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Burden of ocular infections in the Andaman Islands, India: An overview of clinical and epidemiological factors from 2017-2021

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ABSTRACT

Purpose: To know the burden of infectious and non-infectious agents associated with ocular infection in pre pandemic and Covid-19 pandemic period with special emphasis on clinical presentation.

Materials and Methods: Demographic, clinical and associated comorbidities, details were collected from the patients presenting to the ophthalmologist in Andaman Islands from August 2017- August 2021. Collected data were statistically computed by using STATA v15.1(Stata Corporation, College Station, TX, USA).

Results: Ocular infections were found in 50.6% of 10,519 kerato-conjunctivitis patients. The highly affected cohort was aged 31 to 40 years (20.10%). No significant gender distribution difference was seen. Among 70% of cases unilaterality was common. The main clinical complaints were erythema (47.5%), lacrimation (41.2%), and pruritus (26.5%). 32.9% had discomfort, and 10% reported decreased eyesight. Additionally, 1,321 of 5,319 patients were using glasses. Additionally, 9.8% (520 people) had hypertension and 9.3% had diabetes. This investigation identified significant clinical and demographic changes during the COVID-19 pandemic.

Conclusion: This study contributes to improved prevention, control strategies and enhances diagnostic accuracy by analysing diverse clinical-epidemiological factors of keratoconjunctivitis in Andaman Islands.

1. Introduction

Ocular infections are a significant public health concern with implications for both individual well-being and broader healthcare systems. The delicate nature of the eye and its susceptibility to various pathogens and environmental factors make ocular infections a complex and diverse field of study. These infections can range from mild cases of conjunctivitis to severe corneal ulcers, potentially leading to vision impairment or even blindness. The Andaman Islands, located in the Bay of Bengal, represent a unique setting to study ocular infections due to their distinct geographical and climatic characteristics. With a population of nearly 380,000 people residing on around 500 islands, this region provides an opportunity to explore the interplay between environmental factors, individual susceptibility, and infectious agents in the context of ocular health. The emergence of the COVID-19 pandemic further complicates the landscape of ocular infections. The SARS-CoV-2 virus, responsible for COVID-19, has been associated with ocular symptoms such as conjunctivitis and eye irritation. Understanding the prevalence and impact of

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COVID-19-related ocular issues within the specific context of the Andaman Islands is of paramount importance for both immediate patient care and long-term public health planning.

Diagnosing ocular infections in the laboratory is challenging due to the complexity of the eye. Conditions like uveitis, iritis, and chorioretinal cellulitis are considered sterile, while conjunctivitis, dacryocystitis, blepharitis, canaliculitis, preseptal, and septal cellulitis are non-sterile.[1] Eye infections are categorized into outer eye infections affecting susceptible structures and inner eye infections affecting protected structures. Outer eye infections can be easily sampled through swabs for detection, whereas inner eye infections cannot be reached by swabs. These infections can be induced by environmental factors or the patient's microbiome. Both endogenous (systemic) and exogenous (environmental or microbiome-related) factors can cause inner eye infections.[2]

The thin, transparent conjunctiva covering the sclera and inner eyelids remains largely unchanged.[1] Inflammation in the eye can lead to conjunctivitis, which can either develop as a primary symptom or secondary to other conditions.[3] Conjunctivitis has infectious and non-infectious causes, with viruses and bacteria being the primary culprits for infectious cases. Non-infectious conjunctivitis includes various types like allergic, toxic, cicatricial, immune-mediated, and neoplastic-related.[4] The severity and speed of spread determine whether the condition is acute, hyper-acute, or chronic.

Infectious conjunctivitis is highly contagious and a public health concern. Key clinical indicators include "red eye" (conjunctival hyperemia) affecting the bulbar and/or palpebral/tarsal conjunctiva, often accompanied by discomfort and discharge.[3,4] Given the recognizable clinical signs, extensive testing is usually unnecessary.[3] Most cases are viral, caused by Adenovirus, Herpes simplex virus, and enterovirus, resulting in bilateral watery eye inflammation linked to contact with infected individuals.[4–7] Symptoms can include redness, itching, discharge, conjunctival injection, pre-auricular lymphadenopathy, and follicular inflammation.[8,9] Bacterial conjunctivitis, primarily caused by organisms like Staphylococcus aureus, Streptococcus pneumoniae, and Haemophilus influenzae, tends to affect a single eye and displays purulent discharge and matting.[3,4] Neisseria gonorrhoeae-induced conjunctivitis is particularly dangerous, especially in infants and sexually active adults.[10–12] Chlamydia trachomatis-related keratoconjunctivitis leads to trachoma, a sight-threatening infection causing corneal scarring and blindness. The SAFE global initiative aims to combat trachoma through interventions like surgery, antimicrobials, hygiene practices, and environmental improvements.[13]

