

Comparison of Ocular Trauma Between Normalized and The COVID-19 Epidemic Periods in China: A Multi-Center Cross-Sectional Study

Yaxin Zhang

Tianjin Medical University General Hospital

Kang Feng

Peking University Third Hospital

Mengyu Liao

Tianjin Medical University General Hospital

Hua Yan (✉ zyyyanhua@tmu.edu.cn)

Tianjin Medical University General Hospital

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Abstract

Background: To compare the feature of ocular trauma between normalized period and the COVID-19 epidemic period in China, to provide a scientific basis for prevention and control eye injuries in special times in future.

Methods: This study is a multi-center cross-sectional study with 30 participated hospitals involving the China Ocular Trauma Society members. All hospitalized cases who visited the ophthalmology department in participated hospitals with eye injuries during the normalized period (2019) and the COVID-19 epidemic period (2020) were included in this study. Demographic characteristic of cases, date of injury, sites and types of injury were collected.

Results: This study involved 13525 (61cases with both eyes) injured cases. There were 7269 (53.74%) eye-injured cases and 6256 (46.26%) eye-injured cases in 2019 and 2020 separately. Compared with 2019, the incidence of ocular trauma in retirees, housewives and unemployed increased with year-on-year of 4.96%, 102.67% and 11.64% among all occupations. In 2020, the incidence of eye injuries decreased in all injury sites except for an increase in home (30.29% year-on-year). The incidence of mechanical eye injuries decreased, while that of non-mechanical eye injuries (Chemical/Thermal/Radiation) increased (47.45% year-on-year). There were 255 (3.50%, 255/7269) and 376 (6.01%, 376/6256) non-mechanical injured cases in 2019 and 2020 (Pearson $\chi^2 = 47.33$, $P < 0.001$) separately.

Conclusions: During the COVID-19 epidemic period, the incidence of eye injuries decreased. The prevention and control measures should be focused on the non-mechanical injuries, and the retirees, unemployed and housewives during public events period in future.

Background

In December 2019, a novel Coronavirus (severe acute respiratory syndrome Coronavirus 2) rapidly spread in China and around the world^{1,2}. The disease was first described in late December of 2019 as viral pneumonia based on reports from Wuhan, China. It was named COVID-19 that arousing a new worldwide pandemic subsequently^{3,4}. In response to the COVID-19 outbreak, the Chinese government started nationwide measurements to prevent the spreading of infection at the end of January 2020. After a long time of practice, the epidemic in China has been brought under control. However, due to the COVID-19 specific properties and strong infective, China had undergone a period of epidemic lockdown management in 2020, and entered a special anti-epidemic period following the lockdown.

Previous publication have shown that the frequency and nature of accidents leading to severe ocular trauma have been affected by the on-going pandemic⁵. It's inevitable that there are different in the incidence and characteristics of China's ocular trauma under the Covid-19 epidemic period. Thus, we compared the characteristics of hospitalized patients records of ocular trauma in China in 2019 (normalized period) and 2020 (Covid-19 epidemic period) to explore the impact of the public health

emergency on the incidence of eye injuries in China, which will provide a scientific basis and new ideas for prevention and control eye injuries in special times in future.

Methods

The study conformed to the Declaration of Helsinki and was approved by the review board/ethics committee of Tianjin Medical University.

A multi-center cross-sectional study was performed to identify the impact of COVID-19 on the presentation of ocular trauma. All patients who presented to the Ophthalmology department and admitted to the hospital from 30 hospitals in 2019 (from 1st January to 31st December) and 2020 (from 1st January to 31st December) were included in the study. Those victims with less damaged, who did not require being hospitalized, were excluded. The outbreak in China began in December 2019, while China did not under the “lockdown period” for preventing the epidemic, so it can be considered that January 1st to December 31st, 2019 is a non-epidemic “normalized” stage. From January 1st to December 31st, 2020, China under the “lockdown stage” and a special anti-epidemic period for preventing and controlling the COVID-19 epidemic. So the year of 2020 was considered as “Covid-19 epidemic period”.

