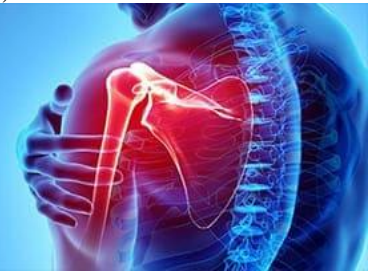


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## Overview of traumatic injuries in female soccer competition in Cameroon

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### Abstract

**Background:** Football is an extremely physical and demanding contact sport, where the risk of injury for professional players is greater than in other professions. There is a notable gap in the existing literature on injury epidemiology in female soccer players from African countries.

**Objectives:** The aim of this study was to describe the traumatic injuries in female soccer competition.

**Study's Design:** Prospective, cross-sectional and descriptive study.

**Method:** This study was conducted at the Mbankomo Sports Center in Yaounde, Cameroon from January to February 2023 during a pre-competition training camp and competition phase of the Cameroonian Women's National Football Team. All selected players were included.

**Results:** During this period, 43 female players were treated - 25 in the preparatory phase and 23 in the competition phase. The overall average age was 25.8 years, with the 20-23 year-old age group being dominant in the preparatory phase and the 23-26 year old group dominant in the competition phase. Analysis of knee alignment issues showed that in the preparatory phase, genu varum was the most common (48%) followed by genu valgum (24%). In the competition phase, genu valgum was the most common (43.48%), followed by genu varum (34.78%). With a total of 23 traumatic injuries, over a third (35.5%) of the players suffered such injuries. Tackle injuries were the most prevalent injury mechanism (43.48%). Goalkeepers sustained the highest number of injuries (30.43%) followed by the Fullback/Defender (21.74%). The majority of injuries occurred on synthetic turf surfaces (73.91%). The most common injury types were ankle sprain (21.74%) and wrist sprain (21.74%). The distribution of injuries by body region was 47.83% (11 cases) lower limb, 39.13% (9 cases) upper limb, 13.04% (3 cases) head. Pain intensity was moderate to high in 60.87% of cases. The BM clinical severity score showed that most players were classified as Stage 1 (score 2) and managed with cryotherapy and return to activity.

**Conclusion:** The results of this study contribute to strengthening the existing literature on injury epidemiology among female professional soccer players in Africa.

**Clinical Relevance:** Improved athletic preparation, comprehensive medical support, and tailored prevention strategies are crucial to address the unique physical demands and risk factors in women's soccer, ensuring the health and performance of Cameroonian female players during competition.

**Keywords:** Trauma, injury, soccer, football, female, players

### Introduction

Football is a demanding and intensive contact sport, and it is almost impossible for a footballer to never suffer from injuries. Between the contacts, tackles, and impacts, footballers are exposed to more or less serious traumatic risks. Furthermore, the intensity and repetition of efforts associated with the playing conditions and fatigue can lead to injuries in players. Currently, more than 65,000 footballers practice their sport professionally worldwide, and the risk of trauma in professional football is about 1,000 times greater than in other professions<sup>[28, 18]</sup>. In the context of sports, traumas are a set of local lesions affecting tissues and organs caused by an external agent, and can be classified as micro-traumas (progressive lesions resulting from repeated traumas) or macro-traumas (sudden-onset lesions resulting from a single trauma)<sup>[8]</sup>. FIFA has established a consensus defining injury or trauma as "any physical complaint suffered by a player, resulting from a soccer match or

training, regardless of the need for medical attention or the inability to participate in the activity" [14]. The traumatic pathology commonly found in competition is of high incidence, with 9.11 traumatic injuries per 1,000 hours of play and 1.9 traumatic injuries per player in 2020 at the highest male and female levels [13]. There is a notable gap in the existing literature on injury epidemiology in female soccer players from African countries, with the majority of available studies conducted in Europe and North America. The limited research from the African context includes a study from South Africa that looked at the incidence and characteristics of injuries in male and female university soccer players, a study from Nigeria that investigated the epidemiology of injuries among male and female youth soccer players, a study from Egypt that examined the incidence and types of injuries in male professional soccer players, and a study from Morocco that looked at the epidemiology of injuries in male professional soccer players. However, these studies did not provide a detailed analysis specific to female soccer players [26, 22, 7, 29]. Based on the foregoing, we were led to study the panorama of traumatic injuries in competition and the diagnostic and emergency therapeutic complexity in Cameroonian female football. The aim of our study was to describe the traumatic injuries in female soccer competition in order to improve the health capital in competition of the Cameroonian female soccer.