In the Andaman and Nicobar Islands, a group of islands in the Bay of Bengal, this study presents the clinical-epidemiological pattern of keratoconjunctivitis. By analysing data from a referral hospital in South Andaman, the study contributes to understanding this ocular infection and improving prevention and control strategies. The analysis involves assessing diverse disease presentations to gauge changes in the clinical spectrum and enhance diagnostic accuracy. In this study, we aim to provide a comprehensive analysis of the epidemiological patterns, clinical manifestations, and potential risk factors associated with ocular infections on the Andaman Islands. By examining both infectious and non-infectious causes, we seek to elucidate the factors driving the occurrence of ocular infections and their implications for the local population. Furthermore, we will explore the impact of the COVID-19 pandemic on the landscape of ocular infections, shedding light on potential shifts in patterns and priorities. Through a thorough investigation of the prevalence and characteristics of ocular infections, we aim to contribute valuable insights to the field of ocular health, inform healthcare policies, and guide future research efforts. This study not only addresses immediate health concerns but also lays the groundwork for proactive measures to mitigate the impact of ocular infections and ensure optimal eye health in the Andaman Islands and beyond.

2. Materials and Methods

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Human Ethical Committee of ICMR- Regional Medical Research Centre, Port Blair, Andaman and Nicobar Islands, India for the project entitled "A multi-centric hospital-based study on epidemiology of Keratoconjunctivitis in India". (RMRC/IEC/2017/06).

The Andaman and Nicobar Islands consist of more than 500 islands, situated in the Bay of Bengal between 92° and 94° East longitude and 6° and 14° North latitude. Among these islands, 38 are inhabited, with a total population of 379,944 individuals.[14] This study focuses on the population of the Andaman Islands.

This study involves a hospital-based observational analysis of individuals with clinically suspected ocular complications who sought care at the Agarwal Eye Care Centre in the Andaman Islands.

The primary criteria to suspect conjunctivitis encompassed patients visiting the ophthalmologist due to the presence of redness, watering, or discharge in one or both eyes.

2.1. Informed consent statement

Informed consent was obtained from all subjects involved in the study.

2.2. Data collection

The data from hospital were gathered like general information from the subjects, encompassing aspects such as residence, onset season, clinical presentations, gender (male or female), age (across all age groups), symptom onset, recent travel history (within the last 14 days), and any existing co-morbidities (e.g., Diabetes Mellitus, Hypertension, Thyroid conditions).

2.3. Observational metrics

The epidemiological characteristics of acute infectious conjunctivitis (AIC), including symptom onset, age distribution, seasonal trends, and clinical manifestations, were subjected to analysis. The collected general data were examined to identify potential risk factors influencing the occurrence of acute infectious conjunctivitis.

Before analysis, data were meticulously examined for potential duplicates, outliers, and logical consistency. The statistical computations were conducted using STATA v15.1 (Stata Corporation, College Station, TX, USA). Descriptive analysis was used to summarize patient characteristics, presenting outcomes as frequencies and percentages. The association between factors and the presence of viral and/or bacterial infections before and after COVID-19 was explored using the Fishers exact and Chi-square test. To assess the trend of viral and bacterial infection over time, the Dickey-Fuller unit root test was used to verify time independence. Additionally, the influence of COVID-19 interruptions on infection diagnosis was assessed using interrupted time series analysis. All statistical tests were two-tailed, with a significance level set at alpha = 0.05.

3. Results

Comprehensiveexamination of general epidemiological characteristics: Over the duration spanning August 2017 to August 2021, a total of 10,533 instances of acute infectious conjunctivitis (AIC) were reported. Among these, 10,519 patients were investigated for kerato-conjunctivitis, revealing that 49.4% (5,200 individuals) exhibited no specific keratoconjunctivitis-related symptoms. Of the remaining cases, 50.6% showed signs of potential ocular infections. Further scrutiny indicated that the primary causative agent was non-infectious in nature, accounting for the majority (78.8%) of cases. Out of 1,129 cases suspected of having infectious ocular infections, 84.2% were attributed to viral origin, 32.6% to bacterial origin, and 18% displayed an association with both viral and bacterial etiologies (Chart 1).

