17.4561	2.69352	
	Bill	3	14.8333	1.72143	
	Total	83	16.9590	2.61958	
Y Balance Test Right (cm)	Right	39	83.6249	3.10904	.005
	Left	41	85.7276	2.89419	
	Bill	3	86.5067	.32021	
	Total	83	84.7677	3.12417	
Y Balance Test Left (cm)	Right	39	82.4926	2.86267	.118
	Left	41	81.7549	2.60261	
	Bill	3	84.8267	1.39414	
	Total	83	82.2125	2.74613	
Y Balance Test Difference %	Right	39	3.7851	1.95023	.161
	Left	41	3.9734	2.04944	
	Bill	3	1.6800	1.15547	
	Total	83	3.8020	2.00588	
Right Single Leg Squat Test (reps)	Right	39	5.00	.000	*
	Left	41	5.00	.000	
	Bill	3	5.00	.000	
	Total	83	5.00	.000	
Left Single Leg Squat Test (reps)	Right	39	5.00	.000	*
	Left	41	5.00	.000	
	Bill	3	5.00	.000	
	Total	83	5.00	.000	
Sit and Reach Test (cm)	Right	39	13.94	4.930	.192
	Left	41	12.44	5.916	
	Bill	3	18.00	13.000	
	Total	83	13.34	5.816	
Countermovement Jump Test (cm)	Right	39	42.74	5.743	.212
	Left	41	41.34	5.575	

	Bill	3	37.33	7.371	
	Total	83	41.86	5.747.0	
Aerobic Fitness Test – 20-Meter (levels)	Right	39	10.067	2.1690	.001
	Left	41	10.797	1.8108	
	Bill	3	6.067	2.5146	
	Total	83	10.283	2.1768	

Source: Own source 2024.

The Y Balance Test found a statistically significant mean difference between the right and left sides (p = 0.005), indicating that players with LEI on the right side had a lower proportion. The Single Leg Squat Test, both on the right and left sides, revealed a perfect mean of 5.00 for players with LEI against other body parts, with a p-value of 0.000. The Aerobic Fitness Test - 20-Meter revealed a significant mean difference, with players with LEI on the right side performing worse than those on the left (p = 0.001). Overall, our findings point to potential links between muscle imbalances and key performance measures, offering important insights into the risk factors for LEI in top women's football players.

H5: Higher training loads, characterised by frequent intense training sessions and matches, will be positively correlated with the incidence of LEI in elite women's football players in Kosovo (Training Load).

The study involving a number of top women's football players in Kosovo sought to evaluate the link between increased training loads and the occurrence of lower extremity injuries (LEI). The study found a substantial positive association (r = 0.318, p = 0.003) between the incidence rate of LEI and the Y Balance Test Right%. This suggests that as the number of injuries rises, so will the performance in the Y Balance Test with the right leg. Furthermore, Y Balance Test Right% correlated positively with both the incidence rate and Y Balance Test Left%, indicating a possible link between injury occurrence and particular balance measurements. Furthermore, the study discovered that Y Balance Test Right% was positively connected with Aerobic Fitness Test - 20-Meter (r = 0.236, p = 0.031), indicating a possible link between balance and aerobic fitness in the context of injury occurrence among top women's football players.

Table 63: Pearson correlation the relationship between training load and incidence.

Correlations

		1	2	3	4	5	6	7	8
Incidence rate	Pearson Correlation	1	.318**	0.019	0.022	-0.185	0.028	.236*	0.092
	Sig. (2-tailed)		0.003	0.862	0.843	0.092	0.804	0.031	0.405
	N		84	84	84	84	84	84	84
Y Balance Test Right	Pearson Correlation		1	.308**	.230*	0.016	0.029	0.044	0.051
	Sig. (2-tailed)			0.004	0.036	0.885	0.793	0.693	0.648
	N			84	84	84	84	84	84
Y Balance Test Left	Pearson Correlation			1	-.220*	0.028	-0.054	0.043	-0.017
	Sig. (2-tailed)				0.044	0.803	0.627	0.698	0.877
	N				84	84	84	84	84
Y Balance Test Difference %	Pearson Correlation				1	-0.113	.245*	-0.058	0.05
	Sig. (2-tailed)					0.304	0.024	0.598	0.653

	N	84	84	84	84
Sit and Reach Test	Pearson Correlation	1	-0.016	**-.223***	-0.165
	Sig. (2-tailed)		0.885	0.041	0.133
	N		84	84	84
Countermovement Jump Test	Pearson Correlation		1	-0.076	**-.246***
	Sig. (2-tailed)			0.491	0.024
	N			84	84
Aerobic Fitness Test – 20-Meter	Pearson Correlation			1	-0.01
	Sig. (2-tailed)				0.928
	N				84
Body Mass Index	Pearson Correlation				1
	Sig. (2-tailed)				
	N				

Source: Own source 2024.

However, other factors did not have significant associations. For example, the Sit and Reach Test, Countermovement Jump Test, and Aerobic Fitness Test - 20-Meter had no significant relationship with injury incidence or other balancing measures. The lack of significant correlations for certain variables suggests that, while balance metrics may be associated with injury incidence, other factors may also play a role in the complex interplay between training loads, physical performance, and the occurrence of lower extremity injuries in elite female football players. The study emphasizes the significance of additional research to clarify the underlying processes and causal elements in these connections, which will provide useful insights for injury prevention techniques in top women's football.

H6: Playing on artificial turf and wearing improper or worn-out footwear will be associated with an increased risk of LEI in elite women's football players in Kosovo (Playing Surface). Independent sample t-test

The study examines a potential correlation between playing on artificial grass and the risk of lower extremity injuries (LEI) among top women's football players in Kosovo. After examining various exposure lengths, physical performance metrics, and injury incidence rates, the results revealed a significant finding in exposure time during matches. Players on artificial grass had a considerably lower mean exposure duration during matches than those on natural grass (mean difference = -143.636, p = 0.034), indicating that the playing surface may have an influence on match-related variables.

Furthermore, certain physical performance measures, such as the countermovement jump test and the 20-meter aerobic fitness test, revealed significant differences between artificial and natural grass surfaces, highlighting the complexities of the relationship between playing surface and player health.

Table 64: Independent sample t-test to Playing Surface and other factors.

	Playing Surface	N	Mean	Mean Difference	P-value
Exposure time of match/h	Artificial grass	66	1426.36	-143.636	.034
	Natural grass	18	1570.00	91.364	.803
Exposure time -Training/h	Artificial grass	66	8746.36	-52.273	.893
	Natural grass	18	8655.00	-2.394	.034
Exposure time Total/h	Artificial grass	66	10172.73	1.523	.803
	Natural grass	18	10225.00	-.793	.903
Match/h	Artificial grass	66	23.77	-.07929	.903
	Natural grass	18	26.17	-.48303	.529
Training /h	Artificial grass	66	145.77	-.91985	.319
	Natural grass	18	144.25	-.08172	.893
Match and Training h	Artificial grass	66	169.98	-1.114	.557
	Natural grass	18	170.78	-1.646	.227
Incidence rate = (Match and Training h/1000 h) *100%	Artificial grass	66	16.9985	.5636	.332
	Natural grass	18	17.0778	-143.636	.034
Y Balance Test Right (cm)	Artificial grass	66	84.6836	91.364	.803
	Natural grass	18	85.1667	-52.273	.893
Y Balance Test Left (cm)	Artificial grass	66	82.0235	-2.394	.034
	Natural grass	18	82.9433	1.523	.803
Y Balance Test Difference %	Artificial grass	66	3.7811	-.793	.903
	Natural grass	18	3.8628	-.07929	.903
Right Single Leg Squat Test (reps)	Artificial grass	66	5.00	-.48303	.529
	Natural grass	18	5.00	-.91985	.319
Left Single Leg Squat Test (reps)	Artificial grass	66	5.00	-.08172	.893

	Natural grass	18	5.00	-1.114	.557
Sit and Reach Test (cm)	Artificial grass	66	13.14	-1.646	.227
	Natural grass	18	14.25	.5636	.332
Countermovement Jump Test (cm)	Artificial grass	66	41.41	-143.636	.034
	Natural grass	18	43.06	91.364	.803
Aerobic Fitness Test – 20-Meter (levels)	Artificial grass	66	10.425	-52.273	.893
	Natural grass	18	9.861	-2.394	.034

Source: Own source 2024.

However, the study found no significant differences in other exposure periods, incidence rates, or balance and strength assessments between the two playing surfaces. The lack of meaningful results in these areas implies that the link between playing surface and player well-being is complex and context dependent.

While artificial grass was linked to certain performance indicators, the overall impact on injury rates and other physical evaluations might be impacted by a variety of factors. More study is needed to fully understand the complex interplay between playing surface, exposure times, and physical performance in elite women's football, which will guide future treatments to reduce injury risks and improve player health.

Chi-square

The data, which were evaluated using Pearson chi-square tests, revealed some noteworthy conclusions. Notably, the interaction between playing surface and the Sit and Reach Test was significant (Chi-square = 45.055, p = 0.029), indicating a possible relationship between artificial grass and flexibility measurements. However, no significant relationships were found between playing surface and other exposure periods, injury incidence rates, or balance and strength assessments, with non-significant p-values ranging from 0.115 to 0.890. These findings highlight a complex relationship between playing surface and specific aspects of player performance and injury risk, emphasizing the importance of gaining a thorough understanding of the multifaceted nature of elite women's football player health on artificial and natural grass surfaces in Kosovo.

Table 65: Chi-square to Playing Surface and other factors.

	Pearson Chi-sqaure	p-value
Playing Surface * Exposure time of match/h	14.362	.349
Playing Surface * Exposure time -Training/h	28.962	.115
Playing Surface * Exposure time Total/h	48.859	.321
Playing Surface * Match/h	14.362	.349
Playing Surface * Training /h	28.962	.115
Playing Surface * Match and Training/h	55.293	.388
Playing Surface * Incidence rate = (Match and Training h/1000 h) *100%	55.293	.388
Playing Surface * Y Balance Test Right (cm)	77.071	.476
Playing Surface * Y Balance Test Left (cm)	78.061	.445
Playing Surface * Y Balance Test Difference %	66.182	.471
Playing Surface * Sit and Reach Test (cm)	45.055	.029
Playing Surface * Countermovement Jump Test (cm)	12.692	.890
Playing Surface * Aerobic Fitness Test – 20-Meter (levels)	45.889	.639

Source: Own source 2024.

H7: According to group division younger players and those with a history of LEI will be more susceptible to sustaining such injuries during the course of the competitive season (Age and Previous Injury History).

Independent Sample t-test

The study searched for to find out the vulnerability of younger players and those with a history of lower limb injuries (LEI) to incur comparable injuries during the competitive season, with a focus on age and past injury history.

The results indicated essential findings with age and several performance indicators. Younger players (No: Mean = 20.26) had a significant mean difference of -2.237 in the Y Balance Test Right% compared to older players (Yes: Mean = 22.50, p = 0.043). Similarly, the Sit and Reach Test shown a significant mean difference in flexibility, with younger players (No: Mean = 13.56) scoring lower than those with a history of LEI (Yes: Mean = 11.63, p = 0.038).

Table 66: Independent Sample t-test to Age and Previous Injury History.

	Has the player had a previous injury of the same location and type?	N	Mean	Mean Difference	P-value
Age (years)	No	76	20.26	-2.237	.043
	Yes	8	22.50	-105.395	.144
Exposure time of match/h	No	76	1447.11	555.987	.382
	Yes	8	1552.50	-1.757	.144
Exposure time -Training/h	No	76	8779.74	9.266	.382
	Yes	8	8223.75	.74934	.456
Match/h	No	76	24.12	2.52513	.159
	Yes	8	25.88	2.45296	.023
Training /h	No	76	146.33	-1.39559	.086
	Yes	8	137.06	1.934	.238
Incidence rate = (Match and Training	No	76	17.0868	-.401	.834
h/1000 h) *100%	Yes	8	16.3375	2.0353	.038
Y Balance Test Right (cm)	No	76	85.0276	-2.237	.043
	Yes	8	82.5025	-105.395	.144
Y Balance Test Left (cm)	No	76	82.4542	555.987	.382
	Yes	8	80.0013	-1.757	.144
Y Balance Test Difference %	No	76	3.6657	9.266	.382
	Yes	8	5.0613	.74934	.456
Right Single Leg Squat Test (reps)	No	76	5.00	2.52513	.159
	Yes	8	5.00	2.45296	.023
Left Single Leg Squat Test (reps)	No	76	5.00	-1.39559	.086
	Yes	8	5.00	1.934	.238

Sit and Reach Test (cm	No	76	13.56	-.401	.834
	Yes	8	11.63	2.0353	.038
Countermovement Jump Test (cm)	No	76	41.72	-2.237	.043
	Yes	8	42.13	-105.395	.144
Aerobic Fitness Test – 20-Meter (levels)	No	76	10.498	555.987	.382
	Yes	8	8.463	-1.757	.144

a. t cannot be computed because the standard deviations of both groups are 0.
Source: Own source 2024.

