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Review Article

Prevalence of Ocular Trauma in New York City

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Abstract

Purpose: To analyze the prevalence of ocular trauma between 2014 and 2018 in five diverse counties comprising New York City. We further examined how race, sex and age could influence prevalence of ocular trauma during this time period. **Methods:** The CDC Vision and Eye Health Surveillance System (VEHSS) were used to obtain data from electronic claims and medical registry. Data was obtained by using the search terms "prevalence ocular injury, burns and surgical complications of the eye". Data was further categorized based on age, race, gender and Medicare claims. We evaluated the data from 2014 to 2018 for New York State and compared it to its most populated counties (New York County, Bronx County, Kings County, Richmond County and Queens County). Multiple logistic regressions were used to study the effects of time across years, age, and the location on the occurrence of ocular trauma. The significance level was set at corrected $p \leq 0.05$. **Results:** Overall, the occurrence of ocular trauma increased significantly in 2014 to 2018 (p-value <0.0001), and is significantly different among age groups ($p<0.0001$) and counties ($p<0.001$). Specifically, those 85 years and older were 2.6 (95% CI 2.4 -2.9; $p<0.0001$) more likely to have ocular trauma when compared to those aged 19-39 years. The prevalence of ocular trauma was 1.2 times (95% CI 1.1-1.2; $p<0.0001$) higher in Kings County when compared with Bronx county. Manhattan county had a 1.4 (95% CI 1.325-1.208, $p<0.0001$) higher prevalence of ocular trauma when compared to Bronx county. When Queens County was compared with Bronx county, Queens County was found to have a 1.4 higher prevalence rate (95% CI 1.1-1.8, $p=0.035$). **Conclusions:** Ocular trauma and its complications are of significant public health concern. Prevalence of ocular trauma differs by age and geographic location. Marginalized communities are more affected and receive the brunt of this problem leading to all the potential issues of visual impairment and blindness. Ensuring that adequate facilities are available to administer timely and appropriate care is essential..

Keywords: Ocular trauma; Prevention of blindness; Race and age; Ocular trauma

Introduction

Epidemiology of Ocular Trauma

Ocular trauma is prevalent among all ages, genders, ethnic backgrounds, and socioeconomic groups. As the leading cause of blindness in almost half a million people worldwide it is important to discuss the causes, treatment, prevention, and outcomes of ocular trauma [1,2]. The number of visits to the emergency department for injury to the eye and orbit was 269 ± 59 (in thousands) according to the National Hospital Ambulatory Medical Care Survey: 2018 [3]. Males suffer from more ocular trauma compared to females [4]. Males had an eye injury rate of 9.5 per 1000, and females had an eye injury rate of 4.5 per 1000 [4]. There is not much data on rates of ocular trauma organized by ethnicity, however, the method of injury varies depending on race. According to a Retrospective chart review of the National Trauma Data Bank (2008-2014), black people had a greater likelihood of firearm injuries than the other racial/ethnic groups, Hispanics experienced more of cut/

pierce injuries, and whites experienced more of falls [5]. Blacks and Hispanics mostly suffered assaults, while the Whites suffered unintentional injuries [5]. Age is a large factor contributing to ocular trauma in US. As individuals, get older the rates of ocular trauma increase [6].

Blindness *vs.* visual impairment/unilateral *vs.* bilateral blindness and most common causes

In the US there are 7.08 million people living with visual acuity loss or blindness [7]. The leading global causes of blindness, in order, in those aged 50 years and older in 2020 were cataracts, glaucoma, under corrected refractive error, age-related macular degeneration and diabetic retinopathy [8]. The leading causes for moderate to severe visual impairment were under corrected refractive error and cataracts [8].

