



Changing trends in ocular trauma during the COVID-19 pandemic in the USA

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ABSTRACT

Background/aims The COVID-19 pandemic has been associated with a decline in emergency department (ED) presentations for trauma. The purpose of this study is to compare the estimated number and characteristics of eye injuries in 2020, the year of the COVID-19 pandemic, to those in 2011–2019.

Methods A stratified probability sample of US ED-treated eye injuries was used to calculate the estimated annual number and incidence of these injuries in 2020, the year of the pandemic, and 2011–2019 (prepandemic years). Two-sample t-tests and Pearson χ^2 were used to assess differences in demographics and injury characteristics. For multiple comparisons, Bonferroni correction was applied.

Results The estimated number of ED-treated eye injuries per year was 152 957 (95% CI 132 637 to 176 153) in 2020 and 194 142 (95% CI 191 566 to 196 401) in 2011–2019. The annual incidence of ED-treated eye injuries was lower in 2020, at 46 per 100 000 population than in 2011–2019, at 62 per 100 000 per year ($p < 0.001$). In 2020 vs 2011–2019, there was a higher incidence of ruptured globes (0.5 per 100 000 vs 0.3 per 100 000 per year, $p < 0.001$), hyphemas (0.6 per 100 000 vs 0.4 per 100 000 per year, $p < 0.001$), lacerations (1.0 per 100 000 in 2020 vs 0.8 per 100 000 per year, $p < 0.001$) and orbital fractures (0.3 per 100 000 vs 0.03).

Conclusion The estimated incidence of eye injuries presenting to the ED was significantly lower in 2020 than in 2011–2019, but there was a higher estimated incidence of severe eye injuries. Changes in living and work environments due to the COVID-19 pandemic were likely associated with the differences in ocular trauma presentations observed in this study.

INTRODUCTION

In March 2020, evidence of rapid community spread of COVID-19 in the USA¹ leads to the institution of stay-at-home orders in 42 states and territories.² In-person outpatient visits were limited, with many providers switching to telemedicine visits,³ resulting in a 60% decrease in in-person visits to ambulatory care practices.³ While emergency departments (ED) remained open, there was a 40% decline in ED visits in the USA.⁴ Globally, the frequency of ED trauma-related visits in particular declined by 20%–80%.⁵

A similar decline was seen in presentations for eye-related emergency visits; a retrospective review of emergency presentations to a tertiary eye care centre in Philadelphia found that the daily mean of emergency visits fell by 26%.⁶ Globally, declines in

emergency eye presentations were higher, possibly due to stricter lockdown measures. An emergency medical unit in Italy found a 68.4% decrease in the number of eye injuries,⁷ while one ED in India reported a 58.5% decline ocular trauma.⁸ Some unique characteristics of eye-related injuries during the COVID-19 pandemic have been reported in multiple studies: eye injuries have been more likely to occur at home and less likely to be school and sports related.^{7,8}

While some studies have evaluated the impact of the COVID-19 pandemic on presentations of eye injuries, a population-based review of eye injuries in the USA has not been carried out. In this study, we used a nationally representative sample of ED-treated eye injuries to determine the estimated number and incidence of eye injuries in 2020 and the preceding 9 years. Furthermore, we compare the characteristics of eye injuries occurring during the COVID-19 pandemic to those occurring in prior years. The burden of ocular trauma may continue to change with the increase in remote work and learning, as well as changes in healthcare delivery models provoked by the pandemic. Population-based data on eye injuries and their characteristics during the COVID-19 pandemic will be useful in understanding these changes in the epidemiology of ocular trauma.

MATERIALS AND METHODS

Eye injury data were obtained from the US Consumer Product Safety Commission (USCPC) National Electronic Injury Surveillance System (NEISS) on 2 April 2021.⁹ Consumer product-related injuries in the USA and its territories are collected from 100 hospitals, a stratified probability sample of all US hospitals with at least six beds and 24-hour ED services.⁹ Patient information collected for each visit includes demographic information, consumer product(s) associated with injury, body part(s) involved, injury location, diagnosis, disposition and a narrative injury description. Deidentified NEISS data are publicly available and may be downloaded on request.

