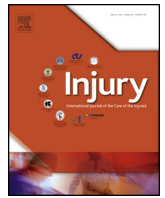




Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury



Ocular injury in the United States: Emergency department visits from 2006–2011

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ARTICLE INFO

Article history:

Accepted 11 July 2015

Keywords:

Ocular
Injury
Eye
Emergency
Trauma
Epidemiology

ABSTRACT

Introduction: Ocular complaints represent a sizeable burden to emergency departments, accounting for an estimated 2.4 million ED visits annually. We sought to characterise visits associated with ocular injury and examine factors contributing to inpatient admission.

Methods: We searched the Nationwide Emergency Department Sample between 2006 and 2011 and identified cases in which patients presented with a primary or secondary diagnosis of ocular trauma. We described these cases according to age, sex, external mechanism of injury, payer status, and identified relationships between these variables. Logistic regression models were employed to identify crude and adjusted relative odds of admission to inpatient status based on patient demographics, mechanism of injury, payer status, and the existence of multiple injuries.

Results: Between 2006 and 2011, a total of 5541,434 visits were made to EDs in the United States with a primary or other diagnosis of ocular trauma; ocular trauma was the primary diagnosis in 77.9% of these cases. Overall, mean age at presentation was 33.8 years and the majority of patients were male (64.8%). Male sex, older age, being struck by or against an object, the existence of multiple injuries, and Medicaid as a primary payer were all associated with significantly higher odds of hospital admission.

Discussion: The distribution of primary external mechanism of injury suggested that individuals are at higher risks for different injury types at each successive stage of life. Age and injury mechanism were correlated with odds of admission to inpatient status, with the highest odds among older adults who had been injured by being struck by or against an object.

Conclusions: Ocular injury plays a substantial role in the ED. Further work is necessary to determine whether developing and implementing age- and sex-appropriate prevention strategies could reduce the incidence of ocular injury and reduce morbidity related to these types of injuries.

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Introduction

Ocular disease and injury represent a sizeable burden to emergency departments (EDs) in the US, and have been associated with long-term sequelae and reduced quality of life [1,2]. The U.S. Centers for Disease Control and Prevention (CDC) estimate that over 2.4 million ED visits are made every year for traumatic or medical ocular disorder [3]. It is likely that individuals of varying age, sex, and environmental status are at different risks for ocular

injury; furthermore, injury severity may be associated with these and other factors. A thorough understanding of the factors contributing to ocular injury is necessary if appropriate preventive and systems-based policy is to be designed to address the issue of ocular injury. To this end, we sought to estimate the number of ED visits between 2006 and 2011 for a primary or secondary diagnosis of ocular trauma, and examine factors associated with inpatient admission among those with a primary diagnosis of ocular injury.

Methods

Ocular trauma data were selected from the Nationwide Emergency Department Survey (NEDS), part of the Healthcare Cost and Utilization Project (HCUP) of the Agency for Healthcare Research and Quality. As the nation's largest all-payer ED database,

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<http://dx.doi.org/10.1016/j.injury.2015.07.020>

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representing a 20% sample of all ED visits that can be weighted to provide estimates at the level of the U.S. population, the NEDS contained information on over 950 hospitals for 2011 [4]. The Johns Hopkins Medical Institutions Institutional Review Board approved this study.

We identified individuals from 2006–2011 in the NEDS presenting for ED treatment with a primary or secondary diagnosis of ocular trauma, as identified using the International Classification of Disease, ninth edition (ICD-9) [802.6, 802.7, 870, 871, 918, 921, 930, 940, 950, 951.0]. From this subset, we included cases containing data on age and sex. Population-based rates were calculated using weighted NEDS data and population data from the United States Census Bureau [5]. Tabulations and data analyses were performed using Stata 12.1 MP statistical package (Statacorp, College Station, Texas).

Since US Census data and inter-census estimates use five-year age groupings, we combined cases into matching five-year age groups for the purpose of calculating population-level incidence rates. ICD-9 E-codes were used to determine mechanism of injury.

Chi-square tests were used to compare proportions between groups within a year or from year to year. Logistic regression modeling was used to calculate odds of inpatient admission among patients presenting to the ED with a primary diagnosis of ocular trauma.

Results

Demographics

Over the period from 2006 to 2011, a total of 5541,434 cases of ocular injury presented to EDs across the United States with ocular trauma being the primary diagnosis in 4317,165 (77.9%) of these (Table 1). Admission to inpatient status occurred among 1.40% of patients with primary ocular injuries and 6.51% of all patients with ocular injuries.

Overall mean patient age at presentation was 33.8 years (SD: 21.0) and 3592,309 (64.8%) patients were male. On average, males were younger than females, with mean age for male patients at 32.4 years (SD: 19.1), while the mean for female patients was 36.5 years (SD: 24.1, $p < .001$).

Population-level rates were higher among men than women across all age groups (Table 2). Among both males and females, 20–29 year olds exhibited the highest population-based rates of ED

Table 1
Characteristics of ocular trauma ED visits, 2006–2011.

