

# Epidemiology and clinical characteristics of football injuries among academy players in Ghana

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## ABSTRACT

**Objective** To determine the epidemiology and clinical characteristics of match and training injuries among football players at an academy in Ghana.

**Methods** In this prospective observational study, we followed 80 youth and adult football players at a Ghanaian academy over a season of 39 weeks. Medical attention and time-loss injuries, as well as exposure times of players, were recorded by resident physiotherapists using a standardised injury surveillance form. The average weekly injury prevalence was calculated. Injury incidence rates were calculated per 1000 exposure hours, with significance indicated as 95% CIs.

**Results** 126 injuries were recorded during the season, with an average weekly injury prevalence of 4.1%. The overall injury incidence was 4.5 (95% CI 3.8 to 5.4) injuries per 1000 hours with under 14 (5.8 (3.3 to 10.2)/1000 hours) and under 18 players (5.7 (4.4 to 7.4)/1000 hours) recording a higher incidence than under 16 (5.1 (3.5 to 7.4)/1000 hours) and senior players (2.7 (1.9 to 3.9)/1000 hours). Match injury incidence was 13 times higher than training injury incidence (27.4 (21.5 to 34.9) vs 2.3 (1.8 to 3.0) injuries/1000 hours). Injuries to the lower extremities had the highest incidence (3.9 (2.1 to 7.2) injuries/1000 hours), with the knee being the most commonly injured site (n=30, 23.8%). The most common type of injury was a joint sprain (1.9 (1.5 to 2.5) injuries/1000 hours), and the most common injury mechanism was direct contact with another player (1.5 (1.1 to 2.0) injuries/1000 hours). Most injuries were moderately severe (2.0 (1.5 to 2.6) injuries/1000 hours). **Conclusion** Ghanaian academy football players have a substantial risk of sustaining injuries, especially among younger players. Further studies should focus on developing specific injury prevention programmes in under-researched football-playing populations.

## INTRODUCTION

Football academies are essential for footballers' tactical, technological and physical growth. However, footballers may still be exposed to certain injury risks due to the complexities (running and sprinting, passes and dribbles, tactical, technical and quick reactions) of football during routine training and matches.<sup>1–3</sup> In a Spanish youth academy,

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ In European football, the injury incidence among academy players reportedly ranges from 3.7 to 7.9 injuries per 1000 hours; however, this rate is only half of that reported in adult African football players.

## WHAT THIS STUDY ADDS

⇒ The overall injury incidence for Ghanaian academy football players is comparable to previous European reports but relatively lower than studies on adult players in Africa.  
⇒ Under 14, under 18 and under 16 Ghanaian academy football players reported higher injury incidences (5.8 (95% CI 3.3 to 10.2), 5.7 (4.4 to 7.4) and 5.1 (3.5 to 7.4) injuries/1000 hours, respectively) than senior players (2.8 (1.9 to 3.9) injuries/1000 hours).

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Our study provides the first epidemiological findings for Ghanaian academy football players.  
⇒ Our results highlight that preventive efforts in the Ghanaian context should target youth football players and focus specifically on the knee and ankle.

the incidence of injury was reported as 2.93 injuries per 1000 hours,<sup>2</sup> while a rate of 6.8 injuries per 1000 hours was reported for Swedish youth players.<sup>3</sup> Both studies recorded higher injury incidence rates during matches than training.<sup>2,3</sup> Other studies involving youth football players in Europe reported 1.8–6.8 injuries per 1000 hours.<sup>2–6</sup> In contrast, a higher injury incidence (between 13 and 82 injuries per 1000 hours) has been reported for football players from Africa.<sup>7–9</sup>

Ghana is a football nation with a great history of success in international tournaments and a passionate fan base that shows enthusiasm by attending games and cheering for their national team.<sup>10–11</sup> However, no prospective studies have been conducted on football players from Ghana, especially among youth players, making this study important. Generally, few prospective epidemiology studies focus on academy football



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players from Africa. The few studies on football injuries have not followed recognised reporting guidelines for epidemiology studies hampering comparisons with other studies.<sup>12–14</sup> The few studies focussing on adult Ghanaian football players were retrospective, which may result in possible misclassification or recall bias. Conducting detailed epidemiology studies on football injuries is necessary to identify unique characteristics of the Ghanaian football population concerning injury incidence and prevalence. This information may guide clinicians in assessing injury patterns, incidence and characteristics in these players.<sup>15</sup> This study aimed to determine the epidemiology and clinical characteristics of academy football players in different age groups over one football season.

## METHODS

### Study design

An observational prospective cohort study was conducted among youth and adult male football players at the West African Football Academy in Ghana. The study was conducted over one season of 39 weeks. Participants older than 18 years signed informed consent forms before the study. Players under 18 assented, and their parents gave informed written consent. Assent and parent consent forms were given to players to be given to parents during vacation after an introductory email was sent to parents. Weekly phone calls and text messages were sent to parents to confirm receipt and completion of forms. All forms were retrieved when the academy resumed.

### Setting and participants

One hundred five players were enrolled in the academy at the time of the study. We invited all players to participate in the study. However, 25 players did not participate. Fifteen players were ‘on-trial’, five were transferred to another team, three young players could not obtain parental consent and two were scheduled to end their contracts in the month data were collected. Resultantly, 80 players participated in the study (n=80). Players were grouped into four age groups, namely, under 14 (U14), under 16 (U16), under 18 (U18) and senior (adult) players. The football academy in the Volta region of Ghana comprises three standard artificial turfs, a physiotherapy unit, one gymnasium and accommodation for all players and some staff. The academy enrolled only male football players, who stay in the football camp for approximately 10 months each year, are given a special diet three times a day, monitored sleep by supervisors, attend a government school and have access to physiotherapists every day. Physiotherapists are the only employed health professionals resident at the academy; hence, they are the primary contact regarding any health issues among players. In a week, the training involved five to seven training sessions for all age groups, each spanning between 90 and 120 min. The senior team attended an additional strength, agility and quickness (SAQ) session (30 min), one power training session (30 min) and one

injury prevention session (45 min) per week. The U18 players attend one additional SAQ session (30 min) and one injury prevention session (45 min) per week. The U14 and U16 players do not attend any additional specific training sessions.

### Patient and public involvement

The study was discussed with the management and medical staff of the football academy when developing the study proposal. The staff of the football academy facilitated data collection, and we distributed the findings to the academy.

### Data collection

Before the start of the season, participants completed a questionnaire regarding demographic and previous injury information, including age, player position, dominant leg, previous injury and being a member of the national team.

Injury definitions and data collection procedures followed the IOC model for recording injury<sup>16</sup> and the 2006 consensus statement on epidemiological studies in football.<sup>17</sup> An injury was recorded as a result of any physical complaint resulting from a match or training that resulted in the player seeking medical attention (medical attention injury) from the physiotherapist or missing the next training or match (time-loss injury). Injuries were documented prospectively on a standardised injury surveillance form.<sup>16</sup> Two resident physiotherapists were trained to collect injury data. The following injury data were recorded: match or training, mode of onset, injury mechanism, injured body region, injury type, new/index injury (first injury of one type recorded during the study), recurrent injury (injury to the same body part and same structure type as the index injury), severity (number of days of time loss). Injury severity was classified as follows: slight (0 days); minimal (1–3 days); mild (4–7 days); moderate (8–28 days) and severe (>28 days).

Weekly player exposure hours were recorded on exposure forms. The primary researcher visited the study setting once a month to assist with recording, ensuring that reporting procedures were maintained and extracting data from physiotherapists’ files. Data collection continued for one season, from September 2021 to June 2022.

To minimise confounding variables in this study, several measures were taken. First, all players, except those in the senior team, played on artificial turf for all their games. Second, the coaching and technical staff were consistent across all age groups throughout the season, ensuring similar training styles. Finally, the environment and climate were standardised as all training and matches occurred at Ghana’s Volta Region Academy. There were only a few exceptions where the senior team played in other regions.