### Materials and Methods

This was a prospective, cross-sectional, descriptive study conducted from January 16 to February 26, 2023. The study was conducted at the Mbankomo Sports Center in Yaoundé, Cameroon, which is a football center of excellence of the Confederation of African Football. This internationally standardized Center has modern infrastructure including two

synthetic turf football pitches, a natural grass field, a multi-sport area, a tennis court, a semi-Olympic swimming pool, gym facilities, and conference/seminar rooms. The team then moved to Hamilton for a pre-competition training camp, and subsequently to Auckland, New Zealand for the competition phase. The study population consisted of 43 selected players of the Cameroonian Women's National Football Team, including 25 local amateur players during the preparatory phase, of which 5 were retained for the competition phase, and 18 professional-level players called up for the competition phase. During this period, 2 preparatory matches and 2 competition matches were played, along with 60 training sessions of 2 hours each. During the pre-competition period, including the preparatory matches, the 25 players each played 30 minutes, rotating. Then during the competition period, only 11 players took the field and 3 substitutions were made. All the 43 selected players were included in this study. The study obtained Ethics Committee approval of the University and the administrative authorization. Data was collected using a questionnaire that included a complete clinical examination, as well as paraclinical tests such as a complete blood count, electrocardiogram, and echocardiogram. The data was entered, recorded, and analyzed using Epi Info software version 3.5.3, with the results presented in the form of figures and tables, using descriptive parameters such as proportions and means.

### Results

During this period, 43 players were treated: 25 in the preparatory phase and 23 in the competition phase. During the preparatory phase, all the players were amateurs. In the competition phase, the professional players were dominant. The overall average age of the players in the Cameroonian selection was 25.8 years.

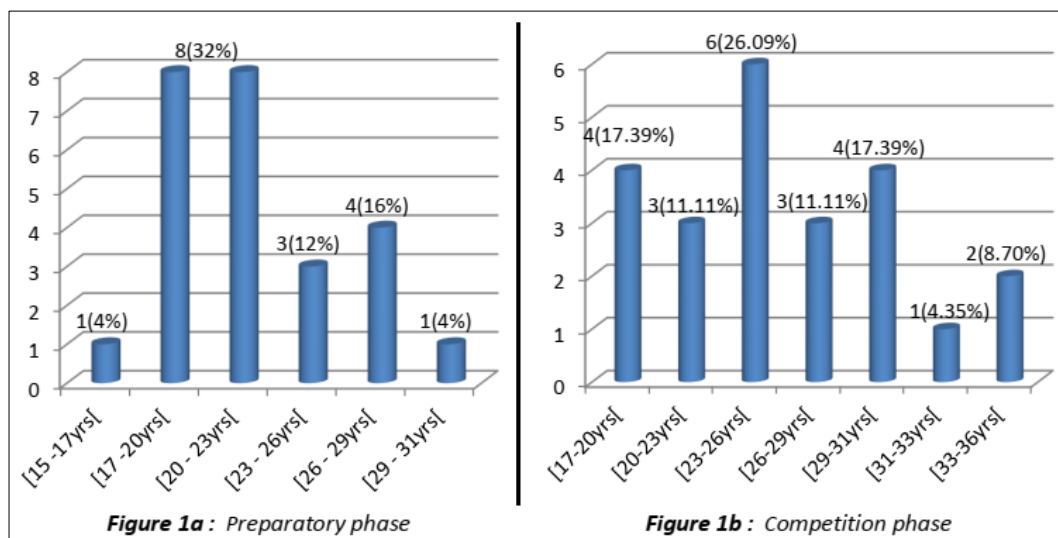
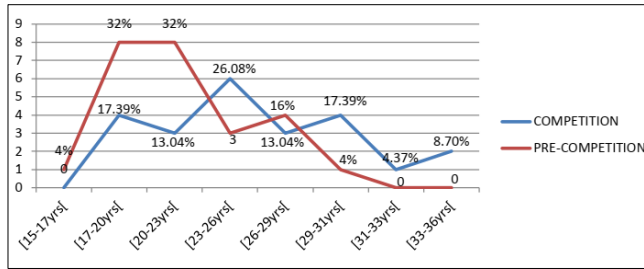