According to the geographical characteristics of China, we divided the area into seven geographical regions (Figure 1.). Namely, North China (including Beijing, Tianjin, Hebei, Shanxi, and Inner Mongolia Autonomous Region); East China (including Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, and Taiwan); South China (including Guangdong, Guangxi Autonomous Region, Hainan, Hong Kong Special Administrative Region, and Macau Special Administrative Region); Central China (including Henan, Hubei, and Hunan); Southwest China (including Chongqing, Sichuan, Guizhou, Yunnan, and Tibet Autonomous Region); Northwest China (including Shaanxi, Gansu, Qinghai, Ningxia Autonomous Region, and Xinjiang Autonomous Region); Northeast China (including Liaoning, Jilin, and Heilongjiang). Inner Mongolia Autonomous Region was included in Northwest China in the study, for most of the patients of the Affiliated Hospital of Inner Mongolia Medical University are coming from the west of Inner Mongolia.

In the study, we selected comprehensive tertiary A hospitals or eye specialist hospitals from 22 cities covering 20 provinces, municipality, and autonomous regions in China as the target hospitals that were listed after the article. Demographic and injured information of all cases were collected base on the hospitalized records, and were input into the electronic version of the Excel data frame. Subsequently, the research group summarized the collected data from the participated hospitals. Special personnel from the research team mark the missing and incorrect data information and then contact the registrars to retrieve the original case data. If the original medical record records are not detailed, the registrars contacted patients by telephone to supplement the information.

The statistical level of significance was preset at 0.05, and all the eligible data were analyzed using SPSS version 26.0 statistical software (SPSS Inc, Chicago, Illinois, USA), data collation and Figures were implemented using Excel (2016 version, Microsoft, Redmond, USA).

Results

Total 13525 (7269 cases in 2019, 6256 cases in 2020) injured cases from 30 participated hospitals were included in this study. There were 11129 (82.28%) male and 2396 (17.72%) female in them whose average age is 40.58 (SD 19.22) years old (0-94 years).

In terms of geographical distribution, the cases of eye trauma in 2019 are mainly concentrated in Central region of China (26.04%, n=1893), East of China (23.76%, n=1727), and North of China (23.74%, n=1726), followed by Southwest of China (14.18%, n=1031), Northwest of China (7.90%, n=574), Northeast of China (2.15%, n=156), and South of China (2.23%, n=162). In 2020, the overall distribution is similar, but the distribution have changed. The number of cases in Northern (30.05%, n=1880) and Northwestern (10.01%, n=626) regions separately increased 8.92% (year-on-year) and 9.06% (year-on-year) while the other areas appear different degree of decline. The number of cases in the Northeast, East and Central decreased significantly, separately decreased 64.74%, 30.57% and 24.46% (year-on-year) (Table 1. & Figure 2.).

Table 1. The regions in China of injured cases in the study.

Regions of China	2019		2020	
	N	(%)	N	(%)
Northeast	156	(2.15)	55	(0.88)
North	1726	(23.74)	1880	(30.05)
East	1727	(23.76)	1199	(19.17)
South	162	(2.23)	143	(2.29)
Central	1893	(26.04)	1430	(22.86)
Northwest	574	(7.90)	626	(10.01)
Southwest	1031	(14.18)	923	(14.75)

The hit map of China represent the increase and decrease in the number of cases, the lighter the color, the more it decreased year-on-year (Figure 2.).

In 2019, farmers (37.75%, n=2744), workers (17.97%, n=1306) and individual (10.14%, n=737) accounted for the main injured patients, while other occupations accounted for a less proportion (Table 2.).

Table 2. The occupation distribution of injured cases in the study.

Occupation	2019		2020	
	N	(%)	N	(%)
Retirees	121	(1.66)	127	(2.03)
Pre-school	554	(7.62)	509	(8.14)
Primary students	595	(8.19)	518	(8.28)
College/Postgraduate	85	(1.17)	29	(0.46)
Housewives	75	(1.03)	152	(2.43)
Workers	1306	(17.97)	1107	(17.70)
Farmers	2744	(37.75)	2472	(39.51)
Drivers	207	(2.85)	80	(1.28)
Staff member	629	(8.65)	430	(6.87)
Military policer	27	(0.37)	22	(0.35)
Individual	737	(10.14)	599	(9.57)
Unemployed	189	(2.60)	211	(3.37)

The same distribution continued in 2020, number of eye trauma cases declined in all occupations especially in college/postgraduate and staff members which went down year-on-year 65.88% and 31.64% separately. Number of eye trauma in retirees, housewives and unemployed rose year-on-year 4.96%, 102.67% and 11.64% respectively (Table 2.). In 2019, 40.39% (2936/7269) injured cases were woke-related injuries but the number had dropped to 36.32% (2272/6256) (Pearson $\chi^2 = 23.56$, $P < 0.001$) in 2020.