Eye injuries in all ages presenting between 1 January 2011 and 31 December 2020 were included in this study. Probability weights were used in calculating the estimated number of eye injuries and to compare eye injury characteristics between 2020 and prepandemic years. The yearly incidence of eye injuries between 2011 and 2020 was calculated using estimated eye injury numbers from the NEISS database and estimated population data from the United States Census Bureau.¹⁰ Where appropriate,



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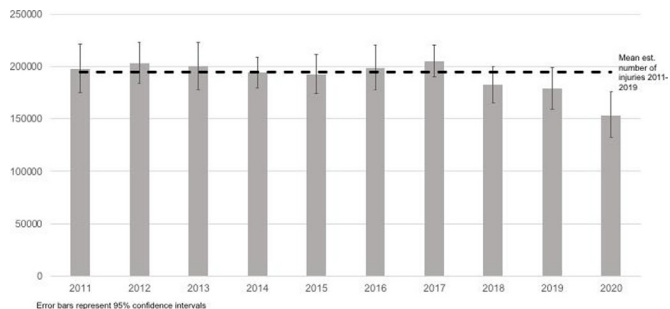


Figure 1 Yearly estimated number in ED-treated eye injuries between 2011 and 2020. ED, emergency department.

two sample t-tests and Pearson χ^2 were used to assess differences in age, sex, race, location, associated consumer product and product category (eg, toys, workshop equipment), diagnosis (type of injury) and disposition between eye injuries occurring in 2020 and those occurring in 2011–2019. Bonferroni corrections were applied to p values to account for multiple comparisons. Given the absence of vision-specific diagnoses, we manually reviewed the narrative diagnosis variable to quantify the number of subjects presenting with ruptured globes and hyphemas. We also compared the proportion of eye injuries associated with fireworks to those in prior years, due to media reports suggesting increased fireworks use during the pandemic in several US cities.^{11 12} All statistical analyses were carried out using STATA (V.16.1 StataCorp).

RESULTS

Yearly and monthly trends in ED-treated eye injuries

In the USCPSC NEISS database, there were 4236 injuries in 2020 and an average of 4959 injuries/year in 2011–2019. Based on stratified probability sampling weights included in the NEISS data, these injuries represented approximately 152 957 injuries (95% CI 132 637 to 176 153) in 2020 and 194 142 injuries/year (95% CI 191 566 to 196 401) in 2011–2019, an estimated 21.2% (95% CI 7.6% to 34.8%) decrease in the annual number of eye injuries (figure 1). There was an estimated 25.9% (95% CI 15.4% to 36.5%) decrease in the estimated annual US incidence of ED-treated eye injuries, from 62 per 100 000 population per year in 2011–2019 to 46 per 100 000 population in 2020 (p<0.001).

In 2020, the estimated monthly number of injuries declined in March and April compared with the same time period in 2011–2019 (figure 2). While there was an increase in the estimated

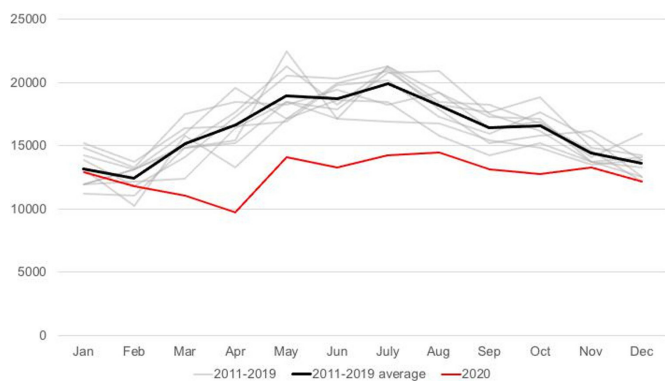


Figure 2 Monthly trends in eye injury presentations in 2020 compared with average monthly presentations between 2011 and 2019.