Causes: Occupational, sports, road, altercation, environmental, falls

There are multiple causes of ocular trauma including but not limited to: Occupational, sports related injury, motor vehicle accident, physical altercation, falls and environmental. The most common cause of ocular trauma is motor vehicle accidents. Over a 6 year period in a major trauma unit it was reported that 52% of ocular injuries were due to motor vehicle accident, and 8% of injuries were attributed to assault [9]. According to the National Electronic Injury Surveillance System, between 2001 to 2009 there were 208,517 cases of sports-related eye trauma [10]. Sport related injury is the third leading cause of eye injuries that result in blindness in the US [10]. However, with adequate protective wear and risk education these injuries can be prevented. Baseball, softball, basketball, racquetball, football, and soccer are the sports where eye injuries happen more frequently [10]. Ocular trauma in the elderly is mostly contributed to falls. According to NIS data from 2000 to 2017, there were 425,725 fall injuries associated with ocular trauma [11]. Most falls were contributed to tripping and stumbling, furniture and stairs [11]. From 2011 to 2018 the Survey of Occupational Injuries and Illnesses reported 197,160 ocular injuries related to the workplace [12] Individuals in the fishing, forestry and farming industries experienced the highest rates of ocular trauma [12]. Injuries were caused by, but not limited to, contact with objects and exposure to harmful substances and chemicals [12].

Types of Ocular Trauma

Ocular trauma can present with different severities and includes orbital floor fracture, retinal detachment, and luxation of globe, secondary glaucoma, contusion, laceration, traumatic hyphema, iritis and post-surgical trauma. Many bones contribute to the formation of the orbit: The frontal, maxilla, zygoma, ethmoid, lacrimal, greater and lesser wings of the sphenoid, and palatine bones [13]. This complex arrangement allows for complicated fractures and injuries to occur, and an increased occurrence of orbital floor fractures. Orbital floor fractures can be caused through two mechanisms. The hydraulic theory states that a fracture occurs with an increased IOP because the globe is displaced posteriorly [14]. The buckling theory is trauma directed to the infraorbital rim resulting in bending of the orbital walls and fracturing [15]. Common mechanisms of fracture are falls, high-velocity ball-related sports, traffic accidents, and interpersonal violence [14]. Patients will report symptoms of diplopia, monocular or binocular blurred vision and pain upon extraocular movements [15]. Injuries may resolve on their own or require surgical intervention [15]. Complication of orbital floor fractures include, but not limited to: Enophthalmos, hypophthalmos, telecanthus, epiphora, cerebrospinal fluid leaks, orbital hematoma, and blindness [13]. Retinal Detachment (RD) is defined as a separation of the neurosensory from the underlying retinal pigmented epithelium [16]. RD can also be subsequent to orbital floor fracture. Patients experiencing retinal detachment may complain of flashes, floaters, dark veil or curtain coming down [17].

Ocular Trauma in New York City

Hospitals in New York City serve an estimated population of 8,335,897 [18]. There are few articles that discuss the impact and epidemiology of ocular trauma in New York City. A study conducted in the Bronx concluded that elderly residents suffering from ocular injuries predominantly happened among females as a result of falls within their home or nursing home environments [19]. A retrospective study conducted at Bellevue Hospital found that orbital wall fractures were the most common injury overall, but found corneal abrasions were the most common injury in females [20]. A study conducted in Kings County Hospital found there were 115 orbital wall fractures evaluated over a two-year period, accounting for 29% of traumatic consults and 1.5% of total consultations [21]. Another retrospective study at Kings County Hospital found 38 patient who sustained ruptured globe injuries [22]. Out of the total of 38 eyes examined, 15 eyes displayed orbit fractures, and 6 eyes had an intraocular foreign body [22] .

Methods

Data was collected from the CDC Vision and Eye Health Surveillance System. The annual prevalence of diagnosed injury burns and surgical complications of the eye was collected for New York, Kings, Bronx, Queens and Richmond counties with Medicare claims coverage between 2014-2018. Data was collected for age ranges: 18-39, 40-64, 65-84 and 85 and above, all races and all genders. Estimates of median household income, SNAP benefit recipients, race and educational level from 2014-2018 in New York, Kings, Bronx, Queens and Richmond counties were recorded from the U.S. Census Bureau. Multiple logistic regressions were used to study the effects of time, age, and the location on the occurrence of

ocular trauma. The significance level was set at 0.05. The analysis was implemented with SAS 9.4 (SAS Institute Inc., Cary, NC).