Fig 1: Age distribution of the female soccer players

In the preparatory phase, the dominant age groups were 17-20 years and 20-23 years, each accounting for 32%, with an average age of 22.44 years (Figure 1a). In the competition phase, the dominant age group was 23-26 years, accounting for 26.09% and the average age of competition was 26.08 years (Figure 1b).

The Figure 2 shows the age ranges and frequencies of the players during the preparatory and competition phases. We

can make the following observations: The [20-23yrs[ age group has the highest representation in both the pre-competition and competition phases. There is a noticeable decrease in the [17-20 yrs [age group from the pre-competition to competition phase. The [26-29 yrs[ age group shows a significant increase from the pre-competition to competition phase. The younger [15-17 yrs[ and older [29-31yrs[ age groups have relatively low representation.



**Fig 2:** Comparative age distribution of the female soccer players during the pre-competition and competition phases

**Table 1:** Distribution of the female soccer players by type of angular deformity of the knees

Injury	Preparatory Phase n (%)	Competition Phase n (%)
Normal knee alignment	7 (28%)	5 (21.74%)
Genu varum	12 (48%)	8 (34.78%)
Genu valgum	6 (24%)	10 (43.48%)
Total	25 (100%)	23 (100%)

The distribution of different knee alignment issues among athletes during the preparatory and competition phases is presented in Table 1. During the preparatory phase, which involved 25 players, genu varum was the most common issue, accounting for 48% (12 cases), while normal knee alignment and genu valgum were less prevalent, with 28% (7 cases) and 24% (6 cases) of the cases, respectively. In the competition phase, which included 23 players, genu valgum was the most common issue, making up 43.48% (10 cases), followed by genu varum as the second most common with 34.78% (8 cases), and normal knee alignment being the least prevalent, accounting for 21.74% (5 cases).

**Table 1:** Distribution of injury mechanism

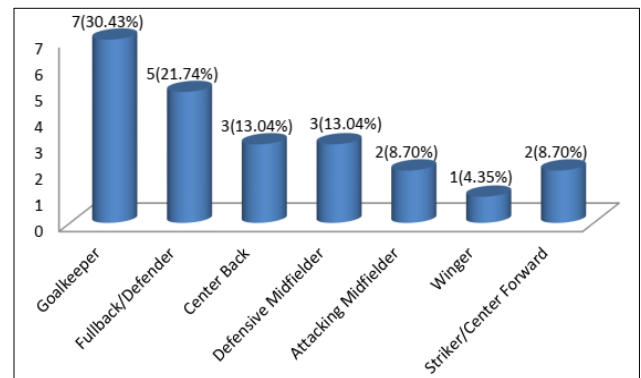
Injury	Number (n)	Proportion %
Fall	7	30.44%
Tackle	10	43.48%
Collision	6	26.09%
Total	23	100%

The data presented in Table 2 shows that tackles were the most common injury mechanism, accounting for 10 out of the 23 (43.48%). This was followed by fall injuries, which accounted for 7 cases, or 30.44% of the total. Collision injuries were the least common, comprising 26.09% of the total with 6 injuries.

