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Sports injuries: a 5-year review of admissions at a major trauma center in the United Kingdom

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Purpose: Sports offer several health benefits but are not free of injury risk. Activity dynamics vary across sports, impacting the injury profile and thereby influencing healthcare resource utilization and health outcomes. The purpose of this study was to investigate sports-related major trauma cases and compare differences across sports and activity groups.

Methods: A retrospective case notes review of sports-related major traumas over a 5-year period was conducted. Demographic, hospital episode-related, and health outcome-related data were analyzed, and differences were compared across sports and activity groups. The Glasgow Outcome Scale (GOS) at discharge was used as the primary outcome measure and the length of hospital stay as the secondary outcome measure.

Results: In total, 76% of cases had good recovery at discharge (GOS, 5), 19% had moderate disability (GOS, 4), and 5% had severe disability (GOS, 3). The mean length of hospital stay was 11.2 days (range, 1–121 days). The most severely injured body region was the limbs (29.1%) and vertebral/spinal injuries were most common (33%) in terms of location. A significant difference (P<0.05) existed in GOS across sports groups, with motor sports having the lowest GOS. However, no significant differences (P>0.05) were found in other health-outcome variables or injury patterns across sports or activity groups, although more competitive sports cases (67%) required admission than recreational sports cases (33%).

Conclusions: Spinal injuries are the most frequent sports injuries, bear the worst health outcomes, and warrant better preventive measures. Head injuries previously dominated the worst outcomes; this change is likely due to better preventive and management modalities. Competitive sports had a higher injury frequency than recreational sports, but no difference in health outcomes or injury patterns.

Keywords: Athletic injuries; Sports medicine; Health care outcome assessment; Demographics; Statistics

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INTRODUCTION

The benefits of sports and exercise on physical, mental, and social health are well-known and documented [1,2]. The National Institute for Health and Care Excellence (NICE) recommends regular exercise as a primary prevention measure against cardiovascular diseases. Exercise also offers prophylactic benefits against autoimmune, malignant, degenerative, and psychiatric diseases [3]. In today's postindustrial developed world, electronic devices and increasing automation reduce the prevalence of physical activity, with resulting adverse effects on physical and mental health [4]. Sports activities act as a means of entertainment and have added physical, mental, and social health benefits [5].

People in the United Kingdom (UK) participate in a wide variety of recreational and competitive sports. The top 15 most popular sports activities, defined by the proportion of participants, across all age groups in 2016 and 2017, in order of popularity, were running, fitness classes, gym workouts, swimming, exercise machines, climbing/mountaineering, football, weight-lifting, golf, badminton, tennis, rowing, and boxing [6]. Moreover, national sports participation statistics estimate that between 2016 and 2020, across all age groups, approximately 56,000 people participated in regular motor sports, 281,400 people participated in equestrian sports, and 955,000 people participated in combat sports at least twice a month. These statistics indicate the popularity of a variety of sports activities in the UK population and warrant further research into the hazards of these sports.

Sports-related injuries impede the physical and psychosocial health benefits of exercise due to physical and psychological damage, disability, rehabilitation, and hospitalization and can tax healthcare resources [7–9]. The National Health Service Hospital episode statistics recorded 367,093 emergency department attendances due to sports-related injuries in 2014 to 2015 (1.9% of all emergency attendances and 7.7% of all trauma-related attendances) [10]. The frequency of sports-related hospital visits is even higher in the pediatric population [11]. Furthermore, sports-related injuries account for approximately 7,000 deaths annually in Europe [11] and about 90,000 life-threatening events annually in the USA [12]. Research into the causes, mechanisms, management, and preventive measures is imperative to minimize the harms of sports injuries and ensure a sustained healthy lifestyle [12].

Sports have unique dynamics depending on the type of activity. Variable factors such as participant's physique, health, skill set, technique, sporting equipment, environment, and kinetics contribute to unique injury profiles [13]. Variations exist in terms of the mechanism of injury, the extent of damage, and patterns of affected body parts. These factors influence the time and resources spent on management, rehabilitation, and health outcomes.