Commonalities and disparities in suspected cases: Among the total 5,319 suspected cases, the age group of 31-40 exhibited a disproportionate share (20.10%) during the study period. Gender distribution showed no significant difference, with females comprising a slightly higher percentage (50.3%). While there was no statistically significant dissimilarity between left and right eye presentations, unilateral cases were more prevalent. Predominant clinical features associated with suspected cases included redness (47.5%), eye-watering (41.2%), and itching (26.5%). Pain was reported by 32.9% of patients, while blurred vision was experienced by 10% of all suspected cases. Additionally, 1,321 out of 5,319 patients had a history of wearing glasses, 520 (9.8%) had hypertension, 9.3% had diabetes mellitus, and only 2.4% suspected ocular infections displayed cataracts. Nearly half of the total cases sought consultation from an optometrist within a week of symptom onset (Table 1).

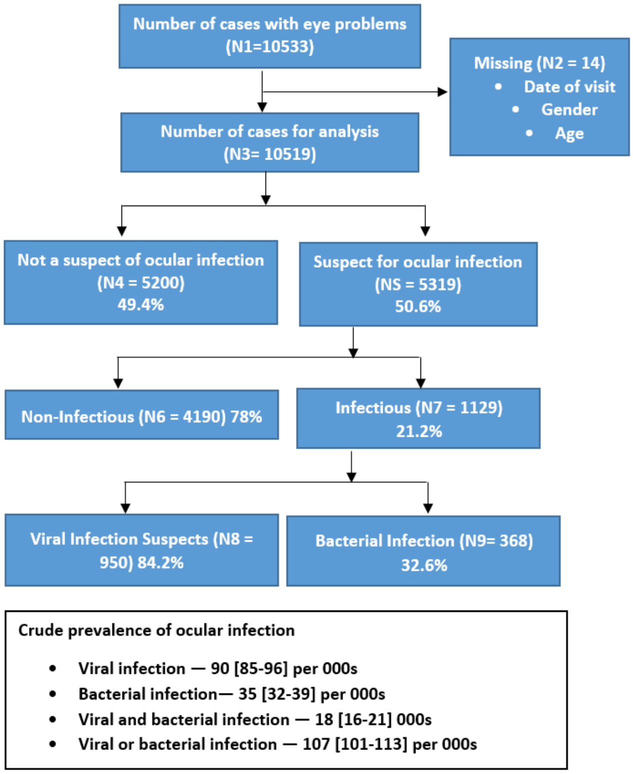

Chart 1: The flowchart showing the classification of the study participants

Table 1: Association of demographic and clinical factors with the pre and post-COVID observations

	Pre-Covid [n=4401]		Post-Covid [n=918]		Total [n=5319]	
	n	%	N	%	n	%
			Age (in Years)			
≤10	657	14.9	89	9.7	746	14.0
11-20	552	12.5	75	8.2	627	11.8
21-30	874	19.9	180	19.6	1,054	19.8
31-40	872	19.8	197	21.5	1,069	20.1
41-50	644	14.6	159	17.3	803	15.1
51-60	466	10.6	119	13.0	585	11.0
61-70	238	5.4	75	8.2	313	5.9
>70	98	2.2	24	2.6	122	2.3
P-value<0.001						
Gender of the Participant						
Male	2,171	49.3	472	51.4	2,643	49.7
Female	2,230	50.7	446	48.6	2,676	50.3
P-value=0.250						
Visited Year						
2017	588	13.4	0	0.0	588	11.1
2018	1,961	44.6	0	0.0	1,961	36.9
2019	1,590	36.1	0	0.0	1,590	29.9
2020	262	6.0	419	45.6	681	12.8
2021	0	0.0	499	54.4	499	9.4
P-value<0.001						
Eye Involvement						
Not Assigned	397	9.0	59	6.4	456	8.6
Left Eye	1,211	27.5	273	29.7	1,484	27.9
Right Eye	1,169	26.6	266	29.0	1,435	27.0
Both Eye	1,624	36.9	320	34.9	1,944	36.5
P-value = 0.020						
Pain						
No	3,008	68.3	559	60.9	3,567	67.1
Yes	1,393	31.7	359	39.1	1,752	32.9
P-value<0.001						
Redness						
No	2,325	52.8	465	50.7	2,790	52.5
Yes	2,076	47.2	453	49.3	2,529	47.5
P-value = 0.230						
Discharge						
No	3,886	88.3	795	86.6	4,681	88.0
Yes	515	11.7	123	13.4	638	12.0
P-value = 0.150						
Watering						
No	2,584	58.7	546	59.5	3,130	58.8
Yes	1,817	41.3	372	40.5	2,189	41.2
P-value=0.669						
Headache						
No	4,051	92.0	847	92.3	4,898	92.1
Yes	350	8.0	71	7.7	421	7.9
P-value = 0.823						
FB Sensation						
No	4,071	92.5	842	91.7	4,913	92.4
Yes	330	7.5	76	8.3	406	7.6

