Original Article

Yearly trends in the incidence of ocular traumas and the effects of COVID-19 pandemic: a nationwide population-based study of Korean data

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Background: Ocular trauma can cause irreversible visual impairment, and its incidence is higher than that of other ocular diseases in young patients. Past studies on ocular trauma have been limited in terms of small sample sizes, specific age groups, or a short period of assessment. Moreover, no studies have yet investigated the effects of changes in lifestyle during the coronavirus disease 2019 (COVID-19) pandemic on these trends. Therefore, we aimed to determine the yearly trends in the incidence of various ocular traumas over a 10-year period (2011–2020), and to evaluate the effects of the COVID-19 pandemic on these trends.

Methods: In this nationwide, population-based, cross-sectional study, we recorded the yearly number of patients diagnosed with hyphema and those who underwent open reduction surgery for orbital blowout fracture (BOF), primary closure of the cornea or sclera (PCCS), and intraocular foreign body (IOFB) removal.

Results: While the annual incidence of closed-globe injuries and PCCS decreased significantly in age groups less than 60 years over the past 10 years, the incidence of surgery for BOF and IOFB increased significantly in age groups greater than or equal to 60 years during the same period. When the 2020 data were compared with data from 2011–2019, hyphema showed the largest decrease (47.24%) in incidence among all ocular traumas, reaching significance in those ages less than 20 years (64.41%, P=0.004); the incidence of surgery for BOF also showed the largest decrease, in patients age less than 20 years. In the population age greater than or equal to 60 years, higher incidences of surgery for BOF and IOFB were observed (13.08% and 25.53%, respectively).

Conclusions: While the incidence of closed-globe injuries has decreased over the past 10 years in age groups less than 60 years, those age with more than 60 years have become more prone to serious ocular trauma. During the COVID-19 era, the incidence of closed-globe injuries fell markedly in patients younger than 20 years of the age, possibly due to social distancing which involved school closures and reduction in outdoor activities.

Keywords: COVID-19; incidence; ocular trauma; yearly trends

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Introduction

Ocular trauma is a major cause of severe visual impairment and blindness (1); 18 million people worldwide experience monocular blindness due to such injuries (2). Ocular trauma may cause irreversible visual impairment, and its incidence in younger patients is higher than that of other ocular diseases (2-5). Therefore, socioeconomic costs tend to be substantially higher on the patients (6).

Ocular trauma can be classified as either a closed globe injury or an open-globe injury (OGI), defined as a full-thickness disruption of the eye wall. To prevent severe intraocular infection, OGI wounds require prompt evaluation and appropriate treatments, such as primary closure of the cornea or sclera (PCCS) and/or intraocular foreign body (IOFB) removal (7,8).

Although ocular trauma can cause serious complications, most of them are preventable. Thus, well-designed epidemiological studies identifying trends in various types of traumas are essential to establish appropriate countermeasures (9,10). However, most previous reports on ocular trauma have enrolled only small populations, have focused on specific age groups (11,12), or the observation periods were too short to reveal trends (13).

During the coronavirus disease 2019 (COVID-19) pandemic, domestic schools were closed, the outdoor activity population decreased due to social distancing, and few companies implemented telecommuting. No study has yet explored the effects of changes in lifestyle during the COVID-19 pandemic on the trends in the incidence of ocular trauma.

Thus, we conducted this study to investigate the epidemiological features of, and trends in the major types of ocular trauma using data from the Korean National Health Insurance (NHI) claims database over the past 10 years. Additionally, we explored the effects of changes in lifestyle during the COVID-19 pandemic on these trends. We present the following article in accordance with the STROBE reporting checklist (available at https://atm.amegroups.com/article/view/10.21037/atm-22-2458/rc).

Highlight box

Key findings

- During the COVID-19 era, the incidence of closed-globe injuries fell markedly in patients younger than 20 years of age.

What is known and what is new?