Long-term statistical reports on population sports injuries in literature are few, and even fewer describe major trauma cases related to sports. The available reports are limited in terms of either the type of sport or injury or population or the use of descriptive variables [14,15]. An Australian study conducted over 10 years and covering a population of 6 million people provided the most comprehensive statistical information about injuries in various sports. Thoracic injuries were most frequent, followed by spine and head injuries across all sports groups in that study. A similar pattern existed in motor sports and cycling; however, in equestrian sports, the spine was the most common injured region, followed by the thorax and head. Interestingly, in Australian football, the abdomen was the most common injured body region, followed by the spine and head [15]. Furthermore, a Danish epidemiological study described sports participation statistics and injury rates but did not include detailed injury profiles and health outcomes [7]. No such study has been concluded so far in the UK across all age groups [11]. There is a gap in the information that can be used to guide prevention and management strategies as well as to reduce healthcare costs and disability. One such prospective study is being conducted and the results are awaited [8]. Our study aimed to examine injury-related, health episode-related, and health outcome-related data concerning major trauma-related sports injuries at a major trauma center in the UK.

METHODS

This study was registered and conducted as a clinical service evaluation at Addenbrooke's Hospital (No.1048868). Ethical approval and patient consent were not needed due to the retrospective nature of the study. No direct patient case or patient identifiable data was used. We used a retrospective descriptive study design and identified sports-related major trauma cases from the hospital trauma registry and electronic healthcare records at Addenbrooke's Hospital between June 15, 2015 and December 15, 2020. We used NICE's definition of major trauma [16]. NICE defines major trauma as "an injury or a combination of injuries that are life-threatening and could be life-changing because it may result in long-term disability." Addenbrooke's Hospital serves as a major trauma center for the East of England region and provides specialist trauma services to a population of up to 6.5 million in-

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habitants (9.9% of the UK population) and 12 trauma units.

Our inclusion criteria encompassed all major trauma cases with: (1) the activity at the time of injury recorded as sports or recreation, or (2) the place of injury recorded as a sports or recreation area, and (3) an Injury Severity Score (ISS) of 4 or above or attendances that required more than 12 hours of hospital stay. We excluded all sports-related injury cases where the ISS was less than 4 or if the hospital stay was less than 12 hours, which excluded all minor injuries. We also excluded equestrian sports cases as our research group did a separate study specifically focusing on such injuries and including the same period [17].

We conducted an unblinded study of the hospital records for all included cases as per recommended guidelines [18] and extracted the following demographic, injury-related, hospital episode-related, and health outcome-related data: age, sex, mechanism of injury, initial Glasgow Coma Scale (GCS; as recorded by first responders), ISS [19], length of hospital and intensive care unit (ICU) stay (days), rapid access acute rehabilitation (RAAR) ward stay, the pattern of injuries (according to the affected body regions), number of operations required, Glasgow Outcome Scale (GOS) and discharge destination. GOS at discharge was used as a primary outcome measure and the length of hospital stay as a secondary outcome measure.

We categorized the data into two groups based on the type of sports activity (sports groups) and the nature of activity at the time of injury (i.e., competitive or recreational activity groups). We analyzed the data using descriptive statistics and described the data as counts and percentages for nominal, ordinal, or discrete variables and as mean, range, and standard deviation (SD) for continuous variables. Furthermore, we used one-way analysis of variance to compare the mean values of certain variables among sports groups and the chi-square test to compare injury patterns among sports groups. Similarly, we used the unpaired t-test to compare means of variables and the binomial exact test to compare injury patterns among activity groups. All statistical analyses were done using GraphPad Prism ver. 9.0.0 (GraphPad Software Inc., San Diego, CA, USA) and Excel 2020 (Microsoft Corp., Redmond, WA, USA).

RESULTS

In total, 6,906 patients were admitted with trauma-related injuries at the major trauma center between June 15, 2015 and December 15, 2020. The ISS ranged from 1 to 75. Out of these, 78 patients (1.1%) met the inclusion criteria. Male patients were more commonly affected, constituting of 64 admissions (82%), with female patients comprising a minority of admissions (n = 14, 18%; male to female ratio, 4.5:1). Patients' age ranged between 11 to 88 years, with a mean ± SD of 33.89 ± 16.5 years.

