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Retrospective Study

Epidemiology of shoulder dislocations presenting to United States emergency departments: An updated ten-year study

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Abstract

BACKGROUND

Glenohumeral dislocation is a common injury that may predispose patients to chronic pain and instability. However, there is a paucity of current data available regarding the epidemiological trends of this injury.

AIM

To provide an updated, comparative assessment of the epidemiology of shoulder dislocations presenting to emergency departments in the United States. We also sought to analyze patient demographic risk factors and consumer products associated with dislocation events.

METHODS

Data were obtained from the national electronic injury surveillance system database for glenohumeral dislocations between 2012 and 2021. Incidence, age, sex, and injury characteristics were analyzed using weighted population statistics as well as incidence rates and 95% confidence intervals (CI).

RESULTS

In total, an estimated 773039 shoulder dislocations (CI: 640598-905481) presented to emergency rooms across the United States during the study period. The annual

incidence rate was 23.96 per 100000 persons and the average patient age at the time of injury was 37.1 years. Significantly more male patients sustained dislocations than female patients (537189, 69.5%, *vs* 235834, 30.5%, $P < 0.001$). With regard to associated consumer products, sports and recreation equipment were involved in the highest proportion of incidents (44.31%), followed by home structures and construction materials (21.22%), and home furnishings, fixtures, and accessories (21.21%). Regarding product sub-groups, stairs, ramps, landings, floors was cited in the greatest number of cases (131745).

CONCLUSION

The national annual incidence rate of glenohumeral dislocations throughout the study period was approximately 23.92 per 100000 persons. Male adolescents sustained the highest proportion of dislocations, with a peak incidence in age group 15-20 years, predominantly secondary to participation in sporting and recreational activities. Conversely, women experienced a relatively consistent incidence of dislocation throughout their lifespan. After age 63, the incidence rate of dislocations in females was found to surpass that observed in males.

Key Words: Shoulder dislocation; Epidemiology; United States; Emergency department; Glenohumeral dislocation; national electronic injury surveillance system

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Core Tip: Shoulder dislocations occur in a bimodal distribution and are commonly seen in young men and older women. The national incidence of shoulder dislocations presenting to United States emergency departments has remained relatively stable compared to previous epidemiologic studies. Among young patients sustaining shoulder dislocations, sporting and recreational activities are the most involved activities.

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INTRODUCTION

The glenohumeral joint is the most mobile joint in the body, making it particularly vulnerable to dislocation[1]. This physiologic predisposition makes shoulder dislocation a common injury across age groups-especially in young, physically active men[2-5]. Existing studies have estimated the incidence of shoulder dislocation to be 23.9 per 100000 person-years in the general population, with rates as high as 169 per 100000 person-years among young, active, and military populations[3,5-7]. Patients with shoulder dislocations often experience lasting functional impairments and are known to be at high risk for recurrent injury[1,8]. Despite the high incidence of shoulder dislocations experienced in the United States, there is a paucity of current epidemiological data available regarding general population risk factors and etiology.

While young populations have the highest incidence of shoulder dislocation, these injuries have a bimodal age distribution, affecting both the young and elderly at higher rates[6,9]. Unsurprisingly, the etiology of shoulder dislocation varies with patients' age as the activities they routinely engage in change. Older patients classically sustain shoulder dislocations as the result of a fall, whereas younger patients are more likely to experience injury while participating in sporting and recreational activities[6]. Because of these observed differences in the mechanism of injury for shoulder dislocations across age groups, there is an interest in exploring the relationship between consumer products and patient demographics as it relates to shoulder dislocation events.

The purpose of this study is to provide an updated, comparative assessment of the epidemiology of shoulder dislocations presenting to emergency departments in the United States. We also sought to analyze patient demographic risk factors and consumer products as-associated with dislocation events. We hypothesized that consumer products involved with shoulder dislocations would vary depending on patient age and gender, with male adolescents utilizing sports and recreation equipment representing the highest incidence of dislocations.