- During the coronavirus disease pandemic, domestic schools were closed, the number of outdoor activities decreased due to social distancing, and few companies implemented telecommuting.
- Given the changes in lifestyle during the COVID-19 pandemic, the incidence of closed globe injuries showed the greatest decrease in patients age less than 20 years of age, while the incidence of surgeries for blow-out fracture and intraocular foreign body removal increased in patients aged 60 years and older.

What is the implication, and what should change now?

- As social distancing due to the COVID-19 pandemic ends, the incidence of ocular trauma can change, so prevention and education on ocular traumas are necessary.

Methods

Study design and database

A nationwide, population-based, cross-sectional study with data from the Korean NHI claims database from January 2011 to December 2020 was conducted. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the Institutional Review Board of St. Vincent's Hospital. Informed consent was waived due to the retrospective nature of this study. All Korean residents were enrolled in the Korean NHI system. All medical claims data nationwide is included in this data. We identified patients whose principal diagnoses or surgeries were attributable to hyphema (International Classification of Diseases, 10th revision code H210), reduction of orbital blow-out fracture (BOF, code S5211), PCCS (code S5380), or IOFB removal (codes S4891 and S4892) were identified. The number of patients diagnosed or treated for ocular traumas annually was recorded.

Statistical analysis

The incidence of ocular traumas by year, sex, and age group and compared the data and used the census data from Statistics Korea to this end was calculated. The Mann–Kendall test was employed to analyze incidence trends. The Chi-square test was used to compare the incidence of each type of ocular trauma between 2011–2019 and 2020. All data analyses were performed using the R software (version 3.6.1; R Development Core Team, Vienna, Austria).

Results

A difference in the incidence rates of ocular trauma over the

Table 1 Parameters obtained after Mann-Kendall analyses with yearly incidence rates during 2011–2020 for ocular traumas depending on age

Age (years)	Hyphema			Orbital blow-out fracture			Primary closure of cornea or sclera			Intraocular foreign body		
	Sen's slope	Kendall's τ	P value	Sen's slope	Kendall's τ	P value	Sen's slope	Kendall's τ	P value	Sen's slope	Kendall's τ	P value
<20	−1.739	−0.956	<0.001	−0.584	−0.956	<0.001	−0.050	−0.644	0.012	0.001	0.289	0.283
≥20 and <40	−0.931	−1.000	<0.001	−0.785	−0.867	<0.001	−0.053	−0.733	0.004	0.000	0.022	1.000
≥40 and <60	−1.083	−1.000	<0.001	−0.268	−0.867	<0.001	−0.074	-0.511	0.049	−0.008	−0.200	0.474
≥60	−0.600	−0.867	<0.001	0.183	0.778	0.002	0.007	0.111	0.721	0.031	0.778	0.002

past 10 years as a factor of both the type of ocular trauma and the patient's age was investigated. In groups of patients less than 60 years of age, the incidence of hyphema, BOF, and PCCS decreased significantly from 2011 to 2020. In patients aged more than 60 years old, the incidence of BOF and IOFB showed a significantly increasing trend, while that of hyphema showed a significant decrease (*Table 1*). The analysis of the changes in trends of ocular trauma during the COVID-19 pandemic showed a decrease in the incidences of hyphema, BOF, and PCCS in 2020 compared to that in years 2011–2019 (*Figure 1*). Most notably, the incidence of closed globe injuries decreased markedly in patients less than 20 years. As the total incidence of IOFB in 2020 increased by 15.10% compared to that in 2011–2019, the incidence of surgeries for BOF and IOFB increased in patients more than 60 years during the same period (*Table 2*).

Hyphema

From 2011 to 2020, the annual incidence (cases per 100,000 person-years) of hyphema declined steadily and significantly from 18.77 to 7.10 (τ=–1.000, P<0.001). Male patients showed a higher incidence than females through all the years. However, the incidence declined significantly over time in both genders (τ=–1.000, P<0.001 and τ=–1.000, P<0.001, respectively) (Figure 1A). All age groups exhibited gradual and significant decreases over the 10-year period (*Table 1*). This finding was most pronounced in patients less than 20 years. When the 2020 data were compared with those of 2011 to 2019, hyphema showed the largest decrease (47.24%) among all ocular traumas, particularly in patients less than 20 years [decline of 64.41% in 2020 (7.70) compared with 21.64 in 2011–2019, P=0.004] (*Table 2*, *Figure 2A*).