The mean ± SD initial GCS of those with intracranial injuries (n = 15) was 13.8 ± 3.26, and the median GCS of all injuries was 15 (range, 3–15). The mean ± SD ISS was 13.0 ± 8.23 with 24 patients (30%) requiring admission to the ICU, with a median duration of ICU admission of 4 days (range, 1–32 days).

The majority of patients (n = 43; 55%) did not require surgery during admission and were treated conservatively. Twenty-six patients (32.9%) underwent a single operation, nine (11.3%) underwent one operation, and one (1.2%) underwent three operations. Across all sports groups, the most severely affected body region (defined by the ISS) was the limbs (n = 23, 29%), followed by the spine (n = 22, 28%), and the least severely affected region was the face (n = 3, 3%). Table 1 outlines the distribution of severely affected body regions. Among patients with a head injury, there was one case of severe traumatic brain injury (GCS < 9 on admission), resulting from a motor sports accident (patient's age, 53 years; initial GCS, 3; ISS, 45; length of stay, 121 days; and GOS, 4 [moderate disability] at discharge).

The admission survival rate was 100% and the majority of patients were discharged home (n = 71, 91.0%), with smaller proportion discharged to a spinal cord injury center (n = 5, 6.4%), rehabilitation unit (n = 1, 1.2%), or a local hospital (n = 1, 1.2%). GOS on discharge indicated a good recovery (i.e., no disability) in three-quarters of cases (n = 59, 76%), with most of the remaining cases (n = 15, 19%) having a moderate disability on discharge (i.e., minor deficits that did not affect function). Four patients (5%) had severe disabilities.

A comparison between sports groups found a significant difference in GOS on discharge (P = 0.003), with motor sports having the lowest mean GOS, but there was no significant difference in GOS between activity groups (P = 0.491). Fig. 1 compares the

Table 1. Most severely injured body regions across all sports groups

Most severely injured body region	Frequency (%)
Limbs	23 (29)
Spine	22 (28)
Head	12 (15)
Thorax	10 (13)
Abdomen/pelvis	5 (5)
Multiple regions	4 (5)
Face	3 (4)

Frequency of most severely injured body regions across all sports groups, based on Abbreviated Injury Scale and Injury Severity Score.

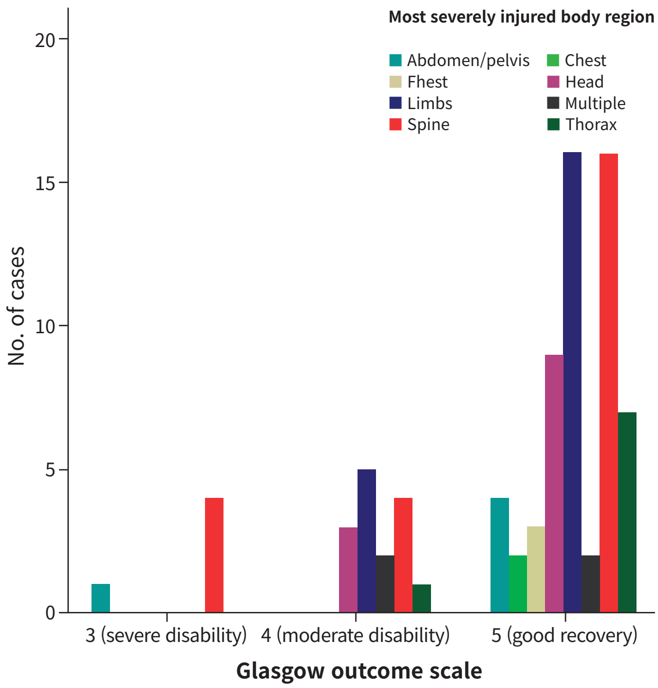

Fig. 1. Glasgow Outcome Scale at discharge, as a function of most severely injured body region. Severe disability (Glasgow Outcome Scale 3) most frequent for cases involving spinal injuries and one case of concurrent abdominal injury.

distribution of the GOS according to the most severely injured body region.