Significant differences were found between exposure time and physical performance in Match/h, Training/h, and Incidence Rate. Players with a history of LEI had a longer mean exposure duration per match hour (Yes: Mean = 25.88) than those without a history (No: Mean = 24.12, p = 0.023). Furthermore, participants with a history of LEI had a substantially higher Incidence Rate (Yes: Mean = 16.3375) than those without (No: Mean = 17.0868, p = 0.038). These findings indicate that, throughout the competitive season, age and past injury history may influence specific physical performance indicators and injury rates among elite women's football players in Kosovo.

Chi-square
The Pearson chi-square tests were used to examine the relationships between age and other factors. The findings revealed that age had no significant connection with exposure time during matches, training sessions, or overall exposure time, as evidenced by non-significant p-values ranging from 0.219 to 0.802. Similarly, there were no significant relationships between age and match-related variables such as Match/h, Training/h, and Incidence Rate (p-values ranged from 0.219 to 0.972).

Table 67: The Pearson chi-square tests between age and other factors.

	Pearson Chi-square	p-value
Age * Exposure time of match/h	26.765	.422
Age * Exposure time -Training/h	48.789	.219
Age * Exposure time Total/h	78.467	.802
Age * Match/h	26.765	.422
Age * Training /h	48.789	.219
Age * Incidence rate	79.934	.972
Age * Y Balance Test Right (cm)	162.13	.311
Age * Y Balance Test Left (cm)	159.19	.370
Age * Y Balance Test Difference %	154.79	.085
Age * Sit and Reach Test (cm)	39.809	.967
Age * Countermovement Jump Test (cm)	36.113	.646
Age * Aerobic Fitness Test – 20-Meter (levels)	99.741	.488

Source: Own source 2024.

While age did not have a significant effect on injury incidence rates or exposure times, there were notable patterns in physical performance indicators. The interaction between age and Y Balance Test Difference% approached significance (Chi-square = 154.79, p = 0.085), indicating a possible trend that should be investigated further. Other physical performance assessments, such as the Sit and Reach Test, Countermovement Jump Test, and 20-Meter Aerobic Fitness Test, showed no significant connection with age. Overall, the findings suggest that, during the competitive season, age may not be a significant determinant in injury vulnerability, but there may be subtle relationships with particular physical performance indicators among elite women's football players in Kosovo.

The diagram illustrates the observed groups and predicted probabilities resulting from the logistic regression model at Step 1. The hypothesis being tested suggests that younger players and those with a history of lower extremity injuries (LEI) will be more susceptible to sustaining such injuries during the competitive season. The diagram presents the predicted probabilities of membership in the "Yes" group (having a previous injury of the same location and type) along the probability scale from 0 to 1. The vertical axis represents the number of cases, with symbols "N" indicating "No" and "Y" indicating "Yes." The cut value at 0.50 is used to classify cases into the respective groups. The model predicts a higher likelihood of "Yes" for players with specific characteristics. The symbols along the probability scale demonstrate the distribution of predicted outcomes, providing a visual representation of the model's effectiveness in distinguishing between players with and without a history of LEI.

Table 68: Correlations of age, and BMI with exposure time and functional parameters.

	Age (years)	Height (m)	Body mass (kg)	BMI (kg/m^2)
Exposure time match (min)	-0.097	-0.051	-0.043	-0.016
Exposure time training (min)	0.137	0.076	0.023	-0.039
Y balance test right (cm)	-0.107	0.106	0.047	-0.034
Y balance test left (cm)	-0.133	0.107	-0.013	-0.116
Single leg squat right (reps)	-0.111	0.092	0.034	-0.033
Single leg squat left (reps)	-0.084	0.069	0.024	-0.028
Sit and reach (cm)	0.124	0.068	-0.067	-0.136
Countermovement jump (cm)	-0.102	0.022	-0.099	-0.130
Aerobic fitness test (levels)	**-0.187***	0.073	0.041	-0.024

Data represent Pearson correlation coefficients (r), Significant correlations are marked with asterisks (*p<0.05). Abbrevations: BMI (body mass index)

Source: Own source 2024.

Correlation analysis revealed no significant correlations between age, body height, body mass, and BMI categories with the exposure time in matches and training, balance outcomes, single leg squat performance, as well as sit and reach and countermovement jump tests. The only significant correlation was between age and aerobic fitness test ($p<0.05$).

Table 69: Correlations of age, and BMI with exposure time and functional parameters.

	Exposure time match (min)	*Exposure time training (min)*
Y balance test right (cm)	0.094	0.162
Y balance test left (cm)	0.034	-0.040
Single leg squat right (reps)	**-0.203***	**-0.194***
Single leg squat left (reps)	-0.154	**-0.203***
Sit and reach (cm)	0.139	-0.031
Countermovement jump (cm)	-0.032	-0.043
Aerobic fitness test (levels)	-0.130	**0.336****

Data represent Pearson correlation coefficients (r), Significant correlations are marked with asterisks (*p<0.05, **p<0.01). Abbrevations: BMI (body mass index)

Source: Own source 2024.

The total exposure time showed a significant positive correlation with the Y Balance Test of the right leg, while demonstrating a negative correlation with the single leg performance for both right and left legs. Furthermore, the Y Balance Test exhibited a significant positive correlation with the Countermovement Jump (CMJ), indicating that better performance on the Y Balance Test corresponds to better outcomes in the CMJ. As expected, there was a significant correlation between the single-leg squat for the right and left legs. However, the sit-and-reach measurement did not show significant correlations with any of the other functional and balance outcomes. Significant correlation was also found between age and the severity of injuries ($p<0.05$). Adding, there was also a significant positive correlation between age and BMI. Older players showed higher values of BMI compared to younger ones.

Table 70: Differences in age, anthropometry, BMI, exposure time, and functional abilities.

	Age categories			
	>24 years n=121	25-29 years n=19	> 30 years n=2	**p-values**
Age (years)	19.3 ± 2.3	26.4 ± 1.3	30.0 ± 0.0	**<0.01 ****
Height (m)	1.66 ± 0.6	1.64 ± 0.7	1.67 ± 0.14	0.48
Weight (kg)	58.4 ± 6.0	58.7 ± 5.7	63.5 ± 13.4	0.49
BMI (kg/m^2)	21.2 ± 1.8	21.8 ± 2.2	22.6 ± 1.0	0.24
Exposure time match (min)	1580.6 ± 383.6	1492.1 ± 386.9	1800.0 ± 127.3	0.45
Exposure time training (min)	9332.5 ± 1915.6	10174.7 ± 1581.3	9450.0 ± 3182.0	0.19
Y balance test right (cm)	85.1 ± 2.9	84.9 ± 2.6	85.1 ± 2.9	0.84
Y balance test left (cm)	82.2 ± 2.7	81.5 ± 2.7	79.8 ± 0.6	0.24
Single leg squat right (reps)	4.93 ± 0.3	4.74 ± 0.6	5.0 ± 0.0	0.12
Single leg squat left (reps)	4.89 ± 0.4	4.79 ± 0.4	5.0 ± 0.0	0.53
Sit and reach (cm)	13.1 ± 5.2^b	17.0 ± 5.2^a	14.5 ± 2.1^a	**0.01***
Countermovement jump (cm)	41.9 ± 5.6	40.4 ± 6.3	35.5 ± 9.1	0.19
Aerobic fitness test (levels)	10.6 ± 2.0^a	9.3 ± 1.9^b	9.8 ± 0.6^a	**0.02***

Source: Own source 2024.

A one-way ANOVA indicated a significant difference between age categories in both the sit-and-reach test and aerobic fitness test. However, post-hoc Scheffe analysis revealed better performance in the sit-and-reach test only between the <24 and 25-29 age groups, with the 25-29-year-old category exhibiting superior performance. The other age categories did not show significant differences among each other. In addition, aerobic fitness appeared to differ significantly among age-group categories. However, the observed difference was statistically meaningful only between the <24 and 25-29-year-old groups, with those under 24 years old exhibiting higher aerobic fitness. No significant differences were found among the other age categories.

Table 71: Previous injury location and type.

	Models	β ± SE	(95% CI)	p-Value	Adjusted R^2 (%)
Previous injury location and type	1				
	Constant	1.35 ± 0.10	1.15 to 1.54	<0.001	
	Aerobic fitness test – 20m run	-0.24 ± 0.009	-0.046 to 0.01	<0.01	5.2
	2				
	Constant	2.81 ± 0.56	1.71 to 3.92	<0.001	
	Aerobic fitness test – 20m run	-0.027 ± 0.01	-0.045 to 0.01	<0.01	9.2
	Y balance test right (cm)	-0.017 ± 0.01	-0.03 to 0.01	< 0.01	
	3				
	Constant	3.10 ± 0.55	2.01 to 4.19	<0.001	
	Aerobic fitness test – 20m run	-0.028 ± 0.01	-0.045 to -0.01	<0.01	14.1
	Y balance test right (cm)	-0.022 ± 0.01	0.09 to 0.40	0.001	
	Y balance test difference %	0.028 ± 0.01	0.01 to 0.05	<0.01	

Source: Own source 2024.

Aerobic fitness, Y Balance Test for the right side and the difference percentage of the Y balance test were the strongest predictors of injury recurrence among the female football players. When all three factors were provided (model 3) the variance was explained at 14.1%.

5 DISCUSSION

Injuries comprise a health threat, particularly in football, which is considered a high-risk sport. Information related to the epidemiology of lower extremity injuries in female football athletes is mandatory for the purpose of developing optimum preventive strategies.

According to recent research, comprehensive knowledge about determinants and risk factors associated with lower extremity injuries provides a composite idea about injury chances and incidences that enable experts to identify predictable factors for injury according to different gender groups and at various performance levels.

However, only a few studies referring to lower extremities concussions in female football athletes are available. Considering that a small data can be available related to the lower extremity injury in elite women football professionals in Kosovo, the goal of this study was to identify the predictive risk factors related to injury incidence and other selected factors as per existing literature.

Stady I

In this section, the findings derived in the previous section have been critically discussed using existing literature to formulate a cohesive narrative that addresses the objectives of the present study. To better understand the influence of each identified factor, the factors have been grouped according to the categories mentioned in Table 6.

Injury rates

As observed in Table 4, the rates of LEI among the participants varied significantly from one study to another, with the lowest injury rate being 38.17% and the highest rate being 66%. All the research articles included in this systematic review study investigated the risk factors of all types of lower extremity injuries.

Notably, although (Faude et al. 2006), aimed to explore the risk factors of all types of injuries in elite women football players, data collected in this study was related to only LEI (Hägglund et al. 2006), recruited both male and female elite football players in their study. However, data related to only female elite football players were extracted from the study of (Hägglund et al. 2006), in this systematic review.

One of the existing studies partially reported that elite athletes' performance is more intense and demands severe actions for the competitions that contribute to the potential risk of injury risks. Additionally, athletes skilled in handling the football, shooting, moving forward, and making optimal decisions about the ball hit at their feet comprise greater ball possession that eventually makes them exposed to increased rigging and relevant contact disorders.

It is noted to recommend that elite athletes have the facility of better resources as compared to sub-elite participants, like better apparatus, complete medical facilities, and expert trainers who perfectly manage match and training sessions.

These advanced resources may allow a decreased ratio of injury risk besides the increased exposure to intense training. One of the studies also included high school football players, where the participants were teenagers, and age could be linked as a factor influencing the development of LEI. However, since this baseline characteristic varied significantly and age was not reported in all studies, it couldn't be included as a sufficient predictor.

Predictors of LEI

As depicted in Table 6, a total of five themes have been identified in relation to factors that increase the risk of LEI in elite women football players. These factors are High BMI; Low normalized knee separation (≤10th percentile); previous knee injury; previous injury in the lower body; and previous injury.

Among these themes, two (High BMI; low normalized knee separation) are related to the physical characteristics of the players, whereas the other three (previous knee injury; previous injury in the lower body; and previous injury) are related to the history of injuries in the players. In addition to the risk factors, one factor has been identified that reduces the risk of LEI among women football players.

This factor is the Lower knee valgus angle in a drop-jump landing. Notably, this factor is related to the practice methods of the players. Based on the grouping of the identified themes, the following major predictors of risk factors of LEI in elite women football players have been identified.

Previous Injury

Three of the four studies reviewed in this study implied that previous injury increases the risk of LEI in elite women football players. While (Nilstad et al. 2014) found that previous knee injury increases the risk of LEI in the population of interest (Faude et al. 2006) found that three specific types of injuries increase the risk of LEI.

These types of injury are anterior cruciate ligament rupture, ankle sprain, and knee sprain. However, according to (Hägglund et al. 2006), any kind of injury in the lower body in the past can effectively increase the risk of LEI in elite women football players.