Orbital blowout fracture

The annual incidence rate of BOF surgery decreased from 12.43 to 8.74 between 2011 and 2020; this trend was significant (τ=–1.000, P<0.001). Male patients showed a higher incidence than females, but the incidence decreased significantly in both genders (τ=–0.956, P<0.001 and τ=–0.600, P=0.020) (*Figure 1B*). While other age groups showed significant and gradual decreases, the population aged more than 60 years old showed a significant increase in the incidence (*Table 1*). Patients ranged from 20 to 40 years of age had the highest incidence; however, this trend gradually fell from 17.42 in 2011 to 2019 to 13.45 in 2020. When the 2020 data were compared with those of 2011 to 2019, patients less than 20 years showed the greatest decrease from 8.51 to 4.91 (42.38%) (*Table 2*, *Figure 2B*).

Primary closure of the cornea or sclera (PCCS) and intraocular foreign body (IOFB) removal

We observed no significant trend in the annual overall incidence of PCCS (τ=–0.289, P=0.283). Male patients had a higher incidence than females. However, the incidence in males decreased significantly (τ=–0.556, P=0.031), while that in females showed an increasing trend (τ=0.289, P=0.283) (Figure 1C). Subjects more than 60 years had the highest annual incidence throughout the observation period. This trend decreased significantly in younger patients, but increased in patients more than 60 years, although a statistically significant difference was not attained (*Table 1*, *Figure 2C*). When the 2020 data were compared with those of 2011–2019, patients less than 20 years showed the greatest decrease, from 0.46 in 2011–2019 to 0.32 in 2020 (30.30%) (*Table 2*).