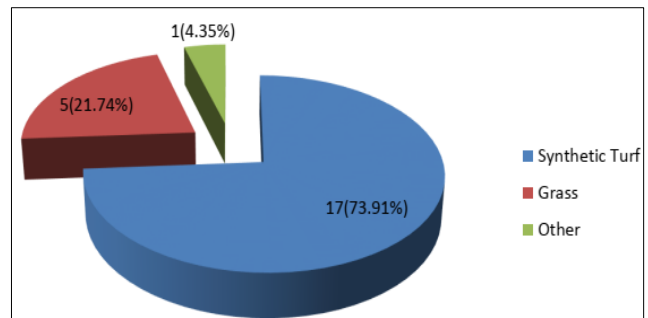
Figure 3 presents the distribution of injuries by playing positions. The most common playing position for injuries was Goalkeeper, accounting for 7 injuries or 30.43% of the total. This was followed by Fullback/Defender with 5 injuries (21.74%) and Center Back with 3 injuries (13.04%). Defensive Midfielder, Attacking Midfielder, and Striker/Center Forward each had 3 injuries, also comprising 13.04% each. The position with the fewest injuries was Winger, with 2 injuries (8.70%).

Figure 4 presents the distribution of injuries by type of playing surface. The majority of injuries occurred on Synthetic Turf, accounting for 17 injuries or 73.91% of the

total. Grass surfaces saw 5 injuries, making up 21.74% of the total. The remaining 1 injury, or 4.35%, occurred on other types of playing surfaces.



**Fig 3:** Distribution of traumatic injuries by playing positions



**Fig 4:** Distribution of traumatic injuries by type of playing surface

**Table 3:** Distribution by types of traumatic injuries

Injury Type	Number (n)	Proportions (%)
Ankle Sprain	5	21.74%
Muscle Strain	2	8.70%
Wounds	4	17.39%
Contusion	3	13.04%
Thumb Sprain	2	8.70%
Wrist Sprain	5	21.74%
Shoulder Sprain	1	4.35%
Cerebral Concussion	1	4.35%
Total	23	100%

According to Table 3, the most prevalent injury types were ankle sprain 21.74% (5 cases) and wrist sprain 21.74% (5 cases), followed by wounds 17.39% (02 eyebrows wounds and 02 Achilles tendon wounds), contusion 13.04% (3 cases), and thumb sprain 8.70% (2 cases).

Among the 23 traumatic injuries, 19 occurred during the preparatory phase and only 04 during the competition phase. During the preparatory period, as shown in figure 5a, the most prevalent injury type was wrist sprain, accounting for 26.32% (5 cases) of the total 19 injuries. This was followed by ankle sprain and muscle strain, each comprising 15.79% (3 cases) of the total. In the competition period, as revealed by figure 5b, the most prevalent injury type was ankle sprain, accounting for 50% (2 cases) of the total 4 injuries. Both cerebral concussion and muscle strain made up 25% (1 case each) of the injuries.