Rehabilitation in the RAAR service was required in 14 cases (18%), with a mean ± SD length of stay of 37.6 ± 31.71 days. The overall mean ± SD length of stay was 11.2 ± 18.15 days. No significant difference existed in total length of hospital stay among sports groups ($P = 0.630$) or among activity groups ($P = 0.953$). Table 2 presents a description and comparison of continuous and discrete variables between sports groups. Table 3 provides a description and comparison between activity groups.

A total of 125 injuries were identified. Spinal injuries were the most common injury (n = 41, 33%), followed by orthopedic injuries (n = 23, 18%), while facial injuries (n = 9, 7%) were the least common. No significant difference ($P > 0.05$) existed in injury patterns among sports groups or activity groups. Patterns of injuries with a comparison among sports groups are presented in Table 4 and Fig. 2 and among activity groups in Table 5 and Fig. 3.

A variety of sports were implicated in patients who were admitted, with motor sports being the most common sport leading to the most number of injuries (n = 43, 34%) and also, the most serious injuries (n = 23, 29.1%), based on the ISS score, requiring admission. Racket sports caused the least serious injury requiring admission (n = 1, 1.3%).

DISCUSSION

Sports and recreation have known health benefits but are not free of injury risk [2]. These injuries can be hazardous to individual well-being, social health, and resources. Our study identified sports or recreation-related major trauma (excluding equestrian sports) cases to be 1.1% of all trauma-related admissions with a male preponderance (male to female ratio, 4.5:1). This is approximately consistent with previous epidemiological studies [11, 15,20]. Interestingly, our group's study of equestrian sports had a reversed male to female ratio (1:2.5), due to equestrian sports' higher popularity among women [17].

Most of the cases had very good outcomes, with no fatalities and good recovery in 76% of cases. Furthermore, 92% of cases were discharged home and the median length of ICU stay was only 4 days. The overall good health outcomes can be attributed to (1) better-commissioned healthcare services for trauma-related injuries [11] such as trauma networks, air-ambulance services, specialist major trauma units, and RAAR services [19], and (2) a lower incidence of traumatic brain injuries, which are canonically associated with the worst health outcomes, compared to spinal and orthopedic injuries [21].

Only 3.8% of cases had severe disability on discharge and 100% of these cases involved injuries of the spinal cord and were transferred to a spinal injury rehabilitation center. This indicates the burden of spinal injuries on individual and social health outcomes. This differs from a few decades ago, when traumatic brain injuries had the highest incidence and were associated with the worst health outcomes. Better preventive and management strategies have reduced the incidence and morbidity associated with head injuries. Such measures are not fully applicable to spinal injuries; for example, no cervical spine injury preventive device is available, unlike the protective headgear that is commonly used in a wide variety of sports [21].

The sports group with the most spinal injuries and the worst GOS was motor sports, followed by contact sports, which corresponds with previous studies [15,22]. We studied quad-bike racing as a motor sport, and spinal injuries were the most common, with similar injury patterns and ISS as for other motor sports. This differed from commercial quad biking accidents in Australia, where limbs and head injuries were more frequent [23]. High kinetic forces and high speeds in motor sports create greater injury risks for drivers [22,24]. This calls for better preventive measures to be implemented in motor sports to prevent permanent disability resulting from spinal injuries. The preventive measures for motor sports include but are not limited to ensuring a license

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Table 2. Comparison of demographics and health-outcome data across sports groups

