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ORIGINAL RESEARCH

Viral Conjunctivitis Rates Unchanged Before and During the COVID-19 Pandemic in an Ophthalmology Clinic

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Background: Millions of acute conjunctivitis cases occur in the United States annually. The impact of COVID-19 mitigation practices on viral conjunctivitis incidence within ophthalmology clinics has not been reported. We hypothesized that viral conjunctivitis rates would decrease with implementation of such practices.

Methods: A retrospective chart review was conducted at a single academic center's ophthalmology clinics. Electronic health record data was queried using ICD-10 diagnostic codes to include 649 patients aged 2–97 with viral, bacterial, or allergic conjunctivitis diagnosed either before (6/1/2018–5/1/2019) or during (6/1/2020–5/1/2021) COVID-19 precautions. Conjunctivitis rates per ophthalmology clinic visit were compared using rate-ratio analysis. Logistic regression evaluated the effects of age, sex, and race among those with conjunctivitis.

Results: A total of 66,027 ophthalmology clinic visits occurred during the study period. Viral conjunctivitis rates per visit did not significantly change after enacting COVID-19 mitigation strategies, but allergic conjunctivitis rates significantly increased (viral: RR 0.82, 95% CI 0.51 to 1.31, p=0.408; allergic: RR 1.70, 95% CI 1.43 to 2.03, p<0.001). When controlling for time, younger age (≤ median age 55) (p=0.005) and Caucasian race (p=0.009) were associated with higher viral conjunctivitis frequency.

Conclusion: Contrary to trends reported in emergency departments, viral conjunctivitis rates within an ophthalmology clinic did not significantly change after COVID-19 mitigation strategies, though allergic conjunctivitis rates increased. Patients' avoidance of emergency departments during the pandemic may have contributed. Further investigation is required to explore variation in ophthalmology patient populations and needs based on care setting.

Plain Language Summary: A retrospective review included 649 patients with viral, bacterial, or allergic conjunctivitis diagnosed at a single center's ophthalmology clinics before (6/1/2018–5/1/2019) or during (6/1/2020–5/1/2021) COVID-19 precautions. Contrary to emergency department experiences, viral conjunctivitis rates did not significantly change after COVID-19 precautions. However, allergic conjunctivitis rates significantly increased. Conjunctivitis presentation in ophthalmology clinics differed from that reported in emergency departments, warranting further evaluation of variation in patient needs by setting.

Keywords: viral conjunctivitis, allergic conjunctivitis, conjunctivitis transmission, COVID-19, COVID-19 precautions

Introduction

Approximately 6 million cases of acute conjunctivitis occur in the United States annually, with a viral etiology of up to 80%.[1] Most conjunctivitis-causing viruses are transmitted through hand-to-eye contact, and adenovirus is the primary pathogenic culprit of viral cases.[2] Infectious tears, ocular discharge, fecal matter, and respiratory droplets may promote transmission through direct and indirect eye contamination.[3] COVID-19 transmission occurs via similar mechanisms, and measures for reducing its spread are commensurate to those intended to reduce transmission of viral conjunctivitis.

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Recommended practices include proper hand hygiene, surface cleaning, social isolation, and the use of personal protective equipment.[4,5] Public health measures aimed at reducing transmission of COVID-19 have been associated with a reduction in incidence of respiratory viruses, as well as the number of emergency department (ED) encounters for viral conjunctivitis.[6–8]

The mean number of weekly ED visits significantly decreased with the onset of the COVID-19 pandemic, as the landscape and utilization of healthcare in the United States drastically changed.[9] The majority of pre-pandemic ED visits (75%) were characterized as non-emergent, allowing for a substantial decline in ED presentation as deterrence from potential COVID-19 exposure grew.[10] Of note, ocular trauma patients were significantly more likely to have delayed presentation to the ED during the COVID-19 pandemic compared to prior.[11]

Early in the COVID-19 pandemic, outpatient ophthalmologic care for non-emergent cases rapidly decreased with implementation of restrictive regulations and recommendations.[12] As ophthalmology practices gradually lifted restrictions, a significant rebound in outpatient visits occurred in both academic and private practices.[13] Differences in visit trends do, however, exist within ophthalmologic care based on factors such as location, patient population, and academic versus private practice setting. For example, when compared to academic centers, private practices had a faster next available appointment for cataract evaluations and greater availability to see patients with flashes and floaters during the pandemic.[14]

We investigate pre-pandemic versus pandemic incidence and etiology of conjunctivitis within an academic center's ophthalmology clinics, as the impact of COVID-19 mitigation practices on these metrics has not been reported.

