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Original Research Article

Concussion among Amateur Adult Male Soccer Players: A Cross-Sectional Study

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Abstract

Background: Sports-related traumatic brain injury is an important public health concern that is often labeled as a silent epidemic. Soccer is a contact sport that may lead to concussion. The prevalence of soccer-related concussion in our region is not known. The aim of this study is to determine the occurrence of concussion among amateur adult male soccer players.

Material and methodology: In August 2018, at King Abdulaziz Univesity, this cross-sectional study was conducted among amateur soccer players living in different regions of Jeddah, Saudi Arabia, using a self-administered Google form questionnaire. The questionnaire assessed demographic data, symptoms, knowledge, and awareness of concussion and its long-term complications. The mean and standard deviation were calculated for quantitative variables (e.g., age). The prevalence of concussion among our targeted population was given as a percentage with 95% confidence level. The correlation between different variables was calculated.

Results: In July 2018 a total of 437 players in Jeddah city participated. The mean age of the participants was 24.39 years old (SD 5.97 years). The most common age for first concussion was between 15-19 years old (n=50, 73.5%). The mean age of first concussion was 18.3 years old (SD 5.1 years). First concussions occurred during a training match 46 (67.6%) and a competitive match 22 (32.4%). Fifty-five (80.9%) reported the most common symptom, headache. Twenty-two (32.4%) concussed players returned to play within an hour after injury. There was no significant correlation between positions of players in the field and concussions (r=.072, n=437, p=.132). Thirty-seven (54.4%) previously concussed players reported sleep disturbance and 39 (57.4%) concentration difficulty.

Conclusion: The prevalence of concussion among amateur male soccer players in Jeddah, Saudi Arabia, is higher than in other regions. Concussed players may suffer from short- as well as long-term consequences. Educational programs and legislative reform are needed to reduce these possible consequences.

Keywords: Soccer; Concussion; Amateurs; Jeddah; Saudi Arabia.

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Introduction

Sports-related traumatic brain injury (TBI) is an important public health concern that is often labeled as a silent epidemic. The concussion is defined by the American Academy of Neurology as "a biomechanically induced clinical syndrome related to alterations in brain function that can affect memory and orientation"[1]. The mechanism of injury in concussion can be from a direct blow to

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the head, face, or neck or to another part of the body [2] that causes the head and brain to move rapidly front and back.This leads to stretch and damage of brain cells, which creates chemical changes in the brain [3].

The most common causes of concussion according to the Centers for Disease Control and Prevention are: motor vehicle accidents (MVA), sports, falls, and assaults. MVA is the most common among them [4]. American football is the most common cause of sports-related concussion (SRC) (36.1%) followed by ice hockey (13.4%) and soccer (8.1%) [5]. Soccer has historically not been considered a high-risk sport for concussion [6-10]. Recently, however, there has been a growing awareness of the dangers of head injuries in soccer.

To establish the diagnosis of concussion, the mechanism of injury needs to be known. Clinical presentation of concussion includes physical, cognitive, and emotional symptoms that might persist for months [11]. The most commonly reported concussion symptom is headache (94.2%), followed by dizziness (75.6%) and concentration difficulty (54.8%) [12]. On the other hand, physical examination might show characteristics changes in the Glasgow Coma Scale of mild traumatic brain injury (GCS 13-15) [13]. The Sport Concussion Assessment Tool (SCAT) is sometimes used to assess the likelihood of having a concussion in sports [14]. However, many concussions go undiagnosed because players often fail to report concussive symptoms or are not accurately identified as having symptoms [15].

The long-term consequences of multiple concussions include cognitive and mood disturbances [16,17]. Repeated concussions can lead to an early and unusual brain deterioration syndrome known as Chronic Traumatic Encephalopathy (CTE), often presenting as severe dementia [18]. Other complications include posttraumatic seizures [19] and second impact syndrome [20], which carries a high risk of mortality [21].