Outcome variable	Combat sports	Motor sports	Contact sports	Cycle sports	Board sports	Water sports	Ball sports	Air sports	Other sports	P-value
No. of cases	5	23	11	2	9	5	17	2	4	NA
Age (yr)										0.084
Mean±SD	29.8±13.3	36.3±15.2	25.4±8.6	25.0±16.9	41.3±16.1	25.8±7.43	34.2±22.1	60.5±14.85	26.2±7.8	
SE of mean	5.94	3.10	2.58	12.0	5.38	3.32	5.37	10.50	3.92	
Range	11–44	13–58	13–40	13–37	14–63	15–35	15–88	50–71	22–38	
Initial GCS										0.700
Mean±SD	15±0	14.2±2.6	15±0	15±0	14.8±0.4	15±0	15±0	15±0	15±0	
SE of mean	0	0.51	0	0	0.14	0	0	0	0	
Range	15	3–15	15	15	14–15	15	15	15	15	
ISS										0.800
Mean±SD	12.6±8.14	14.2±10.0	13.2±8.6	22.0±5.7	13.3±8.5	10.8±5.16	11.1±6.7	9.5±6.4	15.5±11.2	
SE of mean	3.64	2.09	2.59	4.00	2.83	2.31	1.62	4.50	5.60	
Range	4–25	4–45	4–34	18–26	4–25	4–16	3–25	5–16	4–29	
Length of stay (day)										
ICU										0.650
Mean±SD	0.2±0.4	2.8±6.2	4.5±10.2	0.5±0.7	2.1±3.3	5.6±12.5	0.3±0.6	0.5±0.7	5.5±10.3	
SE of mean	0.20	1.30	3.06	0.50	1.09	5.60	0.14	0.50	5.17	
Range	0–1	0–25	0–34	0–1	0–9	0–28	0–1	0–1	0–21	
Hospital										0.630
Mean±SD	6.0±3.5	15.7±25.2	15.1±26.3	3.5±2.1	9.3±4.0	14.8±21.0	4.0±3.0	12.0±5.7	18.5±14.6	
SE of mean	1.50	5.25	7.94	1.50	1.34	9.41	0.73	4.00	7.33	
Range	3–30	2–121	2–54	2–5	5–17	1–52	2–13	8–16	3–32	
GOS										0.003
Mean±SD	5±0	4.2±0.6	4.6±0.8	4.5±0.7	4.6±0.7	4.8±0.4	4.9±0.2	5±0	4.5±1.0	
SE of mean	0	0.12	0.24	0.50	0.24	0.20	0.05	0	0.50	
Range	5	3–5	3–5	4–5	3–5	4–5	4–5	5	3–5	
Most severely injured body part (%)										NA
Spine	2 (40)	6 (26)	3 (27)	0	4 (44)	2 (50)	3 (17)	1 (50)	3 (75)	
Limbs	1 (20)	9 (39)	3 (27)	1 (50)	0	1 (25)	5 (71)	0	1 (25)	
Abdomen/pelvis	0	1 (4)	0	0	0	0	2 (11)	0	0	
Thorax	0	2 (8)	0	0	2 (22)	0	2 (11)	0	0	
Head	0	2 (8)	0	0	2 (22)	0	4 (23)	0	0	
Face	0	0	0	0	0	0	1 (5)	0	0	
Multiple	0	3 (13)	0	0	1 (11)	1 (25)	0	0	0	

Means and standard errors across sports groups were compared using one-way analysis of variance and the differences are shown as P-values. There was a statistically significant difference in GOS with motor sports having the worst GOS at discharge.
NA, not applicable; SD, standard deviation; SE, standard error; GCS, Glasgow Coma Scale; ISS, Injury Severity Score; ICU, intensive care unit; GOS, Glasgow Outcome Scale.