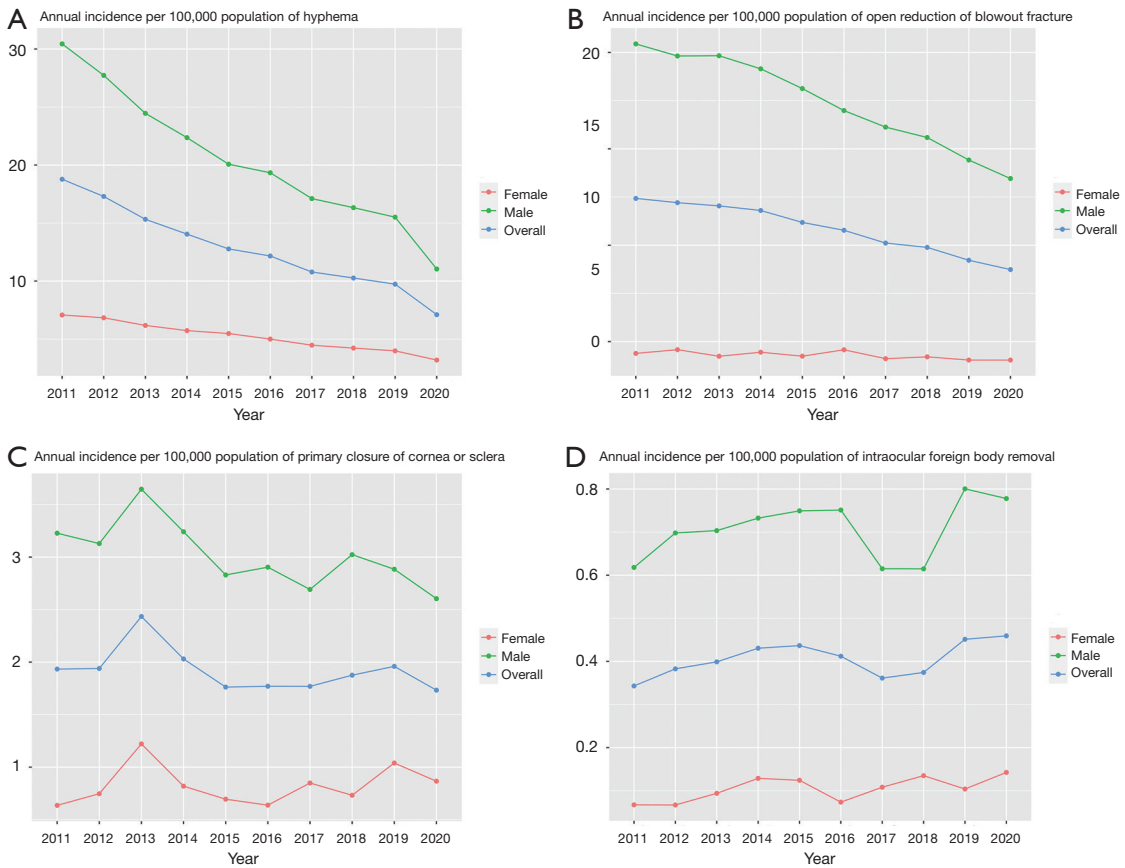

Figure 1 Yearly trends of different ocular traumas showing the annual incidences from 2011–2020. Compared with open globe injuries (C,D), the incidence of hyphema (A) and orbital blowout fractures (B) declined significantly over time. Males were more affected than females in all cases.

The annual incidence of IOFB removal increased from 0.34 to 0.46 (33.89%) between 2011 and 2020; however, this difference was not statistically significant (τ=0.467, P=0.074). Male patients exhibited a higher incidence than females in all years. Males showed no significant trend (τ=0.378, P=0.152), whereas female patients exhibited a significantly increasing trend (τ=0.511, P=0.049) over the years (*Figure 1D*). Patients aged 20–40 years had the highest incidence in 2011, but patients more than 60 years had the highest incidence in 2020 (*Figure 2D*). We found no significant trend in younger patients, but those older patients exhibited a significantly increasing trend (*Table 1*). When the 2020 data were compared with those from 2011 to 2019, patients more than 60 years showed an increase in the annual incidence [from 0.71 in 2011 to 2019 to 0.89 in 2020 (25.53%), whereas patients aged between 20 and 40 years showed a decrease [from 0.21 in 2011–2019 to 0.14 in 2020 (33.58%)] (*Table 2*).

Discussion

This nationwide population-based study revealed significantly decreasing trends in the incidence of ocular trauma cases, particularly hyphema and BOF, but no significant trends in OGI incidence from 2011 to 2020. The incidence of BOF and IOFB increased significantly in those age greater than or equal to 60 years. Subjects aged <20 years showed the greatest decrease in the incidence of closed globe injury in 2020 compared with that in 2011–2019. During the same period, patients aged ≥60 years showed an increase in the incidences of surgery for BOF and IOFB.

Among various ocular traumas, hyphema showed the greatest decrease from 2011 to 2020 (14). Hyphema is the most common ocular trauma; this condition shows a male and pediatric predominance (15,16), occurring principally in those aged 5–14 years during participation in sports (17).

Table 2 Incidences of ocular traumas in 2010–2019 and 2020

Incidences of ocular traumas	Age (years)	Incidence of 2010–2019 (/100,000 person-year)	Incidence of 2020 (/100,000 person-year)	P value
Hyphema	<20	21.64	7.70	0.004
	20≤ and <40	10.64	6.00	0.166
	40≤ and <60	12.18	6.98	0.147
	>60	10.95	8.06	0.384
	Total	13.46	7.10	0.087
BOF	<20	8.52	4.91	0.239
	20≤ and <40	17.42	13.45	0.306
	40≤ and <60	10.26	8.72	0.715
	>60	5.56	6.28	0.859
	Total	11.07	8.74	0.544
PCCS	<20	0.46	0.32	0.505
	20≤ and <40	1.06	0.78	0.920
	40≤ and <60	2.48	2.01	0.785
	>60	3.88	3.40	0.665
	Total	1.94	1.73	0.939
IOFB	<20	0.04	0.03	1.000
	20≤ and <40	0.21	0.140	0.637
	40≤ and <60	0.60	0.62	0.586
	>60	0.71	0.89	0.705
	Total	0.40	0.46	0.505

BOF, blow-out fracture; PCCS, primary closure of the cornea or sclera; IOFB, intraocular foreign body.