The proportion of eye injuries occurred at home increased to 28.53% (n=1785) in 2020, while that is 18.85% (n=1370) in 2019, and remains the highest of all known sites of injury. Data on eye injuries at other sites are presented in Table 3.

Table 3. The occurred sites of injury for cases in the study.

Occurred sites of injury	2019		2020	
	N	(%)	N	(%)
Industrial environment	1480	(20.36)	1123	(17.95)
Farmland	735	(10.11)	716	(11.45)
Construction site	1201	(16.52)	979	(15.65)
Street/Road	867	(11.93)	518	(8.28)
Public buildings	580	(7.98)	462	(7.38)
Sports venue	626	(8.61)	392	(6.27)
Home	1370	(18.85)	1785	(28.53)
Field	410	(5.64)	281	(4.49)

The majority of ocular trauma cases in 2019 are rupture (23.36%, n=1698), penetrating (28.60%, n=2079), contusion (15.82%, n=1150) and the similar happened in 2020 (rupture 23.16%, n=1449; penetrating 30.18%, n=1888; contusion 12.80%, n=801) (Table 4.).

Table 4. The injury type and sites of injury for cases in the study.

Type of injury	2019		2020	
	N	(%)	N	(%)
Rupture	1698	(23.36)	1449	(23.16)
Penetrating	2079	(28.60)	1888	(30.18)
Perforation	161	(2.21)	133	(2.13)
IOFB	728	(10.02)	607	(9.70)
Open globe mixture	191	(2.63)	188	(3.01)
Contusion	1150	(15.82)	801	(12.80)
Corneal lamellar & conjunctival injury	203	(2.79)	195	(3.12)
Severe eyelid injury	249	(3.43)	215	(3.44)
Chemical/Thermal/Radiation injury	255	(3.51)	376	(6.01)
Lacrimal duct injury	322	(4.43)	255	(4.08)
Orbital injury	233	(3.21)	149	(2.38)

IOFB, intraocular foreign body; FB, foreign body.

The incidence of mechanical eye injuries decreased in 2020, while that of non-mechanical eye injuries (Chemical/Thermal/Radiation) increase of 47.45% year-on-year. There were 255 (3.51%, 255/7269) and 376 (6.01%, 376/6256) non-mechanical injured cases in 2019 and 2020 (Pearson chi2 = 47.33, P < 0.001) separately (Table 4.).

Discussion

Since cases of COVID-19 were detected in December 2019, the COVID-19 epidemic has rapidly swept across countries around the world (<https://covid19.who.int>). To reduce the spread of the novel coronavirus, countries have promoted a range of unprecedented public health responses all over the world. These measures aim at reducing the speed and area of epidemic in order to decrease the acute pressure on the health-care system². Governments have restricted public life during the COVID-19 pandemic, inter alia closing social places such as sports facilities and gyms, pubs and restaurants⁶, which drastically reduced the amount of industrial and daily activities. For example, Americans were required to stay at home except to perform essential functions^{4, 7}. In Italy, the government ordered people to stay home, restricting movements with the exception of work, urgent matters and health reasons.⁸ Even after lockdown orders were lifted, many businesses, including gyms, remained closed due to social distancing requirements^{1, 9}.

China has taken the most comprehensive, rigorous, and thorough prevention and control measures since the beginning of the epidemic. A complete lockdown was imposed by the government in 2020 and continued for more than two months, and entered a special anti-epidemic period following the lockdown. People spent most of their time at home, and even when buying necessities, they were confined to restricted areas, often with limited numbers of people. Therefore, there was a series of significant changes in residents' work and daily living behavior in China in 2020. Thus, it is likely that the Covid-19 affect the incidence and characteristics of ocular trauma in China. Severe ocular trauma, while rare, carries a risk of significant morbidity to the patient¹⁰⁻¹³. Common reasons of injury are falls, alleged assaults, sporting injuries, and industrial accidents¹⁴. While prognosis is usually poor, the factors in determining the outcome is various such as the time elapsed between injury and primary repair¹⁵. Therefore, great attention should be taken to discover the characteristics of ocular trauma under COVID-19 epidemic period in China for future prevention, control and clinical treatment during serious public events in future.