Table 3. Patterns of injured body regions across sports groups

Injury pattern	Combat sports	Motor sports	Contact sports	Cycle sports	Board sports	Water sports	Ball sports	Air sports	Other sports	P-value	Total
No. of cases	5	23	11	2	9	5	17	2	4	-	78
No. of injuries (%)	7 (6)	43 (34)	18 (14)	4 (3)	15 (12)	7 (6)	20 (16)	4 (3)	7 (6)	-	125 (100)
Intracranial	1 (14)	2 (5)	1 (9)	1 (25)	2 (13)	1 (14)	6 (3)	0	1 (14)	0.332	15 (12)
Spinal	2 (29)	15 (35)	8 (44)	0	6 (40)	4 (57)	1 (5)	2 (50)	3 (49)	0.345	41 (33)
Orthopedic	1 (14)	9 (21)	2 (11)	2 (50)	3 (20)	0	4 (20)	1 (25)	1 (14)	0.819	23 (18)
Thoracic	0	9 (21)	1 (5)	1 (25)	2 (13)	0	2 (10)	1 (25)	1 (14)	0.712	17 (14)
Abdomen/pelvic	1 (14)	6 (14)	3 (17)	0	2 (13)	1 (14)	4 (20)	0	1 (14)	0.989	18 (14)
Facial	2 (29)	1 (2)	3 (17)	0	0	0	3 (15)	0	0	0.132	9 (7)
Other	0	1 (2)	0	0	0	1 (14)	0	0	0	0.397	2 (1.6)

Patterns of injuries across sports groups were compared using the chi-square test (by observed and expected frequencies) and the difference calculated as P-value. No statistically significant difference existed in injury patterns across sports groups.

Table 4. Comparison of demographics and health-outcome data across activity groups

Outcome variable	Competitive sports (n=53)	Recreational sports (n=25)	P-value
Age (yr)			0.040
Mean±SD	31.02±12.86	40.42±20.65	
Standard error	1.76	4.04	
Range	13–58	11–88	
Initial GCS			0.331
Mean±SD	14.68±1.70	14.92±0.27	
Standard error	0.24	0.05	
Range	3–15	14–15	
ISS			0.836
Mean±SD	12.70±7.40	13.09±8.60	
Standard error	1.18	1.46	
Range	4–29	3–45	
Length of stay (day)			0.772
ICU			
Mean±SD	2.24±6.20	2.70±6.80	
Standard error	0.86	1.33	
Range	0–32	0–28	
Hospital			0.953
Mean±SD	11.29±20.8	11.08±11.27	
Standard error	2.80	2.21	
Range	2–121	1–52	
GOS			0.491
Mean±SD	4.70±0.61	4.60±0.58	
Standard error	0.08	0.12	
Range	3–5	3–5	
Most severely injured body part (%)			NA
Limb	17 (32)	5 (19)	
Spine	13 (25)	7 (27)	
Head	8 (15)	4 (15)	
Thorax	6 (11)	5 (19)	
Abdomen/pelvis	5 (9)	-	
Face	2 (4)	1 (4)	
Multiple	2 (4)	2 (8)	

Means and standard errors of healthcare and health outcome variables across activity groups were compared using unpaired t-test and the difference shown as P-value. No statistically significant difference in health outcomes was found across activity groups.
NA, not applicable; SD, standard deviation; GCS, Glasgow Coma Scale; ISS, Injury Severity Score; ICU, intensive care unit; GOS, Glasgow Outcome Scale.

for motor sports, adequate protective gear, safe vehicle and track design, better training for participants, better awareness about these injuries in the population, and better training and practices for healthcare providers [24].

Likewise, similar preventive and management measures can be

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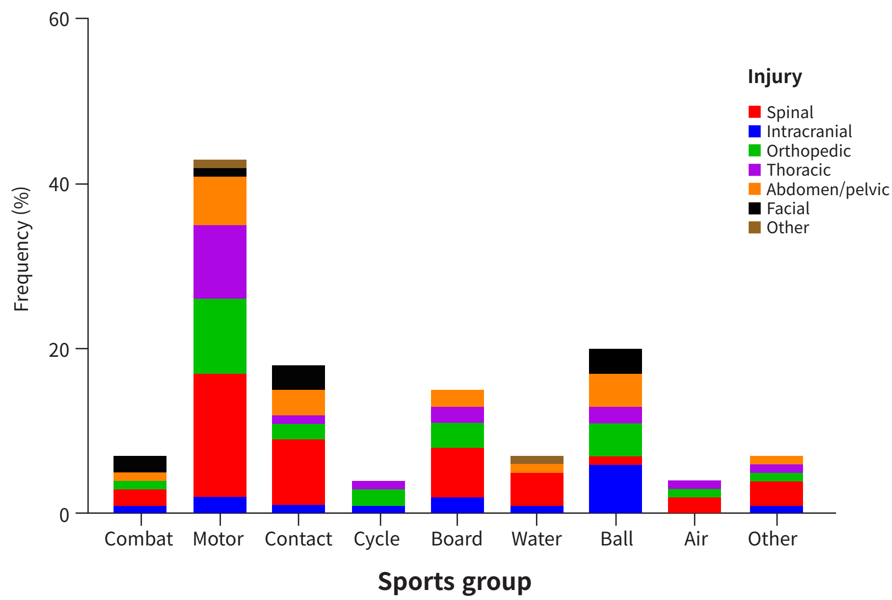