Notably, although the three studies focused on different types of injuries, the relative risk (or relative odds) of elite women football players sustaining LEI was found to be significant in each of these studies.

Thus, it can be concluded that, regardless of the nature of the injury, any kind of LEI increases the risk of future injuries in elite women's football players. Although the cause behind this correlation has not been satisfactorily described, other researchers have also found that previous injuries increase the risk of future injuries in elite women football players regardless of the location of the injury (Alahmad et al. 2021).

This risk factor can be partially explained based on the findings of Hagglund and colleagues (Hägglund et al. 2006). The researchers found that athletes who have experienced injuries in the past are likely to repeat the same movements or components along the kinematic chain that led to the previous injuries, thereby increasing the risk of future injuries.

Knee Position and Movement

Nilstad and colleagues as well as O'Kane and colleagues (O'Kane et al. 2017; Nilstad et al. 2014) found lower knee valgus angle in a drop-jump landing, and low normalized knee separation respectively to be associated with the risk of LEI in elite women football players.

While lower knee valgus angle in a drop-jump landing was found to decrease the risk of LEI in the target population, low normalized knee separation was found to increase the risk of LEI in the same population group. These predictors can also be explained based on the findings of Hagglund at al. (Hägglund et al. 2006).

Both factors are components of the kinematic chain involved in the jumps and landing of elite women football players. Therefore, changes in these factors influence the probability of LEI injuries in such players.

BMI

(Nilstad et al. 2014) and colleagues found that a higher BMI increases the risk of LEI in elite women football players. BMI is a direct indicator of the weight status of individuals (Weir and Jan 2022). In other words, a higher BMI refers to a higher inclination to be overweight or obese. As such, it is understandable that a higher BMI increases the risk of LEI in elite women's football players.

Another explanation of the high risk of injury could be related to the third law of physics where every action has an equal and opposite reaction, Since the body mass of high BMI players is high the overall force which is a product of the mass and acceleration with which they hit the ground is high, this can cause a significantly greater impact on the lower extremities with more extensive injuries.

Other contemporary studies have implied that overweight or obese players demonstrate lower control over their motions during games and are therefore more likely to demonstrate a higher incidence of injuries (Richmond et al. 2016).

Limitations and future directions

Despite following a systematic database searching and screening method for data collection, the present systematic review and meta-analysis study is associated with certain limitations. Due to a lack of existing contemporary primary research on the topic of interest, only a limited amount of secondary data could be collected in this study. Due to this drawback, the findings of this study may not be generalizable for the global population of women football players (Futoma et al. 2020).

One limitation of the study was the limited number of studies available to conduct a relevant meta-analysis, as the sample size is small to compare the results on a more global level, hence trials involving a larger sample size for more comparable results should be considered. For another, due to time and resource constraints, only one researcher was involved in the screening of research articles in this study.

This might have resulted in a certain degree of selection bias in this systematic review. Since the study had different predictors of LEI, the heterogeneity among the studies was high and even the baseline characteristics of all studies were not the same increasing the risk of bias.

However, even though only four relevant articles could be identified for this systematic review and meta-analysis study, it not only highlights the major limitation of this study but also underscores an important knowledge gap pertaining to the domain of LEI in elite women football players.

Based on the limitations of the present study, as well as those identified from the existing body of evidence related to the topic of interest, the future direction of research related to the risk factors of LEI among elite women football players can be determined.

The higher incidences of knee and ankle injuries in female football athletes observed in meta-analysis might predict the fact that women possess double the rate of injuries related to joints and ligaments when compared to male participants Sex-associated differences in lower trunk and limbs neuromuscular performance, joint flexibility, hormonal changes, biomechanical mechanisms, and anatomical differences are recommended to be the predictive reasons for female players that makes them more susceptible to be affected by joint and ligament concussions, primarily targeting the ankle and knee joints.

Study II

The inclusive participants for this study were the female football athletes of the elite league having 12 contributing teams specifically in Kosova. The current study is Kosovo is the first epidemiological study that examined the soccer-related injuries in women soccer elite players. A total of 84 injuries were noticed while monitoring 26,123 hours of exposure among 12 clubs and 142 players from the Elite Women's Soccer League. According to these results, there are 3.21 (CI: 1.24, 3.27) overall IR injuries for every 1000 hours of exposure.

Incidence rate of overall injury

Many studies have been investigating soccer-related injuries played in various major soccer leagues (Valenciano 2017; Martín-San et al. 2021; Horan et al. 2022; Jacobson and Tegner 2007; O'Faude et al. 2005), many of which show significant differences across countries in the frequency of injuries. In this study, the elite women's soccer league's overall injury rate was observed in Kosovo is 3.21 (CI: 1.24, 3.27), which was surprisingly lower than in other studies.

In this context, a systematic review and meta-analysis conducted by (Valenciano 2017), reported an overall injury incidence in soccer football players being 6.1 injuries /1000 h exposure, out of which a number of match injury incidence (19.2 injuries / 1000 h of exposure) about 6 times higher than training injury incidence rate (3.5 injuries / 1000 h of exposure).

However, Horan D and colleagues were in the same line with their findings from the Irish Women's National League (Horan et al. 2022), reporting a 7.9 injuries / 1000 h exposure overall injury incidence ratio with an even higher difference (7.5 times) in between match (192 / 1000 h) and training (2.5 / 1000 h). Another recent study from the first division of Spanish Women's Soccer League (Martín-San et al. 2021), reported an injury incidence ration of 3.65 injuries / 1000 h with an even higher match versus training injury incidence ratio (19.02 / 1000 h and 1.70 / 1000 h, respectively). An earlier 2005 study from the German's National League (Faude et al. 2005), reported an injury rate of 6.8 injuries / 1000h of exposure, while being as high as 23.3 / 1000 in match hours and 2.8 / 1000 hours of training.

Another study from the same year though coming from Swedish female elite soccer players (Jacobson and Tegner 2007) reported an injury ratio 4.6/1000 h of soccer being 13.9 / 1000 h exposure during match and 2.7 / 1000 exposure during training.

The differences in between all the findings (including ours within this poll) could be due to the methodological differences, different time periods when the studies were performed etc. However, the very low injury incidence ratio observed within our study might just correspond to the generally lower level of our elite soccer league and on its late internationalization.

The quantity of exposure and the total number of games played in a season have both been linked to injury occurrence because they have an impact on how long players need to regenerate between games (Ekstrand et al. 2011). In our study, participating players played an average of 26.20 ± 6.37 matches. Although the best clubs may use more elite players and switch up their lineups more frequently (the differences in average match hours were just 13% and 17%, respectively), the much-reduced match exposure may account for Kosovo's low injury rate overall.

The fact that Kosovo joined FIFA and UEFA extremely late and missing in international competitions, can be linked to the causes for the lesser number of matches played during the season. Kosovo's unusually low injury rate may also be explained by the "northern bias" mentioned by (Waldén et al. 2005).

According to these articles, teams from northern European regions—which have also undergone more in-depth study—had a higher frequency of injuries than teams from Mediterranean climatic zones. This can be because the climate has an impact on injuries incidence. Higher wind speeds and colder outside temperatures, according to a study on Scottish rugby players, increased the chance of injury. (Lee and Garraway 2000).

The style of playing may also be attributed to the geographical variations in injury occurrence. It is probable that a more technical and physically less demanding style of play would be related with a lower overall risk of injury, according to (Dellal et al. 2011).

Types of injuries

In our studies, contusions, sprains, and fractures were the three most common types of injuries, accounting for more than half of all injuries. The most common differential diagnoses included contusions (n = 15 - 17.9%), sprains (n = 12, 14.3%), fractures, dislocations, and lacerations/abrasions (n = 24, 28.5%). Based on these data, "a re-evaluation of injury prevention program in women's soccer," should be performed with the goal of more effectively reducing the most common types of injuries.

The statistical analysis and evaluation of the study data revealed a "need for targeted preventive women's soccer programs especially for sprains, contusions, fractures, dislocations, abrasions to reduce the need for surgical intervention, as well as further research into potential reasons for these observed ratings regarding types and severity as well as location and severity.

These findings do not differ from findings of other epidemiological research, such as the one by (Wong 2005), in which sprains were the most frequent type of game injury and contusions were reported in 21 investigations.

Injuries in matches vs. training

According to our data, trauma injuries damage that was about two times higher than overuse syndrome (n-28, 33.3% vs. n-56, 66.7%) or exercises (IR = 3.2). Although this result is consistent with earlier research (Waldén et al. 2007). The dramatically greater rates of injuries in games may be explained by a study by (Rahnama et al. 2002) and colleagues that investigate at playing behaviours linked to an increased risk of injury in soccer matches (Rahnama et al. 2002).

It might be assumed that during matches, these activities happen more frequently and are carried out more forcefully. Additionally, it has been discovered that injuries tend to happen more frequently at the conclusion of each half (Ekstrand et al. 2011), providing evidence that suggests weariness may play a part in making injuries more likely to happen during games.

Injuries depending on age and playing position.
Soccer injury rates have been the subject of several studies looking at the connection between playing position and injury rates, with varying degrees of success. Regarding playing positions, there is limited data available in the existing literature about the injury incidences and playing positions of football players, as most of the studies ignore explaining the detailed information regarding female football elite group players.
However, particular physiological demands account for various playing positions (Bradley et al. 2009).

Due to different physiological and tactical requirements, it is a general observation that training methodologies followed in football games inevitably require maximum specialisation skills. Recent studies have documented that team leaders tend to apply specific methods for the preparation of their participants to enhance training modalities. These cases, however, require specific and intensive movements that may be a possible risk for the incidences of concussions.

However, different studies reported a significant difference in the percentage of injury incidence according to playing positions, documenting that midfield athletes and defending members were at greater risk of injuries. However, a few research studies stated no varying results for injury incidence that could relate to playing position.

The rate of injuries occurring as compared to playing position was relatively similar in all the age members and lesser significant variables were found. Despite different studies that looked at the impact of playing spots on the rate of injury occurrence (Hägglund et al. 2009), it is somehow difficult to compare them as the study design is different in all studies Thus, proper training programs are designed according to specific sport rather than focusing on the positional role.

The age of the players is one element that can contribute to this variability of results. Despite some conflicting data (Hägglund et al. 2006), various research has predicted that the frequency of soccer injuries will rise with advancing age (Kristenson et al. 2022). In our study, the injury ratio decreased with age starting with younger players (n = 72, 85.7%), middle players (n = 11, 13.1%), and elderly players (n = 1, 1.2%). According to these findings, injuries are six times more common in the youngest age group, with statistically significant disparities between the young and middle age groups.

According to these findings, injuries are six times more common in the youngest age group, with statistically significant disparities between the young and middle age groups. These findings might point to a more aggressive, les of experience and dangerous playing style among young players (Shalaj et al. 2016).

To account for any age-related biases when comparing IR injury amongst players who were involved in different playing positions, age was included as a covariate in the Poisson regression analyses due to the considerable differences between age groups. T

he results extracted from previous studies manifested a growth ratio between the percentage of injuries that vary according to the age showing a statistically significant value when a comparative study was performed for the injury incidences in athletes more than 14 years and younger players. Such events relate to other findings.

When a few researchers compared the age teams, they also noticed that the injury incidences were greater in the youngest players. Another older study manifested a higher ratio of injury incidences in 14- to 16-year-old athletes as compared to 16 to 18-year-old athletes. A justified explanation related to this trend might involve weak techniques and tricks as well as improper muscle training, strength, and coordination in the younger athletes having less experience of playing sports.

This finding may be connected to the idea that the incidence of injury is highest during games (where most injuries occur) in the regions of the field where possession is most fiercely contested, such as in the defensive areas close to the goal (Rahnama et al. 2002). It is crucial to remember that the differences weren't statistically significant and were somewhat slight.

Our findings confirm earlier research suggesting that playing position has no bearing on the frequency of injuries (Lüthje et al. 2007). Six variables have been identified as influencing the risk of lower extremity injuries (LEI) among women football players.

The factors associated with an increased risk of knee injuries include a higher body mass index (BMI) (odds ratio [OR] 1.51, 95% confidence interval [CI]), a lower knee valgus angle in a drop-jump landing (OR 0.64, 95% CI), a previous knee injury (OR 3.57, 95% CI), low normalised knee separation (≤10th percentile) (relative risk [RR] 1.92, 95% CI), previous injury such as anterior cruciate ligament rupture (OR 5.24, 95% CI), ankle sprain (OR 1.39, 95% CI), knee sprain (OR 1.50, 95% CI), and previous injury in the lower body (OR 2.97, 95% CI).

All four-research examined various factors, with BMI being found as a risk factor in just one study, while two studies recognised past injury as a significant risk factor.