To better understand the disinfection and precaution measures implemented at the site studied, the University of Minnesota ophthalmology facility practices are described here. In the initial weeks of COVID "lock downs", outpatient facilities were closed for all elective care due to limited personal protective equipment (PPE) and unknown risk to medical staff. The consult policy was adjusted to provide emergent and urgent consults only. For all COVID suspected or confirmed patients, providers were required to wear eye protection, masks, two pairs of gloves and two gowns. Consult requests were triaged by the physician on-call and deemed emergent if felt to pose "immediate risk of vision loss" or urgent if "critical diagnostic impact of ophthalmic care cannot be delayed by greater than 6 hours".

After normal outpatient care was reinstated, all patients were required to answer COVID screening questions when scheduling appointments and checking in for examination. Patients were required to present alone, practice social distancing of 6 feet, wear masks, and practice universal hand hygiene. Common water fountains and coffee machines were decommissioned. Universal hand hygiene was continued by all clinic staff, social distancing was required, and nonclinical personnel were transitioned to work from home. PPE was provided as it became available, including but not limited to: protective eyewear, paper masks for all providers, N95 or equivalent protection for aerosolizing procedures, barrier screens at the front desk and on slit-lamps. Throughout the pandemic, the clinic, hospital, and surgical center followed recommendations from the Minnesota Department of Health and the Center for Disease Control.

Prior to COVID mitigations listed above, the clinic had no restrictions on patient guests, spacing in waiting areas, or requirements for patient hand hygiene. All providers were required to practice universal hand hygiene.

Materials and Methods

Our retrospective chart review examined conjunctivitis incidence at the University of Minnesota ophthalmology clinics between June 2018 and May 2021. It was approved by the local ethics committee of the University of Minnesota and followed the tenets of the Declaration of Helsinki to involve no greater than minimal risk to subjects and thus meet waiver from the informed consent process. Utilizing information and data exchange services through Clinical and Translational Science Institute (CTSI) Best Practices Informatics Consulting, electronic health record (EHR) data was queried using ICD-10 diagnostic codes to identify patients diagnosed with viral, bacterial, or non-chronic allergic conjunctivitis. Cases were recorded to occur in one of two groups: prior to COVID-19 infectious precautions (6/1/2018–5/1/2019) and during COVID-19 infectious precautions (6/1/2020–5/1/2021) as instituted in the state of Minnesota. Patient demographics, diagnostic code, and date of first conjunctivitis diagnosis were recorded. Cases with nonspecific conjunctivitis ICD-10 codes were manually reviewed and included if confirmed to be nonchronic viral, bacterial, or allergic. Patients with a conjunctivitis diagnosis identified in both the pre-COVID-19 and COVID-19 time

periods were excluded by cross-checking patient IDs between the pre-COVID and COVID time periods and removing all duplicated IDs to ensure no double records between the time periods. Patient IDs within each time period were also checked to ensure there were no double records within one time period.

Query was run using Oracle to identify the total number of ophthalmology clinic visits from the EHR for each time period. The dataset generated was de-identified and exported prior to statistical analysis. Patients' demographic characteristics were summarized as medians and interquartile ranges (IQRs) for continuous variables, and frequencies and percentages for categorical variables. Between the pre-COVID and COVID period, Wilcoxon Rank Sum and Chi-square tests were used for comparison of continuous and categorical characteristics, respectively. Rates of viral, bacterial, and allergic conjunctivitis per 1000 clinic visits were calculated and compared using rate-ratio analysis and reported with the 95% confidence interval (CI) and the p-value derived from the chi-square test. Potential confounding variables (age at diagnosis, sex, and race) were compared between the pre-COVID and COVID time periods, and no significant differences were identified. Therefore, the rate-ratio analysis remained univariate without adjusting for other variables. Selecting conjunctivitis diagnoses only, multivariable logistic regression with adjustment for time period was used to determine the effect of age at diagnosis, sex, and race on odds of viral conjunctivitis diagnosis. We adjusted for time period by incorporating the binary time variable into the logistic regression models in addition to the demographic variables. Race categories were consolidated to Caucasian or Non-Caucasian in order to improve the statistical power of this analysis. The statistical analysis was performed using SAS version 9.4 (SAS Institute, Inc., Cary NC). A p-value less than 0.05 was considered statistically significant.