During the COVID-19 epidemic period in 2020, the number of severe ocular trauma cases was less than that in 2019. This decrease is partially due to more eye injuries occur outdoors formerly. In China, the number of cases of eye trauma dropped significantly in Northeast, East, Southwest and Central regions of China after the COVID-19, while the number of cases increased in North and Northwestern regions of China (Figure 1. & Figure 2.). It may be due to the government's restrictions on population mobility, which resulted in the decline of the migrant population in developed cities, especially in East and Southeast regions. Northwest China is an inland area, so it is also the least affected area by the epidemic. Beyond

that, the tertiary class A comprehensive hospitals in Beijing, which belong to North of China, receive many complex eye injury cases from all over the country at any time. Similar to a comparative study where *Pellegrini et al.*⁸ studied the trends of ocular trauma during the pandemic in Italy, they found a striking 68.4% decrease in the number of eye injuries seen compared to the same period of the previous year.

When considering the influence of the occupation for ocular trauma, retirees and housewives are increased significantly (Table 2.), which may be because the prolonged indoor activities increase the risk of indoor eye trauma. In addition, many domestic services have been suspended due to the epidemic, leaving housewives to “do it themselves” that include some dangerous tasks such as changing light bulbs, dry cleaning clothes, replace fluorine in the air conditioner, and so on. At the same time, the proportion of work related injured cases in 2020 (36.32%, 2272/6256) is lower than that in 2019 (40.39%, 2936/7269), and there is statistically significant between them (Pearson $\chi^2 = 23.56$, $P < 0.001$), which confirmed that the “outdoor” eye injuries are decreasing while the “indoor” eye injuries are increasing. *Stedman et al.*¹⁶ also found that the number of serious ocular trauma cases was more than three times the average of the previous 5 years during the COVID-19 lockdown. This increase is partially due to more “do-it-yourself” injuries as people stayed at home, but also surprisingly an increase in falls, which also verified the results of our study in which retirees are often injured because of falls. Other researchers noted that patients with ocular trauma were more likely to have injuries at home and “do-it-yourself” or exercise during the COVID-19 pandemic¹⁷⁻¹⁹, those are consistent with the results observed in this study. What's more, the rate of injuries among unemployed people has increased, maybe due to the sharp rise in unemployment during the pandemic. The clearly declined incidence of eye injuries in workers, farmers, and drivers (Table 2.) maybe due to closed factories and reduced outdoor work following the Covid-19 outbreak. This can be verified in the results of the injured sites (Table 3.).

Corresponds to the previous result of this study, the home injury was the highest among all injury sites, proportion of injury site of “home” increased sharply in 2020 compared with 2019, which is the most noteworthy point for us. In the previous study of ocular trauma, increasing outdoor protection has always been the focus. However, under the epidemic situation, the home has become the site of a high incidence of eye injuries, reminding us that home protection is also important in future especially during major public health events like the COVID-19. Also, people are easily agitated due to the quarantine, which increases the possibility of a quarrel or even fight, so how to relieve psychological pressure during special period is worthy of exploring. In addition, more laboratory work has led to an increase in chemical injuries during lockdown from our study, which is the result of quarantine too. During the epidemic period, many students could not leave school, so experimental work became the first choice of many students, so laboratory safety education is particularly important. Lack of safety awareness will lead to a greater risk of injuries, such as sulfuric acid corrosion and gas explosion. This can be reflected through the composition ratio of the types of injury (Table 4.) in the study. Between 2019 and 2020, the distribution of mechanical eye trauma types has not changed much. However, the non-mechanical, mainly the chemical injury, increased obviously because of the reasons above. In this study, there were 255 (3.50%, 255/7269) and 376 (6.01%, 376/6256) non-mechanical injured cases in 2019 and 2020 (Pearson $\chi^2 = 47.33$, $P <$

0.001) separately. Although there are still more mechanical injuries during the epidemic, we cannot ignore a key point that non-mechanical injuries are increasing during the Covid-19 period.

The limitation to this article is that this study is a hospital based cross sectional study, the subjects representativeness is not so well compared with community-based survey. But the results can reflect the current status of ocular trauma in China. Besides, the participated hospitals are not randomized selected, all of them are the China Ocular Trauma Society members. However, the patients tend to choose a comprehensive tertiary A hospitals or specialist eye hospitals for treatment. Furthermore, the primary hospitals treated patients with the first-stage surgery and then transferred patients to the higher-level comprehensive or specialized hospitals for the second-stage surgery, which is features of medical treatment in China and also affected by China's national conditions.