**Table 1** Demographic characteristics of football players at an academy in Ghana (n=80)

Age groups	Total players	Age (years)	BMI	Player position				Member of the national team	
	N (%)	Mean±SD	Mean±SD	GK N (%)	DF N (%)	MF N (%)	ATT N (%)	Yes N (%)	No N (%)
U14	7 (8.8)	13±0.38	17.6±2.0	0 (0)	2 (28.6)	3 (42.9)	2 (28.6)	0 (0)	7 (100)
U16	17 (21.2)	15±0.51	18.5±1.2	3 (17.7)	7 (41.2)	3 (17.7)	4 (23.5)	0 (0)	1 (100)
U18	29 (36.2)	17±0.51	20.3±1.9	3 (10.3)	11 (37.9)	5 (17.2)	10 (34.5)	3 (10.3)	26 (89.7)
Senior team	27 (33.8)	21±2.65	21.7±1.7	3 (11.1)	9 (33.3)	8 (29.6)	7 (25.9)	6 (22.2)	21 (77.8)
Total population	80 (100)	17±3.10	20.1±2.2	9 (11.3)	29 (36.3)	19 (23.8)	23 (28.8)	9 (11.3)	71 (88.8)

ATT, attacker; BMI, body mass index; DF, defender; GK, goalkeeper; MF, midfielder; U14, under 14 years; U16, under 16 years; U18, under 18 years.

**Data analysis**

Data were analysed using SPSS IBM Statistics V.28 software. All injuries (medical attention and time-loss) were included in the analysis. The data analysis consisted of descriptive statistics (means and SD) for continuous variables and frequency tables (counts and percentages) for categorical variables. Injury incidence was calculated per 1000 hours and interpreted at 95% CIs. For the average weekly prevalence, the injury prevalence (number of injuries by the total number of players expressed in percentage) was calculated for each week. Subsequently, the mean prevalence was calculated for the study period of 39 weeks, at 95% CI.

**RESULTS**

**Demographics and player-specific factors**

All participants completed the 39-week study period. The total exposure hours for all participants for the 2021/2022 academy season was 28 082.4 hours. The match exposure hours were 2406.6 hours, while the training exposure hours were 25 675.8 hours. Table 1 shows participants’ demographics and player-specific factors for the total population and per age group.

**Injury prevalence and injury incidence**

The average weekly injury prevalence for the population was 4.1% (95% CI 2.94 to 5.56), with 2.1% (1.30 to 3.21) in matches and 1.9% (1.14 to 2.97)

in training. As long as a player was not injured or sick, the player participated in all the training and matches in the season. The overall injury incidence rate was 4.5 (95% CI 3.8 to 5.4) per 1000 hours, while match and training incidence rates were 27.4 (21.5 to 34.9) and 2.3 (1.8 to 3.0) per 1000 hours, respectively. A total of 126 injuries were recorded, of which 52.4% (n=66) occurred during matches, and 47.6% (n=60) occurred in training. Table 2 shows the injury incidence for the study population per age group.

**Injury characteristics**

**Mode of onset and mechanism of injury**

The mode of onset of most injuries was sudden after acute trauma (n=57, 45.2%). About 24.6% (n=31) of injuries occurred suddenly but no acute trauma and 30.2% (n=38) occurred gradually. Most injuries were sustained via direct contact with another player (n=42, 33.3%). Details of the frequency and incidence by mechanism are shown in table 3.

**Injured body region**

The most commonly injured body region was the knee (n=30, 23.8%), followed by the ankle (n=18, 14.3%), hip/groin (n=17, 13.5%) and hamstring (n=16, 12.7%). A slightly different pattern was observed for match injuries (table 4).

**Table 2** The incidence of injuries among football players at an academy in Ghana

Age category	Overall			Match			Training		
	N (%)	Exposure hours	IR (95% CI)	N (%)	Exposure hours	IR (95% CI)	N (%)	Exposure hours	IR (95% CI)
U14	12 (9.5)	2069.0	5.8 (3.3 to 10.2)	8 (12.1)	186.9	42.8 (21.4 to 85.6)	4 (6.7)	1882.2	2.1 (0.8 to 5.6)
U16	28 (22.2)	5522.9	5.1 (3.5 to 7.4)	13 (19.7)	510.2	25.5 (14.8 to 43.9)	15 (25.0)	5012.7	3.0 (1.8 to 5.0)
U18	58 (46.10)	10 138.0	5.7 (4.4 to 7.4)	31 (47.0)	964.5	32.1 (22.6 to 45.6)	27 (45.0)	9173.5	2.9 (2.0 to 4.2)
Senior team	28 (22.2)	10 078.9	2.8 (1.9 to 3.9)	14 (21.2)	745.1	18.8 (11.1 to 31.7)	14 (23.3)	9333.8	1.5 (0.9 to 2.5)
Total	126 (100)	28 082.4	4.5 (3.8 to 5.4)	66 (100)	2406.6	27.4 (21.5 to 34.9)	60 (100)	25 675.8	2.3 (1.8 to 3.0)

IR, injury incidence rate; U14, under 14 years; U16, under 16 years; U18, under 18 years.



**Table 3** The number (n), frequency (%) and IR (per 1000 hours) of all injuries, match and training injuries by the injury mechanism per age category

Mode of onset	Total population			U14			U16			U18			Senior team		
	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	
All injuries (n=126)															
No single identifiable event	29 (23.0)	1.0 (0.7 to 1.4)	4 (33.3)	1.9 (0.7 to 5.1)	5 (17.9)	0.9 (0.4 to 2.2)	11 (19.0)	1.1 (0.6 to 2.0)	9 (32.1)	0.9 (0.5 to 1.7)					
Acute non-contact trauma	32 (25.4)	1.1 (0.8 to 1.6)	4 (33.3)	1.9 (0.7 to 5.1)	11 (39.3)	2.0 (1.1 to 3.6)	16 (27.6)	1.6 (1.0 to 2.6)	1 (3.6)	0.1 (0.0 to 0.7)					
Direct contact with another player	42 (33.3)	1.5 (1.1 to 2.0)	3 (25.0)	1.4 (0.5 to 4.3)	8 (28.6)	1.4 (0.7 to 2.8)	21 (36.2)	2.1 (1.4 to 3.2)	10 (35.7)	1.0 (0.5 to 1.9)					
Following contact with another player	8 (6.3)	0.3 (0.2 to 0.6)	0 (0.0)	0	2 (7.1)	0.4 (0.1 to 1.6)	3 (5.2)	0.3 (0.1 to 0.9)	3 (10.7)	0.3 (0.1 to 0.9)					
Direct contact with an object	11 (8.70)	0.4 (0.2 to 0.7)	1 (8.3)	0.5 (0.5 to 3.5)	1 (3.6)	0.2 (0.0 to 1.4)	5 (8.6)	0.5 (0.2 to 1.2)	4 (14.3)	0.4 (0.2 to 1.1)					
Following contact with an object	4 (3.2)	0.1 (0.0 to 0.3)	0 (0.0)	0	1 (3.6)	0.2 (0.0 to 1.4)	2 (3.4)	0.2 (0.1 to 0.8)	1 (3.6)	0.1 (0.0 to 0.7)					
Training injuries (n=60)															
No single identifiable event	14 (23.3)	0.5 (0.3 to 0.8)	2 (50.0)	1.1 (0.3 to 4.4)	3 (20.0)	0.6 (0.2 to 1.9)	6 (22.2)	0.7 (0.3 to 1.6)	3 (21.4)	0.3 (0.1 to 0.9)					
Acute non-contact trauma	17 (28.3)	0.6 (0.4 to 1.0)	2 (50.0)	1.1 (0.3 to 4.4)	7 (46.7)	1.4 (0.7 to 2.9)	7 (25.9)	0.8 (0.4 to 1.7)	1 (7.1)	0.1 (0.0 to 0.7)					
Direct contact with another player	13 (21.7)	0.5 (0.3 to 0.9)	0 (0.0)	0	2 (13.3)	0.4 (0.1 to 1.6)	7 (25.9)	0.8 (0.4 to 1.7)	4 (28.6)	0.4 (0.2 to 1.1)					
Following contact with another player	6 (10.0)	0.2 (0.1 to 0.4)	0 (0.0)	0	2 (13.3)	0.4 (0.1 to 1.6)	3 (11.1)	0.3 (0.1 to 0.9)	1 (7.1)	0.1 (0.0 to 0.7)					
Direct contact with an object	8 (13.3)	0.3 (0.2 to 0.6)	0 (0.0)	0	1 (6.7)	0.2 (0.0 to 1.4)	3 (11.1)	0.3 (0.1 to 0.9)	4 (28.6)	0.4 (0.2 to 1.1)					
Following contact with an object	2 (3.3)	0.1 (0.0 to 0.4)	0 (0.0)	0	0 (0.0)	0	1 (3.7)	0.1 (0.0 to 0.7)	1 (7.1)	0.1 (0.0 to 0.7)					
Match injuries (n=66)															
No single identifiable event	2 (25.0)	10.7 (2.7 to 42.8)	2 (15.4)	3.9 (1.0 to 15.6)	5 (16.1)	5.2 (2.2 to 12.5)	6 (42.9)	8.1 (3.6 to 18.0)	2 (25.0)	10.7 (2.7 to 42.8)					
Acute non-contact trauma	2 (25.0)	10.7 (2.7 to 42.8)	4 (30.8)	7.8 (2.9 to 20.8)	9 (29.0)	9.3 (4.8 to 17.9)	0 (0.0)	0	2 (25.0)	10.7 (2.7 to 42.8)					
Direct contact with another player	30 (37.5)	16.1 (11.3 to 23.0)	6 (46.2)	11.8 (5.3 to 26.3)	14 (45.2)	14.5 (8.6 to 24.5)	6 (42.9)	8.1 (3.6 to 18.0)	3 (37.5)	16.1 (5.2 to 49.9)					
Following contact with another player	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	2 (14.3)	2.7 (0.7 to 10.8)	0 (0.0)	0					
Direct contact with an object	1 (12.5)	5.4 (0.8 to 38.3)	0 (0.0)	0	2 (6.5)	2.1 (0.5 to 8.4)	0 (0.0)	0	1 (12.5)	5.4 (0.8 to 38.3)					
Following contact with an object	0 (0.0)	0	1 (7.7)	2.0 (0.3 to 14.2)	1 (3.2)	1.0 (0.1 to 7.1)	0 (0.0)	0	0 (0.0)	0					
IR, injury incidence rate; U14, under 14 years; U16, under 16 years; U18, under 18 years.															