Table 1 Characteristics of eye injuries in 2020 vs 2011–2019

	2011–2019 (N=44 629)	2020 (N=4 236)	P value*
Estimated population size/year† (CI)	194 142 (191 566 to 196 401)	152 957 (132 637 to 176 153)	<0.001
Mean age, years (CI)	32.2 (31.0 to 33.4)	34.6 (31.9 to 37.2)	0.01
Male (%) (CI)	69.5 (67.9 to 71.1)	66.6 (64.7 to 68.5)	0.04
Race (%) (CI)			
White/Caucasian	53.4 (44.6 to 61.9)	51.2 (38.3 to 63.9)	>0.99
Black/African American	10.1 (6.8 to 14.8)	13.2 (8.6 to 19.8)	0.12
Other‡/unspecified	36.6 (27.9 to 46.2)	35.6 (22.4 to 51.3)	>0.99
Location (%) (CI)			
Home	49.0 (43.3 to 54.6)	54.5 (47.1 to 61.6)	0.55
Sports	6.5 (5.5 to 7.6)	3.9 (3.1 to 5.0)	0.002
Public	3.1 (2.7 to 3.5)	3.4 (2.7 to 4.2)	>0.99
School	3.5 (3.1 to 4.1)	1.5 (1.2 to 2.0)	<0.001
Unknown/other§	38.0 (31.8 to 44.5)	36.7 (29.5 to 44.6)	>0.99
Product category (%) (CI)			
Workshop	22.8 (20.4 to 25.5)	21.4 (18.7 to 24.5)	>0.99
Sports and recreation	15.7 (14.5 to 17.1)	11.7 (10.5 to 13.1)	<0.001
Home maintenance	12.8 (11.9 to 13.7)	13.8 (11.9 to 15.9)	>0.99
Home furnishings	7.6 (7.1 to 8.0)	9.7 (8.3 to 11.3)	0.008
Yard and garden	8.5 (7.4 to 9.7)	7.4 (6.2 to 8.9)	0.82
Personal use items	7.7 (7.2 to 8.4)	8.0 (7.0 to 9.2)	>0.99
Home structures	5.8 (5.3 to 6.4)	7.4 (6.3 to 8.7)	0.01
Toys	4.6 (4.1 to 5.2)	5.3 (4.2 to 6.6)	>0.99
Fireworks	0.8 (0.6 to 1.0)	1.7 (1.2 to 2.5)	<0.001
Other¶/miscellaneous	13.7 (13.0 to 14.4)	13.5 (12.5 to 14.6)	>0.99

*Bonferroni corrected for multiple comparisons.
 †Estimated population size using stratified probability sampling of all US hospitals with more than five beds and 24-hour emergency department care.
 ‡Other race: Asian, American Indian/Alaska Native, Native Hawaiian/Pacific Islander.
 §Other locations: Farm, street, mobile and industry.
 ¶Other product categories: child nursery, home entertainment/communications/hobby, packaging, household appliances, heating/cooling, housewares, farm products.

monthly numbers of eye injuries in the summer months of May, June and July of 2020, they remained lower than estimated numbers during the same time period in prepandemic years.

Patient and injury characteristics

Overall, mean age among patients presenting to US ED’s with eye injuries was 32.4 years (95% CI 31.1 to 33.7 years) between 2011 and 2020, 69.3% (95% CI 67.8% to 70.8%) of whom were male and 53.2% (95% CI 44.3% to 61.9%) were of white/Caucasian race. Compared with patients with eye injuries occurring between 2011 and 2019, those presenting in 2020 were 2.4 years older on average (p=0.01) (table 1). A lower proportion of all eye injuries occurred among individuals between the ages of 0 and 18 in 2020 compared with prepandemic years (26.1% (95% CI 20.3% to 32.8%) vs 30.7% (95% CI 27.4% to 34.3%), p=0.03). Eye injuries were less common among males in 2020 compared with prepandemic years (66.6% (95% CI 64.7% to 68.5%) vs 69.5% (95% CI 67.9% to 71.1%), p=0.04). No difference was found by race in the proportion of injuries presenting in 2020 versus 2011–2019. In 2020, a lower proportion of eye injuries occurred at school (1.5% (95% CI 1.2% to 2.0%) vs 3.5% (95% CI 3.1% to 4.1%), p<0.001) and in sports facilities (3.9% (95% CI 3.1% to 5.0%) vs 6.5% (95% CI 5.5% to 7.6%), p=0.002) compared with prior years. No statistically significant difference was found in the proportion of eye injuries occurring at home or in public between 2020 and 2011–2019. A lower proportion of eye injuries were associated with the product category ‘sports and recreation equipment’ compared with

Table 2 Diagnosis and disposition associated with eye injuries in 2020 vs 2011–2019

	2011–2019 (N=44 629)	2020 (N=4 236)	P value*
Diagnosis (%) (CI)			
Contusion, abrasion	43.3 (40.8 to 45.9)	40.8 (38.1 to 43.5)	0.30
Foreign body	19.4 (17.6 to 21.4)	18.4 (16.4 to 20.7)	>0.99
Dermatitis/conjunctivitis	9.1 (8.2 to 10.2)	6.1 (4.9 to 7.6)	<0.001
Burn, chemical	5.0 (3.6 to 6.9)	5.8 (3.1 to 10.8)	>0.99
Laceration	1.3 (1.1 to 1.5)	2.2 (1.7 to 2.9)	0.007
Ruptured globe	0.4 (0.3 to 0.6)	1.1 (0.7 to 1.8)	<0.001
Hyphema	0.6 (0.5 to 0.8)	1.3 (0.9 to 1.9)	0.004
Fracture	0.05 (0.03 to 0.09)	0.6 (0.3 to 1.1)	<0.001
Other†	20.7 (18.5 to 23.2)	23.7 (20.0 to 27.8)	0.17
Disposition (%) (CI)			
Treated/examined and released	95.9 (95.1 to 96.5)	94.7 (93.5 to 95.7)	0.06
Treated and transferred	1.3 (0.9 to 1.8)	2.1 (1.4 to 3.1)	0.008
Treated and admitted/hospitalised	1.1 (0.7 to 1.5)	1.8 (1.2 to 2.7)	0.009
Other‡ or unknown	1.8 (1.4 to 2.4)	1.4 (0.9 to 2.2)	0.59

