

## Ocular injury in pediatric patients admitted with major trauma



An estimated 2.4 million eye injuries occur in the United States annually, 35% of which occur in children under the age of 17 years.<sup>1</sup> Ocular trauma is a leading cause of childhood visual impairment and blindness and concurrence with other trauma can result in complicated rehabilitation and can negatively affect development. However, few reports detail the effects of polytrauma in pediatric patients admitted with ocular injuries.<sup>2–4</sup> We sought to evaluate the epidemiology of these patients using the National Trauma Data Bank (2008–2014).<sup>5</sup> This retrospective study was approved by our Institutional Review Board. De-identified patients (<21 years of age) admitted with ocular

trauma were identified using ICD-9CM (International Classification of Disease Ninth Revision - Clinical Modification) stands for International Classification of Disease Ninth Revision - Clinical Modification. codes (800.00 to 959.9). Sex, race/ethnicity, age, type of ocular injury, mechanism, intention, hospital length of stay, injury severity score (ISS), and Glasgow Coma Score (GCS) were tabulated. ISS is an assigned numerical value indicating extent of injury in patients with polytrauma. GCS indicates the degree of traumatic brain injury (TBI). Mean, median, standard deviation (SD), and interquartile range were calculated for all continuous variables that were subsequently categorized for logistic regression analysis, 2-tailed Student's *t* test, and  $\chi^2$  calculations, using SPSS version 24 (IBM Corp, Armonk,

**Table 1—Descriptive findings and demographic data of pediatric ocular trauma, National Trauma Data Bank (2008–2014)**

Characteristic	Number	Percent	Characteristic	Number	Percent	Mean (SD)	Median (interquartile range)
Year			Age (y)			11.9 (6.9)	14 (5–18)
2008	7733	13.2	0–3	10 812	18.4		
2009	8364	14.2	4–6	5626	9.6		
2010	8484	14.4	7–11	7532	12.8		
2011	8357	14.2	12–18	22 772	38.8		
2012	8801	15	19–21	12 023	20.5		
2013	8325	14.2	ISS*			12.6 (4)	15 (12–15)
2014	8701	14.8	1–8	26 777	45.6		
Total	58 475	100	9–15	13 288	22.6		
Sex			16–24	8673	14.8		
Male	40 395	68.7	>24	7621	13		
Female	18 370	31.3	Unknown	2406	4.1		
Race			GCS†			13 (4)	15 (14–15)
Black	10 360	17.6	<8	8048	13.7		
White	34 721	59.1	9–12	2117	3.6		
Other	13 684	23.3	13–15	42 155	71.7		
Hispanic	9603	16.3	Unknown	6445	11		
Injury type			TBI	32 173	54.7		
Penetrating	3523	6	Mortality	1687	2.9		
Blunt	41 892	71.3	Stay (d)			5 (9)	2 (1–5)
Other	9848	16.8	1	21 057	35.8		
Unknown	3502	6	2–3	17 962	30.6		
Hospital level			4–6	8760	14.9		
I	20 946	35.6	>6	10 917	18.6		
II	8319	14.2	Unknown	69	0.1		
III	1011	1.7	Intention				
IV	150	0.3	Assault	9579	16.3		
Not applicable	28 339	48.2	Self-inflicted	437	0.7		
Locations			Unintentional	44 812	76.3		
Home	17 239	29.3	Other	18	0		
Other	2952	5.5	Undetermined	417	0.7		
Public building	2232	3.8	Unknown	3502	6		
Recreation	4720	8	US regions				
Residential Institute	305	0.5	Midwest	12942	22		
Street	24 754	42.1	Northeast	9323	15.9		
Unspecified	4433	7.5	South	23 105	39.3		
Unknown	1852	3.2	West	12 282	20.9		
			Not applicable	161	0.3		
			Unknown	952	1.6		

ISS, injury severity score; GCS, Glasgow coma score; TBI, traumatic brain injury.  
 \*ISS categories: 1–8 = minor, 9–15 = moderate, 16–24 = severe, and >24 = very severe injury severity.  
 †GCS categories: <8 = severe, 9–12 = moderate, and 13–15 = mild brain injury.

NY). Significance was set at  $p < 0.05$ . Patients with incomplete or unspecified data were excluded.

Of the 316,485 patients admitted with ocular trauma, 58,765(18.6%) were <21 years of age. Mean (SD) age was 11.9 years (6.9) and most were 12 to 21 years of age (59.3%). Males (68.7%) outnumbered females (31.3%). Whites accounted for 59.1%, Blacks, 17.6%, and Hispanic ethnicity, 16.3% (Table 1). Most injuries were unintentional (76.3%). Common mechanisms were motor vehicle traffic accident - occupant (MVTO), 28.1% and struck by/against, 16.1%. Common injuries were eye/adnexa contusion (30.6%), orbital injuries (29.9%), and open adnexa wounds (29%). Open globe injury occurred in 11.6%. More than half (54.7%) had TBI. Mean (SD) hospital length of stay was 5 days (9) and mortality rate was 2.9% (Table 1).