**Table 4** The number (n), frequency (%) and IR per 1000 hours of all injuries, match and training injuries by body region

Body region	Total population			U14			U16			U18			Senior team		
	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	
All injuries (n=126)															
Face	1 (0.8)	0 (0.0 to 0.0)	0 (0.0)	0	1 (3.6)	0.2 (0.0 to 1.4)	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	
Upper limb (all)	4 (3.2)	0.1 (0.0 to 0.3)	0 (0.0)	0	3 (10.7)	0.5 (0.2 to 1.6)	1 (1.7)	0.1 (0.0 to 0.7)	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	
Shoulder	2 (1.6)	0.1 (0.0 to 0.4)	0 (0.0)	0	1 (3.6)	0.2 (0.0 to 1.4)	1 (1.7)	0.1 (0.0 to 0.7)	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	
Elbow	1 (0.8)	0 (0.0 to 0.0)	0 (0.0)	0	1 (3.6)	0.2 (0.0 to 1.4)	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	
Forearm	1 (0.8)	0 (0.0 to 0.0)	0 (0.0)	0	1 (3.6)	0.2 (0.0 to 1.4)	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	
Trunk (all)	12 (9.5)	0.4 (0.2 to 0.7)	2 (16.7)	1 (0.3 to 4.0)	4 (14.3)	0.7 (0.3 to 1.9)	4 (6.9)	0.4 (0.2 to 1.1)	2 (7.1)	0.2 (0.1 to 0.8)	0	0	0 (0.0)	0	
Upper back	1 (0.8)	0 (0.0 to 0.0)	0 (0.0)	0	1 (0.8)	0.2 (0.0 to 1.4)	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	
Chest	1 (0.8)	0 (0.0 to 0.0)	0 (0.0)	0	0 (0.0)	0	1 (1.7)	0.1 (0.0 to 0.7)	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	
Lumbosacral spine	10 (7.9)	0.4 (0.2 to 0.7)	2 (16.7)	1 (0.3 to 4.0)	3 (10.7)	0.5 (0.2 to 1.6)	3 (5.2)	0.3 (0.1 to 0.9)	2 (7.1)	0.2 (0.1 to 0.8)	0	0	0 (0.0)	0	
Lower limb (all)	109 (86.5)	3.9 (3.2 to 7.2)	10 (35.7)	4.8 (2.6 to 8.9)	20 (71.4)	3.6 (2.3 to 5.6)	53 (91.4)	5.2 (4.0 to 6.8)	25 (89.3)	2.5 (1.7 to 3.7)	0	0	0 (0.0)	0	
Hip/Groin	17 (13.5)	0.6 (0.4 to 1.0)	2 (16.7)	1 (0.3 to 4.0)	5 (17.9)	0.9 (0.4 to 2.2)	6 (10.3)	0.6 (0.3 to 1.3)	4 (14.3)	0.4 (0.2 to 1.1)	0	0	0 (0.0)	0	
Thigh	6 (4.8)	0.2 (0.1 to 0.4)	0 (0.0)	0	1 (0.8)	0.2 (0.0 to 1.4)	3 (5.2)	0.3 (0.1 to 0.9)	2 (7.1)	0.2 (0.1 to 0.8)	0	0	0 (0.0)	0	
Hamstring	16 (12.7)	0.6 (0.4 to 1.0)	2 (16.7)	1 (0.3 to 4.0)	5 (17.9)	0.9 (0.4 to 2.2)	5 (8.6)	0.5 (0.2 to 1.2)	4 (14.3)	0.4 (0.2 to 1.1)	0	0	0 (0.0)	0	
Knee	30 (23.8)	1.1 (0.8 to 1.6)	4 (33.3)	1.9 (0.7 to 5.1)	3 (10.7)	0.5 (0.2 to 1.6)	15 (25.9)	1.5 (0.9 to 2.5)	8 (28.6)	0.8 (0.4 to 1.6)	0	0	0 (0.0)	0	
Tibia/Fibula	9 (7.1)	0.3 (0.2 to 0.6)	0 (0.0)	0	1 (0.8)	0.2 (0.0 to 1.4)	7 (12.1)	0.7 (0.3 to 1.5)	1 (3.6)	0.1 (0.0 to 0.7)	0	0	0 (0.0)	0	
Calf	1 (0.8)	0 (0.0 to 0.0)	0 (0.0)	0	1 (0.8)	0.2 (0.0 to 1.4)	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	
Ankle	17 (13.5)	0.6 (0.4 to 1.0)	1 (8.3)	0.5 (0.1 to 3.5)	2 (16.7)	0.4 (0.1 to 1.6)	12 (20.7)	1.2 (0.7 to 2.1)	2 (7.1)	0.2 (0.1 to 0.8)	0	0	0 (0.0)	0	
Achilles tendon	1 (0.8)	0 (0.0 to 0.0)	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	
Foot	12 (9.5)	0.4 (0.2 to 0.7)	1 (8.3)	0.5 (0.1 to 3.5)	2 (16.7)	0.4 (0.1 to 1.6)	5 (8.6)	0.5 (0.2 to 1.2)	4 (14.3)	0.4 (0.2 to 1.1)	0	0	0 (0.0)	0	
Match injuries (n=66)															
Face	1 (1.5)	0.4 (0.1 to 2.8)	0 (0.0)	0	1 (7.7)	2 (0.3 to 14.2)	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	
Upper limb (all)	1 (1.5)	0.4 (0.1 to 2.8)	0 (0.0)	0	1 (7.7)	2 (0.3 to 14.2)	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	
Shoulder	1 (1.5)	0.4 (0.1 to 2.8)	0 (0.0)	0	1 (7.7)	2 (0.3 to 14.2)	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	
Elbow	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	
Forearm	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	
Trunk (all)	6 (9.1)	2.5 (1.1 to 5.6)	1 (12.5)	5.4 (0.8 to 38.3)	2 (15.4)	3.9 (1.0 to 15.6)	1 (3.2)	1 (0.1 to 7.1)	2 (14.3)	2.7 (0.7 to 10.8)	0	0	0 (0.0)	0	
Upper back	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	
Chest	1 (1.5)	0.4 (0.1 to 2.8)	0 (0.0)	0	0 (0.0)	0	1 (3.2)	1 (0.1 to 7.1)	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	
Lumbosacral spine	5 (7.6)	2.10.9 to 5.8)	1 (12.5)	5.4 (0.8 to 38.3)	2 (15.4)	3.9 (1.0 to 15.6)	0 (0.0)	0	2 (14.3)	2.7 (0.7 to 10.8)	0	0	0 (0.0)	0	
Lower limb (all)	58 (87.9)	24.1 (18.6 to 31.2)	7 (87.5)	37.5 (17.9 to 78.7)	9 (69.2)	17.6 (9.2 to 33.8)	30 (96.8)	31.1 (21.7 to 44.5)	11 (78.6)	14.8 (8.2 to 26.7)	0	0	0 (0.0)	0	
Hip/Groin	8 (12.1)	3.3 (1.7 to 6.6)	1 (12.5)	5.4 (0.8 to 38.3)	1 (7.7)	2 (0.3 to 14.2)	4 (12.9)	4.1 (1.5 to 10.9)	2 (14.3)	2.7 (0.7 to 10.8)	0	0	0 (0.0)	0	
Thigh	2 (3.0)	0.8 (0.2 to 3.2)	0 (0.0)	0	0 (0.0)	0	2 (6.5)	2.1 (0.5 to 8.4)	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	