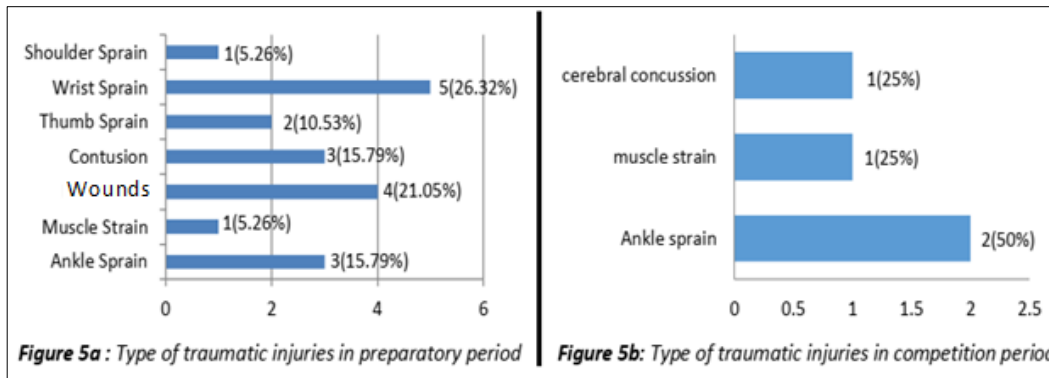


Fig 5: Distribution of traumatic injuries by type in each period

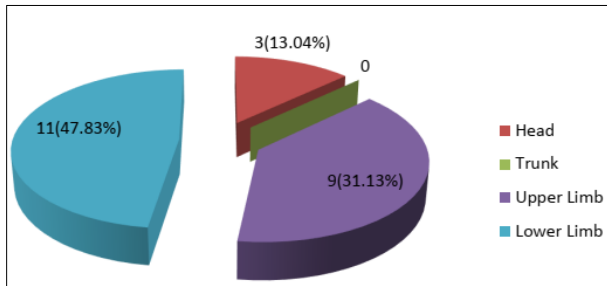


Fig 6: Distribution of traumatic injuries by body region

The Figure 6 shows that the distribution of traumatic injuries by site was: lower limb 47.83% (11 cases), upper limb 39.13% (9 cases), head 13.04% (3 cases), and trunk 0% (0 cases), out of a total of 23 injuries.

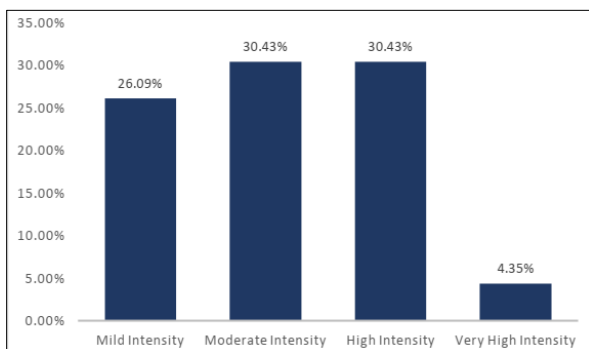


Fig 7: Distribution of pain intensity evaluated by visual analogue scale after traumatic injury

The pain intensity following traumatic injuries represented 60.87% between moderate and high intensity according to the Visual Analogue Scale, as shown in Figure 7.

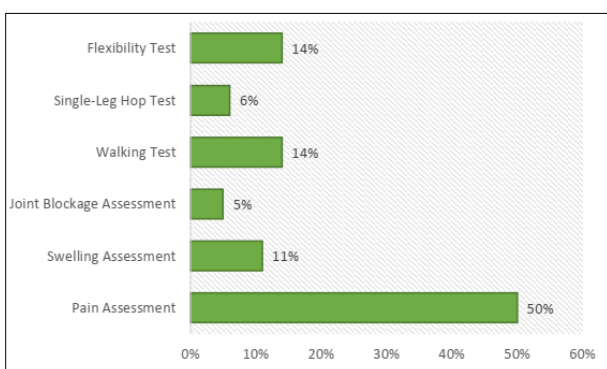


Fig 8: Distribution according to various injury severity tests in sports medicine used on the injured players

The Figure 8 presents the various sports medicine severity tests used in cases of traumatic injuries, with the Pain Assessment evaluated in 50% of the cases, the Swelling Assessment in 11%, the Joint Blockage Assessment in 5%, the Walking Test in 14%, the Single-Leg Hop Test in 6%, and the Flexibility Test in 14%. These injury severity tests were used to determine the BM (Biomechanical) clinical severity score.

Table 4: Distribution of traumatic injury according to the Biomechanical (BM) Score

BM Stage	Score	Number	Management
Stage 1	2	17	- Cryotherapy - Return to activity
Stage 2	3	5	- Cryotherapy - Strapping - Delayed return to activity
Stage 3	4	1	- RICE protocol - Activity cessation - Specialized follow-up

The table 4 provides details on the distribution of players based on their BM score, along with the corresponding management approaches for each stage:

- **Stage 1 (score 2):** 17 players, managed with cryotherapy and a return to activity.
- **Stage 2 (score 3):** 5 players, managed with cryotherapy, strapping, and a delayed return to activity.
- **Stage 3 (score 4):** 1 player, managed with the RICE (Rest, Ice, Compression, Elevation) protocol, activity cessation, and specialized follow-up.