Fig. 2. Injury patterns across sports groups.

Table 5. Patterns of injured body regions across activity groups

Injury pattern	Competitive sports	Recreational sports	Total	P-value
No. of cases	53	25	78	-
No. of injuries (%)	84 (67)	41 (33)	125 (100)	-
Intracranial	10 (12)	5 (12)	15 (12)	0.585
Spinal	27 (32)	14 (34)	41 (33)	0.868
Orthopedic	17 (20)	6 (15)	23 (18)	0.657
Thoracic	12 (14)	5 (12)	17 (14)	0.496
Abdomen/pelvis	11 (13)	7 (17)	18 (14)	0.618
Facial	6 (7)	3 (7)	9 (7)	0.609
Other	1 (1)	1 (2)	2 (2)	0.548

Patterns of injuries across activity groups were compared using binomial exact test and difference calculated as P-value. No statistically significant difference existed in injury patterns across activity groups. The number of cases and the total number of injuries may differ as cases can have more than one injured body part.

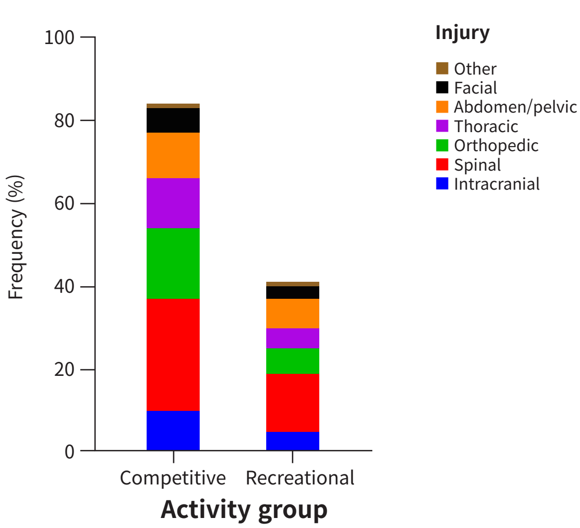

Fig. 3. Injury patterns among activity groups.

implemented in contact sports such as rugby and football to prevent serious injuries. For instance, a change in tackling rules in American football resulted in a reduction of catastrophic spinal injuries [12] and such changes in rules can be considered for other sports groups to minimize the risk of major injuries.

The incidence of head injuries and traumatic brain injuries was relatively low (12%), and among patients with head injuries, 66.6% had a good recovery (GOS, 5) and 33.3% had moderate disability (GOS, 4). This is consistent with previous studies [20,25]. Sports groups with the most head injuries were bicycle and ball sports. The relatively low prevalence and relatively better GOS is attributed to widespread awareness regarding traumatic brain injury in the population, better preventive measures in sports activity, such as restricting dangerous moves, tackles, better training of players use of appropriate headgear, and better healthcare services for immediate management of head injuries [19,21]. Still, there is a need to sustain the present practices and further improve the services such as encouraging headgear use in motor sports, contact and ball sports, and bicycle sports (as has been in practice for routine motorcycle use) [13,26].

The limbs were the most severely injured site across all sports groups, which corresponds to previous studies across multiple sports groups [7,15,20]. Most patients (n = 18, 95.5%) with severe limb injuries had good recovery (GOS, 5) at discharge. Although no specific limb injury preventive practices exist across most sports groups included in our study, better health outcomes could be due to improved management and the generally less severe nature of these injuries. Nonetheless, better public awareness about preventive measures such as bone/muscle fitness, endurance, technique, and strength training can reduce the incidence of such injuries.