Results

New York Counties

The occurrence of ocular trauma increases significantly with time (p-value <0.0001), and is significantly different among age groups (p-value<0.0001) and counties (p-value<0.001). Specifically, the odds ratio estimate was 1.305 (95% CI 1.202-1.4170, p<0.0001) when age group 40-64 was compared with age group 19-39. The odds ratio estimate was 1.751 (95% CI 1.620-1.892, p<0.0001) when age group 64-84 was compared with age group 19-39. The odds ratio estimate was 2.555 (95% CI 2.361-2.765, p<0.0001) when age group 85 and above was compared with age group 19-39. The odds ratio estimate was 1.202 (95% CI 1.166-1.239, p<0.0001) when Kings County was compared with Bronx county. The odds ratio estimate was 1.202 (95% CI 1.166-1.239, p<0.0001) when Kings County was compared with Bronx county. The odds ratio estimate was 1.366 (95% CI 1.325-1.208, p<0.0001) when Manhattan county was compared with Bronx county. The odds ratio estimate was 1.410 (95% CI 1.106-1.770, p=0.035) when Queens County was compared with Bronx county. The odds ratio estimate was 1.130 (95% CI 1.083-1.179, p=0.0498) when Richmond county was compared with Bronx county.

Demographics

In 2010, Bronx County had a population of 1,361,473 [22]. In 2010, the racial diversity index was 0.61 and in 2019 it was 0.59 [22]. In 2010, Queens County had a population of 2,230,722 [23]. The racial diversity index in Queens was 0.76 in 2010 and 2019. In 2010, Kings County had a population of 2,508,340. The racial diversity index in Kings County was 0.72 in 2010 and 0.73 in 2019. The population of Manhattan County in 2010 was 1,586,698. The diversity index of Manhattan County in 2010 and 2019 was 0.68 [24].

Discussion

The results showed that older individuals have an increased likelihood of ocular trauma when compared to younger individuals. This finding is similar to findings in other studies of ocular trauma. One study showed increased incidence of ocular trauma in the elderly caused by falls due to tripping, stairs and furniture related accidents [11]. Another study found that ocular trauma associated with falls in the elderly population is associated with poor functional outcomes and high inpatient mortality rates [25]. As the elderly population grows there is an increased risk for more falls and more ocular trauma. These incidences may also be linked to underlying eye diseases such as cataracts, glaucoma or macular degeneration. These diseases impair vision and may cause an increased risk in falls for the elderly population. It's important that we implement changes in the environment for the elderly to reduce the risk of falls. These include but are not limited to: Increasing lighting, removing clutter from the home and having non slip rugs or mats.

The results showed that individuals living in Kings, Queens, Manhattan and Richmond counties have greater odds of ocular injury when compared to individuals living in the Bronx. One factor that may contribute to this finding is that Queens, Kings and Manhattan County have a larger population of 65 and older compared to the Bronx. The elderly population has a higher rate of ocular injury, as discussed earlier, and this may contribute to the increased prevalence of trauma in these counties.

There were a few limitations to this study due to the database used. The Vision and Eye Health Surveillance System (VEHSS) only listed the prevalence of ocular trauma in the New York counties for individuals insured by Medicare claims. Therefore, the prevalence of individuals with a diagnosis of ocular trauma with insurance other than Medicare claims was not recorded in this data set. We may speculate that there are fewer individuals in the Bronx with Medicare claims coverage but there is no available data to prove this theory. The VEHSS also does not allow filters for data by age, race and gender all at once. We were only allowed to analyze the data by age groups when it included all races and all genders. The VEHSS also did not provide any additional factors such as annual household income, comorbidities, private insurance, uninsured and outcomes of trauma. It would be interesting to see these factors accounted for in future data sets [26].