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Table 1 continued

P-value = 0.418						
Itching						
No	3,323	75.5	589	64.2	3,912	73.5
Yes	1,078	24.5	329	35.8	1,407	26.5
P-value<0.001						
Irritation						
No	3,786	86.0	846	92.2	4,632	87.1
Yes	615	14.0	72	7.8	687	12.9
P-value<0.001						
Blurry Vision						
No	3,983	90.5	803	87.5	4,786	90.0
Yes	418	9.5	115	12.5	533	10.0
P-value = 0.005						
Onset of Symptoms						
Not Assigned	555	12.6	157	17.1	712	13.4
≤1 Week	2,260	51.4	463	50.4	2,723	51.2
2 Week	330	7.5	79	8.6	409	7.7
3 Week	149	3.4	30	3.3	179	3.4
4 Week	4	0.1	1	0.1	5	0.1
5-6 Week	328	7.5	38	4.1	366	6.9
7-8 Week	177	4.0	36	3.9	213	4.0
>8 Week	598	13.6	114	12.4	712	13.4
P-value = 0.001						
Hypertension						
No	3,967	90.1	832	90.6	4,799	90.2
Yes	434	9.9	86	9.4	520	9.8
P-value = 0.647						
Diabetes Mellitus						
No	3,998	90.8	826	90.0	4,824	90.7
Yes	403	9.2	92	10.0	495	9.3
P-value = 0.412						
Cataract						
No	4,296	97.6	893	97.3	5,189	97.6
Yes	105	2.4	25	2.7	130	2.4
P-value = 0.547						
Ocular Infection						
No	3,480	79.1	710	77.3	4,190	78.8
Yes	921	20.9	208	22.7	1,129	21.2
P-value = 0.243						
Viral Infection						
No	3,627	82.4	742	80.8	4,369	82.1
Yes	774	17.6	176	19.2	950	17.9
P-value =0.254						
Bacterial Infection						
No	4,098	93.1	853	92.9	4,951	93.1
Yes	303	6.9	65	7.1	368	6.9
P-value=0.832						

% - Column Percentage; Source: Secondary Data Collection

Table 2: The factors associated with the viral and bacterial Infections

	Total		Viral Infection		Bacterial Infection	
	N	**%**	**n**	**%**	**n**	**%**
Age (in Years)						
≤10	166	14.7	116	12.2	80	21.7
11-20‘	133	11.8	114	12.0	38	10.3
21-30	264	23.4	238	25.1	63	17.1
31-40	222	19.7	177	18.6	83	22.6
41-50	162	14.3	145	15.3	45	12.2
51-60	109	9.7	98	10.3	32	8.7
61-70	55	4.9	48	5.1	19	5.2
>70	18	1.6	14	1.5	8	2.2
p-Value			<0.001		<0.001	
Gender of the Participant						
Male	651	57.7	558	58.7	193	52.4
Female	478	42.3	392	41.3	175	47.6
p-Value			0.092		0.014	
Visited Year						
2017	112	9.9	86	9.1	43	11.7
2018	420	37.2	341	35.9	168	45.7
2019	334	29.6	301	31.7	74	20.1
2020	143	12.7	125	13.2	39	10.6
2021	120	10.6	97	10.2	44	12.0
	p-Value		0.001		<0.001	
Eye Involvement						
Not Assigned	91	8.1	77	8.1	32	8.7
Left Eye	344	30.5	292	30.7	91	24.7
Right Eye	353	31.3	311	32.7	102	27.7
Both Eye	341	30.2	270	28.4	143	38.9
	p-Value		0.014		<0.001	
Pain						
No	646	57.2	533	56.1	231	62.8
Yes	483	42.8	417	43.9	137	37.2
	p-Value		0.081		0.009	
Redness						
Yes	1,129	100.0	950	100.0	368	100.0
	p-Value		NA		NA	
Discharge						
No	761	67.4	761	80.1	0	0.0
Yes	368	32.6	189	19.9	368	100.0
	p-Value		<0.001		<0.001	
Watering						
No	179	15.9	0	0.0	179	48.6
Yes	950	84.1	950	100.0	189	51.4
	p-Value		<0.001		<0.001	
Headache						
No	1,099	97.3	926	97.5	359	97.6
Yes	30	2.7	24	2.5	9	2.4
	p-Value		0.529		0.759	
FB Sensation						
No	1,060	93.9	886	93.3	352	95.7
Yes	69	6.1	64	6.7	16	4.3
p-Value			0.043		0.085	