**Discussion**

The Cameroonian Women's National Football Team, with an average age of 25.8 years and ranging from 15 to 34 years, was divided into two groups for the study: the first group was the preparation period, with an average age of 22.44 years (range 15-30 years), consisting of only local players due to the unavailability of internationally-based players; the second group was the competition period, with an average age of 26.08 years (range 17-34 years). These results on the age distribution of players are consistent with trends observed in the literature on high-level women's soccer. Compared to other studies, the average age of players in this study was slightly higher than the 25.7 years reported in the United States by Darvin *et al.*, 2019 and the 23.5 years reported in France by Scelles *et al.*, 2016 [5, 25]. This difference may be an indication of the challenges many women face in accessing sufficiently competitive incomes to commit themselves durably to professional football. The



younger average age of 22.44 years in the preparation period group, consisting only of local players, suggests that younger domestic players may have more limited opportunities to join the national team compared to their older, more experienced counterparts who play internationally. The unavailability of internationally-based players and clubs' reluctance to release players for national team duties during this preparatory phase highlights the barriers that hinder the participation of the best Cameroonian women footballers. The dominance of the 17-20 years and 20-23 years age groups in the preparatory phase which is common in literature gives way to a majority of 23-26 year old players in the competition phase, reflecting better retention and greater experience of the older players [12, 15, 19]. The decrease in the representation of the younger players and the increase in that of the 26-29 age group are explained by a higher dropout rate among the youngest, and greater physical and technical maturity of the older players<sup>15</sup>. These findings underscore the need to address the structural and systemic issues that limit the participation and development of women's football in Cameroon and other parts of the world. Strategies to improve access to competitive incomes, facilitate the release of players for national team duties, and provide more opportunities for younger domestic players to join the national team may be crucial in fostering the growth and competitiveness of women's football.

The high prevalence of genu varum (bowlegged condition) observed in this study, with 65.2% of players affected during the preparatory period and 60.9% during the competition period, underscores the association between knee joint malalignment and the demands of football. Hewett *et al.*, (1999) and Nagano *et al.*, (2009) have further demonstrated that dynamic knee valgus malalignment is a key predictor of non-contact ACL injury risk in female soccer players [17, 20]. As noted by Besier *et al.* (2001), the increased varus and valgus stresses on the knee joint during cutting maneuvers common in football can lead to malalignments [1]. This is particularly concerning for female soccer players, who have been shown to exhibit greater knee abduction (valgus) angles and moments compared to their male counterparts [23]. The evaluation and selection process of top amateur players into professional teams could account for the high proportion of players exhibiting genu varum in competitive squads. While it remains unclear if cutting tasks can directly lead to genu varum alone, the high proportion of professional players (72%) observed in the competition phase may be attributed to the evaluation and selection of the best local amateur players, as well as the improved implementation of the Cameroon Professional Football League since 2011 [10]. Similarly, the most successful national teams now field almost exclusively players with international experience. Targeted interventions to address knee joint biomechanics, such as neuromuscular training programs, may be crucial for mitigating the risk of knee injuries in female soccer players [6].

In this study, we had 80% contact mechanisms and the rest were non-contact. In the contact mechanisms, duels with the opponent were 90% and 10% with teammates, we had 43.5% tackles, followed by 30.4% falls and 26.1% collisions with head-to-head collisions, shoulder-to-shoulder collisions. In the collisions we had: collisions or pushes by the opponent and collisions or kicks from the opponent. In the non-contact mechanisms, we found: overload sprint

injuries and landing injuries. Combined mechanisms were also found, namely: collision and fall on the shoulder. These are closely aligned with the results reported in Faude *et al.*'s (2005) study on injury patterns among female soccer players in Germany, where challenges/tackling, player-to-player contact, and shooting/kicking were identified as the primary injury mechanisms [11].