As a result, the characteristics of the selected studies varied. There are some risk indicators associated with injuries, according to the research. For example, according to (Nilstad et al. 2014), those who are overweight, have a shorter knee value angle, and have had knee injuries before are more prone to further harm.

Another finding from (Faude et al. 2006), is that previous ruptures, especially in the ligament area, are the main cause of future injuries. A higher number of risk factors was also associated with knee and ankle sprains. When normalized (O'Kane et al. 2017), suggested that a lower knee separation was associated with a higher incidence of risk variables.

A previous lower-body injury was also shown to be a strong predictor of future injuries by (Hägglund et al. 2006), These studies highlight the need to examine accidents and danger indicators among athletes with a wide range of variables, and they also provide strategies for preventing injuries.

On further investigation, it was shown that a higher body mass index (BMI) was associated with LEI alterations and that factors such as previous injuries, previous episodes of LEI, knee strains, and ankle apron were the main causes of knee problems. On the other side, research suggests that fewer lower limb injuries may result from less knee valgus. Therefore, these factors should be considered while assessing the individual risk of LEI and developing strategies to avoid injuries.

Those who are overweight or who have had knee problems in the past should take precautions to avoid further harm. Weight loss, targeted exercise, and improved knee stability are all potential therapies that might help with this.

More information on the typical football player's age, weight, height, and body mass index (BMI) was presented in the discussion. Most players were found to have a superior right leg, which means that their training may be adjusted to meet their unique needs. For instance, attackers may benefit from power and strength training, while goalkeepers might focus on their agility with exercises like jumping.

The majority of injuries, accounting for 69.2% of cases, were found in the lower extremities. Specifically, the knee (n = 21, 25.0%), the side of the ankle (n = 10, 11.9%), and the foot (n = 7, 8.3%) were the most often injured locations. It is important to note that shoulder injuries were the most prevalent form of injury to the upper extremities, accounting for 7.1% of cases. In contrast, injuries to the lumbar region, pelvis/sacrum, and cervical spine were distributed more evenly, with each accounting for 2.4% and 1.2% respectively.

The study included a total of 84 injuries, with an incidence rate (IR) of 2.00 and a confidence interval (CI) ranging from 1.24 to 3.27. Among these injuries, 56 were classified as traumatic or overuse, with an IR of 2.14 and a CI ranging from 1.61 to 2.78.

These traumatic and overuse injuries accounted for 66.7% of all injuries and were considerably higher ($p < 0.05$) compared to the overuse injuries, which accounted for 33.3% (n = 28) with an incidence rate ratio (IRR) of 1.07 and a CI ranging from 0.71 to 1.54.

The total number of injuries varied between training and matches, with 34 injuries in training and 50 injuries in matches. Among players aged 24 and younger, the injury rate was 36.90% in training and 48.81% in matches, affecting 31 and 41 players, respectively. For players aged 25 to 29, the injury rate was 3.57% in training and 9.52% in matches, affecting 3 and 8 players, respectively. Among athletes aged 30 and older, the injury rate was 0% in training and 1.19% in matches, affecting 0 and 1 player, respectively.

This discovery might be linked to the concept that the occurrence of injuries is greatest during matches (where the majority of injuries happen) in the parts of the field where possession is strongly disputed, such as in the defensive zones around the goal.

In addition, the percentage of injuries, including both overuse and traumatic injuries, decreased from 29.76% and 55.95% (25 overuse injuries and 47 traumatic injuries, respectively) in the age group of 24 years old and below, to 3.57% and 9.52% (3 overuse injuries and 8 traumatic injuries, respectively) in the 25 – 29-year-old group, and there were no injuries and 1.19% (0 overuse injuries and 1 traumatic injury, respectively) in the age group of 30 years and above.

Regarding injuries, the severity may vary according to age. The players were categorised into several age groups: young (< 24 years, n = 72, 85.7% IR = 8.57; CI = 6.70, 10.79), middle-aged (24–29 years; n = 11, 13.1% IR = 1.31; CI = 0.65, 2.34), or elderly (> 29 years older; n = 1, 1.2%). In this context, it was revealed that younger women football players had a considerably greater frequency of injuries compared to the "middle" age group. The incidence rate ratio (IRR) was 6.54, with a confidence interval (CI) of 3.43 to 13.69 (p 0.001). A total of 84 injuries were documented, with the severity varying based on the player's position.

The most affected groups were goalkeepers (n = 9, 10.7%, IR = 1.07; CI = 0.49, 2.03), strikers (n = 17, 20.2%; IR = 2.02; CI = 1.18, 3.24), midfielders (n = 23, 27.4%; IR = 2.74; CI = 1.74, 4.11), and defenders (n = 35, 4.17%; IR = 2.47; CI = 1.72, 3.43 of all injuries). The defenders had the lowest average age within the group, at 20.4 ± 3.52 years, while the midfielders had the highest average age, at 20.9 ± 3.56 years.

Forwards have an average age of 20.24 ± 2.70 years, while goalkeepers have an average age of 20 ± 3.16 years. The incidence rate ratios (IRRs) for injuries were substantially greater in goalkeepers (IRR = 25.71, CI = 10.87, 54.57, $p < 0.001$) compared to defenders (n = 35, 41.7%). However, there were no significant differences seen between strikers (n = 17, 20.2%) and midfielders (n = 23, 27.4%).

The much higher incidence of injuries during games may be attributed to research conducted by Rahnama and his colleagues, which examined playing habits associated with an elevated risk of injury in football matches. Existing literature on football player injuries and playing positions lacks comprehensive data, particularly involving female football elite group players. Most studies fail to provide specific information on this topic.

Nevertheless, certain physiological requirements contribute to the different playing positions (Bradley et al. 2009). Training approaches in football games need optimum specialised skills due to varying physiological and tactical demands. Recent research has shown that team leaders use particular techniques to prepare their members in order to improve training approaches. However, these circumstances need precise and vigorous actions that might potentially increase the danger of concussions.

A subsequent study indicated that correlation analysis did not find any noteworthy associations between age, body height, body mass, and BMI categories with the duration of exposure in matches and training, outcomes related to balance, and performance in single-leg squats, as well as results from sit and reach and countermovement leap tests. The only notable link seen was between age and the aerobic fitness test ($p<0.05$).

The post-hoc Scheffe analysis indicated that the sit-and-reach test showed significantly greater performance only in the age categories less than 24 and between 25-29 years old, with the 25-29-year-old group demonstrating superior performance.

No significant differences were seen among the other age groups. Furthermore, there was a noticeable variation in aerobic fitness across different age groups. Nevertheless, the disparity seen was statistically significant just between the groups of those aged under 24 and those aged 25-29, with the former demonstrating superior levels of aerobic fitness. The players' age is a factor that might contribute to the diversity of outcomes.

Although there is some contradictory evidence (Damon P.S. Andrew 2019), several studies have forecasted an increase in the occurrence of football injuries as individuals become older (Bowen et al. 2020). Subsequent examination indicated that the athletes said that their mood was positive (27.4%) and very positive (70.2%) after their recovery from injuries, with just a negligible fraction reporting a neutral mood (2.4%).

The players' physical condition, with regards to a prospective comeback to the squad, was rated as excellent (36.9%) and very good (54.8%). Only 8.3% of the participants indicated neither a good nor terrible physical status.

The subjective assessment of the participants on the functional evaluation of the injured area indicated that 79.8% rated it as very excellent, 17.9% rated it as good, and just 2.4% rated it as neither good nor terrible. 72.6% of the participants reported no pain or limits that would hinder their typical training, whereas 27.4% were uncertain about experiencing such symptoms.

The majority of participants (60.7%) expressed a strong sense of security while engaging in physical acts or movements in the damaged region. Additionally, 38.1% felt a general sense of security, while just 1.2% reported feeling neutral about it.

The major purpose of the discussion is to present primary findings and literature findings in terms of discussing the association and contradiction. The first hypothesis it was found that the association between the injured body part and the rate of occurrence, as assessed using the Chi-square test. The study on injuries among female football players in Kosovo found a two-sided asymptotic significance of .245 and a Pearson Chi-Square value of 59.718 with 53 degrees of freedom for the top 84 injuries. The Likelihood Ratio test yielded a test statistic of 65.544, with 53 degrees of freedom and an asymptotic significance level of .116.

The Linear-by-Linear Association test, with a single degree of freedom, resulted in a value of .250 and an asymptotic significance of .617. The chi-square test results suggest that there is insufficient evidence to support the claim that injuries to the lower extremities (LEI) are more prevalent among elite women's football players in Kosovo compared to injuries in other body segments.

The literature study indicated that injury mechanisms are categorised based on a range of injuries. The injury mechanisms most often seen were shooting, turning, twisting, landing, tackling, leaping, sprinting, and being tackled (Drevon et al. 2017). Tackling is a common occurrence in football games, as players aim to gain possession of the ball.

Athletes often get injuries to the lower regions of their bodies due to their inability to react swiftly and evade rapid, unexpected movements when tackling. Poor playing grounds and improper footwear are the main causes of injuries related to turning, jogging, and twisting (Falah et al. 2010).

Uneven playing surfaces elevate the magnitude of the loading force exerted on the muscles and ligaments located in the lower extremities. When the external pressure exceeds the tolerable capacity of ligaments and muscles, it leads to damage. Insufficient frictional force caused by inappropriate footwear might result in slippage (Fuller et al. 2006). In contrast, an additional frictional force leads to a significant torque during twisting and turning motions, hence causing damage. In addition, defenders in sports can use various strategies to prevent opponents from scoring goals.

Consequently, instances of severe injuries typically occur when shooting (Hägglund et al. 2006). Furthermore, injuries often occur during activities involving bouncing and landing, which are considered essential components of actions like goalkeeping, heading, and shooting.

The injuries occur due to imprecise landing techniques and forceful collisions between players during the execution and completion of landing actions (Hawkins 2001). Prior studies have shown that minimising body exposure is a fundamental measure to prevent injuries (Schmidt-Olsen et al. 1985).

Researchers have found that injuries resulting from less body contact had a higher prevalence rate (59%) compared to injuries resulting from body contact (41%). This supports the results. Furthermore, rotational movements, firing projectiles, locomotion, and leaping constitute 39% of total concussions, categorised as non-contact injuries involving the body (Kucera 2005).

A group of researchers conducted a study on adolescent athletes and found that running accounted for 27% of all non-body contact injuries (Rahnama et al. 2002). The incidence of concussions in professional football players resulting from body contact was found to be 58%, while body contact injuries accounted for 38%. The most often seen injury mechanisms include striking (4%), rushing (19%), sliding (4%), and spinning and diverging (8%). These mechanisms are characterised as non-contact injuries (Weightman and Browne 1975).

Lower extremity injuries may be categorised into many categories, including fractures, strains, sprains, contusions, tendinitis, and bursitis (Sullivan et al. 1980). Anterior cruciate ligament injuries (LEI) are common among female players, accounting for approximately 60%-80% of all injuries that prevent them from participating in exercise and play.

This information is supported by various studies conducted by (Clausen et al. 2014; Faude et al. 2005). Nevertheless, the severity of concussions is assessed based on the number of days missed from playing due to the injury (Nielsen and Yde 1989).

A further Chi-square test was performed to examine the hypothesis that the occurrence of Lower Extremity Injuries (LEI) among the top female football players in Kosovo is higher during competitive seasons compared to non-competitive times.

The study focused on analysing two variables: "LEI - Other body parts" and "When did the injury occur." The Pearson Chi-square value for "LEI - Other body parts" was 59.718, with a corresponding p-value of 0.245. The Pearson Chi-square score for the question "When did the injury occur" was 57.021, with a p-value of 0.328. Nevertheless, both p-values above the commonly recognised significance threshold of 0.05.

The literature research indicated that precise and efficient evaluation of training sessions enables athletes to attain their specified training objectives and be prepared for intense competitive matches, while also minimising the likelihood of injury and the occurrence of injuries. Injury may occur when the body's physical demands are disregarded in terms of its capacity to undergo a full recovery session after training sessions and competitive sports (Anderson et al. 2003).

Football has a higher likelihood of injury due to its intricacies. The most frequently reported injuries among football athletes during competitive games and training sessions include adductor stress (7.6%), hamstring stretching (12.3%), and ankle fractures (8.5%). These findings support the notion that most concussions are associated with lower extremity injuries (LEI), or concussions that affect the lower parts of the body (Toohey et al. 2017)

The results show that Lateral Epicondylitis Injuries (LEIs) are a common kind of football concussion. Research shows that football teams differ in the likelihood and severity of lower extremity injury (LEI) concussions, regardless of the player's gender (Fortington and Finch 2016).

No data was missing from the 84 encounters that were included in the research, as stated in the case processing summary. The major goal of this research was to find out what factors put elite female Kosovo football players at risk for Lower Extremity Injuries (LEIs). There are a lot of factors to think about, including injury history, playing surface, age, musculoskeletal imbalances, and training intensity.