Recreational sports are activities that are primarily for participation, with the associated goals of improving physical fitness, recreation, and being social. Competition, on the other hand, is more about achieving goals and competing besides physical fitness and social interaction. Competitive sports are presumed to have higher intensity and activity levels and consequently more injuries (and worse outcomes) than recreational sports. However, recreational sports are usually performed in a casual way and uncontrolled environments, with less compliance in terms of protective equipment and less enforcement of rules and regulations, and therefore can result in more injuries and worse health outcomes. Studies comparing the injury-related data between competitive and recreational sports are scarce and limited to individual sports groups. A couple of studies have demonstrated significantly higher rates of injuries in competitive running and cycling than in recreational versions of these sports [13,27]. In our study as well, the percentage of admissions related to competitive sports (n = 53, 67%) was significantly higher than the number of admissions for injuries sustained while engaging in recreational sports (n = 25, 33%), but the health outcomes and injury patterns did not differ significantly among these activity groups (Tables 3, 5, Fig. 3)

Statistical studies on injury prevention measures are scarce and existing studies are limited to the type of sports and mostly address competitive sports. Studies focusing on injury preventive measures in recreational sports are almost nonexistent. This creates a gap in information regarding the prevalence and efficacy of injury prevention practices in the population [28], especially in the context of recreational sports. This information can dictate improvements in the implementation of injury prevention practices and consequently reduce the injury rates and the overall burden on healthcare resources [22,28].

Our study has several limitations. Firstly, the data are from a single center, which may limit generalizability. Secondly, the retrospective study design creates information bias. Thirdly, our sample size was small, as we only included cases that required hospital admission and excluded equestrian injuries. This underestimates the actual burden of sports-related injuries because a majority of sports injuries are minor injuries with an ISS of less than 4 and do not require hospital stay [25]. The small sample size also reduces the significance of comparative statistics. Further, as only data for admitted cases were taken, no comparisons were possible between types of sports and admission rates. Lastly, we used the GOS as a functional health-outcome tool representing the overall extent of functional recovery at discharge. It was designed for traumatic brain injury cases, and its functionality for other injuries has not been optimized yet. It is not a generic disability score such as the Barthel index or the Extended Rehabilitation Complexity Score and lacks adequate resolution and validity to detect resulting disability in the nontraumatic brain injury population. The retrospective nature of our study also limits the additional objective assessments we can carry out. Further studies are, therefore, recommended to address these limitations.

In conclusion, immense popularity of sports and recreation activities warrant comprehensive studies to address information gaps about injury prevention and management. While sport-related major trauma is uncommon, motor sports are associated with the highest rate of major injuries requiring hospital admission, and are associated with worse health outcomes than other sports. Spinal cord injuries are a major cause of disability, necessitating better preventive measures. Comparative analysis of demographical and health-outcome data shows a significant difference in GOS across sports groups, but no significant difference in the length of ICU or hospital stays and in injury patterns across sports groups. Competitive sports accounted for a higher proportion of major trauma cases than recreational sports, but the health outcomes did not differ significantly; however, the existing literature is inadequate and needs more studies covering wider periods and sports groups. Furthermore, better information on injury prevention practices and their efficacy is needed to reduce the burden of these injuries on individual and population well-being and healthcare resources.

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NOTES

Ethical statements

This study was registered and conducted as a clinical service evaluation at Addenbrooke's Hospital (No.1048868). Ethical approval and patient consent were not needed due to the retrospective nature of the study.

Conflicts of interest

The authors have no conflicts of interest to declare.

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Author contributions

Conceptualization: AH, AAG, FA; Data curation: AH; Formal analysis: AH, AAG, FA; Methodology: AH, AG, FA; Project administration: AH, FA; Visualization: all authors; Writing–original draft: AH; Writing–review & editing: all authors. All authors read and approved the final manuscript.

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