MATERIALS AND METHODS

Database and Query

Data for this cross-sectional, epidemiologic study of glenohumeral dislocations that present to United States emergency departments was obtained from the national electronic injury surveillance system (NEISS) database[10,11]. The NEISS database collects de-identified patient demographics, injury characteristics, and associated consumer product information

from approximately 100 emergency departments across the United States. Data was obtained by a hospital coordinator assigned to the facility and acquired from both clinical information and follow-up telephone communication as needed. These data points are then extrapolated to establish national estimates for each category after weighing each hospital. NEISS is managed by the Consumer Product Safety Commission, who have been responsible for collecting this data since 1999. This organization makes annual adjustments by weighting probabilities of each of the included emergency departments, then uses the number of annual emergency department visits to establish their calculated national estimates [12,13].

The NEISS database was queried for a 10-year period between 2012 and 2021. All age groups were included in the study. "Shoulder (30)" was selected for body part and "dislocation (55)" was selected for diagnosis for all queries. Information was further stratified by age, gender, product group, and product sub-group.

Statistical Analysis

When querying data from the NEISS database, 95% confidence intervals (CI) were calculated based on input requests. Following data acquisition, incidence rates were calculated per 100000 persons. Unstable data, characterized by a national estimate of less than 1200, number of cases less than 20, or coefficient of variation exceeding 33%, were excluded from data analysis, based on NEISS database outputs. Sub-group analysis was performed comparing ages over and under 40 years. This comparison essentially split life expectancy in half (currently approximately 79 years) and compared "early life" and "later life" with known bimodal distribution of patient age[14]. Chi-squared tests were used to compare categorical variables between cohorts. A *P* value < 0.05 was used to determine statistical significance.

RESULTS

In total, an estimated 773039 (CI 640598-905481) shoulder dislocations presented to emergency departments between 2012–2021 across the United States (Table 1). The annual incidence rate was 23.96 per 100000 persons (CI 19.86-28.07). Average age at time of injury was 37.1 +/- 22.0 years. Male patients accounted for a greater proportion of shoulder dislocations than female patients (537189, 69.5%, vs 235834, 30.5%, *P* < 0.001). Young males accounted for the highest proportion of dislocations, with 17.70% of all dislocations occurring in males aged 15-20 years. The incidence rate for this demographic was observed to be 106.91 per 100000 persons (95%CI: 84.24-129.57).

The largest number of dislocations occurred in patients 17 years old (national estimate 30796, 3.98%). The peak age for dislocation was 18 years in males (national estimate 26661, 4.96% of males) and 66 years in females (national estimate 4833, 2.05% of females). Young males experienced a higher dislocation rate and reached a relative plateau around age 40. Conversely, females had a relatively stable rate of dislocations throughout all age groups and the incidence increased in their later decades. The incidence rate of dislocations in females surpassed that of males at approximately age 63 years. The overall rate per year of shoulder dislocations by gender and age is seen in Figure 1.

The NEISS database divides consumer products into broad categories, which were analyzed to determine overall injury patterns (Table 2). Sports and recreation equipment were associated with 44.31% (365348) of dislocations, followed by home structures and construction materials (21.22%), and home furnishings, fixtures, and accessories (21.21%).

In an analysis of sub-groups, stairs, ramps, landings, floors were associated with the greatest number of dislocations (131745, 14.0%), with a predominance noted among patients ≥ 40 years (9.6% for ≤ 39 years, 28.4% for ≥ 40 years, *P* < 0.001) and females (12.0% for males, 28.6% for females, *P* < 0.001). Among sport and recreational activities, most dislocations occurred during basketball (56600) followed by football (45167). A more throughout breakdown of this information is seen in Table 3.

Specific analysis of males aged 15-20, previously identified as having the highest incidence of dislocation, was undertaken (Table 4). In this group of young males, 82.88% (113421) of dislocations were associated with sports and recreation equipment[3,6]. Specifically, basketball (18.60%) and football (18.59%) were involved in the greatest number and percentage of dislocations. Eight of the top ten subcategories for this age group involved sports and recreation equipment.

DISCUSSION

This study represents a current analysis of the epidemiology of shoulder dislocations presenting to emergency departments in the United States from 2012-2021. The national annual incidence rate throughout the study period held was approximately 23.92 per 100000 persons. Male adolescents sustained the highest proportion of dislocations, with 17.70% of all dislocations occurring in males aged 15-20 years, predominantly resulting participation in sports and recreation equipment. Conversely, women experienced a relatively consistent incidence of dislocation throughout their lifespan. After age 63, the incidence rate of dislocations in females surpassed that observed in males.