Sports, in general, are a major cause of TBI. It is estimated that approximately 300,000 sports-related TBIs occur each year [22]. In the United States, SRCs occur between 1.6 and 3.8 million times a year, making them the most common cause of mild traumatic brain injury [23]. Unfortunately, research on concussions in athletes in Saudi Arabia is limited; the only study on soccer-related concussion was in 1998 [24]. Considering that soccer is the most popular sport in Saudi Arabia, with an increasing population spanning all ages, more information about this subject is needed.

Lack of knowledge about concussions may be one of the main predictors of athletes returning to play prematurely after sustaining a concussion [25-27]. Evidence also suggests that young athletes, parents, and coaches do not have the knowledge to assess and manage concussions and make return-to-play decisions [28,29]. The literature suggests a need for ongoing education about concussions to increase awareness and understanding of this injury [30-32].

In this paper, we first study the prevalence of concussion among amateur adult male soccer players and second,assess their baseline knowledge of concussion and potential related health consequences. This will help us implement an awareness program about concussion in Saudi Arabia, as it has been found that many soccer players do not entirely understand the definition of concussion, symptoms, or return- to-play protocols [33,34].

Methodology

The study was approved by the Institutional Review Board (IRB) of the King Abdulaziz University Hospital (KAUH). In August 2018,at King Abdulaziz University, this cross-sectional study was conducted among 520 adult amateur soccer players living in different regions of Jeddah, Saudi Arabia, using a self-administered Google form questionnaire distributed through online groups and individuals [*Questionnaire link in Arabic*]. The questionnaire assessed demographic data, symptoms, knowledge, and awareness of concussion and its long-term complications. All the statistical analysis was performed using IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.

The knowledge part of the questionnaire was adopted from Weber et al. [35], but we only used 12 of the 26 questions. The Weber's questionnaire provided definite and nondefinite answers; this was changed to correct, not correct, and don't know. We made this change to establish a measure of whether the soccer players had the necessary or basic knowledge of concussion [35]. The questions about concussion symptoms in our questionnaire were adopted from LaBotz et al. [36]. The included sample was adult ages 15 years or older (according to our hospital policy, pediatric age group is below 15 years) who play soccer in Jeddah. Professional soccer players were excluded

as were female players (soccer is not a popular female sport in Saudi Arabia). Qualitative variables (e.g., symptoms, player position, type of match, playground type, and level of education) were generated by frequencies and percentages, while mean and standard deviation were calculated for quantitative variables (e.g., age). The prevalence of concussion among our targeted population was given in percentage with 95% confidence level. Chi-square analyses were conducted to compare frequencies. The correlation was calculated between different variables using the Spearman rank-order correlation coefficient. We considered p values < .05 to be statistically significant.

Results

Subject demographics

Our aim in this study was to study the prevalence of concussion among amateur soccer players and assess their baseline knowledge of concussion and potential related health consequences. This study included a total of 520 participants in Jeddah city in July 2018 who played soccer on a regular basis and were given an online questionnaire. Eighty-three were excluded from the study (57 were not in Jeddah, 23 were professional players, 3 were children under the age of 15. Thirty were excluded due to their nondefinitive answers (they were only excluded from the baseline knowledge part of the research, i.e., they were included in the epidemiology part of the study). The mean age of participants was 24.39 years old (SD of 5.97 years) and all participants were male (Table 1).

Table 1: Basic characteristics of the participants

Age (n=437)			
Minimum	15		
Maximum	45	**Position (n=437)**	
Mean	24.39	Goalkeeper	20(4.6%)
		Defender	150(34.3%)
Last degree (n=437)		Center	161(36.8%)
Below high school	20(4.6%)	Striker	62(14.2%)
High school	245(56.1%)	Unspecified	44(10.1%)
College	172(39.4%)		
		Number of matches per month (n=437)	
Medical field (n=437)		Less than 1	50(11.4%)
Yes	79 (18.1%)	One	29 (6.6%)
No	358 (81.9%)	Two	36 (8.2%)
		Three	47 (10.8%)
Type of match (n=437)		Four	77 (17.6%)
Training (friendly)	32 6(74.5%)	From 5-8	90 (20.6%)
Competition	111 (25.4%)	More than 8	108 (24.7%)
Type of playground (n=437)		**Years of play (n=437)**	
Natural grass	112 (25.6%)	Less than 5	123 (28.1%)
Synthetic grass	386 (88.3%)	5 to 10	135 (30.9%)
Sand	207 (47.4%)	11 to 15	97 (22.2%)
Solid concrete	100 (22.9%)	More than 15	82 (18.8%)
Water soup	34 (7.8%)		