Regrettably, the offered information does not provide conclusive results or comprehensive statistical data about the relationships between these risk characteristics and the frequency of LEI. The purpose of this research was to identify risk factors for Lower Extremity Injuries (LEIs) in elite female Kosovo football players, including but not limited to age, workout intensity, playing surface, muscular imbalances, and injury history.

Codification of the variable under study assigns a value of 1 for systemic problems and a value of 0 for LEI. Researchers do not yet have definitive statistical proof, and the available data does not clearly indicate a correlation between these risk variables and an elevated probability of LEI.

The top Kosovo women's football players' Lower Extremity Injury classification table was 77.4 per cent accurate in predicting these injuries. But there are worries about the absence of projections for other parts of the body.

Evidence from the studies looked at suggests that to effectively avoid injuries, we need to address the factors that place athletes at greater risk of LEIs. (Harøy et al. 2019; Larruskain et al. 2022; Dalen-Lorentsen et al. 2022) indicate that football players are at a higher risk of injuries due to factors such as age, prior injuries, excessive training, imbalances in muscular strength, or playing on certain surfaces.

The only way to find out what might cause injuries and how different variables interact is to conduct a thorough investigation. (Hawkins and Fuller 1998) both suggest using a multivariate model for this purpose.

Previous studies have looked at the age-injury connection as a main risk factor, and multivariate analyses have shown that, with certain limitations, both age and injury affect the probability of injury. While some research has linked older age to an increased risk of injury, other studies have shown that prior injury is a major risk factor for injury at any age (Morris 2022).

Several studies have shown conflicting findings when looking at age as a risk factor; for example, some older athletes seem to be more prone to injuries than younger ones. (Lewis 2023) is the referenced source.

Previous studies have shown that football players often have a high risk of injury recurrence (Schlewing et al. 2022). Strains and sprains of the ankle, groyne, and hamstrings are among these disorders.

An earlier injury is a strong predictor of a more serious one, according to the literature (Kucera 2005). Additional factors that might lead to hamstring or adductor strain injuries include variations in bone structure and the formation of scar tissue in the affected muscle or tendon. Possible other causes include not getting enough rest and playing football too soon after a previous injury (Hawkins 2001).

Research conducted by (Hägglund et al. 2009), suggests that athletes who continue to experience instability after a ligament sprain may have worse neuromuscular control of the ankle joint. This instability is also noticeable during the early stages of recovery from an acute injury, but it won't be a problem in a complicated situation since it can be fixed with training programs (Fuller et al. 2006).

Based on the findings of (Falah et al. 2010) and other research, mechanical instability in the ankles is common after multiple sprain injuries, especially in sportsmen.

Ankle sprains are more likely to occur in patients with limited range of motion, according to previous research. (Dellal et al. 2011) found no indication that it is involved in hamstring strains. There is a lack of data on the correlation between adductor strength, the ratio of hamstring to quadriceps strength, and other relevant variables at this time. Elite athletes with restricted hip hinge range of motion are more likely to injure or rupture the adductor muscles or develop tendinopathy, say (Ekstrand et al. 2016).

New research by (Ardern et al. 2013) confirmed a link between football players and their hip extension, knee flexion, and hip abduction flexibility levels. Some football qualities that might be affecting this link include the sport's demanding nature, which includes intense play, quick turns, bursts of speed, and the capacity to shift speed patterns quickly (Robinson 2023).
Tense muscles might be a side effect of engaging in these activities, which need strong muscles. To add insult to injury, doing faulty flexibility exercises while playing football may amplify the existing risks (Söderman et al. 2001).

Leading women's football players' vulnerability to Lower Extremity Injuries (LEIs) was further explored in the main study. Nonetheless, several criteria did not show any significant changes in the research. There was no statistically significant variance in total exposure duration, mean exposure time during training, or injury type when contrasting athletes with LEI to those with other types of injuries.

Finding out if top female football players are more likely to suffer from Lower Extremity Injuries (LEIs) and whether there is a correlation between muscle imbalances and LEIs was the driving force behind this research. However, there were no significant differences in several characteristics that were uncovered by the investigation.

There was not a statistically significant distinction in the average time of being subjected during competition, training sessions, or overall, between players who received lower extremity injuries (LEI) and those who incurred injuries to other regions of their bodies. The parameters in question did not show a statistically significant difference in their mean values according to an independent sample t-test, with p-values of 0.280, 0.656, 0.554, and 0.674, respectively.

Unilateral dynamic imbalance, defined as the ability to keep one's centre of mass within the body during movements like single-leg stances, is linked to muscular imbalance, according to the literature review (Schmidt-Olsen et al. 1985).

People who play high-intensity sports like football need to be able to stand on one leg and retain dynamic balance so they can be safe and precise (Drevon et al. 2017). Unilateral dynamic balance affects football performance, according to new research. Athletes are required to engage in rapid directional shifts, sprinting, kicking, leaping, landing, abrupt acceleration, and deceleration, all of which need recurrent unilateral actions (Lockwood et al. 2015).

The intricate skill of maintaining a one-sided dynamic balance calls on the integration and coordination of ocular, vestibular, and somatosensory pathways. Several muscular elements, including ankle and groyne strength, core stability, and lower extremity joint range of motion, may impact this (Bahr 2005).

If athletes want to reduce their risk of lower extremity injuries (LEIs), they must be aware of the variables that put them at increased risk (Harøy et al. 2019; Larruskain et al. 2022; Dalen-Lorentsen et al. 2022) all found that football players are more likely to sustain injuries when they are older, have a history of injuries, train intensely, have muscle imbalances, and play on soft surfaces. Because of this, the findings from both primary and secondary sources are not very noteworthy.

Further primary research conducted in Kosovo aimed to assess the correlation between heightened training volumes and the prevalence of lower extremity injuries (LEI) among elite female football players. The research revealed a significant positive correlation ($r = 0.318$, $p = 0.003$) between the rate at which lower extremity injuries occur and the percentage score of the Y Balance Test on the right side.

This implies a positive correlation between the increase in the number of injuries and the improvement in performance in the Y Balance Test specifically with the right leg. Moreover, there was a significant correlation between the Y Balance Test Right % and both the incidence rate and Y Balance Test Left %, suggesting a potential association between injury occurrence and specific balance metrics.

In addition, the research found a significant correlation ($r = 0.236$, $p = 0.031$) between Y Balance Test Right% and Aerobic Fitness Test - 20-Meter. This suggests a potential association between balance and aerobic fitness in relation to injury incidence among elite female football players.

The literature study indicated that player exposure has been regarded as a prognostic risk factor for football injuries, however, there is a limited number of research that supports this aspect (Tysvaer 1992). A study conducted by Inklaar 1994) revealed that football players with varying training experiences had varying rates of injury. To achieve this objective, participants might be classified into high-exposure and low-exposure groups, as well as immediate groups.

Another element that contributes to predicting risk factors is the improved health condition of players, since they are given more playing time and are motivated by their coaches (Olsen 2004).
Under these circumstances, it is presumed that athletes develop enhanced performance attributes such as skills, perception, and foresight, which might provide a more effective approach to preventing injuries and imbalances (Engström and Renström 1998).

This research further investigated the possible association between playing on synthetic turf and the likelihood of lower extremity injuries (LEI) among elite female football players in Kosovo. After looking at various exposure times, physical performance metrics, and injury rates, they found something interesting about how long matches last.

There was a statistically significant difference between the two types of playing surfaces, with players on artificial grass enduring much less time in the sun during matches (mean difference = -143.636, $p = 0.034$).

This provides further evidence that the field conditions could influence match-related variables. Moreover, some tests measure certain physical abilities, such as the 20-meter aerobic test and the countermovement leap. No significant differences in extra exposure lengths, occurrence frequencies, or ratings of strength and balance were found between the two playing surfaces in the investigation.

It seems that the relationship between the playing field's condition and the player's well-being is complex and situationally dependent, given that there were no notable results in these areas.

There is a link between synthetic turf and certain performance measures, but other factors may have greater effects on the incidence of injuries and other physical evaluations. To fully understand the complex interaction between playing surface, exposure time, and athletic ability in professional women's football, further research is needed. This research will inform future interventions aimed at minimising injury risks and enhancing player well-being.

The research further aimed to determine the susceptibility of younger athletes and those with a history of lower limb injuries (LEI) to experiencing similar injuries during the competitive season, specifically focusing on age and previous injury history. The results revealed significant correlations between age and many performance markers.

The Y Balance Test Right% showed a significant mean difference of -2.237 between younger players (No: Mean = 20.26) and older players (Yes: Mean = 22.50, p = 0.043). Similarly, the Sit and Reach Test revealed a notable disparity in flexibility, as younger athletes (No: Mean = 13.56) scored lower than those who had experienced lower extremity injuries (Yes: Mean = 11.63, p = 0.038).

Statistically significant disparities were seen in Match/h, Training/h, and Incidence Rate when comparing exposure duration and physical performance. Players who had a history of LEI (Lateral Epicondylitis Injury) had a greater average length of exposure per hour of play (Yes: Mean = 25.88) compared to those without a history (No: Mean = 24.12, p = 0.023). In addition, those with a prior history of LEI had a significantly greater Incidence Rate (Yes: Mean = 16.3375) compared to those without (No: Mean = 17.0868, p = 0.038).

The results suggest that age and previous injury history may have an impact on certain physical performance measures and injury rates among top female football players in Kosovo throughout the competitive season.

During the literature research (Gabbett 2004) observed that in rugby sessions, there is a direct correlation between the intensity, duration, and frequency of training sessions and sporting activities and the likelihood of injuries. In their study (Putlur et al. 2004) found that 53-64% of sickness cases occurred among university-level football players. These incidences were associated with an increase in training intensity, stress, and boredom.

The ultimate objective of the training session is to cultivate endurance in athletes to optimise their performance in pivotal competitive matches (Suzuki et al. 2006). The capacity to analyse training sessions is crucial for implementing measurable training frequency control (Foster et al. 2001).

Precise and efficient evaluation of training sessions enables athletes to attain their chosen training objectives and prepare for intense competitive matches, while also minimising the likelihood of injury and the occurrence of injuries. Injury may occur when the body's physical demands are disregarded in relation to its capacity to undergo a full recovery session after training sessions and competitive sports (Anderson et al. 2003).

In general, it was discovered that there is a probability of more injuries occurring during competitive games, and the severity of these injuries tends to increase with the age of the participants.

Implications of the Findings

This subchapter in discussion part will discuss the practical and theoretical implications of the findings, emphasizing their significance in addressing existing gaps and contributing to the broader knowledge in physiotherapy. The implications of the findings of our study have shown that the study was initially carried out for the first time, being essential in the preventive strategy of injuries in the superior league of soccer among women in Kosovo and highlighting the small number of injuries that appeared for during a racing season. The comprehensive exploration of risk factors, injury prevention strategies, and performance markers among elite female football players in Kosovo provides valuable insights with potential implications for advancing the field of physiotherapy science.

The observed correlation between improved health conditions, enhanced performance attributes, and the potential for injury prevention raises intriguing possibilities for physiotherapists working with elite female soccer players. By understanding how players' health impacts their performance, physiotherapy practitioners can tailor sport physiotherapy interventions to cultivate specific attributes that contribute to injury resilience. This finding highlights the need for sport physiotherapy programs that integrate health optimization strategies, aiming not only to treat injuries but also to proactively enhance elite female soccer players' overall well-being.

The investigation into the association between playing on synthetic turf and lower extremity injuries offers crucial insights into field conditions' impact on athlete well-being. The statistically significant difference in exposure time between different playing surfaces underscores the importance of considering field characteristics in injury prevention strategies. Physiotherapists can use this information to tailor interventions based on playing surfaces, potentially reducing the incidence of injuries. However, further research in Kosovo physiotherapy is warranted to fully comprehend the nuanced interaction between playing surface, exposure time, and athletic ability in professional women's football.

The identified correlations between age, performance markers, and injury rates highlight the need for personalized physiotherapeutic interventions. Understanding how age and injury history influence physical performance measures enables physiotherapy practitioners to tailor rehabilitation and injury prevention programs based on individual characteristics. This finding emphasizes the importance of considering female soccer players' unique profiles in physiotherapy assessments and interventions, moving towards a more personalized and effective approach. The dissertation emphasizes the significance of precise training session evaluation in minimizing injury risks and optimizing performance. Physiotherapists can use this information to design training programs that balance physical demands with the body's recovery capacity, ultimately reducing the likelihood of injuries. The dissertation encourages a shift towards a more analytical approach to training sessions within the realm of physiotherapy, fostering a better understanding of how training intensity and duration influence injury occurrence among elite women football players.

In consolidating these findings, the dissertation contributes to current sport physiotherapy practices by offering nuanced perspectives on injury prevention and athlete optimization. Physiotherapists can integrate these insights into their clinical decision-making processes, fostering a more evidence-based and targeted approach to care. This contribution is particularly crucial in enhancing the scientific foundation of physiotherapy, paving the way for more effective and tailored interventions in the field of sport physiotherapy in elite women football players.