The findings of this study align with the existing literature. We observed an annual incidence rate of 23.92 per 100000 throughout the study period. Similarly, Zacchilli *et al*[6] noted an incidence of 23.9 per 100000 person-years in a study analyzing NEISS data between 2002 and 2006. Of note, a study by Owens *et al*[3] reported a much higher incidence rate of dislocations among United States Military Academy cadets at 169 per 100000 person-years, although their study was comprised of primarily young, physically active males. Additionally, other studies have reported dislocation rates among young, physically active patients to be as high as seven times greater than that observed in the general population[6,9]. These findings agree with the results of our analysis, which noted male adolescents to account for the greatest number of

Table 1 Total weighted national electronic injury surveillance system estimates, rate per year, national incidence, and demographics, for all United States shoulder dislocations between 2012 and 2021

	National estimate	95%CI
Total	773039	640598-905481
Rate per year	77304	64060-90548
Incidence per 100000	23.92	19.86-28.07
	Mean	St. Deviation
Age	37.1	22.0
Gender	National estimate	Percent
Male	537189	69.5%
Female	235834	30.5%

CI: Confidence intervals.

Table 2 Total weighted national electronic injury surveillance system estimates for all United States shoulder dislocations between 2012 and 2021, by consumer product categories

Consumer product category	National estimate	Percent of cases
Sports and recreation equipment	365348	44.31%
Home structures and construction materials	174975	21.22%
Home furnishings, fixtures, and accessories	174883	21.21%
Personal use items	32235	3.91%
Packing and containers, household	15511	1.88%
Home communication, entertainment and hobby	13940	1.69%
Yard and garden	8943	1.08%

shoulder dislocations presenting to emergency departments.

The current study found an estimated total reported cases of 136844 men 15-20 years old, which made up for 17.70% of the total cases reported in this study, with an annual incidence of 106.91 per 100000. These results are higher to those of similar studies in other countries which found men 16-20 years old to have an incidence of 80.5 per 100000 in the United Kingdom and 98.3 per 100000 in Canada[15,16]. Studies have attributed this difference in rates of injury to the prevalence of competitive contact sports played among men within this age range in the United States and Canada (American football and ice hockey) compared with their peers in the United Kingdom[15]. Further, it was observed that in this population, 113421 (82.88%) of the injuries occurred while using sports and recreational equipment. This finding is consistent with prior studies that have analyzed the incidence of this injury among young athletes and military populations[3,4,17,18].

During our study period, women were found to account for less than one third of dislocations presenting to emergency departments and previous studies have reported a similarly low incidence of this injury in women when compared to men[7,15,16]. However, the incidence of shoulder dislocation in women was noted to surpass that of men after the age of 63. This aligns with existing data demonstrating a higher dislocation rate in women after the sixth decade[7,15]. While this discrepancy is poorly understood, we hypothesize that it may be due to a combination of biological differences between men and women as they age, such as muscle bulk and tendon strength, as well differences in the rate of falls between sexes[19,20]. Interestingly, over 60% of dislocations events in female patients were associated with home furnishings, fixtures, or structures. This suggests a need for separate preventative measures and strategies for older female patients from the already established sports-related strategies directed at young males. Further research is necessary to fully understand underlying differences in risk between patient demographics and may assist in the development of preventative measures aimed at decreasing the burden of shoulder dislocations associated with falls in the elderly[21].

Of note, there were too few recorded cases of shoulder dislocation in children younger than 12 years to provide national estimates, suggesting that this is a relatively rare injury among this demographic. One existing study reporting on the epidemiology of pediatric shoulder dislocation in Italy demonstrated an incidence of 0.3 per 100000 inhabitants less than age 14[22]. The low incidence of shoulder dislocation in pediatric patients may be explained by skeletal immaturity as the mechanisms of injury generally associated with dislocation are more likely to cause proximal humerus fractures or physeal injury in patients whose physis has not yet closed[23].