We found that, although the incidence was highest among all ocular traumas, the decline in the incidence was the sharpest. This may reflect recent safety and preventive measures. In addition, a decrease in outdoor activities due to the recent popularization of the use of smartphones and indoor games may be the cause of these results.

In agreement with our results, previous studies showed that BOFs caused by assaults, traffic accidents, and sports peaked in those aged 20–40 years (17-19). The rate of BOF surgery gradually and significantly decreased by 29.70% over the 10 study years; however, the overall incidence of PCCS and IOFB did not significantly change in the same period. PCCS and IOFB can cause permanent visual disturbances, endophthalmitis, traumatic cataracts, glaucoma, retinal detachment, and corneal opacity (20-22). Prevention of such injuries is the most desirable approach.

We found that the incidence of more serious ocular traumas, including BOF and IOFB increased significantly in the older population (aged more than 60 years old). The incidence of BOF increased by 35.46%, while that of IOFB increased by 58.95%. As life expectancy increases and physiological aging slows, older adults are becoming more socially active and are more likely to work (23). Although physiological functioning in the elderly is better now than in the past, physical deterioration and reaction delays are inevitable. We inferred that increased ocular trauma rates are associated with increased social participation. As older adults are particularly prone to occupational accidents, workplace safety requires greater attention (24,25).

The changes in lifestyle which occurred during the COVID-19 pandemic had the largest impact on the incidence of hyphema; in 2020, this rate was 47.23%