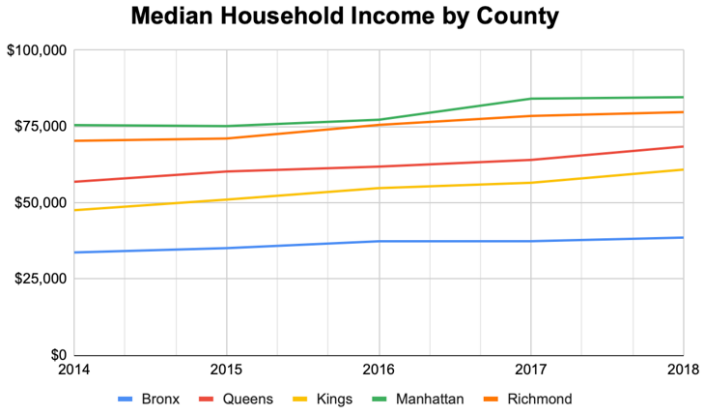

Figure 1: Median Household Income by County.

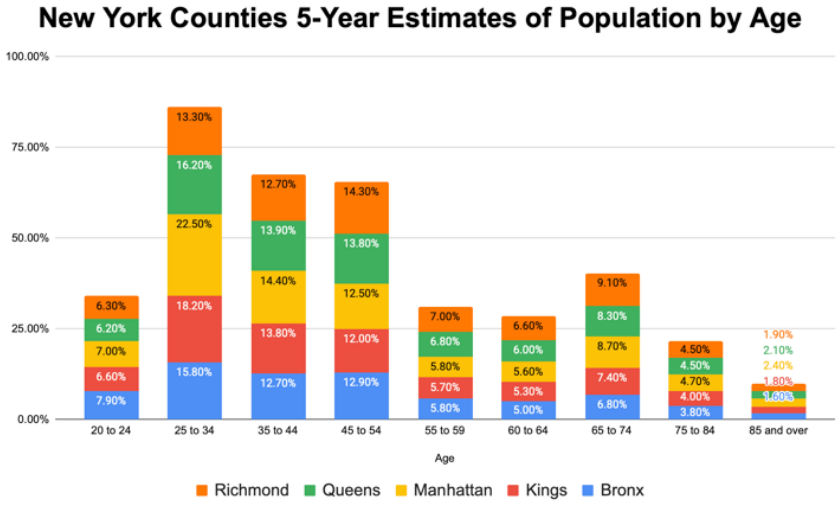

Figure 2: New York Counties 5-Year Estimates of Population by Age.

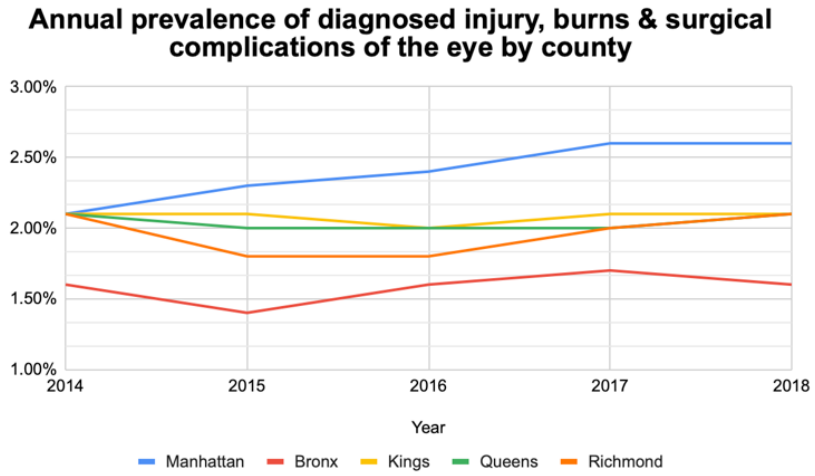

Figure 3: Annual prevalence of diagnosed injury, burns and surgical complications of the eye by county.

Effect	Point Estimate	95% Wald CI		P-value
Year	1.031	1.025	1.037	<.0001
Age Group 2 *vs* 1	1.305	1.202	1.417	<.0001
Age Group 3 *vs* 1	1.751	1.62	1.892	<.0001
Age Group 4 *vs* 1	2.555	2.361	2.765	<.0001
County Kings *vs* Bronx	1.202	1.166	1.239	<.0001
County New York *vs* Bronx	1.366	1.325	1.408	<.0001
County Queens *vs* Bronx	1.141	1.106	1.177	0.035
County Richmond *vs* Bronx	1.13	1.083	1.179	0.0498

Table 1: Odds Ratio Estimates Prevalence of Trauma.

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