The finding in our study of higher injury rates among goalkeepers (30.4%) and fullbacks (21.7%) compared to other positions is reinforced by the Hawkins *et al* (1999) study, which also reported the highest overall injury incidence rates for goalkeepers and fullbacks in professional football [16]. Unlike us, Bigot Lise at the University of Limoges in 2022 found 19% in fullbacks, 17% in goalkeepers and 16% in central defenders and defensive midfielders [2].

The injuries were recorded on synthetic pitches in 73.91% versus 21.74% on natural grass. Indeed, several recent studies have examined the differences in injury risk between playing on third-generation synthetic turf and natural grass among professional and elite football players. The results of these studies are revealing. Bjorneboe *et al.* (2010) reported an overall higher risk of injury on synthetic turf compared to natural grass, particularly for knee and ankle injuries<sup>3</sup>. Similarly, Ekstrand *et al.* (2006) observed a 40% higher rate of injuries among players competing on artificial turf compared to those on natural grass [9]. Complementing these data, our own study showed even more marked results, with 74.91% of injuries occurring on synthetic turf versus only 21.74% on natural grass; which can be explained by inappropriate type of studs on the boots of the players, often bought by themselves. This significant gap underscores the importance of considering these risk differences in injury prevention and football team management, particularly in terms of training and rest strategies tailored to the playing surfaces.

The injuries seem little different between the periods; we collected 23 cases of injuries during this regrouping of the Cameroonian Women's National Football Team, wrist and ankle sprains were the most common injuries at 43.5%, followed by wounds at 17.4%, we had two eyebrow wounds and two wounds at the level of the Achilles tendon. Among these 23 traumatic injuries, 19 occurred during the preparatory phase and only 04 during the competition phase. The only potential bias in this study could be related to the fact that the players did not disclose, hide or underestimate some of their traumatic injuries. This higher incidence of traumatic injuries during the preparatory phase (potentially due to increased training load, unfamiliar training drills, or inadequate recovery time) compared to the competition phase suggests the need for the Cameroonian Football Federation to closely monitor and optimize their training and injury prevention strategies specifically during the preparatory period in order to mitigate the elevated risk of injuries observed. Out of the 19 cases found during the preparation period for the competition, sprains represented 57.90%, namely 3 cases of mild ankle sprains, 5 cases of moderate wrist sprains, 2 cases of moderate thumb sprains and 1 case of moderate shoulder sprain, followed by wounds at 21.05%, then muscle contusions at 15.79% and finally cases of muscle tears at 5.26%. On the other hand, among the 4 cases found during the competition period, we found 2 cases of ankle sprains, 01 case of mild cerebral concussions and 01 case of quadriceps muscle tears. Many studies have

shown that female football players have a higher risk of suffering certain types of injuries compared to their male counterparts [27]. Indeed, women suffer more often from sprains and have an increased risk of anterior cruciate ligament (ACL) rupture [27, 24]. Our own results confirm that their knees and ankles experience more trauma. Several factors explain these differences between men and women. First, the female anatomy, with a wider pelvis, favors knee deformities [23]. Additionally, the gluteal and hamstring muscles are generally less powerful in women, making them less resistant to constraints [17]. It is also possible that hormones play a role, with estradiol and progesterone being able to affect neuromuscular control and joint hyperlaxity [17]. Finally, women also have a higher risk of concussions, potentially related to a smaller cranial volume and less developed trapezius and cervical musculature [4].

The finding in the Cameroonian national team study that the lower limb was the most affected injury site (47.8%), followed by the upper limb (39.1%), is consistent with the results reported by Ekstrand *et al.* (2011) in their large-scale study of professional football players, where they found that the vast majority (87%) of injuries occurred in the lower extremities, with the thigh, ankle, and knee being the most common injury locations<sup>8</sup>. Our results are somewhat similar to those of Bigot Lise in France in 2022 who found 78% of injuries at the lower limb level [2]. Football being played almost exclusively with the lower limb, this would explain the fact that this is the most affected area.