In summary, the implications of the findings underscore the potential impact on physiotherapy practices, emphasizing the need for personalized interventions, consideration of field characteristics, and a more analytical approach to training sessions. By incorporating these implications into current physiotherapy practices, practitioners can strive towards more effective, evidence-based, and individualized care for elite female football players

Validity and Reliability of the Results

Numerous writers have pointed out that inconsistent methods of defining injuries and gathering and documenting data pose a challenge for epidemiological investigations of sports injuries. Few studies have been conducted to date that describe the validity and/or reliability of injury surveillance systems used in scientific investigations.

The definitions and methods of data collection used in this thesis are those created by F-MARK specifically for research on injuries sustained by female professional soccer players.

Reliability is an inevitable concern since multiple observers and team medical staff were used in the data collection process. Though, in comparison to comparable or recreational investigations, the data gathered in our elite-level studies by us and with the assistance of skilled physicians and physiotherapists working with the teams undoubtedly have a high degree of accuracy.

Numerous steps were taken during the investigations to guarantee the most thorough and precise data collecting. After a detailed description that will be provided by our research team, each participant will sign a participation consent form and a data publication consent form (in accordance with international standards and a good approach to publishing). We have explained to each player their role in the process and the possibility of withdrawing from the study at any appropriate time (although this is not advisable).

At the beginning of the season, together with my mentor and the entire medical staff, including the team coaches, we held an informative lecture about the research, where we informed all players about the standardized injury questionnaire. Prior to this, club managers, agents, and coaches were informed in advance as a way to avoid misunderstandings and to include as many potential participants as possible in the study.

As a result, the complete reports from the clubs that took part during the study period served as the foundation for all analyses.

Limitations and Drawbacks

Despite following a systematic database searching and screening method for data collection, the present systematic review and meta-analysis study are associated with certain limitations. Due to a lack of existing contemporary primary research on the topic of interest, only a limited amount of secondary data could be collected in this study. Due to this drawback, the findings of this study may not be generalizable for the global population of women football players.

One limitation of the study was the limited number of studies available for conducting a relevant meta-analysis, as the sample size is too small to compare the results on a more global level; hence, trials involving a larger sample size for more comparable results should be considered. Furthermore, due to time and resource constraints, only one researcher was involved in the screening of research articles in this study.

This might have resulted in a certain degree of selection bias in this systematic review. Since the study had different predictors of LEI, the heterogeneity among the studies was high and even the baseline characteristics of all studies were not the same, increasing the risk of bias.

However, the fact that only four relevant articles could be identified for this systematic review and meta-analysis study not only highlights a major limitation of this study, but also underscores an important knowledge gap pertaining to the domain of LEI in elite women football players. Based on the limitations of the present study, as well as those identified from the existing body of evidence related to the topic of interest, the future direction of research related to the risk factors of LEI among elite women football players can be determined.

Extensive primary research must be conducted to identify the risk factors of LEI among women football players, with a specific focus on elite women football players.

Experimental case–control research should be conducted to determine how addressing the factors identified in this study reduces the incidence of LEI among elite women football players. We are faced with a large number of unnecessary injuries that can be predicted and avoided in the future. Injuries reported by players as well as non-consent for research may affect the final results.

Incorrect diagnosis by medical staff can affect the presentation of injuries. However, the female football league is still not very competitive and does still not attract the needed attention (including the receiving of necessary economic benefits to develop this particular sport).

It should be acknowledged as a potential drawback of our investigation that the incidence of injury recorded in this study solely depended on the assessment of members of the medical staff teams. A thorough multidisciplinary medical team might be able to address this gap as different diagnoses could not be independently verified by a single supervising expert. The age distribution of the players was also skewed, with the majority of athletes being 24 years or younger (72/142) and the minority being 29 years or older (11/142).

Contribution to Physiotherapy Science

The present PhD dissertation seeks to bridge critical gaps in the field of physiotherapy science, particularly in understanding the epidemiology of soccer-related injuries among elite female football athletes in Kosovo. While the existing systematic literature review with metanalysis in the first part suggests a higher incidence of knee and ankle injuries in female football athletes, the specific factors contributing to these injuries remain underexplored. Our longitudinal study in empirical part of PhD dissertation (2. Nd part) aims to address this knowledge gap by providing a comprehensive epidemiological analysis of injuries, focusing on the elite women's soccer league in Kosovo. The dissertation aims to make a significant contribution to the field of physiotherapy science by addressing identified gaps in the existing literature. While acknowledging the relevance of maintaining dynamic balance in high-intensity sports like football, the current body of knowledge lacks a comprehensive understanding of the intricate factors influencing one-sided dynamic balance and their implications for lower extremity injuries (LEIs).

The current systematic literature review with meta-analysis (in 1st part of empirical part) has revealed a scarcity of research exploring the integration of ocular, vestibular, and somatosensory pathways in the context of maintaining dynamic balance. Furthermore, the existing studies provide limited insights into the specific muscular elements affecting balance, such as ankle and groin strength, core stability, and lower extremity joint range of motion. These gaps form the basis for the present longitudinal research, which seeks to elucidate the nuanced connections between these elements and the occurrence of LEIs among elite female football players in Kosovo.

One of the primary research objectives is to establish a clear correlation between heightened training volumes and the prevalence of LEIs, particularly focusing on the impact of one-sided dynamic balance as measured by the Y Balance Test. Initial findings indicate a positive association, underscoring the need for a more nuanced understanding of the interplay between training intensity, balance metrics, and injury rates.

Moreover, the dissertation investigates the influence of playing surfaces on injury likelihood, specifically examining the correlation between synthetic turf and lower extremity injuries. While initial results suggest a connection between playing on artificial grass and certain performance measures, the complexity of this interaction requires further exploration in future sport physiotherapy research in Kosovo. This research not only fills a void in the existing literature but also lays the groundwork for interventions aimed at minimizing injury risks and enhancing player well-being.

In addition, the current longitudinal study delves into the susceptibility of younger women football players and those with a history of LEIs, highlighting statistically significant correlations between age, previous injury history, and various performance markers. These findings contribute valuable insights into the factors influencing physical performance measures and injury rates among top female football players during the competitive season.

By addressing these specific gaps in the literature, this dissertation aims to provide a robust scientific foundation for physiotherapy practices in the context of high-intensity sports, offering nuanced insights that can inform preventive measures and optimize the well-being of elite women football players in Kosovo. Based on my research, we have not come across such studies in Kosovo and the Balkan countries and given the incidence of various injuries in European countries, it was necessary to have a clear overview of injuries in elite football. women in Kosovo and regions.

This research will contribute to the science of physiotherapy, more specifically to sports physiotherapy and sports medicine, based on the results found, contributing to the elimination of factors, identification, and prevention of football injuries.

Evidence of injury occurrences will allow coaches, trainers, club managers and health care experts dealing with female soccer players to improve the current situation as well as improve overall performance.

Thus, in our opinion it is very important to work towards further analysis and evaluation of predictive factors. By studying injury incidence rates and risk prediction in elite football players in Kosovo, we will contribute to the prevention of injury incidence and enable other researchers to collect valuable data on the prevalence, types of injuries and to compare them.

Understanding the circumstances and mechanisms of these traumatic injuries among the elite women soccer players of the Kosovo Super League can contribute to the development of targeted prevention strategies in their sport physiotherapy. An important finding is that the incidence rate is higher during competition compared to training period. This can influence the design of tailored prevention programs that focus on specific aspects related to each of these activities. The results provide guidelines for the design and improvement of prevention programs and directions for further research that may further contribute to the development of the most effective strategies to reduce the risk of LEI among female soccer players. The results of the epidemiological study lay the groundwork for further research and the implementation of preventive measures in football in Kosovo, and at the same time it offers valuable insights that can also be used on a wider European and international level.

Understanding the specific challenges faced by elite female soccer players in Kosovo allows for tailored strategies to improve their health and performance on the soccer field.

The current longitudinal research aims to contribute significantly to the field of physiotherapy science by addressing critical gaps related to injury incidence and risk factors in female football athletes. The study recognizes the inherent complexities in training methodologies in football, particularly the need for specialized skills due to diverse physiological and tactical requirements. Recent investigations mentioned in the systematic review (1^{st} part of empirical part) have shed light on the specific techniques employed by team leaders to enhance training modalities, often involving intensive and specific movements that may pose a potential risk for concussions.

Despite existing studies noting variations in injury incidence based on playing positions, specifically highlighting midfield athletes and defending members as having a higher risk, there is still a lack of consensus in the literature. The research emphasizes the need for targeted training programs designed according to the specific demands of the sport rather than focusing solely on positional roles.

One notable finding of current longitudinal study is the influence of age on injury rates, with a decrease in injury ratios observed in older players. This is consistent with previous research predicting an increase in soccer injuries with advancing age. Our study further explores the age-related biases in injury incidence among players involved in different playing positions, incorporating age as a covariate in the analyses.

The investigation delves into risk factors associated with lower extremity injuries (LEI) among female football players. Notably, factors such as body mass index (BMI), knee valgus angle, previous knee injuries, and lower normalised knee separation are identified as influencing the risk of knee injuries. The study acknowledges the variation in findings across different research, underlining the need to comprehensively examine accidents and risk indicators among athletes, considering a wide range of variables where sport physiotherapists should be focused in their prevention role. Furthermore, the current longitudinal research contributes to the understanding of the relationship between age, weight, height, body mass index (BMI), and playing characteristics in football players. The findings suggest potential individualized training strategies based on players' characteristics, such as focusing on power and strength training for attackers and agility exercises for goalkeepers. The current longitudinal study also provides valuable insights into injury types and their distribution. The majority of injuries occurred in the lower extremities, with the knee, ankle, and foot being the most commonly injured locations. Notably, traumatic injuries were more prevalent than overuse injuries, emphasizing the importance of addressing factors contributing to traumatic injuries, especially during matches.

The longitudinal study further examines the impact of age on injury severity, with younger players exhibiting a significantly greater frequency of injuries. The study categorizes players into different age groups, revealing that younger female football players have a considerably higher injury frequency compared to the "middle" age group. The analysis of playing positions also demonstrates variations in injury incidence, with goalkeepers experiencing substantially higher injury rates compared to defenders.

This doctoral research contributes to physiotherapy science by offering a comprehensive examination of injury incidence, risk factors, and characteristics among female football athletes. The findings have implications for the development of targeted training programs, injury prevention strategies, and individualized interventions, thereby filling critical gaps in the existing physiotherapy literature. The existing literature provides a comprehensive overview of injury mechanisms in football, with a focus on various activities such as shooting, turning, twisting, landing, tackling, leaping, sprinting, and being tackled. Tackling, a common occurrence in football, often leads to injuries in lower body regions due to players' challenges in reacting swiftly to rapid, unexpected movements. Poor playing grounds and improper footwear are identified as primary causes of injuries related to turning, jogging, and twisting.

Uneven playing surfaces contribute to increased loading forces on lower extremity muscles and ligaments, potentially leading to damage when the external pressure surpasses their tolerable capacity. Additionally, inappropriate footwear may result in slippage, while excessive frictional force during twisting and turning motions can cause injuries. Severe injuries are more likely during shooting activities, emphasizing the need for preventive measures.

Injuries related to activities like bouncing, landing, goalkeeping, heading, and shooting often occur due to imprecise landing techniques and forceful collisions between players. Minimizing body exposure is recognized as a fundamental measure to prevent injuries, and studies support that injuries resulting from less body contact have a higher prevalence rate compared to those resulting from body contact.

Concussions, categorized as non-contact injuries, are associated with rotational movements, firing projectiles, locomotion, and leaping. Lower extremity injuries, including fractures, strains, sprains, contusions, tendinitis, and bursitis, are common in football, with anterior cruciate ligament injuries being prevalent among female players. The results of this PhD dissertation hold significant importance for sport physiotherapists working with elite female soccer players. The findings offer valuable insights that can directly inform and enhance the practice of sport physiotherapy in this specific context. The identified risk factors, including age, previous injury history, and playing surface conditions, allow sport physiotherapists to tailor injury prevention strategies to the unique needs of elite female soccer players. By understanding the specific factors that contribute to injury susceptibility, physiotherapists can develop targeted interventions to mitigate risks and enhance player resilience.

The correlation between improved health conditions and enhanced performance attributes provides physiotherapists with an opportunity to focus not only on injury treatment but also on proactive strategies for optimizing athletes' overall well-being. This may involve designing training programs that prioritize health and performance simultaneously, leading to a holistic and effective approach to athlete care. The investigation into the influence of synthetic turf on lower extremity injuries offers practical insights for physiotherapists working with teams that regularly play on different surfaces. Sport physiotherapists can use this information to tailor their interventions based on the playing field conditions, potentially reducing the incidence of injuries associated with specific surfaces. Understanding the correlation between age, previous injury history, and physical performance measures enables sport physiotherapists to design personalized rehabilitation and training programs. By considering individual player characteristics, physiotherapists can address specific needs, optimize recovery, and reduce the risk of recurrent injuries.