Results

A total of 66,027 ophthalmology clinic visits occurred during the study period (34,468 pre-COVID-19 and 31,559 during COVID-19). 649 patients were identified to have viral, bacterial, or allergic conjunctivitis (267 pre-COVID-19 and 382 during COVID-19), after removing 63 patients who were identified in both periods. Demographics information for all included patients is outlined, including comparison between the two time periods (Table 1). Viral conjunctivitis rates did not significantly change after enacting COVID-19 mitigation strategies (RR 0.82, 95% CI 0.51 to 1.31, p=0.408). In

Table 1 Summary of Demographic Characteristics

	All Patients (N=649)	Pre-COVID (N=267)	COVID (N=382)	P-value
Sex				0.954
– Female	425 (65.5%)	174 (65.2%)	251 (65.7%)	
– Male	224 (34.5%)	93 (34.8%)	131 (34.3%)	
Age at diagnosis (years)				0.327
– Median (IQR)	56 (38, 68)	57 (38, 70)	55 (38, 67)	
Race[a] (binary)				0.452
– Caucasian	403 (62.1%)	168 (62.9%)	235 (61.5%)	
– non-Caucasian	163 (25.1%)	70 (26.2%)	93 (24.3%)	
– Unknown	83 (12.8%)	29 (10.9%)	54 (14.1%)	
Race				0.205[b]
– White	401 (61.8%)	166 (62.2%)	235 (61.5%)	
– American Indian or Alaska Native	10 (1.5%)	2 (0.7%)	8 (2.1%)	
– Asian	40 (6.2%)	20 (7.5%)	20 (5.2%)	
– Black or African American	113 (17.4%)	48 (18%)	65 (17%)	
– Multiracial	2 (0.3%)	2 (0.7%)	0 (0%)	
– Unknown	83 (12.8%)	29 (10.9%)	54 (14.1%)	
Ethnicity				0.287
– Hispanic or Latino	26 (4%)	14 (5.2%)	12 (3.1%)	
– Not Hispanic or Latino	515 (79.4%)	213 (79.8%)	302 (79.1%)	
– Unknown	108 (16.6%)	40 (15%)	68 (17.8%)	

Notes: [a]Patients whose self-identified race are White or including White are categorized into Caucasian group. [b]Fisher's exact test was used to compare between pre-COVID and COVID period due to small cell sizes.

Table 2 Conjunctivitis Diagnoses per 1000 Ophthalmology Clinic Visits

Conjunctivitis Type	Study Time Period	# of Diagnoses	Total Visits	Rate per 1000 Visits	Rate Ratio	95% CI	P-value
Viral	Pre COVID-19	40	34,468	1.160	0.82	0.51, 1.31	0.408
	During COVID-19	30	31,559	0.951			
Bacterial	Pre COVID-19	17	34,468	0.493	1.16	0.60, 2.24	0.667
	During COVID-19	18	31,559	0.570			
Allergic	Pre COVID-19	207	34,468	6.006	1.70	1.43, 2.03	<0.001
	During COVID-19	323	31,559	10.235			

Note: Rate ratios of conjunctivitis diagnoses per 1000 ophthalmology clinic visits between two study time periods.

contrast, allergic conjunctivitis diagnosis rates significantly increased between time periods (RR 1.70, 95% CI 1.43 to 2.03, p<0.001). There was no significant change in bacterial conjunctivitis rates between time periods (RR 1.16, 95% CI 0.60 to 2.24, p=0.667) (Table 2).

The effect of age at diagnosis, race, and sex on likelihood of viral conjunctivitis was calculated using logistic regression. With adjustment for the time period, the likelihood of viral conjunctivitis was higher in younger ages (p=0.005). However, a significant interaction between time period and age at diagnosis was observed (p=0.030). Dividing by the median age, the 70 viral events were dichotomized into younger age≤55 (n=40) and older age>55 (n=30). Odds of younger patients compared to older patients presenting with viral conjunctivitis declined during COVID-19 mitigation (OR 3.0 pre-COVID-19 vs OR 0.6 during COVID-19).