*Bonferroni correction for multiple comparisons.
†Diagnosis uncategorised.
‡Other disposition categories include held for observation, left without being seen, fatality.

prepandemic years (11.7% (95% CI 10.5% to 13.1%) vs 15.7% (95% CI 14.5% to 17.1%), $p<0.001$), but a higher proportion of injuries was associated with home furnishings (9.7% (95% CI 8.3% to 11.3%) vs 8.5% (95% CI 7.4% to 9.7%), $p=0.008$), home structures (7.4% (95% CI 6.3% to 8.7%) vs 5.8% (95% CI 5.3% to 6.4%), $p=0.01$) and fireworks (1.7% (95% CI 1.2% to 2.5%) vs 0.8% (95% CI 0.6% to 1.0%), $p<0.001$) in 2020 compared with prepandemic years.

The majority of eye injuries between 2011 and 2020 were associated with a contusion or abrasion (table 2). A diagnosis of dermatitis/conjunctivitis was less common in 2020 versus previous years (6.1% (95% CI 4.9% to 7.6%) vs 9.1% (95% CI 8.2% to 10.2%), $p<0.001$), whereas vision-threatening diagnoses were more common, including lacerations (2.2% (95% CI 1.7% to 2.9%) vs 1.3% (95% CI 1.1% to 1.5%), $p<0.007$), ruptured globes (1.1% (95% CI 0.7% to 1.8%) vs 0.4% (95% CI 0.3% to 0.6%), $p<0.001$), traumatic hyphemas (1.3% (95% CI 0.9% to 1.9%) vs 0.6% (95% CI 0.4% to 1.0%), $p<0.01$) and orbital fractures (0.6% (95% CI 0.3% to 1.1%) vs 0.05% (95% CI 0.03% to 0.09%), $p<0.001$).

The estimated incidence of severe ED-treated injuries was higher in 2020 than in 2011–2019, including lacerations (1 per 100 000 in 2020 vs 0.8 per 100 000 per year in 2011–2019, $p<0.001$) ruptured globes (0.5 per 100 000 in 2020 vs 0.3 per 100 000 per year in 2011–2019, $p<0.001$), hyphemas (0.6 per 100 000 in 2020 vs 0.4 per 100 000 per year in 2011–2019, $p<0.001$) and fractures (0.3 per 100 000 in 2020 vs 0.03 per 100 000 per year in 2011–2019, $p<0.001$).

Overall, the majority of patients were treated/examined and released between 2011 and 2020. In 2020, a higher proportion of ED-treated eye injuries resulted in hospitalisation (1.8%

(95% CI 1.2% to 2.7%) vs 1.1% (95% CI 0.7% to 1.5%), $p=0.009$) and transfer to another facility (2.1% (95% CI 1.4% to 3.1%) vs 1.3% (95% CI 0.9% to 1.8%), $p=0.008$) compared with injuries occurring in 2011–2019.

DISCUSSION

Here, we report the estimated number and incidence of ED-treated eye injuries in 2020, the year of the COVID-19 pandemic, as well as the unique characteristics of eye injuries presenting in this time period. There was an overall decline in the estimated number and incidence of ED-treated eye injuries in 2020 compared with the prepandemic 2011–2019 years. Eye injuries declined in March and April of 2020 compared with the same period in preceding years. The incidence of severe eye injuries such as ruptured globes, hyphemas, lacerations and orbital fractures was higher in 2020 versus prepandemic years.

Overall, the yearly incidence of ED-treated eye injuries between 2011 and 2020 was much lower than the 3.15 per 1000 incidence reported in 2005 using the NEISS database.¹³ This is consistent with studies showing a decline in ED-treated eye injuries between 2006 and 2013.^{14 15} Despite the declining incidence of eye injuries in prepandemic year, the incidence of eye injuries in 2020 was significantly lower. On repeat analysis using data from 2018 to 2020, the incidence of eye injuries in 2020 was significantly lower than in 2018–2019, the prepandemic years with the lowest incidence of eye injuries. Monthly trends in eye injuries between 2011 and 2019 were consistent with those seen in the literature,¹⁴ with a higher estimated number of injuries in the summer months. In 2020, however, there was a decline in the estimated monthly number of injuries in the months of March and April, coinciding with the institution of stay-at-home orders in the beginning of the COVID-19 pandemic.² While there was a rebound in eye injuries in the summer months of 2020, they did not return to prepandemic levels.