Continued



**Table 4** Continued

Body region	Total population			U14			U16			U18			Senior team		
	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	
Hamstring	9 (13.6)	3.7 (1.9 to 7.1)	1 (12.5)	5.4 (0.8 to 38.3)	3 (23.1)	5.9 (1.9 to 18.3)	3 (9.7)	3.1 (1.0 to 9.6)	2 (14.3)	2.7 (0.7 to 10.8)					
Knee	19 (28.8)	7.9 (5.0 to 12.4)	3 (37.5)	16.1 (5.2 to 49.9)	1 (7.7)	2 (0.3 to 14.2)	10 (32.3)	10.4 (5.6 to 19.3)	5 (35.7)	6.7 (2.8 to 16.1)					
Tibia/Fibula	5 (7.6)	2.1 (0.9 to 5.0)	0 (0.0)	0	1 (7.7)	2 (0.3 to 14.2)	3 (9.7)	3.1 (1.0 to 9.6)	1 (7.1)	1.3 (0.2 to 9.2)					
Calf	1 (1.5)	0.4 (0.1 to 2.8)	0 (0.0)	0	1 (7.7)	2 (0.3 to 14.2)	0 (0.0)	0	0 (0.0)	0					
Ankle	7 (10.6)	2.9 (1.4 to 6.1)	1 (12.5)	5.4 (0.8 to 38.3)	1 (7.7)	2 (0.3 to 14.2)	5 (16.1)	5.2 (2.2 to 12.5)	0 (0.0)	0					
Achilles tendon	1 (1.5)	0.4 (0.1 to 2.8)	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0					
Foot	6 (9.1)	2.5 (1.1 to 5.06)	1 (12.5)	5.4 (0.8 to 38.3)	1 (7.7)	2 (0.3 to 14.2)	3 (9.7)	3.1 (1.0 to 9.6)	1 (7.1)	1.3 (0.2 to 9.2)					
Training injuries (n=60)															
Face	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0					
Upper limb (all)	3 (5.0)	0.1 (0.0 to 0.3)	0 (0.0)	0	2 (13.3)	0.4 (0.1 to 1.6)	1 (3.7)	0.1 (0.0 to 0.7)	0 (0.0)	0					
Shoulder	1 (1.7)	0 (0.0 to 0.0)	0 (0.0)	0	0 (0.0)	0	1 (3.7)	0.1 (0.0 to 0.7)	0 (0.0)	0					
Elbow	1 (1.7)	0 (0.0 to 0.0)	0 (0.0)	0	1 (6.7)	0.2 (0.0 to 1.4)	0 (0.0)	0	0 (0.0)	0					
Forearm	1 (1.7)	0 (0.0 to 0.0)	0 (0.0)	0	1 (6.7)	0.2 (0.0 to 1.4)	0 (0.0)	0	0 (0.0)	0					
Trunk (all)	6 (10.0)	0.2 (0.1 to 0.4)	1 (25.0)	0.5 (0.1 to 3.5)	2 (13.3)	0.4 (0.1 to 1.6)	3 (11.1)	0.3 (0.1 to 0.9)	0 (0.0)	0					
Upper back	1 (1.7)	0 (0.0 to 0.0)	0 (0.0)	0	1 (6.7)	0.2 (0.0 to 1.4)	0 (0.0)	0	0 (0.0)	0					
Chest	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0					
Lumbosacral spine	5 (8.3)	0.2 (0.1 to 0.5)	1 (25.0)	0.5 (0.1 to 3.5)	1 (6.7)	0.2 (0.0 to 1.4)	3 (11.1)	0.3 (0.1 to 0.9)	0 (0.0)	0					
Lower limb (all)	51 (85.0)	2 (1.5 to 2.6)	3 (75.0)	1.6 (0.5 to 5.0)	11 (73.3)	2.2 (1.2 to 4.0)	23 (85.2)	1.5 (1.0 to 2.3)	14 (100)	1.5 (0.9 to 2.5)					
Hip/Groin	9 (15.0)	0.4 (0.2 to 0.8)	1 (25.0)	0.5 (0.1 to 3.5)	4 (26.7)	0.8 (0.3 to 2.1)	2 (7.4)	0.2 (0.1 to 0.8)	2 (14.3)	0.2 (0.1 to 0.8)					
Thigh	4 (6.7)	0.2 (0.1 to 0.5)	0 (0.0)	0	1 (6.7)	0.2 (0.0 to 1.4)	1 (3.7)	0.1 (0.0 to 0.7)	2 (14.3)	0.2 (0.1 to 0.8)					
Hamstring	7 (11.7)	0.3 (0.1 to 0.6)	1 (25.0)	0.5 (0.1 to 3.5)	2 (13.3)	0.4 (0.1 to 1.6)	2 (7.4)	0.2 (0.1 to 0.8)	2 (14.3)	0.2 (0.1 to 0.8)					
Knee	11 (18.3)	0.4 (0.2 to 0.7)	1 (25.0)	0.5 (0.1 to 3.5)	2 (13.3)	0.4 (0.1 to 1.6)	5 (18.5)	0.5 (0.2 to 1.2)	3 (21.4)	0.3 (0.1 to 0.9)					
Tibia/Fibula	4 (6.7)	0.2 (0.1 to 0.5)	0 (0.0)	0	0 (0.0)	0	4 (14.8)	0.4 (0.2 to 1.1)	0 (0.0)	0					
Calf	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0					
Ankle	10 (16.7)	0.4 (0.2 to 0.7)	0 (0.0)	0	1 (6.7)	0.2 (0.0 to 1.4)	7 (25.9)	0.8 (0.4 to 1.7)	2 (14.3)	0.2 (0.1 to 0.8)					
Achilles tendon	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0					
Foot	6 (10.0)	0.2 (0.1 to 0.4)	0 (0.0)	0	1 (6.7)	0.2 (0.0 to 1.4)	2 (7.4)	0.2 (0.1 to 0.8)	3 (21.4)	0.3 (0.1 to 0.9)					

IR, injury incidence rate; U14, under 14 years; U16, under 16 years; U18, under 18 years.

### Injury type

The most commonly reported injury type was joint sprain (n=54, 42.9%) and muscle strain (n=30, 23.8%), similar during training and matches. A detailed summary is shown in [table 5](#).

### Injury severity

Most injuries were classified as ‘moderate’ severity (8–28 days) (n=56, 44.4%) and occurred during matches and training sessions (n=26, 39.4% and n=30, 50%), respectively. [Table 6](#) shows injury severity for all match and training injuries per age group.

### New versus recurrent injury

The overall injury incidence rate for new injuries was 17.8 (95% CI 14.8 to 21.4) injuries per 1000 hours, with 111.4 (86.3 to 143.8) and 8.7 (6.6 to 11.4) injuries per 1000 hours occurring during matches and training, respectively. The overall injury incidence for recurrent injuries was 1.5 (95% CI 0.9 to 2.5) injuries per 1000 hours, with 7.9 (3.8 to 16.6) and 0.8 (0.4 to 1.7) injuries per 1000 hours occurring during matches and training, respectively. About 88.9% (n=112) of injuries recorded were considered ‘new injuries’, while 11.1% (n=14) were recurrent injuries; 47.3% (n=53) of new injuries occurred during training, and 52.7% (n=59) during matches. Most recurring injuries were reported among U18s (n=10, 71.4%). The U14s reported no recurrent injuries, the U16s reported 1 (7.1%) and senior players reported 3 (21.4%).