Epidemiology

A total of 68 (15.6%) reported that they had a concussion. The most common age at which they had their first concussion was between 15-19 years old (n=50, 73.5%) (Table 2). The mean age of first concussion was 18.3 years old (SD 5.1 years). Thirty-eight of the participants had a concussion once (55.9%), 19 twice (27.9%), 8 three times (11.8%), and only 3 four or more times (4.4%). Forty-six (67.6%) concussions occurred during a training match and 22 (32.4%) during a competitive match.

Table 2: Age group distribution of concussed soccer players

Age group	Number concussed (percent) (n=68)
15-19	50 (73.5%)
20-24	10 (14.7%)
25-29	6 (8.8%)
30-34	1 (1.5%)
35-39	0
40-44	1 (1.5%)

The most commonly reported symptoms were headache, experienced by 55 (80.9%), followed by imbalance, reported by 47 (69.1%) (Table 3). Also, among the 68 who reported a concussion, 22 (32.4%) experienced loss of consciousness and among them, 11 (50%) said they lost consciousness for less than 5 minutes. Twenty-two players (32.4%) returned to play within an hour after concussion and the others took a day, a week, a month, or more to return to play (Table 4).

Table 3: Symptoms of concussed soccer players

Symptom	Percent (n = 68)
Headache	55 (80.9%)
Blurry vision	42 (61.8%)
Tinnitus	35 (51.5%)
Memory issues	30 (44.1%)

Vomiting	16 (23.5%)
Imbalance	47 (69.1%)
Confusion	34 (50.0%)

Table 4: Return -to-play time after concussion

Return-to-play time	Frequency (percent) (n = 68)
Within 1hr	22 (32.4%)
Within 24hrs	11 (16.2%)
Within a week	17 (25%)
Within a month	6 (8.8%)
More than a month	12 (17.6%)

There was no significant correlation between player position and concussion (r=. 072, n=437, p=.132). Table 5 shows the percentage of concussions for each position. Also, there was no significant correlation between the number of matches played per month and concussion (r=. 075, n=437, p=.119).

Table 5: Frequency of concussion in each position

Position	Frequency of concussed/total	Percent
Goalkeeper	6/20	30%
Defender	27/150	18%
Midfielder	22/161	15.52%
Striker	5/62	8.06%
Unspecified	8/44	18.1%
Total	68/437	

The survey included questions about current symptoms that might be associated with previous concussion. Thirty-seven (54.4%) of previously concussed players reported sleep disturbance and 39 (57.4%) concentration difficulty (Table 6). There was significant change in academic performance before and after concussion (r=. 438, n=68, p=.001). Before concussion, 4.4% of the participants had academic issues, and after they increased to 8.8%. The results revealed a correlation between anxiety and concentration difficulty as a complication of concussion (r=.387, n=68, p=.011). Results also showed that among the 68 (15.6%) with previous concussion, the playground most used was synthetic grass 35 (51.5%) followed by solid concrete for 22 (32.4%) sand for 13 (19.1%), natural grass for 8 (11.8%), and water soup for 7 (10.3%), with no significant correlation between any of them and concussion (p=.228, .891, .637, .168, .886, respectively).

Table 6: Long-term symptoms of concussed players

Long-Term Consequences	Percent (N = 68)
Irritability	35 (51.5%)
Difficulty Concentrating	39 (57.4%)
Anxiety	34 (50%)
Memory Issues	25 (36.8%)
Sleep Disturbance	37 (54.4%)

Knowledge of Concussion

Two -hundred forty-five (56.1%) of our sample were high school graduates, 172 (39.4%) were college graduates, and 20 (4.6%) were not high school graduates. Seventy-nine (18.3%) were involved in a medical field. Thirty-two (7.3%) didn't know that concussions have a short- and long-term negative impact on the brain. One-hundred four (25.6%) didn't know that concussions without loss of consciousness can still damage the brain. More than 50% of participants were not aware of the psychological effects (e.g., irritability and depression) of concussions on the brain (Table 7).