The pain intensity represented 60.87% between moderate and severe intensity according to the Visual Analogue Scale. This is similar to Ekstrand, *et al.* (2011) study, which reported that 59% of injuries in professional European football players resulted in moderate or severe pain levels<sup>8</sup>. The severity of the trauma resulting from the pain intensity allowed us to evaluate: work stoppage time, complete physical activity stoppage time, and delay in returning to football. During this study, we had only one trauma that required a complete stoppage of physical activity with a return delay of 45 days, which was a moderate ankle sprain during a decisive match. This required an X-ray of the affected ankle and an MRI of the ankle.

We used the lesional severity test to determine the BM clinical severity score. Thus:

- 17 of our players had: an absence of oedema and blockage, only pain was present. They benefited from cryotherapy and brief emergency rehydration, and were able to immediately resume activity.
- Five players had: pain, presence of oedema, temporary incapacity on jump and flexion-extension tests. They benefited from cryotherapy and joint taping, with active monitoring and a delayed return to activity.
- One player had: an inability to walk, jump, flex-extend, and a reflex block. She was evacuated to the stadium infirmary, received the RICE protocol, and specialized care.

The findings from our study are comparatively consistent with the injury severity assessment categories and management strategies reported by Orchard *et al.* (2002) in their comprehensive four-season epidemiological study of injuries in the Australian Football League [21]. The researchers classified injury severity into three main groups - minimal (59% of injuries), mild (29%), and moderate (12%) - based on factors such as the presence of pain,

edema, functional impairment, and required treatment and return-to-play timelines. This detailed injury severity classification and management approach reported in this landmark Australian football study provides a useful point of comparison for the results of the Cameroonian national team research [29].

## Conclusion

The findings of this study provide important insights into the injury profile of the Cameroonian women's national football team. The higher average age compared to previous studies in the US and France suggests potential challenges for women in accessing competitive incomes to commit to professional football long-term. The younger average age in the preparation group also indicates that domestic players may have more limited opportunities to join the national team compared to older, more experienced international players. A key concern is the high prevalence of genu varum (bowlegged condition) observed, which is a risk factor for non-contact ACL injuries in female soccer players. This may be attributed to the evaluation and selection process favoring players with this condition. The study also found a high proportion of contact injuries, primarily from tackles, falls, and collisions with opponents and teammates. Non-contact injuries included overload sprint injuries and landing injuries. Goalkeepers and fullbacks had the highest injury rates, consistent with previous research. Interestingly, the majority of injuries (73.91%) occurred on synthetic playing surfaces, corroborating findings that artificial turf poses a greater risk of injury compared to natural grass. The most common injuries were ankle and wrist sprains, as well as wounds, with the lower limbs being the most affected body region. The only potential bias that could have occurred in this study could be constituted by unreported, hidden or minimized traumatic injuries by the players. These results could be generalizable because the study was conducted on a full selection for an entire competition. To address the findings and elevate women's football in Cameroon, the Football Federation should take comprehensive measures. This includes implementing evidence-based neuromuscular training programs to improve knee and ankle biomechanics and reduce non-contact ACL and ankle injuries. Establishing a screening process to identify players with genu varum and providing tailored interventions, such as strengthening exercises and orthotic support, to address this risk factor. Exploring the transition to natural grass playing surfaces, which have lower injury risks compared to synthetic turf. Developing a robust injury surveillance system to track and analyze injury patterns, enabling the implementation of targeted prevention strategies. Educating players on promptly reporting physical discomfort and emphasizing proper warm-up, recovery, and rehabilitation in injury prevention. By addressing these structural and systemic issues, the long-term participation and development of women's football in Cameroon can be significantly enhanced.

## Conflicts of interest

The authors declare no conflicts of interest.

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