## DISCUSSION

This may be the first prospective study to report injuries’ epidemiology and clinical characteristics among Ghanaian adolescent and adult academy football players. The study sought to determine the epidemiology and clinical characteristics of football injuries among players at an academy in Ghana. The study found the overall injury incidence rate to be 4.5 (95% CI 3.8 to 5.4) injuries per 1000 hours with a higher incidence of 27.4 (21.5 to 34.9) per 1000 hours in matches than in training (2.3 (1.8 to 3.0) injuries/1000 hours). The most common type of injury was an ankle sprain, with the knee being the most frequently injured. The injury mechanism was mostly direct contact with another player, and most injuries were moderate in severity.

### Injury incidence and prevalence

Some epidemiological studies showed injury risks to be age-related among young football players.<sup>18–20</sup> The reported injury incidence in this study (4.5 injuries/1000 hours) is similar to other European studies in amateur and youth players (5.1–10.9 injuries/1000 hours).<sup>421–23</sup> However, the injury incidence in this study is lower than that reported among South African youth academy players (13.4–36.4 injuries/1000 hours).<sup>7,9</sup>

The overall injury incidence among adult male football players in Africa is between 10 and 90 injuries

per 1000 hours,<sup>7,9,24</sup> which is contrary to our findings (2.8/1000 hours) but similar to some European studies.<sup>225</sup> One reason for the wide discrepancy in results may be attributed to the variations in the methodologies where only time-loss injuries were recorded over two seasons for some studies.<sup>9,24</sup> In contrast, we reported time-loss and medical injuries over only one season. It is plausible that older athletes may experience fewer injuries due to their increased strength, stamina and coordination than reported in younger age groups.<sup>26</sup> We found that senior players experienced fewer injuries than younger players. Younger players may have a higher risk of injury because they have more obligations, including attending classes, studying for examinations and attending field and gymnasium practice sessions before and after the daily academic class schedule, which may impact sleep, rest and recovery times.<sup>27</sup>

In our study, football players experienced more injuries during matches than during training sessions, which supports recent international research.<sup>1,28–30</sup> During matches, players may experience increased physical demands, contact and collisions and fatigue.<sup>4,20,28</sup> Our study recorded the highest training injury incidence in U16 and U18 players and the highest match injury incidence in U18 players. This finding was similar to previous results in English Premier League academy football players.<sup>28</sup> Our finding, however, was contrary to Qatari male youth football players who reported U15 and U17 players to be more prone to suffering injuries during training.<sup>31</sup> The difference in exposure hours,<sup>26,31</sup> as well as higher match intensity<sup>32</sup> and aggression with age,<sup>15</sup> may well explain this finding.

We calculated the average weekly injury prevalence to reflect the overall injury frequency throughout the season accurately. We found that approximately 4% of players sustain an injury weekly during a playing season. Previous studies in Africa that determined injury prevalence used a retrospective data collection method, making comparison enigmatic.<sup>33–36</sup>

### Injury characteristics

#### Mode of onset and injury mechanism

Most reported injuries were sustained as sudden onset after acute trauma (45.2%). Injuries sustained gradually had a similar incidence to those sustained suddenly after acute trauma. Per the age groups, the overall injury incidence rate for injuries brought on suddenly without acute trauma was slightly higher than the ‘gradual’ and ‘sudden after acute trauma’ mode of onsets for the U14 players. Football’s contact and physical nature may explain the high prevalence of contact injuries. Most studies have reported the traumatic nature of football injuries.<sup>28,37</sup>

As reported in most studies, most football injuries are contact injuries.<sup>9,24,36,38</sup> Our research supports this finding and identifies ‘direct contact with another player’ as the most common cause of injury among all age groups of players, similar to other studies in South Africa,<sup>9</sup> Asia<sup>31</sup> and Europe.<sup>2,22,38</sup> Direct contact with another player



**Table 5** The number (n), frequency (%) and IR (per 1000 hours) of all injuries, match and training injuries by injury type per age category

Injury type	Total		U14		U16		U18		Senior team	
	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)
All injuries (n=126)										
Bone										
Fracture	2 (1.6)	0.1 (0.0 to 0.4)	0 (0.0)	0.0	0 (0.0)	0.0	1 (1.7)	0.1 (0.0 to 0.7)	1 (3.6)	0.1 (0.0 to 0.7)
contusion	11 (8.7)	0.4 (0.2 to 0.7)	0 (0.0)	0.0	2 (7.1)	0.4 (0.1 to 1.6)	7 (12.1)	0.7 (0.3 to 1.5)	2 (7.1)	0.2 (0.1 to 0.8)
Stress injury	4 (3.2)	0.1 (0.0 to 0.3)	0 (0.0)	0.0	0 (0.0)	0.0	4 (6.9)	0.0	0 (0.0)	0.0
Ligament										
Joint sprain	54 (42.9)	1.9 (1.5 to 2.5)	6 (50.0)	2.3 (1.0 to 5.1)	8 (28.6)	1.4 (0.7 to 2.8)	29 (50.0)	2.9 (2.0 to 4.2)	11 (39.3)	1.1 (0.6 to 2.0)
Muscle/Tendon										
Muscle strain	33 (26.2)	1.2 (0.9 to 1.7)	4 (33.3)	1.9 (0.7 to 5.1)	11 (39.3)	2.0 (1.1 to 3.6)	9 (15.5)	0.9 (0.5 to 1.7)	9 (32.1)	0.9 (0.5 to 1.7)
Muscle contusion	5 (4.0)	0.2 (0.1 to 0.5)	0 (0.0)	0.0	2 (7.1)	0.4 (0.1 to 1.6)	2 (3.4)	0.2 (0.1 to 0.8)	1 (3.6)	0.1 (0.0 to 0.7)
Tendinopathy	2 (1.6)	0.1 (0.0 to 0.4)	0 (0.0)	0.0	1 (3.6)	0.2 (0.0 to 1.4)	0 (0.0)	0.0	1 (3.6)	0.1 (0.0 to 0.7)
Meniscus										
Meniscus tear	1 (0.8)	0.2 (0.0 to 1.4)	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0	1 (3.6)	0.1 (0.0 to 0.7)
Superficial/Tissue skin										
Bruise	6 (4.8)	0.2 (0.1 to 0.4)	1 (8.3)	0.5 (0.1 to 3.5)	3 (10.7)	0.5 (0.2 to 1.6)	1 (1.7)	0.1 (0.0 to 0.7)	1 (3.6)	0.1 (0.0 to 0.7)
Laceration	2 (1.6)	0.1 (0.0 to 0.4)	0 (0.0)	0.0	1 (3.6)	0.2 (0.0 to 1.4)	0 (0.0)	0.0	1 (3.6)	0.1 (0.0 to 0.7)
Abrasion	4 (3.2)	0.1 (0.0 to 0.4)	0 (0.0)	0.0	0 (0.0)	0.0	4 (6.9)	0.4 (0.2 to 1.1)	0 (0.0)	0.0
Non-specific										
Chest pains	1 (0.8)	0.2 (0.0 to 1.4)	0 (0.0)	0.0	0 (0.0)	0.0	1 (1.7)	0.1 (0.0 to 0.7)	0 (0.0)	0.0
Osgood-Schlatter disease	1 (0.8)	0.2 (0.0 to 1.4)	1 (8.3)	0.5 (0.1 to 3.5)	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0
Match injuries (n=66)										
Bone										
Fracture	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0
contusion	7 (10.6)	2.9 (1.4 to 6.1)	0 (0.0)	0.0	1 (7.7)	2 (0.3 to 14.2)	5 (16.1)	5.2 (2.2 to 12.5)	1 (7.1)	1.3 (0.2 to 9.2)
Stress injury	1 (1.5)	0.4 (0.1 to 2.8)	0 (0.0)	0.0	0 (0.0)	0.0	1 (3.2)	1.0 (0.1 to 7.1)	0 (0.0)	0.0
Ligament										
Joint sprain	32 (48.5)	13.3 (9.4 to 18.8)	6 (75.0)	32.1 (14.4 to 71.5)	4 (30.8)	7.8 (2.9 to 20.8)	15 (48.4)	15.6 (9.4 to 25.9)	7 (50.0)	9.4 (4.5 to 19.7)
Muscle/Tendon										
Muscle strain	15 (22.7)	6.2 (3.7 to 10.3)	1 (12.5)	5.4 (0.8 to 38.3)	4 (30.8)	7.8 (2.9 to 20.8)	6 (19.4)	6.2 (2.8 to 13.8)	4 (28.6)	5.4 (2.0 to 14.4)
Muscle contusion	2 (3.0)	0.8 (0.2 to 8.3)	0 (0.0)	0.0	1 (7.7)	2 (0.3 to 14.2)	1 (3.2)	1.0 (0.1 to 7.1)	0 (0.0)	0.0
Tendinopathy	2 (3.0)	0.8 (0.2 to 8.3)	0 (0.0)	0.0	1 (7.7)	2 (0.3 to 14.2)	0 (0.0)	0.0	1 (7.1)	1.3 (0.2 to 9.2)
Meniscus										
Meniscus tear	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0