In analyzing the effects of race on odds of viral conjunctivitis, Caucasian race was associated with higher likelihood of viral conjunctivitis diagnosis compared to non-Caucasians (p=0.009) after adjusting for the time period. There was a significant interaction with the time period (p=0.044), showing Caucasians to be 5.1 times more likely than non-Caucasians to have viral conjunctivitis pre-COVID-19 and only 1.1 times more likely during COVID-19. The likelihoods of viral conjunctivitis in non-Caucasian patient populations were too low for logistical regression analysis of individual groups. Analysis of sex revealed no difference in incidence of viral conjunctivitis (p=0.457).

Discussion

Viral conjunctivitis incidence within a single tertiary care ophthalmology clinic did not significantly change between the pre-COVID-19 and COVID-19 study time periods, in contrast to emergency department experiences. Consistent with changes seen across several other specialties, the total number of outpatient ophthalmology clinic visits at this single center's clinics decreased between the study time periods. However, it is reasonable that patients in need of ophthalmologic care were more likely to seek care at outpatient clinics rather than emergency departments in the midst of the pandemic. An increased likelihood of presentation to outpatient ophthalmology clinics compared to emergency departments or urgent care centers likely offset a decrease in viral conjunctivitis rates that was expected as a result of precautions aimed at reducing COVID-19 transmission. The summation of such possibilities and behaviors may explain the non-significant decrease in viral conjunctivitis rates observed between the two time periods.

Allergic conjunctivitis rates significantly increased between the two study periods. It is possible that patients experienced prolonged exposure to both indoor and outdoor allergic conjunctivitis triggers as a result of the effort to quarantine and limit social interaction. As the outdoors were a primary setting for physical activity, leisure, and social interaction for many during the pandemic, outdoor allergic triggers were likely present at increasing rates and duration to the general public during that time. Additionally, pet ownership and increased remote work rates likely contributed to prolonged exposure to indoor allergens such as pet dander, dust, mold, and mites. Patients needing ophthalmologic care for allergic conjunctivitis during the COVID-19 pandemic would, too, be more likely to seek care at an outpatient facility rather than at an emergency department.

Younger age (≤55) was associated with significantly higher odds of a viral conjunctivitis diagnosis pre-COVID-19 but not during COVID-19. When assessing the effect of time period separately for younger and older ages, there was a substantial decrease in viral etiology during COVID-19 for younger patients compared to a slight increase in viral etiology for older patients. While multifactorial, variation in odds of viral etiology based on age may be related to participation in higher-risk behavior by younger individuals and a decrease in such behaviors during the pandemic, in some part due to the vast majority of businesses and events having been closed or canceled for prolonged periods of time. The behaviors referenced include but are not limited to: interaction with young children, attendance at crowded events, restaurants, and bars, and interaction with other individuals of the same age group, further compounding this risk. It has been found that with advancing age, there was a decrease in protective measures such as hand-washing or covering a cough and an increase in risk-taking behaviors such as leaving isolation.[15] Additionally, older individuals may have uniquely faced increased exposure to spread of communicable diseases within nursing homes or assisted living facilities.

Caucasian race was associated with significantly higher odds of viral etiology both pre-COVID-19 and during COVID-19, though this association was less pronounced during COVID-19. Though racial discrepancies and inequalities in health care are well-recognized, further investigation is needed to better understand potential disparities in access to and use of ophthalmologic care during the pandemic.

There were several limitations to this study. As a single-center study assessing outpatient ophthalmology cases, our sample size was limited. Specifically, logistic regression assessing the effect on demographic factors such as race, ethnicity, sex, and age would have benefitted from a larger sample size. Accuracy of ICD coding errors could have contributed to over-inclusion or under-inclusion of patients, as ICD-10 coding was not confirmed for each individual patient encounter. Findings from our single academic center may not be generalizable to other practice types or geographical regions.

Conclusions

In summary, we found that contrary to emergency department experiences, viral conjunctivitis rates in a single tertiary care outpatient ophthalmology clinic did not decline due to pandemic mitigation strategies. In addition, the rates of allergic conjunctivitis visits increased during the pandemic compared to a similar pre-pandemic time period.

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None of the sources of funding support had any role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Ethics Approval and Informed Consent

This work was approved by the local ethics committee of the University of Minnesota and followed the tenets of the Declaration of Helsinki to involve no greater than minimal risk to subjects and thus meet waiver from the informed consent process.

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Disclosure

The authors report no conflicts of interest in this work.

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