The 19-21 year age group had the greatest odds of MVTO trauma (odds ratio [OR], 2.01;  $p < 0.001$ ) and the 0- to 3-year age group, falls (OR, 3.24;  $p < 0.001$ ). MVTO was the most common mechanisms in all race/ethnicities, however, Black children were most often injured by firearms (OR, 3.83;  $p < 0.001$ ), White patients, by environmental causes (OR, 2.46;  $p < 0.001$ ), and Hispanic patients, by hot objects (OR, 1.52;  $p < 0.001$ ) than other race/ethnicities. Of the most common mechanisms, the Northeast had greatest odds of falls (OR, 1.44;  $p < 0.001$ ), the South, MVTO (OR, 1.27;  $p < 0.001$ ), the Midwest, struck by/against (OR,1.08;  $p = 0.007$ ), and the West, motor vehicle traffic accident (MVT)-pedestrian (OR, 1.65;  $p < 0.001$ ).

The 0- to 3-year age group had greater odds of assault (OR, 2.38;  $p < 0.001$ ) and the 19- to 21-year age group, and self-inflicted injury (OR, 1.45;  $p < 0.001$ ). Black and Hispanic patients were mostly victims of assault (OR, 2.68 and OR, 1.41;  $p < 0.001$ , respectively) and White patients, of unintentional and self-inflicted injury (OR, 2.28 and OR, 1.45;  $p < 0.001$ , respectively) and White patients, of unintentional (OR, 2.28;  $p < 0.001$ )Firearm injury had greatest odds of very severe ISS (OR, 2.62;  $p < 0.001$ ), and cut/pierce of low ISS (OR, 32.96;  $p < 0.001$ ). Open globe injuries were most associated with low ISS (1-8; OR, 3.82;  $p < 0.001$ ) and orbital injury, with higher ISS (9-15; OR, 1.75;  $p < 0.001$ ). Optic nerve and visual pathway injuries had greatest odds of severe ISS (16-24; OR, 4.63;  $p < 0.001$ ) as did injuries associated with TBI (OR, 12.52;  $p < 0.001$ ; Table 2).

We affirmed previous findings for admitted patients with ocular trauma that included preponderance of male and older children, and association between open globe injuries and lower ISS and visual pathway injuries with higher ISS.<sup>2-4,6,7</sup> These associations have management implications; patients with low ISS may be triaged to minor injury areas despite having potentially vision-threatening injuries. Additionally, we found that 54.7% had associated TBI and these patients had greater likelihood of severe ISS. Most

**Table 2—Summary of regression analysis of association between mechanisms and ocular injury and injury severity score in pediatric ocular trauma National Trauma Data Bank (2008–2014)**