*Total number of participants was *437*; as mentioned, we excluded *30* due to their nondefinitive answers. Thus, total after exclusion of those with nondefinitive answers was *407*.

Table 7: Concussion knowledge assessment among the study group

	Frequency of answers (percent) (n=407)		
Knowledge questions	Correct	Not correct	Didn'know
A SRC is harmless and never results in long-term problems or brain damage. (F)	295 (72.5%)	26 (6.4%)	86 (21.1%)
A SRC can cause brain damage even if the player is not knocked out. (T)	283 (69.5%)	20 (4.9%)	104 (25.6%)
Most players with a SRC are not fully aware of its effect on their behavior and performance. (T)	181 (44.5%)	35 (8.6%)	191 (46.9%)
A concussed player may have trouble remembering events before the concussion but usually does not have trouble learning new things. (F)	49 (12.1%)	154 (37.8%)	204 (50.1%)
Players usually have more trouble remembering things that happened after a SRC than before. (T)	91 (22.4%)	75 (18.4%)	241 (59.2%)
A SRC may cause one to feel depressed, hopeless, and sad. (T)	114 (28%)	54 (13.3%)	239 (58.7%)
Emotional problems after SRC are usually not related to brain damage. (F)	68 (16.7%)	70 (17.2%)	269 (66.1%)
It is good advice to rest and remain inactive during recovery. (F)	19 (4.7%)	309 (75.9%)	79 (19.4%)

Once a recovering player feels "back to normal," the recovery process is complete. (F)	147 (36.1%)	101 (24.8%)	159 (39.1%)
Recovery from a SRC is usually complete in about a week. (F)	111 (27.2%)	30 (7.4%)	266 (65.4%)
The only sure way to tell if someone has suffered brain damage from a SRC is by brain X-ray. (F)	91 (22.4%)	82 (20.1%)	234 (57.5%)
Players who have had one SRC are more likely to have another. (T)	155 (38.1%)	31 (7.6%)	221 (54.3%)

Discussion

Soccer is the most common sport worldwide, with approximately 200,000 professional and 240,000,000 amateur players [37]. Concussions are considered to be common [38]. Continued participation despite experiencing symptoms of a concussion can be harmful andresult in a range of consequences from prolonged symptoms (post-concussion-syndrome) to second-impact syndrome and death [39, 40].

In this study, our primary aim was to determine the prevalence of concussion among amateur soccer players. We found that 15.6% had at least one concussionrelated to soccer. A study published in 2012 of United States high school athletes covered 20 sports (14,635 injuries included) and reported 1936 (13.2%) who had concussions [12]. A recent cross-sectional study in 2016 among United States high school football players showed that 20% of 5232 soccer players had positive concussion history [41]. In our study. the age of first concussion was between 15-19 years old (mean 18.3 years), while the other study reportedthe mean age to be 16 years [42]. This is within the range of our findings. First concussion can be a potential performance impairment factor for this age group that is mostly enrolled in schools or colleges to train for future careers.

One of our important findings was that the return-to-play (RTP) time was within an hour after concussion (32.4%). A North American study of high school players showed only 12 (2%) of players returning the same day. This does not follow the 2017 National Collegiate Athletic Association (NCAA) concussion guidelines and current consensus statement that concussed athletes should not return to play on the same day, as it may result in delayed onset of worse symptoms [43]. This emphasizes the importance of players, coaches, and team managers having good knowledge and practice regarding concussion.

We also found that most of the participants had a concussion once (55.9%), others twice (27.9%), three times (11.8%), and four or more (4.4%). Other studies show that 20% of 5,232 soccer players experienced positive concussion history, 69.9% reported 1 past injury, 20.6% reported 2, 6.4% reported 3, and 3.14% reported ≥ 4 (37). The reason for this difference between our results and other studies is due to underestimating the occurrence of concussion. Another possible explanation is lack of knowledge about the meaning of concussion and RTP recommendations.