Continued



**Table 5** Continued

Injury type	Total		U14		U16		U18		Senior team	
	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)	N (%)	IR (95% CI)
Superficial/Tissue skin										
Bruise	2 (3.0)	0.8 (0.2 to 3.2)	1 (12.5)	5.4 (0.8 to 38.3)	1 (7.7)	2 (0.3 to 14.2)	0 (0.0)	0.0	0 (0.0)	0.0
Laceration	2 (3.0)	0.8 (0.2 to 3.2)	0 (0.0)	0.0	1 (7.7)	2 (0.3 to 14.2)	0 (0.0)	0.0	1 (7.1)	1.3 (0.2 to 9.2)
Abrasion	2 (3.0)	0.8 (0.2 to 3.2)	0 (0.0)	0.0	0 (0.0)	0.0	2 (6.5)	2.1 (0.5 to 8.4)	0 (0.0)	0.0
Non-specific										
Chest pains	1 (1.5)	0.4 (0.1 to 2.8)	0 (0.0)	0.0	0 (0.0)	0.0	1 (3.2)	1.0 (0.1 to 7.1)	0 (0.0)	0.0
Osgood-Schlatter disease	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0
Training injuries (n=60)										
Bone										
Fracture	2 (3.3)	0.1 (0.0 to 0.4)	0 (0.0)	0.0	0 (0.0)	0.0	1 (3.7)	0.1 (0.0 to 0.7)	1 (7.1)	0.1 (0.0 to 0.7)
contusion	4 (6.7)	0.2 (0.1 to 0.5)	0 (0.0)	0.0	1 (6.7)	0.2 (0.0 to 1.4)	2 (7.4)	0.2 (0.1 to 0.8)	1 (7.1)	0.1 (0.0 to 0.7)
Stress injury	3 (5.0)	0.1 (0.0 to 0.3)	0 (0.0)	0.0	0 (0.0)	0.0	3 (11.1)	0.3 (0.1 to 0.9)	0 (0.0)	0.0
Ligament										
Joint sprain	22 (36.7)	0.9 (0.6 to 1.4)	0 (0.0)	0.0	4 (26.7)	0.8 (0.3 to 2.1)	14 (51.9)	1.5 (0.9 to 2.5)	4 (28.6)	0.4 (0.2 to 1.1)
Muscle/Tendon										
Muscle strain	18 (30.0)	0.7 (0.4 to 1.1)	3 (75.0)	1.6 (0.5 to 5.0)	7 (46.7)	1.4 (0.7 to 2.9)	3 (11.1)	0.3 (0.1 to 0.9)	5 (35.7)	0.5 (0.2 to 1.2)
Muscle contusion	3 (5.0)	0.1 (0.0 to 0.3)	0 (0.0)	0.0	1 (6.7)	0.2 (0.0 to 1.4)	1 (3.7)	0.1 (0.0 to 0.7)	1 (7.1)	0.1 (0.0 to 0.7)
Tendinopathy	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0
Meniscus										
Meniscus tear	1 (1.7)	0.0	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0	1 (7.1)	0.1 (0.0 to 0.7)
Superficial/Tissue skin										
Bruise	4 (6.7)	0.2 (0.1 to 0.5)	0 (0.0)	0.0	2 (13.3)	0.4 (0.1 to 1.6)	1 (3.7)	0.1 (0.0 to 0.7)	1 (7.1)	0.1 (0.0 to 0.7)
Laceration	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0
Abrasion	2 (3.3)	0.1 (0.0 to 0.4)	0 (0.0)	0.0	0 (0.0)	0.0	2 (7.4)	0.2 (0.1 to 0.8)	0 (0.0)	0.0
Non-specific										
Chest pains	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0
Osgood-Schlatter disease	1 (1.7)	0.0 (0.0 to 0.0)	1 (25.0)	0.5 (0.1 to 3.5)	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0

IR, injury incidence rate; U14, under 14 years; U16, under 16 years; U18, under 18 years.

**Table 6** The number (n) and percentage (%) of injury severity categories for all injuries, match and training injuries per age category

Severity category	All injuries (n=126)			Match injuries (n=66)			Training injuries (n=60)		
	N	%	IR (95% CI)	N	%	IR (95% CI)	N	%	IR (95% CI)
Total population (n=80)									
Slight (0 days)	8	6.3	0.3 (0.2 to 0.6)	4	6.1	1.7 (0.6 to 4.5)	4	6.7	0.2 (0.1 to 0.8)
Minimal (1–3 days)	14	11.1	0.5 (0.3 to 0.8)	7	10.6	2.9 (1.4 to 6.1)	7	11.7	0.3 (0.1 to 0.7)
Mild (4–7 days)	26	20.6	0.9 (0.6 to 1.3)	17	25.8	7.1 (4.4 to 11.4)	9	15.0	0.4 (0.2 to 0.8)
Moderate (8–28 days)	56	44.4	2.0 (1.5 to 2.6)	26	39.4	10.8 (7.4 to 15.9)	30	50.0	1.2 (0.8 to 1.7)
Severe (>28 days)	22	17.5	0.8 (0.5 to 1.2)	12	18.2	5.0 (2.8 to 8.8)	10	16.7	0.4 (0.2 to 0.8)
U14 (n=70)									
Slight (0 days)	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Minimal (1–3 days)	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Mild (4–7 days)	2	16.7	1.0 (0.3 to 4.0)	1	12.5	5.4 (0.8 to 38.3)	1	25.0	0.5 (0.3 to 0.8)
Moderate (8–28 days)	9	75.0	4.3 (2.2 to 8.3)	6	75.0	32.1 (14.4 to 71.5)	3	75.0	1.6 (1.2 to 2.1)
Severe (>28 days)	1	8.3	0.5 (0.1 to 3.5)	1	12.5	5.4 (0.8 to 38.3)	0	0.0	0.0
U16 (n=17)									
Slight (0 days)	2	7.1	0.4 (0.1 to 1.6)	2	15.4	3.9 (1.0 to 15.6)	0	0.0	0.0
Minimal (1–3 days)	7	25.0	1.3 (0.6 to 2.7)	4	30.8	7.8 (2.9 to 20.8)	3	20.0	0.6 (0.3 to 1.1)
Mild (4–7 days)	4	14.3	0.7 (0.3 to 1.9)	2	15.4	3.9 (1.0 to 15.6)	2	13.3	0.4 (0.2 to 0.8)
Moderate (8–28 days)	12	42.9	2.2 (1.2 to 3.9)	3	23.1	5.9 (1.9 to 18.3)	9	60.0	1.8 (1.3 to 2.5)
Severe (>28 days)	3	10.7	0.5 (0.2 to 1.6)	2	15.4	3.9 (1.0 to 15.6)	1	6.7	0.2 (0.1 to 0.5)
U18 (n=29)									
Slight (0 days)	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Minimal (1–3 days)	6	10.3	0.6 (0.3 to 1.3)	3	9.7	3.1 (1.0 to 9.6)	3	11.1	0.3 (0.1 to 0.7)
Mild (4–7 days)	17	29.3	1.7 (1.1 to 2.7)	11	35.5	11.4 (6.3 to 20.6)	6	22.2	0.7 (0.4 to 1.2)
Moderate (8–28 days)	24	41.4	2.4 (1.6 to 3.6)	12	38.7	12.4 (7.0 to 21.8)	12	44.4	1.3 (0.9 to 1.9)
Severe (>28 days)	11	19.0	1.1 (0.6 to 2.0)	5	16.1	5.2 (2.2 to 12.5)	6	22.2	0.7 (0.4 to 1.2)
Senior team (n=27)									
Slight (0 days)	6	21.4	0.6 (0.3 to 1.3)	2	14.3	2.7 (0.7 to 10.8)	4	28.6	0.4 (0.2 to 0.7)
Minimal (1–3 days)	1	3.6	0.1 (0.0 to 0.7)	0	0.0	0.0	1	7.1	0.1 (0.0 to 0.7)
Mild (4–7 days)	3	10.7	0.3 (0.1 to 0.9)	3	21.4	4.0 (1.3 to 12.4)	0	0.0	0.0
Moderate (8–28 days)	11	39.3	1.1 (0.6 to 2.0)	5	35.7	6.7 (2.8 to 16.1)	6	42.9	0.6 (0.4 to 0.9)
Severe (>28 days)	7	25.0	0.7 (0.3 to 1.5)	4	28.6	5.4 (2.0 to 14.4)	3	21.4	0.3 (0.2 to 0.5)