Table 3 Total weighted national electronic injury surveillance system estimates for all United States shoulder dislocations between 2012 and 2021, for the top ten product sub-groups, with subgroup analysis for age ≤ 39 and ≥ 40 years, and gender

Rank	Product sub-group	National estimate	≤ 39	Percent (%)	≥ 40	Percent (%)	Male	Percent (%)	Female	Percent (%)
1	Stairs, ramps, landings, floors	131745	45193	9.6	86551	28.4	64235	12.0	67510	28.6
2	Beds, mattresses, pillows	76778	45200	9.6	31579	10.4	48119	9.0	28660	12.2
3	Basketball	55226	53619	11.4	1607	0.5	51081	9.5	4145	1.8
4	Football	43158	42172	9.0	¹	¹	42006	7.8	¹	¹
5	Exercise and equipment	39052	26388	5.6	12665	4.2	26836	5.0	12216	5.2
6	Bicycles and accessories	32789	15733	3.4	17040	5.6	28600	5.3	4189	1.8
7	Clothing, all	26832	12714	2.7	14118	4.6	13653	2.5	13180	5.6
8	Ladders, stools	22372	4930	1.1	17442	5.7	17529	3.3	4842	2.1
9	Bathtub and shower structures	21640	8861	1.9	12779	4.2	11076	2.1	10564	4.5
10	Chairs, sofas, and sofa beds	21193	8143	1.7	13050	4.3	10667	2.0	10526	4.5
Total		773039	468458		304566		537189		235834	

¹Estimates denoted by have at least one of the following unstable characteristics and were not returned: Estimate is less than 1200, number of cases is less than 20, coefficient of variation exceeds 33%.

P < 0.001 age groups *vs* gender groups.

Table 4 Total weighted national electronic injury surveillance system estimates for shoulder dislocations among males aged 15-20 years between 2012 and 2021, including the top ten product sub-groups

		National estimate	95%CI
	Total	136844	107830-165857
	Rate per year	13684	10783-16586
	Incidence per 100000	106.91	84.24-129.57
Rank	Product sub-group	National estimate	Percent
1	Basketball	25448	18.60%
2	Football	25435	18.59%
3	Beds, mattresses, pillows	7314	5.34%
4	Exercise and equipment	6350	4.64%
5	Miscellaneous sports	5941	4.34%
6	Soccer	5772	4.22%
7	Skateboards, scooters, hoverboards	5771	4.22%
8	Stairs, ramps, landings, floors	5627	4.11%
9	Swimming activity, pools, equipment	5440	3.98%
10	Baseball/softball	5163	3.77%

CI: Confidence intervals.