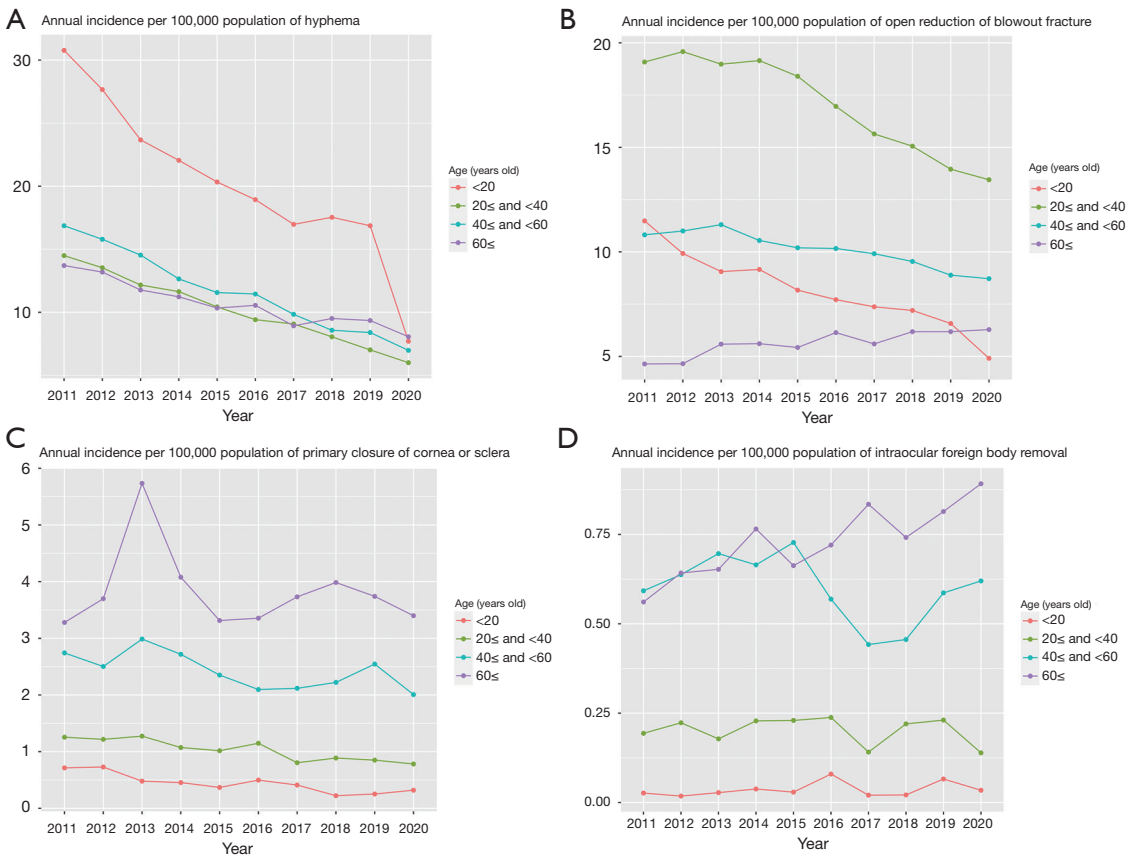

Figure 2 Yearly trends in the incidence of ocular traumas by age, from 2011–2020. (A) The decreasing hyphema incidence was most marked in individuals aged <20 years. (B) Although younger patients had a significantly decreased incidence of orbital blowout fracture, the reverse was true for those aged ≥60 years. (C) While younger patients showed a significantly decreased incidence of primary closure of the cornea or sclera, this was not seen for those aged ≥60 years. (D) Compared with other age groups, those aged ≥60 years showed a significant and gradual increase in the rate of intraocular foreign body removal.

less than that in 2011–2019. In contrast, the incidence of IOFB removal in 2020 was 15.10% higher than that in 2011–2019. In patients age less than 20 years, the incidence of hyphema dropped by 64.41%, BOF by 42.38%, and IOFB removal by 30.30%. Conversely, the incidence of IOFB increased by 3.8% in patients aged 40–60 years and by 25.55% in those aged ≥60 years in the same period. In Korea, the COVID-19 pandemic affected daily life in a variety of ways. Many domestic schools were closed and participation in outdoor activities decreased due to social distancing. Few companies applied telecommunicating to enable employees to work from home; while industries requiring on-field human labor continued field work despite the special circumstance of the pandemic. Therefore, in the COVID-19 era, while the young age group exhibited the greatest decline in ocular trauma, PCCS and IOFB did not.

Our study has several limitations which should be noted. First, due to the retrospective nature of the study, we could not identify the cause of trauma. Second, we inferred the incidence of BOF, PCCS, and IOFB removal based on the number of surgeries performed; therefore, the incidence may have been underestimated. As social distancing due to the COVID-19 pandemic ends, future studies are needed to search for further differences in the incidence of ocular traumas.

Conclusions

In this nationwide population-based cross-sectional study, we explored the incidence and yearly trends of four major types of ocular trauma from 2011 to 2020. Overall, we found that the incidence of closed-globe injuries and PCCS

decreased significantly in population groups age less than 60 years, while the incidence of BOF and IOFB increased significantly in those age greater than or equal to 60 years. Given the changes in lifestyle during the COVID-19 pandemic, the incidence of closed globe injuries showed the greatest decrease in patients age less than 20 years, while the incidence of surgeries for BOF and IOFB increased in patients age greater than or equal to 60 years.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://atm.amegroups.com/article/view/10.21037/atm-22-2458/rc

Peer Review File: Available at https://atm.amegroups.com/article/view/10.21037/atm-22-2458/prf

Conflicts of Interest: Both authors have completed the ICMJE uniform disclosure form (available at https://atm.amegroups.com/article/view/10.21037/atm-22-2458/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the Institutional Review Board of St. Vincent's Hospital. Informed consent was waived due to the retrospective nature of this study.

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