IR, injury incidence rate.

accounted for one-third (n=42, 33%) of all injuries and was associated with more severe injuries. Comparatively, a considerable percentage of injuries were caused by overuse/gradual and acute but non-contact trauma during training. The study by Bester *et al* corroborates our finding.<sup>9</sup>

### Injured body region

The most frequently reported injury locations were general across players in all age groups. The knee was the most commonly injured body region for all players, which corroborates findings in a few studies.<sup>36,39</sup> However, several studies conducted in Europe and America have reported the thigh as the most common injured body part.<sup>28,40,41</sup> Nevertheless, most of these studies report the knee as the second or third most commonly injured

body part.<sup>28,40,41</sup> The difference in injury definition may explain the discrepancy in results. The knee accounted for four of the most severe injuries sustained during the season, with a total time loss of 1035 days. A study conducted among South African players corroborates the finding.<sup>39</sup>

Although the knee was the most commonly injured body part during both training and matches, there was only one injury to the knee among the U16 players during a match. The U16 players reported the hip/groin as the most commonly injured body region, with 80% occurring during training. The relatively low number of absolute injuries in the U16 group could have influenced and possibly biased the results for this group.

## Injury type

Joint sprains were the most injuries, followed by muscle strains during matches and training. Together, these injuries accounted for 71% of lost playing time. One study has reported similar findings among South African players.<sup>39</sup> However, previous studies among youth and academy players in Portugal,<sup>42</sup> New Zealand<sup>43</sup> and England<sup>44</sup> have reported muscle strains as the most common type of injury. The assertion that growth-related injuries are sometimes mistakenly diagnosed as muscle injuries among younger players<sup>45</sup> might explain the difference between studies.

The U14 and U16 players recorded the fewest joint sprains, while the U18 teams recorded the most. Older players involved in more competitive matches and intensive training with longer duration and increased frequency might explain the higher prevalence and incidence of joint sprains in the U18 and senior team players. More than half of all reported injuries were joint sprains and muscle strains, followed by bone contusions, which were mostly caused by acute contact trauma. This could indicate how different Ghanaian football is from football played elsewhere, with Ghanaian football involving a potentially heightened physicality between players. Therefore, to provide safer football practice, referees must be thoroughly trained to discern foul play and appropriately issue yellow and/or red cards.<sup>46</sup> In addition, physiotherapists and fitness professionals should be urged to employ interventions primarily aimed at preventing the number and severity of joint sprains, such as proprioceptive and neuromuscular control exercises.<sup>47</sup>

## Severity

Most of the injuries reported in this study were classified as 'moderate' (8–28 days lost), followed by 'mild' (4–7 days lost), which are in contrast to similar international studies which reported minimal (1–3 days lost) severity.<sup>18 28 48 49</sup> A study conducted among Uruguayan, Brazilian and Spanish academy players reported a higher percentage of severe injuries among U14 and U16 players,<sup>40</sup> while our study found that U18 players suffered the greatest injury severity. This difference may be explained by the comparatively high incidence of severe injuries, such as joint sprains, muscle strains and bone contusions, in the U18 players in our cohort.

Players around 14 and 16 years have been observed to miss more days per injury than players in other age groups since their biological maturation frequently coincides with increases in training load at these ages.<sup>50</sup> This was not the case in our study, as U18 players reported the most severe injuries, possibly due to the greater number of players in that age group than in the others. Many studies have established that most severe injuries usually occur during matches,<sup>28</sup> as our study shows. However, a different pattern was observed among the U18 and U16 players, where training injuries were more severe than match injuries. The high volume of training loads among the groups, especially the U18 players, as they get ready

to be promoted to the senior squad, may contribute to the disparity in findings.

## New versus recurrent injury

As expected, the new injury incidence was higher than the recurrent injury rate (4.0 vs 0.5 injuries/1000 hours). Most epidemiological studies on football corroborate this finding, although the incident rates may differ between studies.<sup>2 20 28 30 31 37 40 51</sup> Regarding age groups, U18 players recorded the highest number of recurrent injuries split equally during training and matches (n=10). In contrast, U16 players reported only one injury during training, and U14 players not reporting any recurrent injuries throughout the season. This finding suggests that rehabilitation for injuries should be adequate to prevent a premature return to play, which is one of the main reasons for recurrent injuries.<sup>52</sup>

## Implications

The high frequency of match injuries and their traumatic characteristics suggested that player workload should be managed to limit the frequency of injuries, especially among the U18 players. The authors encourage other Ghanaian football academies to create their objective and affordable injury database using the techniques described in this study. By modifying training and recovery programmes, coaching staff and physiotherapists would be better equipped to respond to changes in injury patterns during a competitive season.

## Limitations

The study was conducted in one football academy in Ghana, which might limit its generalisability. One of the limitations of the data collection was that the precise date for some of the players' final return to play could not be determined; instead, an estimate was given based on the clinical judgement of the physiotherapists regarding the general return to play period for each diagnosis. More prospective studies should be conducted in other football academies in different regions to allow for comparisons and a broader picture.

## CONCLUSION

The study showed that the injury incidence rate among academy football players is similar to that reported among most European studies, with U14 and U18 players recording the highest injury incidence. A relatively moderate weekly injury prevalence was reported over the season. The knee was the most commonly injured body part. Joint sprains were the most common type of injury, mostly due to direct contact with other players, with most injuries classified as moderate severity. Future research should focus on the epidemiology of specific football injuries among academy players in different regions of Ghana.

## Equity, diversity and inclusion statement

Our study was on youth and adult male academy football players in Ghana. The research team included one

woman and three men (the first author is a final year master's student and three senior authors, of which one is a woman and two are men) from the physiotherapy and statistics disciplines. Three authors are from and/or based in low-income and middle-income countries (Ghana and South Africa), and one is in a high-income country (UK). We acknowledge that our study used only players in a single football academy, with most of the players being young.