Mechanism	ISS*	Frequency	p value	OR	95% CI
Fall	1-8	2592	<0.0001	1.15	1.09-1.22
	9-15	1451	<0.001	1.32	1.24-1.41
	16-24	724	0.003	0.88	0.81-0.96
	>24	376	<0.001	0.47	0.42-0.52
MVT-occupant	1-8	5190	<0.001	0.42	0.41-0.44
	9-15	4154	<0.001	1.24	1.18-1.29
	16-24	3319	<0.001	1.74	1.65-1.83
	>24	3203	<0.001	2.04	1.94-2.14
MVT-pedestrian	1-8	539	<0.001	0.33	0.30-0.36
	9-15	688	<0.001	1.41	1.28-1.54
	16-24	520	<0.001	1.62	1.47-1.80
	>24	563	<0.001	2.10	1.90-2.32
Pedal cyclist	1-8	219	<0.001	0.45	0.39-0.53
	9-15	248	<0.001	1.62	1.38-1.89
	16-24	162	<0.001	1.51	1.26-1.80
	>24	123	0.039	1.23	1.00-1.50
Struck by/against	1-8	6328	<0.001	3.09	2.94-3.24
	9-15	2020	0.002	0.92	0.87-0.97
	16-24	541	<0.001	0.30	0.27-0.33
	>24	198	<0.001	0.12	0.10-0.13
Firearm	1-8	663	<0.001	0.60	0.55-0.67
	9-15	341	<0.001	0.72	0.64-0.81
	16-24	332	0.006	1.18	1.05-1.34
	>24	534	<0.001	2.62	2.36-2.91
Cut/Pierce	1-8	1449	<0.001	32.96	24.98-44.37
	9-15	36	<0.001	0.08	0.05-0.11
	16-24	11	<0.001	0.04	0.02-0.07
	>24	5	<0.001	0.02	0.01-0.05
Natural/Environment	1-8	295	<0.001	1.58	1.32-1.90
	9-15	132	0.147	1.16	0.94-1.42
	16-24	49	<0.001	0.58	0.43-0.79
	>24	28	<0.001	0.37	0.24-0.54
Hot object	1-8	510	<0.001	8.17	6.36-10.63
	9-15	53	<0.001	0.33	0.24-0.43
	16-24	12	<0.001	0.11	0.06-0.20
	>24	6	<0.001	0.06	0.02-0.14
Injury type	ISS	Frequency	p value	OR	95% CI
	Open globe	1-8	4951	<0.001	3.82
9-15		607	<0.001	0.30	0.27-0.32
16-24		475	<0.001	0.39	0.36-0.43
>24		578	<0.001	0.58	0.53-0.64
Orbital fracture	1-8	5407	<0.001	0.41	0.39-0.42
	9-15	5188	<0.001	1.75	1.70-1.82
	16-24	3338	<0.001	1.60	1.53-1.68
	>24	2802	<0.001	1.45	1.38-1.53
Adnexal contusion	1-8	6272	<0.001	0.53	0.51-0.55
	9-15	4788	<0.001	1.40	1.34-1.46
	16-24	3169	<0.001	1.39	1.32-1.46
	>24	2910	<0.001	1.50	1.42-1.58
Open adnexal wound	1-8	4951	<0.001	3.82	3.60-4.05
	9-15	607	<0.001	0.30	0.27-0.32
	16-24	475	<0.001	0.39	0.36-0.43
	>24	578	<0.001	0.58	0.53-0.64
Superficial wound	1-8	3784	<0.001	1.25	1.19-1.32
	9-15	1741	0.25	1.03	0.98-1.10
	16-24	946	<0.001	0.81	0.75-0.87
	>24	749	<0.001	0.71	0.66-0.77
Visual pathway injury	1-8	176	<0.001	0.25	0.22-0.30
	9-15	181	0.004	0.79	0.67-0.92
	16-24	189	<0.001	1.42	1.21-1.67
	>24	380	<0.001	4.63	4.05-5.29
Other cranial nerves	1-8	346	<0.001	0.25	0.22-0.28
	9-15	483	0.008	1.15	1.04-1.29
	16-24	507	<0.001	2.15	1.93-2.39
	>24	510	<0.001	2.55	2.29-2.83

ISS, injury severity score; MVT, motor vehicle traffic accident.

\*ISS categories: 1-8 = minor, 9-15 = moderate, 16-24 = severe, and >24 = very severe injury severity.

patients survived with potential for long-term disability if not targeted for early multidisciplinary rehabilitation efforts. Demographic differences in mechanism and intention were identified. Black children, who represent 14% of children in the United States,<sup>8</sup> suffered 17.6% of ocular trauma. Also, they were mostly victims of assault and firearm injuries. White patients were more likely to be suicide victims than other race/ethnicities.

Although extensive and detailed, data from the National Trauma Data Bank on pediatric patients admitted with ocular injuries was collected and submitted by emergency department and trauma team members. While serving to identify the most vision-threatening injuries and mechanisms, this study may have underestimated nationwide pediatric ophthalmic injuries and overstated severity. Despite these limitations, this study identified differences between groups that could assist in development of focused strategies aimed at preventing visual disability and morbidity in this vulnerable population.

**Timothy Truong, MD,\* Ethan K. Sobol, MD,† Afshin Parsikia, MD, MPH,‡,§ Joyce N. Mbekeani, MD, FRCS, FRCOphth<sup>||,\*</sup>**

\*Department of Ophthalmology, California Pacific Medical Center, San Francisco, CA; †Department of Ophthalmology, Mount Sinai Medical Center, Icahn School of Medicine, New York, NY; ‡Research Services, University of Pennsylvania, Philadelphia, PA; §Department of Surgery (Trauma), Jacobi Medical Center, Bronx, NY; <sup>||</sup>Department of Surgery (Ophthalmology), Jacobi Medical Center, Bronx, NY; <sup>\*\*</sup>Department of Ophthalmology & Visual Sciences, Albert Einstein College of Medicine, Bronx, NY.

Originally received Aug. 5, 2020. Final revision Dec. 12, 2020. Accepted Dec. 20, 2020.

Correspondence to Joyce N. Mbekeani, Department of Surgery (Ophthalmology), Jacobi Medical Center, 1400 Pelham Parkway, Bronx, NY 10461.; [jnanjinga888@gmail.com](mailto:jnanjinga888@gmail.com).

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## Footnotes and Disclosure

The authors acknowledge John McNelis, MD, FACS, FCCM, MHCM, chair, and Melvin Stone Jr, MD, associate director, Trauma Services & Surgical Critical Care, Department of Surgery; and James Meltzer, MD, Department of Pediatrics, Jacobi Medical Center, Bronx, NY for their contributions and support.

The authors have no proprietary or commercial interest in any materials discussed in this article.