The emphasis on analyzing training sessions for injury prevention purposes encourages sport physiotherapists to adopt a more analytical mindset. By evaluating training intensity, duration, and recovery periods, physiotherapists can contribute to the design of training regimens that strike a balance between performance enhancement and injury prevention. The dissertation's contribution to the scientific foundation of physiotherapy practices ensures that sport physiotherapists have access to evidence-based information. This enables practitioners to make informed decisions, aligning their interventions with the latest research findings and promoting a higher standard of care for elite female soccer players. The comprehensive nature of the research, covering various aspects such as health conditions, playing surfaces, and training sessions, encourages sport physiotherapists to adopt a holistic approach to athlete care.

This means considering multiple factors that contribute to injury risk and performance, leading to a more comprehensive and effective physiotherapeutic intervention. The results of this dissertation are essential for sport physiotherapists as they provide actionable insights for tailored injury prevention, performance optimization, field-specific considerations, personalized rehabilitation, analytical training sessions, evidence-based decision-making, and holistic athlete care. By incorporating these findings into their practice, sport physiotherapists can contribute to the well-being and performance excellence of elite female soccer players.

The importance of precise evaluation of training sessions is emphasized, highlighting its role in helping athletes achieve training objectives, prepare for competitive matches, and reduce the risk of injuries. The intricate nature of football contributes to a higher likelihood of injuries, with adductor stress, hamstring stretching, and ankle fractures being frequently reported among football athletes. The longitudinal study (2^{nd} part of empirical part) introduces the concept of predicting LEIs using a classification table, achieving 77.4% accuracy but expressing concerns about the absence of projections for injuries to other body parts.

Despite referencing various studies suggesting factors such as age, prior injuries, excessive training, and muscular imbalances as contributors to the risk of LEIs, the research does not provide conclusive results or comprehensive statistical data on the relationships between these risk characteristics and the frequency of LEIs. The correlation between heightened training volumes and the prevalence of LEIs is explored, revealing a significant positive correlation between the rate of lower extremity injuries and performance in the Y Balance Test. The current longitudinal study suggests potential associations between injury occurrence, specific balance metrics, and aerobic fitness among elite female football players.

The systematic literature review acknowledges the complexity of assessing player exposure as a prognostic risk factor for football injuries, with limited research supporting this aspect. This PhD dissertation delves into various aspects of injury mechanisms and risk factors in female football athletes, in order for better articulation of the precise scientific contribution it intends to make within the broader field of physiotherapy science. The dissertation delves into various aspects of injury prevention and risk factors in the context of physiotherapy for elite female football players in Kosovo. The exploration of the association between players' improved health conditions, enhanced performance attributes, and the potential for preventing injuries and imbalances is presented.

The research investigates the correlation between playing on synthetic turf and the likelihood of lower extremity injuries (LEIs). The findings suggest a statistically significant difference in exposure time between players on artificial grass and natural surfaces, emphasizing the potential influence of field conditions on match-related variables. Similarly, the examination of susceptibility to injuries based on age and previous injury history adds valuable information. The significant correlations identified between age, performance markers, and injury rates contribute to the understanding of risk factors among top female football players.

We strongly believe that our paper will contribute to the path towards reaching a general consensus in favor of documenting the incidence and predicting the risk of injuries in sports. Based on the findings of this study, the following recommendations have been formulated.

These recommendations can be implemented to reduce the incidence and severity of LEI among elite women football players.

- Fitness conditional coaches should focus on rectifying the postures and knee positions of players during matches.

- Specialized injury prevention programmes should be designed and led by coaches for elite women football players.

- Players should focus on reducing their BMI and increasing lumbopelvic control.

- Trainers should study the history of LEI sustained by players in the past to devise strategic training programmes that will reduce the risk of future LEI in the players.

- A questionnaire can be constructed, assessing all the relevant predictors, to provide relevant treatment beforehand.

- Trials with larger sample sizes and similar baseline characteristics should be considered for limited heterogeneity.

- The role of age and use of protective equipment needs to be explored.

- The role of nutritional status in addition to BMI, and possible mechanisms involving the risk of BMI in LEI, needs further exploration.

- Routine involvement of physiotherapists and occupational therapists can play a protective role.
- A thorough screening and recovery time should be offered to players after each game.

This research provides novel data on the frequency, nature, and severity of injuries in a developing European soccer league as it is the first cohort longitudinal study assessment of soccer injuries in Kosovo. Future research will use these findings to identify risk factors for the most prevalent differential diagnosis and will work to create specialized preventative strategies.
The IR for women in Kosovo women's soccer players is low while being around 11% below the international average. This comparison opens a discussion about the specific factors that influence injuries among female soccer players in Kosovo and possible differences in the preparation and implementation of prevention programs. Almost 2 out of every 4 injuries were categorized as traumatic, with the IRs being more than 5-fold larger during games than during training. Understanding the circumstances and mechanisms of these traumatic injuries can contribute to the development of targeted prevention strategies.

An important finding is that the incidence rate is higher during competition compared to training. This can influence the design of tailored prevention programs that focus on specific aspects related to each of these activities.

The results provide guidelines for the design and improvement of prevention programs and directions for further research that may further contribute to the development of the most effective strategies to reduce the risk of LEI among female soccer players.

The results of the epidemiological study lay the groundwork for further research and the implementation of preventive measures in football in Kosovo, and at the same time it offers valuable insights that can also be used on a wider European and international level. Understanding the specific challenges faced by elite female soccer players in Kosovo allows for tailored strategies to improve their health and performance on the soccer field.

6 CONCLUSION

Lower extremity injury (LEI) proves to be a prominent issue in professional athletes throughout sports. Several analytical reports on injury incidence surveillance facts gathered from the National Collegiate Athletic Authority continuously described LEI to consist of almost half of total injuries.

The pattern of increased chances of LEI is also observed in a number of sports studies (Drevon et al. 2017). LEI comprised 57% of total injury incidences reported by the Union of European Football Associations (UEFA 2022).

Among these Elite Group Injury studies showed detailed injuries such as shin (34%), ankle (12%) and groin (11%) considered to be commonly present during the time span of the 2018/2019 men's match season. Whereas existent literature shows LEI's in women's football, to be among the most common and severe injuries (Bahr and Krosshaug 2005).

Female players undergo more time wastage and longer come back to play games, due to injuries like bottom extremities and anterior cruciate ligament (ACL) damage in comparison to the male athletes. Women participants show prominent dissimilarities relative to hormonal profile, structure, and muscular characteristics in comparison to male athletes, whereas the latter have increased injury chances of occurrence patterns (Shea et al. 2017).

This may describe why throughout sports; female players are exposed to more chronic LEI damaging the knee bones and ankle structure whereas require more time to get back to training sessions and competition. However, previous LEI studies have also explained LEI as a leading factor for incoming injury which, if exposed, might get chronic, and demand surgery treatments along with a prolonged recovery period (Bittencourt et al. 2016).

Preventive measures for an initial LEI may be responsible for a normal athletic group who have the quality to complete higher frequency and time span of training, proven to reduce injury incidence in coming days and elevate activity (Bradley and Ade 2018). Assessment of physical fitness is analysed by continuous monitoring of complete athletic careers. Results obtained are analysed to identify physiological parameters that inform practising patterns and display to training load.

It also focuses on modifications and recovery as a component of come-back-to-practice sessions and participation. Typical clinic-related monitoring approaches like limited range of mobility, manual muscle testing and ligament laxity show constrained figures in identifying a player's injury incidence (Bizzini and Dvorak 2015).

Laboratory testing is referred to as the 'gold standard' while analysing exercise trends that otherwise are potentially dangerous, but techniques are mostly expensive and demand laboratory time. The majority of athletes are permitted to perform field-based testing to be monitored regularly and profiled without acquiring expert techniques or costly and hour-consuming processes like three-dimensional movement capture and kinematic assessment.

However, this study provides a satisfactory list of predictors of LEI; however, more research is needed to establish their mechanisms of action. In total, eight factors that influence the risk of LEI among elite women football players were identified.

Among these factors, six increase the risk of LEI, whereas two decrease the risk of LEI. Notably, the factors increasing the risk of LEI among elite women football players can be broadly divided into two categories: physical characteristics and history of injuries. Meanwhile, the two factors identified to decrease the risk of LEI among elite women football players are related to the practice and posture of the players.

Due to complexities, football has a comparatively greater chance of injuries. Certain forms of injury, reported commonly, that are experienced by football athletes while playing competitive games and training sessions of the game include adductor stress (7.6%), hamstring stretching (12.3%) ankle fractures (8.5%), thus supporting the fact that the most concussions are related to lower extremity injuries (LEI), or concussions damaging the portions of the lower extremity (Toohey et al. 2017).

Therefore, results described that LEI are among the major groups of concussions in football sports. As these injuries have an impact on both genders of athletes in football sports, research states that the predictive chances and effects of such LEI concussions are different among opposite individual teams (Fortington and Finch 2016).

The current study was crucial to recognize the risk factors causing LEI in football athletes, especially females. Hence, previous studies have also stated the rehabilitation duration and decline in job and fitness complications related to concussions are specifically more in female participants of football.

However, it is mandatory to consider parameters enhancing the chances of LEI incidences in female participants of football, so that those risk factors can be eliminated, and reduced in female football players.

A substantial theme of study has been arranged to be conducted so that predictive risk factors for LEI in female football players can be identified and analysed. However, the majority of this study considers particular demographics of women football athletes and possible modes of LEI.

Hence, other studies are required to draw a comparison among the results of the associative current findings that determine majorly distinguished factors leading to LEI in female players of football. Additionally, another benefit of such assessment studies is their ability to guide possible novel parameters by describing a detailed comprehension explanation of discovered risk factors affecting the chances of raising LEI between female football athletes. (Smith et al. 2012).

As mentioned before, injuries not only affect careers but also have major effects on the mind and complete fitness of female players playing football. Other than shallow effects, football-associated injuries also show the capacity for converting to serious prolonged undesired impacts causing serious damage to women athletes playing football.

These results involve Kinesio phobia or anxiety related to activities, elevated stress, and disappointment as a result of career decline and losing feelings related to competitive games (Eime et al. 2013).

Assessment of a physiological range shows that LEI correlated to football games may lead to chronic health complications, involving thigh stretches, stress fissures, along tendon inflammation, which causes permanent damage to the fitness status of the suffering athletes with the passage of time. However, several researchers have discovered the possible factors of injuries among female players of football practising advanced techniques and approaches.

So, by correlating and studying the conclusions of these previous research findings, dominant parameters responsible for LEI in women football players can be recognised, accompanying the possible chances of LEI in Kosovo football players. Identification of these predictive factors then proves to be beneficial in modifying and reducing the drastic chances of LEI in elite girl athlete players.

Research findings of the current study can be efficiently important for elevating the athlete job promotions and fitness parameters of elite female players playing football. So, this study aimed to highlight and assess the risk factors of bottom extremity injuries in elite women football participants (Caine et al. 2008).

Based on the findings, it is concluded that the risk of LEI among the target population can be decreased by focusing on their physical characteristics, knee postures, and movements. However, due to a limited sample size and high heterogeneity, studies with homogenous results, similar baseline characteristics, and a larger sample size are required.

Previous studies have mentioned that exposure to a neuromuscular training warm-up program can prominently provide protection against Lower extremity injury in football players.

Although the studies do not provide any statistically significant proof for effectively measurable modifications, the impact of the observed warm-up programme is different in players having different past LEI histories.

Those players exposed previously to LEI have a greater risk of being impacted by LEI Again. However, in contrast, gender, BMI, age, and previous history of LEI can guide in predicting

the risk of injury occurrence. A previous study demonstrates the impact of NMT warm-up programs in decreasing the risk of LEI in female football athletes (Annett 1999).
According to this literature review, neuromuscular training warm-up programs have consistently effect on exhibiting positive effects in decreasing the chances of LEIs in several sports individuals involving females and adults (Richman and Vermeil 2023).

The physical requirements of a football game are quite challenging. Several physiotherapists and exercise physiologists have attempted for a longer period to elaborate and evaluate the major characteristics of optimum participation in football sports (Smith et al. 2012).

A variety of research reports are present, and different writers have reported the abundance of parameters responsible for participation in football sports (Foschia 2022).

The game of football is characterised as a grouped game, and, irrespective of the complex style of performance, it is evident that football athletes are mandatory to acquire the appropriate physique to compete with the needs of this competitive sport. Physical characteristics required for football performance can be maintained by severe intermittent endurance. Previous studies have stated that high-intensity endurance is an important factor for physical health.