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#### REFERENCES

- Jones S, Almousa S, Gibb A, *et al*. Injury incidence, prevalence and severity in high-level male youth football: a systematic review. *Sports Med* 2019;49:1879–99.
- Raya-González J, Suárez-Arrones L, Navandar A, *et al*. Injury profile of elite male young soccer players in a Spanish professional Soccer Club: a prospective study during 4 consecutive seasons. *J Sport Rehabil* 2020;29:801–7.
- Nilsson T, Östenberg AH, Alicrsson M. Injury profile among elite male youth Soccer players in a Swedish first league. *J Exerc Rehabil* 2016;12:83–9.
- Bianco A, Spedicato M, Petrucci M, *et al*. A prospective analysis of the injury incidence of young male professional football players on artificial turf. *Asian J Sports Med* 2016;7:e28425.
- Nogueira M, Laiginhas R, Ramos J, *et al*. Injuries in portuguese amateur youth football players: a six-month prospective descriptive study. *Acta Med Port* 2017;30:840–7.
- Light N, Johnson A, Williams S, *et al*. Injuries in youth football and the relationship to player maturation: an analysis of time-loss injuries during four seasons in an English elite male football academy. *Scand J Med Sci Sports* 2021;31:1324–34.
- Calligeris T, Burgess T, Lambert M. The incidence of injuries and exposure time of professional football club players in the premier soccer league during football season. *S Afr J SM* 2015;27:16.
- Nuhu A, Kutz M. Descriptive epidemiology of soccer injury during elite international competition in Africa. *Int J Athl Ther Train* 2017;22:21–8.
- Bester MJ, Dawood MA, Mostert K. Incidence of injury in South African male youth Footballers from an elite football Academy. *S Afr J Res Sport Ph* 2021;43:1–12.
- Darby P. 'Let us rally around the flag': football, nation-building, and pan-Africanism in Kwame Nkrumah's Ghana. *J Afr Hist* 2013;54:221–46.
- Fumanti M. Black chicken, white chicken: patriotism, morality and the aesthetics of Fandom in the 2008 African cup of nations in Ghana. In: *Global perspectives on football in Africa*. Routledge, 2013: 138–50.
- Larwch M, Quartey J, Kwakye SK, *et al*. Retrospective review of injury patterns among Ghanaian footballers during the 2009–2010 league season. *J Prev Rehabil Med* 2020;2:61–7.
- Omoniyi MM, Kwaku BA, Francis O. Sports injuries and therapeutic patterns in professional Footballers. *Am J Sports Sci* 2016;4:105–11.
- Sarpong EO, Mawuli MS, Kofi EO. Prevailing injuries among senior high students-athletes in the Akuapem municipality. *Uni J Sports Sci* 2022;2:16–24.
- Walls RJ, Ross KA, Fraser EJ, *et al*. Football injuries of the ankle: a review of injury mechanisms, diagnosis and management. *World J Orthop* 2016;7:8–19.
- Bahr R, Clarsen B, Derman W, *et al*. International olympic committee consensus statement: methods for recording and reporting epidemiological data on injury and illness in sport 2020 (including STROBE extension for sport injury and illness surveillance (STROBE-SIIS)). *Br J Sports Med* 2020;54:372–89.
- Fuller CW, Ekstrand J, Junge A, *et al*. Consensus statement on injury definitions and data collection procedures in studies of football (Soccer) injuries. *Scand J Med Sci Sports* 2006;16:83–92.
- Read PJ, Oliver JL, De Ste Croix MBA, *et al*. An audit of injuries in six English professional soccer academies. *J Sports Sci* 2018;36:1542–8.
- Bult HJ, Barendrecht M, Tak IJR. Injury risk and injury burden are related to age group and peak height velocity among talented male youth soccer players. *Orthop J Sports Med* 2018;6:2325967118811042.
- Cezarino LG, Grüniger BL da S, Scatone Silva R. Injury profile in a Brazilian first-division youth soccer team: a prospective study. *J Athl Train* 2020;55:295–302.
- Stubbe JH, van Beijsterveldt A-MMC, van der Knaap S, *et al*. Injuries in professional male Soccer players in the Netherlands: a prospective cohort study. *J Athl Train* 2015;50:211–6.
- Kurittu E, Vasankari T, Brinck T, *et al*. Injury incidence and prevalence in Finnish top-level football—one-season prospective cohort study. *Sci Med Footb* 2022;6:141–7.
- Jones A, Jones G, Greig N, *et al*. Epidemiology of injury in English professional football players: a cohort study. *Phys Ther Sport* 2019;35:18–22.
- Pfirrmann D, Herbst M, Ingelfinger P, *et al*. Analysis of injury incidences in male professional adult and elite youth soccer players: a systematic review. *J Athl Train* 2016;51:410–24.
- Nogueira M, Laiginhas R, Ramos J, *et al*. Injuries in portuguese amateur youth football players: a six month prospective descriptive study. *Acta Med Port* 2017;30:840–7.
- Renshaw A, Goodwin PC. Injury incidence in a premier league youth soccer academy using the consensus statement: a prospective cohort study. *BMJ Open Sport Exerc Med* 2016;2:e000132.
- Shearer DA, Jones RM, Kilduff LP, *et al*. Effects of competition on the sleep patterns of elite Rugby Union players. *Eur J Sport Sci* 2015;15:681–6.
- López-Valenciano A, Ruiz-Pérez I, García-Gómez A, *et al*. Epidemiology of injuries in professional football: a systematic review and meta-analysis. *Br J Sports Med* 2020;54:711–8.
- Bello B, Sa'Ad UB, Ibrahim AA, *et al*. Pattern and risk factors of sport injuries among amateur football players in Kano, Nigeria. *Hum Mov* 2020;21:61–8.
- Krill MK, Borchers JR, Hoffman JT, *et al*. Analysis of football injuries by position group in division I college football: a 5-year program review. *Clin J Sport Med* 2020;30:216–23.
- Materne O, Chamari K, Farooq A, *et al*. Injury incidence and burden in a youth elite football academy: a four-season prospective study of 551 players aged from under 9 to under 19 years. *Br J Sports Med* 2021;55:493–500.



- 32 Buchheit M, Mendez-Villanueva A. Effects of age, maturity and body dimensions on match running performance in highly trained under-15 soccer players. *J Sports Sci* 2014;32:1271–8.
- 33 Naidoo MA. The epidemiology of soccer injuries sustained in a season of a professional soccer team in South Africa, 2007. Available: <http://etd.uwc.ac.za/handle/11394/3786>
- 34 Nshimiyimana JB, Frantz JM. Epidemiology of soccer-related injuries among male high school players in Kigali, Rwanda: health. *Afr J Phys Health Edu Recreat Dance* 2012;18:598–604.
- 35 Onakunle TO, Owoeye OBA, Ajepe TO, et al. Assessment of risk and severity of injuries among male professional and National football league players in southwest Nigeria. *Med Sport* 2016;12:2703–8.
- 36 Lategan L, Conley S. Injury prevalence and functional movement screentm scores in young football players. *S Afr J Res Sport Ph* 2019;41:1–11.
- 37 Wik EH, Lolli L, Chamari K, et al. Injury patterns differ with age in male youth football: a four-season prospective study of 1111 time-loss injuries in an elite National academy. *Br J Sports Med* 2021;55:794–800.
- 38 Jaber A, Weishorn J, Berrsche G, et al. Injury profile among elite youth male football players in a German academy. *Int J Sports Med* 2022;43:138–44.
- 39 Bayne H, Schweltnus M, van Rensburg DJ, et al. Incidence of injury and illness in South African professional male Soccer players: a prospective cohort study. *J Sports Med Phys Fitness* 2018;58:875–9.
- 40 Hall ECR, Larruskain J, Gil SM, et al. An injury audit in high-level male youth Soccer players from English, Spanish, Uruguayan and Brazilian academies. *Phys Ther Sport* 2020;44:53–60.
- 41 Ekstrand J, Häggglund M, Waldén M. Injury incidence and injury patterns in professional football: the UEFA injury study. *Br J Sports Med* 2011;45:553–8.
- 42 Brito J, Malina RM, Seabra A, et al. Injuries in portuguese youth soccer players during training and match play. *J Athl Train* 2012;47:191–7.
- 43 Junge A, Cheung K, Edwards T, et al. Injuries in youth amateur soccer and rugby players—comparison of incidence and characteristics. *Br J Sports Med* 2004;38:168–72.
- 44 Price RJ, Hawkins RD, Hulse MA, et al. The football association medical research programme: an audit of injuries in academy youth football. *Br J Sports Med* 2004;38:466–71.
- 45 DiFiori JP, Benjamin HJ, Brenner JS, et al. Overuse injuries and burnout in youth sports: a position statement from the American medical society for sports medicine. *Br J Sports Med* 2014;48:287–8.
- 46 Ryyänänen J, Börjesson M, Karlsson J. Match-related factors influencing injury risk. In: Musahl V, Karlsson J, Krutsch W, et al., eds. *Return to play in football: an evidence-based approach*. Berlin: Springer-Verlag, 2018: 63–72.
- 47 Lloyd RS, Oliver JL, Faigenbaum AD, et al. Chronological age vs. biological maturation: implications for exercise programming in youth. *J Strength Cond Res* 2014;28:1454–64.
- 48 Gebert A, Gerber M, Pühse U, et al. A comparison of injuries in different non-professional Soccer settings: incidence rates, causes and characteristics. *Open Sports Sci J* 2019;12:28–34.
- 49 Ekstrand J, Häggglund M, Waldén M. Epidemiology of muscle injuries in professional football (Soccer). *Am J Sports Med* 2011;39:1226–32.
- 50 Elferink-Gemser MT, Huijgen BCH, Coelho-e-Silva M, et al. The changing characteristics of talented Soccer Players—a decade of work in Groningen. *J Sports Sci* 2012;30:1581–91.
- 51 Tabben M, Eirale C, Singh G, et al. Injury and illness epidemiology in professional Asian football: lower general incidence and burden but higher ACL and hamstring injury burden compared with Europe. *Br J Sports Med* 2022;56:18–23.
- 52 van der Horst N. Preventing hamstring injuries in football through enhanced exercise and RTP strategies. *Br J Sports Med* 2018;52:684–5.