Conclusions

The COVID-19 pandemic will continue and recur for a long time in the future^{2,9}, it is bound to change the medical mode, and the prevention and treatment mode of ocular trauma during public events periods in future²⁰⁻²². Effective measures should be carried out to response for the Covid-19 epidemic. The findings of this study suggest that under the epidemic period, the retirees and housewives should be paid more attention. Besides, more prevention and control measures should be focused on the non-mechanical injuries during serious public events period in future.

Declarations

Ethics approval: The study conformed to the Declaration of Helsinki and was approved by the review board/ethics committee of Tianjin Medical University.

Consent for publication: Not applicable.

Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

competing interests: The authors declare that they have no competing interests.

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Both figures were created by the author of this article using Excel (2016 version, Microsoft, Redmond, USA).

Statement: According to the requirements of the Ethics Committee of Tianjin Medical University, this study is a retrospective study and does not include the names of patients, so there is no need to apply for ethics.

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Figures

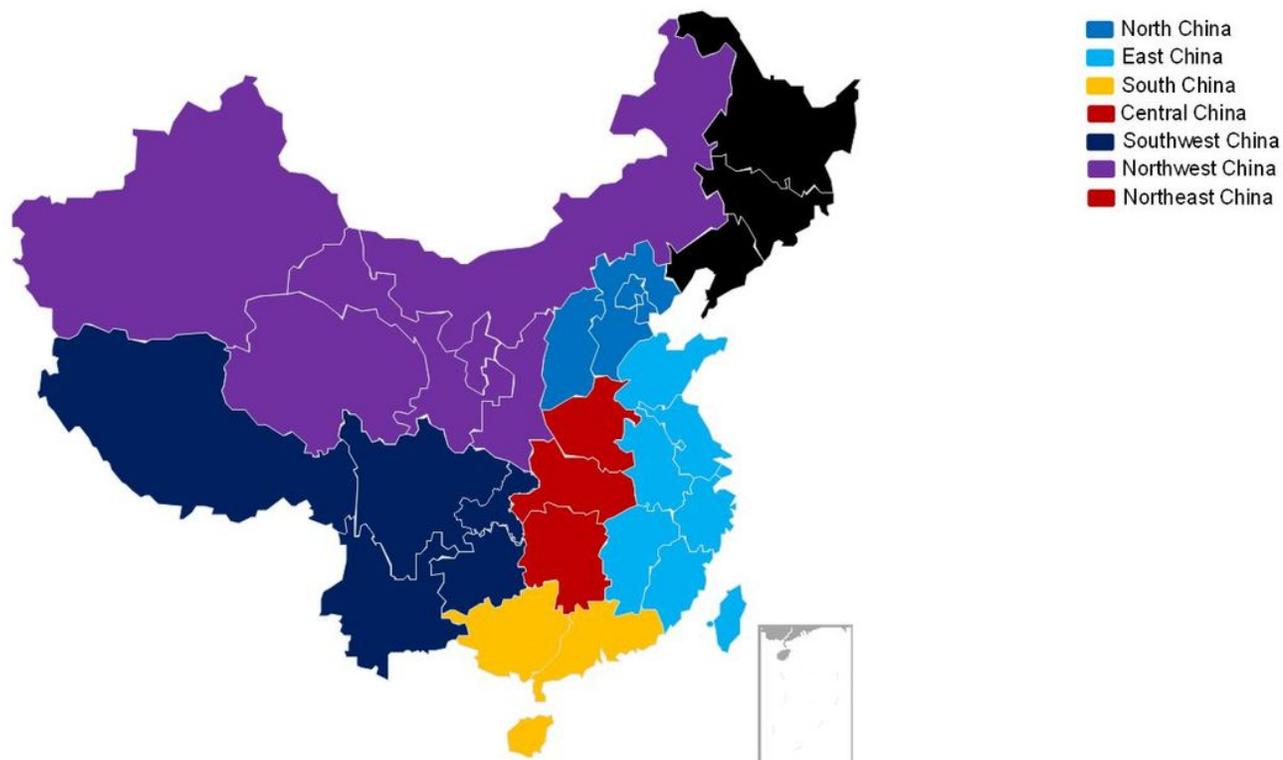


Figure 1

China is divided into seven regions in this study, the white lines are provincial administrative divisions, different colors represent different regions.



Figure 2

The injured cases increased from 2019 to 2020 in Northwest and North of China, and that of other regions decreased. More lighter color means more reduction.