For maintaining football-associated training arrangements, it becomes crucial to comprehend the workload applied to football athletes when they play tough games. Different game-report methodologies are utilised to observe performance profiles when playing football matches (Bangsbo et al. 1991; Di Salvo et al. 2007), for worldly ranking management (Harley et al. 2010; Buchheit et al. 2010).

These efforts provide a detailed explanation of the severity of difficult movements during matches, posture-associated performance details of athletes, and the presence of a lower work rate between different athletes and games.

Specialists and football trainers commonly manifest the complete work ratio of participating athletes according to the complete length of distance completed in a session, ignoring the velocity, duration, and direction related to activities done.

But these values differ for different athletes so conclusions drawn based on a player’s performance must be handled with caution. However, recent studies showed that female football player's fitness affects technical action, Tactical contexts, playing style, and team coordination (Carling et al. 2008).

Although football players pass the majority of the time duration by “off-the-ball” less intense aerobic movements—managing all postures with relevance to the condition of the game—different studies supported the fact that football is identified by long intermittent exercises, that combine brief spans of optimum or approximately optimum tries along with highly diverse and undetectable activity postures (Castellano et al. 2011; Mohr et al. 2003; Di Salvo et al. 2007).

Therefore, capability to do severe intermittent movements is considered to be mandatory for female football athletes (Bradley et al. 2009; Mohr et al. 2003). Therefore, explosive movements excluding running, jumping, turning, kicking, tackling, decelerating, turning, accelerating, changing speed, and maintaining stressful contractions for balance maintenance and actions of the body in response to defensive stress, enhance the physiological stress applied on the female athletes and participate to enhance physiological demands of football (Iaia et al. 2009; Stølen et al. 2005).

Moreover, LEI risk can be reduced in elite female players by regulating the strenuous efforts during the practice sessions, as athletes are required to practise the changes in speed techniques that help store increased-intensity movements in later sessions of matches (Dellal et al. 2011).

It is an explanation of the fact that players are not necessarily required to approach their complete stamina physically between match sessions. However, the demand for central and peripheral responses required in the football game is still debatable — such as a collection of metabolic components in body tissues, plasma values of molar content, substitute availability, moisture level, protection complete deterioration of all areas of peripheral system, in the last part of the play (Edwards et al. 2012).

Differences in general performance profiles between games are also reported according to ground position responsibilities. The majority of studies explained that defenders standing in central positions travel a lesser average distance and participate in lesser intensified movements as compared to players covering other areas (Bradley and Ade 2018; Rampinini et al. 2007; Salvo et al. 2007).

Players in the midfield center participate in more severe sprints, whereas those covering the front and back cover an enhanced range of sprints (Salvo et al. 2007). This study shows that Kosovo has fewer soccer injuries overall than other European leagues, on average. These outcomes can be attributed to the Kosovar players playing in significantly fewer matches than their international counterparts.

Nearly two out of every four injuries in soccer were categorized as traumatic, which is consistent with the findings of another cohort longitudinal study research.

Although some of the findings on women's soccer players in Kosovo were not in line with other research—particularly related to overall injuries, the larger scale and more extensive detail offered in the current study should give coaches and trainers better insight into the future prevention needs of their women's soccer players.

As strikers, defenders, midfielders, and goalkeepers all have different physical and physiological demands it is of great importance to understand and train for these differences to properly prepare women for their specific position and simultaneously reduce the risk of sports injury.

The two differential diagnoses that were used most frequently were contusion and sprain, while there were no differences between players playing in different positions, with younger players having much higher injury IRs than middle-aged and older players.

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APPENDICES

Appendix A: Questionary for Injuries report form

Questionary for Injury reports

Team:____

1. General physical examination

Player-ID:____________________ Age:____ Height____ cm Weight ______kg

Date:

2. Competition history

Position on the field: □ goalkeeper □ defender □ striker □ midfielder

Dominant leg: □ left □ right □ both

3. Injured body part

		right	left		right	left	
□ head / face	□ shoulder	□	□	hip	□	□	knee
□ neck/cervical spine	□ upper arm	□	□	groin	□	□	lower leg
□ thoracic spine	□ elbow	□	□	m. adductor	□	□	achilles tendon
□ lumbar spine	□ lower arm	□	□	hamstrings	□	□	ankle
□ sternum / ribs	□ wrist	□	□	m. quadriceps	□	□	foot
□ abdomen	□ hand	□	□	m. abductor	□	□	toe
□ pelvis/sacrum	□ finger / thumb	□	□	thigh			

4. Type of injury

□ concussion with loss of consciousness	□ sprain
□ concussion without loss of consciousness	□ strain
□ fracture	□ contusion
□ dislocation	□ tendonitis / bursitis
□ rupture of mescle	□ dental injury
□ rupture of tendon	□ deep wound
□ ligamentous rupture with instability	□ laceration / abrasion
□ ligamentous rupture without instability	□ others Diagnosis:
□ lesion of meniscus	____________________

5. Has the player had a previous injury of the same location and type?

* no * yes, ________________ months ago

6. Was the injury caused by overuse or trauma?

* overuse * trauma

7. When did the injury occur?

* training * match Date ____________

8. Was the injury caused by contact with another player?

* no * yes

9. Approximately how long will the player not be able to participate as usual in the raining sessions or matches?

Approx.. ______________ days

10. Severity of injury in days

Estimated duration of absence from training or play for example:

0	= 0 days	7	= 1 week
1	= 1 days	14	= 2 week
2	= 2 days	30	= more than 4 week

Signature Player____________ Date:__________________

Appendix B: Psychological Readiness of injured Athlete to return to Sport (PRIA-RS)-Questionnaire

For each question, please indicate the answer that comes closest to your personal assessment or your current state of mind.

1. How do you evaluate the progression you have experienced during the rehabilitation/sport functional recovery period since your injury?	very bad ☐	bad ☐	neither goodnor bad ☐	good ☐	very good ☐
2. How is your mood?	very bad ☐	bad ☐	neither goodnor bad ☐	good ☐	very good ☐
3. What is your physical state in view of a potentialreturn to the team?	very bad ☐	bad ☐	neither goodnor bad ☐	good ☐	very good ☐
4. How do you evaluate the functional status of your damaged area?	very bad ☐	bad ☐	neither goodnor bad ☐	good ☐	very good ☐
5. Do you feel any discomfort or limitations thatprevent you from training as normal?	yes ☐	—	don't know ☐	—	no ☐
6. Are you feeling nervous about returning to regular training with the team?	yes ☐	—	don't know ☐	—	no ☐
7. How secure do you feel when performing physical actions or movements in the injured area?	verybad ☐	bad ☐	neither goodnor bad ☐	good ☐	verygood ☐
8. Give an estimated percentage of how likely you are to experience a recurrence of the injurysoon.	80–100% ☐	60–80% ☐	40–60% ☐	20–40% ☐	0–20% ☐
9. What level of pressure do you feel in your surroundings to return to training with the team?	excessive ☐	high ☐	normal ☐	low ☐	none ☐
10. How would you evaluate your overall conditionin view of a potential return to full training?	verybad ☐	bad ☐	neither goodnor bad ☐	good ☐	very good ☐

Total score: 0

Appendix C: The form of registration of tests performance

Y balance Test

Limb Length___________________/cm

Direction /cm	R- Trial 1	R- Trial 2	R- Trial 3	L-Trial 1	L-Trial 2	L-Trial 3
Anterior						
Posteromedial						
Posterolateral						

Singel Leg Squat Test

	Trial 1	Trial 2	Trial 3	Trial 4	Trail 5
Right					
Left					

Sit and reach Test:_________________________________ /cm

Countermovement Jump Test_______________________/cm

Aerobic Fitness Test - 20 Metre______________________/levels

Appendix D: The First publication

sports

MDPI

Review

Predicting Risk Factors of Lower Extremity Injuries in Elite Women's Football: Systematic Review and Meta-Analysis

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Abstract: This study identified and analyzed the risk factors of lower extremity injuries (LEI) in elite women football players to improve career and health outcomes. To address this aim, a systematic review and meta-analysis methodology was used. In total, four relevant research articles were identified through database searching and screening using the PRISMA flow diagram. From these articles, eight predictors were identified that influence the risk of LEI among elite women football players: higher body mass index (OR 1.51, 95% CI); previous knee injury (OR 3.57, 95% CI); low normalized knee separation (≤10th percentile) (RR 1.92, 95% CI); all previous injury (previous ACL tear: OR 5.24, 95% CI; ankle sprain: 1.39, 95% CI; knee sprain: 1.50, 95% CI); and previous injury in the lower body (OR 2.97, 95% CI). Meanwhile, lower knee valgus angle in a drop-jump landing (OR 0.64, 95% CI) was found to decrease the risk of LEI among elite women football players.

Keywords: lower extremity injuries; women; elite; football; players; risk factor

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1. Introduction

Injuries sustained by athletes are a long-standing and significant issue in virtually every form of outdoor sports. The impacts of such injuries on both individual and organizational levels are significant. Such player injuries not only lead to significant financial damages to their respective teams but also pose major ethical and regulatory concerns to professional sports leagues at large [1]. Meanwhile, severe sports injuries can lead to early retirement and long-term health issues in players, as injury rates range from 62%, 38.17%, and 60.83% to 66%, which can result in major negative outcomes related to the physical, mental, and overall well-being of players [2]. Therefore, reducing the prevalence and mitigating the impacts of sport-related injuries is essential for protecting the interests of both players and sports organizations.

As a complex contact sport, football is associated with a relatively high risk of injuries. According to Forsythe et al. [3], for every 1000 h of exposure, professional football players sustain between 4 and 35 injuries. The most common types of injuries sustained by football players during the game include adductor strains (7.6%), ankle sprains (8.5%), and hamstring strains (12.3%) [3], thus suggesting that the majority of injuries are lower extremity injuries (LEI), or injuries affecting parts of the lower extremity of the body [4]. Thus, it can be stated that LEI are the most prevalent type of injuries in football. While such injuries affect both male and female football players, contemporary research has proven

Appendix E: The Second Publication

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BMC Sports Science, Medicine and Rehabilitation

RESEARCH Open Access

Injuries in professional women's elite soccer players in Kosovo: epidemiological injury study

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Abstract

Background An emphasis has been given lately towards women's engagement together with their potential in soccer. As this sport develops with athletes becoming more physically fit and skilled, it is unclear what the consequences in terms of injuries are. Having this in mind, this study aimed to investigate the major injuries that occur in women's soccer players.

Methods This descriptive epidemiological study invited all 286 women's soccer players from the 12 participating women clubs in the Kosovo 1st Soccer League (elite football level) during the 2021/2022 season, out of which 142 from 12 clubs participated. Exposure time for 1000 h of playing and training were recorded in addition to the anthropometric data, playing position, and prior injury history during the end of the season, practice, and match. The exact type of injury, severity, and post-injury recovery time, as well as the circumstances surrounding the injuries, were recorded.

Results In total 84 injuries were registered with an overall injury ratio (IR) being 3.21 (CI: 2.56, 3.98) injuries/1000 exposure hours. During the competitive season, each player sustained 1.4 injuries on average. IRs were significantly higher during competition (n = 50; IR = 1.57; CI: 1.52, 1.62) compared to training (n = 34; IR = 0.26, CI: 0.25, 0.27). Out of a total of 142 women players, 84 (59.2%) injuries occurred, and no record of injuries was made in 58 (40.8%) players. The overall IR was observed to be 3.21 (CI: 1.24, 3.27), with moderate and severe injuries accounting for 38.1% of total injuries (each), followed by mild (16.7%) and minimal (7.1%) injuries.

Conclusion The women IR in Kosovo women's soccer players is low while being circa 11% below the international average. Almost 2 out of every 4 injuries were categorized as traumatic, with the IRs being more than 5-fold larger during games than during training. Additionally, these findings emphasize the higher rate of injuries amongst younger athletes, suggesting caution to be taken by the coaches when planning for the match. The collected data may help coaches and trainers create more targeted women's soccer injury prevention programs.

Keywords Injury incidence, Female, Trauma, Overuse, Sports

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AUTHORSHIP STATEMENT

I, Feim Gashi declares that I am the sole author of this PhD topic. I have written this work entirely by myself, and all ideas, concepts, and content presented in this topic are my original creations unless otherwise cited.

I acknowledge that any external sources used in this topic have been properly cited and referenced according to the appropriate citation style of the Chicago Manual of Style 16th edition. I assume full responsibility for the accuracy and integrity of the information presented in this topic.

Date: 02.05.2024

Signature: ______________________________

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with the title: **INJURY PATTERN, INCIDENCE, AND PREDICTING OF RISK FACTORS OF LOWER EXTREMITY INJURIES IN ELITE WOMEN'S FOOTBALL PLAYERS IN KOSOVO**

Place: Prishtinë

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