The most commonly reported symptom was headache (80.9%). The significance of brief, isolated posttraumatic headaches in contact sports is still questionable [36]. On the other hand, some reviewers stated that "amnesia or memory loss is the hallmark of a concussive head injury"[44,45]. This was reported by 44.1% of players in our study.

One result of our study was not consistent with the current evidence that most concussions occur in competitive matches rather than practice matches [12]. Our results showed that the types of matches in which players might have concussions were practice matches (67.6%) and competitive matches (32.4%). This finding may be explained by the fact that amateur and unprofessional players who participated in our study typically played in practice (friendly) rather than competitive matches. The amateur players usually lacked the skills to avoid injury [46].

We thought the position of soccer players would influence concussion rate. But after analysis of the data, we did not find any significant correlation between player position and concussion (p= 0.127). Some studies showed that the goalkeeper and defensive player were the most vulnerable to concussion [43]. Our study and Helmich et al highlight the difference between amateur and professional soccer-related concussion.

There are many types of playgrounds in Jeddah, Saudi Arabia, some of which are solid concrete. One would conclude that this type of playground leads to the highest percentage of concussions since players can fall on them. But the results were not significant. Other studies demonstrated that the most common cause of adult head injury among soccer players is player-to-player contact rather than falling on the playground [47,48].

Concussion is known to have neurological and psychological effects on memory, concentration, and attention [49]. In our study 57.4% players

reported concentration difficulties with a significant change in academic performance before and after the concussion (p = 0.01). We believe more research is needed as Multiple concussions, particularly within a short period, have been shown to lead to long-term and sometimes permanent cognitive deficits [50,51], and increase the concussed person's risk of postconcussion syndrome [52]. Soccer headgear is probably needed at least for amateurs as it may reduce the effects of concussion [53].

The secondary aim of this study was to assess amateur soccer players' baseline knowledge of concussion and potential related health consequences. Concussion needs more attention, especially in this population. Our study showed that these players have little knowledge about concussion, which will lead to underestimation of potential future consequences.

The Knowledge and Awareness Survey Assessment used in the current study has questions regarding memory difficulties (Q4,5): 50.1% and 59.2%,respectively, of participants did not know the right answers. Other questions regarding emotional problems after concussion (Q6,7): 58.7% and 66.1%, respectively,of participants did not know the answers. Regarding recovery items (Q8-10):more than two-thirds of participants did not know the right answer. The next question was on concussion "diagnosis" by using only brain X-ray: 57.2% said that they did not know, while 22.4% and 20.41% answered correctly and incorrectly, respectively.

This lack of knowledge of concussive injuries may affect self-reporting rates in concussive episodes [26,54]. Knowledge and attitude are changeable factors. That may influence care-seeking and concussion-reporting behaviors [55]. Furthermore, improvements in these factors have been linked to improvements in other health behaviors [56]. We believe that lack of knowledge about concussions is the result of a lack of quality education [57].

An educational program is needed among soccer players about head concussions. This program should include mechanism of injury, symptoms, and prevention of this potentially serious injury.

Limitation

Because of lack of information about the mechanism of injury, we could not determine how the injuries happened and the management delivered at the time of concussion. Second, the study also couldnot account for under reporting of concussion symptoms, and there were no follow-up visits after concussion. Last, all the participants in our sample were males. We encourage future research in our region to focus on female players since the current literature shows that concussion occurs more in females than males (7,12,58,59). Future research is needed to monitor these sports to see if the trend remains stable over time or varies.

Conclusion

The prevalence of concussion among amateur soccer players is high, and the time of return to play on the same day of injury is dangerously short. Knowledge about concussion and its symptoms and complications is poor, which can lead to unfortunate consequences; thus, we recommend implementing an awareness program for soccer players about concussion. More research about concussion in a larger population is needed, especially in different regions of the kingdom and among school-age players.

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