Despite an overall decline in the number of eye injuries in 2020 compared with prepandemic years, there was a higher incidence of severe eye injuries, including ruptured globes, hyphemas, lacerations and orbital fractures during the pandemic. Conversely, dermatitis/conjunctivitis, a less severe diagnosis, was less common in 2020 compared with prior years. Furthermore, there was an increased incidence of eye injuries resulting in hospitalisation in 2020 versus prior years, suggesting that eye injuries during the pandemic were associated with greater morbidity compared with prepandemic injuries. It is possible that patients with mild ocular trauma, like conjunctival injury, were less likely to present to the ED during the pandemic, whereas the overall increase in the incidence of severe ED-treated injuries may be due to changes in behaviours during stay-at-home orders. A rise in intimate partner violence,¹⁶ associated with a higher risk of severe ocular trauma,¹⁷ as well as an increase in home-improvement projects during the pandemic,⁶ may have resulted in an increase in the overall number of severe eye injuries. There was also a greater proportion of cases that were treated but transferred to other facilities, possibly due to decreased ED and hospital capacities for non-COVID-related patients.¹⁸

On average, patients presenting with eye injuries in 2020 were 2.4 years older than those presenting in previous years, a finding that is consistent with a report of ocular trauma during the COVID-19 pandemic in Italy.⁷ A lower proportion of eye injuries occurred among children and adolescents, explaining the higher mean age reported. One possible reason for the decrease in eye injuries in this age group is the transition from in-person learning in schools to virtual learning at home. This is consistent

with the lower proportion of eye injuries occurring at school in 2020 vs prior years reported in this study. Similarly, the cancellation of sports events due to the pandemic may explain the higher mean age reported in 2020, as well as the lower proportion of eye injuries related to sports and recreational equipment.

While prior studies showed that injuries occurring at home were more common during the pandemic compared with previous years,^{6–8} likely due to stay-at-home orders, a statistically significant difference in the proportion of home injuries between 2020 and 2011–2019 was not observed in this study, possibly due to missing injury location data in 37% of cases. Our analysis of product categories associated with eye injuries found that injuries related to home furnishings and home structures were more common among those presenting in 2020 than in 2011–2019, suggesting that eye injuries during the pandemic may have occurred at home more commonly than in previous years.

A strength of this study is its use of a large, nationally representative database of ED-treated eye injuries from a sample of 100 hospitals in the USA. Eye injury data collected over a period of 10 years were used in this study, allowing for the discovery of significant differences in eye injury incidence and characteristics during the COVID-19 pandemic compared with previous years.

This study has several limitations. General trauma-related diagnoses such as abrasions and lacerations are coded in the NEISS database, but eye-specific trauma diagnoses such as ruptured globe and hyphema are not systematically categorised, making the diagnosis codes less informative. We relied on narrative descriptions to quantify the proportion of injuries resulting in ruptured globes and hyphemas, but we have likely underestimated the proportions of these injuries, given that some cases may not be reported in the narrative diagnosis descriptions. Vision-specific data such as visual acuity was also not available in the NEISS database, making it difficult to measure vision-related outcomes of eye injuries in our cohort. However, using the diagnosis variable, as well as narrative diagnosis descriptions, allowed us to appreciate some differences in eye injury severity between 2020 and preceding years.

In conclusion, the estimated incidence of eye injuries presenting to the ED was significantly lower in 2020 than in nine pre-pandemic years, but the incidence of severe injuries, including ruptured globes, hyphemas and lacerations increased during the pandemic. Differences in patient age, injury location, associated consumer product category, diagnosis and disposition were detected between eye injuries presenting in 2020 and those in pre-pandemic years. Changes in living and work environments due to stay-at-home orders instituted to limit the spread of COVID-19 were likely associated with the differences in ocular trauma presentations observed in this study.

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Contributors OH has contributed to study design, data extraction and analysis and manuscript writing, preparation and revision. DF has contributed to study design and manuscript writing, preparation and revision. AMR has contributed to study design and manuscript writing, preparation and revision. NZ has contributed to study design, data analysis and manuscript writing, preparation and revision.

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