| Characteristic | Male (%) | Female (%) | Total |
|-------------------------|-----------------|-----------------|-----------|
| Total | 3592,309 (64.8) | 1949,125 (35.2) | 5541,434 |
| Age | | | |
| 0–9 years | 463,623 (61.4) | 290,956 (38.6) | 754,579 |
| 10–19 years | 484,447 (67.5) | 233,468 (32.5) | 717,916 |
| 20–29 years | 771,223 (68.9) | 348,615 (31.1) | 1,119,838 |
| 30–39 years | 634,251 (70.4) | 267,196 (29.6) | 901,447 |
| 40–49 years | 581,382 (69.3) | 256,978 (30.7) | 838,360 |
| 50–59 years | 358,553 (64.0) | 201,906 (36.0) | 560,459 |
| 60–69 years | 157,662 (56.5) | 121,536 (43.5) | 279,198 |
| 70+ years | 141,168 (38.2) | 228,470 (61.8) | 369,638 |
| Injury mechanism | | | |
| Foreign body | 970,912 (77.1) | 288,004 (22.9) | 1,258,916 |
| Fall | 265,423 (47.7) | 291,029 (52.3) | 556,451 |
| Assault | 354,319 (70.8) | 145,830 (29.2) | 500,149 |
| Struck by/against | 202,091 (63.4) | 116,842 (36.6) | 318,934 |
| Sports-related | 125,198 (81.0) | 29,276 (19.0) | 154,474 |
| Corrosive material | 78,046 (61.0) | 49,824 (39.0) | 127,870 |
| Animal/insect | 57,352 (46.8) | 65,076 (53.2) | 122,428 |
| Cutting/piercing | 64,408 (68.2) | 30,062 (31.8) | 94,470 |
| Other | 1176,247 (61.0) | 751,468 (39.0) | 1,927,715 |
| Data missing | 298,403 (62.1) | 181,760 (37.9) | 480,164 |

Table 2
Population-based rate of individuals presenting to the ED with a primary diagnosis of ocular trauma, per 100,000 age-specific population, by sex and year.

| Category | Year | | | | | | Overall |
|---------------|-------|-------|-------|-------|-------|-------|---------|
| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | |
| Male | | | | | | | |
| 0–9 | 371.9 | 349.8 | 329.8 | 308.9 | 297.2 | 311.5 | 327.9 |
| 10–19 | 356.8 | 319.3 | 292.7 | 267.9 | 257.8 | 253.0 | 291.4 |
| 20–29 | 588.8 | 534.8 | 472.3 | 410.0 | 431.7 | 399.4 | 471.7 |
| 30–39 | 524.7 | 476.9 | 426.6 | 382.8 | 402.0 | 387.0 | 433.4 |
| 40–49 | 427.0 | 395.1 | 351.2 | 319.0 | 340.6 | 318.3 | 359.0 |
| 50–59 | 265.5 | 253.6 | 229.9 | 216.3 | 226.5 | 223.4 | 235.4 |
| 60–69 | 176.1 | 163.4 | 146.4 | 137.4 | 141.9 | 137.1 | 149.3 |
| 70+ | 129.2 | 120.7 | 113.5 | 105.6 | 113.7 | 114.1 | 116.0 |
| Female | | | | | | | |
| 0–9 | 243.3 | 226.4 | 216.3 | 197.2 | 192.9 | 203.0 | 213.0 |
| 10–19 | 176.7 | 158.4 | 146.3 | 131.9 | 130.2 | 128.7 | 145.4 |
| 20–29 | 243.1 | 227.4 | 211.8 | 198.1 | 209.7 | 195.0 | 213.9 |
| 30–39 | 200.8 | 191.2 | 166.6 | 162.7 | 172.3 | 159.2 | 175.5 |
| 40–49 | 179.7 | 160.8 | 149.4 | 137.5 | 141.7 | 134.3 | 150.8 |
| 50–59 | 140.3 | 131.5 | 119.1 | 113.7 | 118.9 | 114.4 | 122.7 |
| 60–69 | 110.9 | 105.2 | 92.9 | 90.9 | 98.3 | 92.0 | 97.9 |
| 70+ | 111.0 | 112.5 | 103.3 | 100.7 | 104.1 | 108.5 | 106.7 |

presentation for treatment of ocular injury; among men, these rates were 62% higher than those of the 10–19 year-old group.

Overall, 41.1% of patients were covered by private insurance. Patients listed as “self-pay,” which may include uninsured patients, made up the second-largest group with 19.6%, followed by Medicaid at 17.1% and Medicare at 10.3% of cases. Hospital write-offs and alternative payers, including workers’ compensation, military insurance programs, and government-sponsored women’s and children’s programs combined to account for 11.8% of all cases.

Overall, foreign bodies in or near the eye accounted for the highest proportion of external injury mechanism (22.7%), followed by falls (10%), assaults (9%), being struck by or against an object (5%), sports-related injuries (2.7%), corrosive burns (2.3%), animal and insect bites/stings (2.2%), and injuries due to cutting or piercing instruments (1.7%). All other mechanisms of injury combined accounted for 34.8% of cases. In 8.7% of visits, no mechanism was listed. Predominant mechanisms of injury varied notably by age (Fig. 1).

Sex was also associated the external mechanism of injury. While the leading cause of injury among men, foreign bodies, accounted for 27% of injuries, that type of injury only accounted for 14.8% of injuries among women. The greatest proportion of ocular injuries among women was due to falls (14.9%), a category that only accounted for 7.4% of male injuries. Conversely, assault-related injuries were proportionally more common among males than among females (9.9% vs. 7.5%, $p < .001$).

Superficial ocular and periocular wounds accounted for the largest majority of cases (43.7%), followed by foreign bodies in the eye (24%), contusions to the eye (11.9%), and adnexal wounds (11.8%). Blowout fractures were diagnosed for 3.7% of cases, and ocular and periocular burns were reported for 2.9% of patients.

Changes in ED presentation across time

Over the study period, the annual number of ocular trauma cases in the ED (both primary and secondary) fell 16.9% from 1040,297 cases in 2006 to 864,009 in 2011 ($p < .001$), with the largest reduction seen among those with foreign body as the primary mechanism of injury (Fig. 2). ED presentation for treatment of primary ocular injuries also fell 20.9% over the period, from 835,774 in 2006 to 661,368 in 2011 ($p < .001$).

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