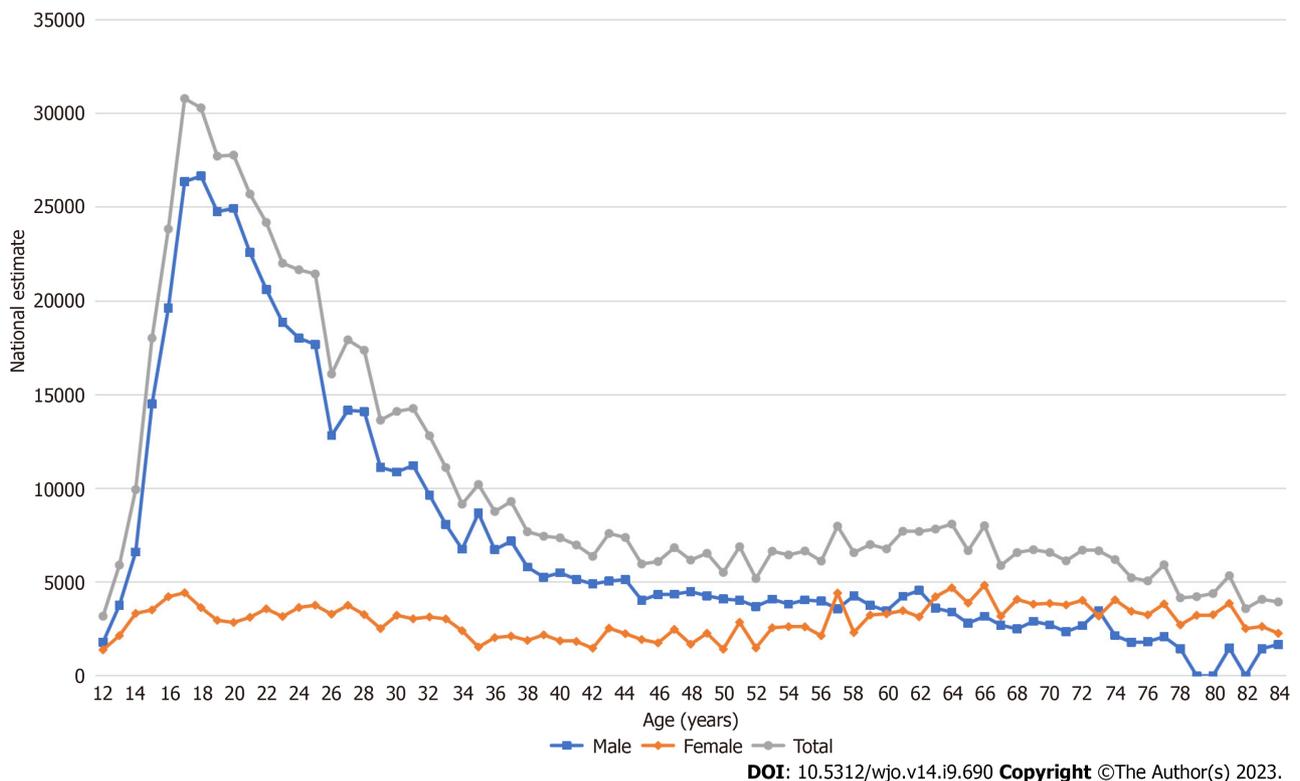


Figure 1 Total weighted national electronic injury surveillance system estimates per year for all United States shoulder dislocations between 2012 and 2021, by age in years and gender. There was insufficient data to provide national estimates for ages < 12 and > 84 years, as well as males ages 79, 80, and 82.

This study was not without its limitations. As with any database, the scope of this study is limited to variables obtained by data collectors and does not include patients who presented to primary care, urgent care, or sports medicine clinics. Because the provided totals are weighted estimates based on a probability sample of emergency room visits, the numerical estimates could be subject to sampling bias and therefore may not represent the true incidence of injury in the defined study population. Additionally, it is possible that errors were made while coding these injuries and their associated consumer products within the NEISS. Furthermore, logging products into broad categories relies on the coder's judgment and this carries bias. Due to the nature of the NEISS database, we were unable to retrieve more detailed information regarding specific consumer products associated with injury, nor were we able to retrieve exact mechanism of injury. Lastly, the database did not differentiate between anterior and posterior shoulder dislocations, nor did it indicate whether dislocation events were primary or recurrent. It is possible that the presence of patients with multiple recurrent dislocations may contribute to a falsely elevated incidence rate[6].

CONCLUSION

The national annual incidence rate throughout the study period was approximately 23.92 per 100000 persons. Male adolescents sustained the highest proportion of dislocations, with peak incidence occurring in age 15-20 years, predominantly secondary to participation with sports and recreation equipment. Conversely, women experienced a relatively consistent incidence of dislocation throughout their lifespan. After age 63, the incidence rate of dislocations in females was found to surpass that observed in males.

ARTICLE HIGHLIGHTS

Research background

This research was conducted to examine temporal trends regarding shoulder dislocations in the United States.

Research motivation

Shoulder dislocations are common among all populations, especially young men, and understanding the epidemiology is important for orthopedic surgeons.

Research objectives

To provide an updated assessment of the epidemiology of shoulder dislocations in the United States.

Research methods

Emergency department within the United States was collected using the national electronic injury surveillance system database between 2012 and 2021, and epidemiologic data was collected and analyzed for shoulder dislocations.

Research results

The national annual incidence of shoulder dislocations in the United States was approximately 23.92 per 100000 persons, with a predominance of dislocations occurring in male adolescents between the ages of 15-20.

Research conclusions

There is a bimodal distribution of shoulder dislocations in the United States. A large portion of male adolescents sustain these injuries between the ages of 15-20 secondary to participation in sporting events. Conversely, women have a relatively consistent incidence of dislocations in their lifespan with an increase in their later decades of life.

Research perspectives

Future studies should help create measures to help lower the incidence of shoulder dislocations in at risk population, particularly adolescent males participating in sports.

FOOTNOTES

Author contributions: Patrick CM performed the majority of the research, collected data, analyzed data, and contributed to the manuscript; Snowden J and Eckhoff MD contributed equally to this work by performing research, and contributing to the manuscript and background research; Green CK and Scanaliato JP oversaw manuscript revisions and project design; Dunn JC and Parnes N designed the research study, coordinated the research team, and oversaw final manuscript revisions; All authors have read and approved the final manuscript.

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