Continued on next page

Table 2 continued

Itching						
No	829	73.4	702	73.9	273	74.2
Yes	300	26.6	248	26.1	95	25.8
	p-Value			0.413		0.689
Irritation						
No	1,001	88.7	838	88.2	335	91.0
Yes	128	11.3	112	11.8	33	9.0
	p-Value			0.27		0.081
Blurry Vision						
No	1,069	94.7	896	94.3	354	96.2
Yes	60	5.3	54	5.7	14	3.8
p-Value				0.202		0.116
Onset of Symptoms						
Not Assigned	89	7.9	77	8.1	23	6.3
≤1 Week	799	70.8	674	70.9	272	73.9
2 Week	92	8.1	76	8.0	35	9.5
3 Week	28	2.5	22	2.3	9	2.4
5-6 Week	42	3.7	36	3.8	11	3.0
7-8 Week	21	1.9	17	1.8	6	1.6
>8 Week	58	5.1	48	5.1	12	3.3
	p-Value			0.957		0.201
Hypertension						
No	1,050	93.0	884	93.1	343	93.2
Yes	79	7.0	66	6.9	25	6.8
	p-Value			0.879		0.852
Diabetes Mellitus						
No	1,040	92.1	874	92.0	336	91.3
Yes	89	7.9	76	8.0	32	8.7
	p-Value			0.737		0.481
Cataract						
No	1,107	98.1	929	97.8	362	98.4
Yes	22	1.9	21	2.2	6	1.6
p-Value				0.142		0.591

% - Column Percentage; Source: Secondary Data Collection

Association of infectious factors during the COVID-19 period: Analysis unveiled notable shifts in clinical and demographic characteristics during the COVID-19 period. The age group most affected shifted to 31-40 (21.5%), as compared to the pre-pandemic distribution where 19.9% and 19.8% belonged to the 21-30 and 31-40 age groups, respectively. Furthermore, the male gender exhibited a higher impact during the COVID-19 period, whereas females were predominantly affected before the pandemic. Unilaterality remained a prevailing trend in both periods. Redness saw an increase during coronavirus pandemic (49.3%) compared to the pre-COVID period (47.2%). Eye-watering showed a decrease of 1% during the pandemic (41.3% pre-COVID). Remarkably, itching experienced a significant surge of approximately 11% during the COVID-19 period. Blurred vision, reported in 9.5% of cases before COVID, increased to 12.5% during the pandemic. Moreover, around half of the total suspected cases sought consultation from an ophthalmologist within a week of symptom onset in both periods. Despite fluctuations, the prevalence of hypertension, diabetes mellitus, and cataracts remained approximately 10%, 10%, and 2.7%, respectively, across both study periods. Notably, the COVID-19 period exhibited a higher association of viral and bacterial infections (Table 1).

3.1. Characteristics analysis of infectious agent-associated ocular infections

Among 1,129 cases associated with infectious agents, 950 were indicative of viral infections. Within this subset, the age groups 21-30 (23.4%) and 31-40 (19.7%) showed the highest prevalence. A similar pattern emerged in cases suspected to be viral in nature. Males exhibited a higher susceptibility to infectious agent-related eye infections (57.7% for all infectious agents, and 58.7% for viral infections). The presentation trend of unilateral cases persisted in both infectious agent-associated cases and suspected viral cases. Although both eyes were affected, a slightly higher incidence was observed in the right eye (32% versus 31%) (Table 2).

3.2. Clinical spectrum

Eye redness was a universal feature across all cases, irrespective of the causative agent, while eye-watering was noted in 84.1% of all cases and 100% of suspected viral cases. Discharge was more common in bacterial infections (100%) compared to viral infections (19.9%). Itching was observed in approximately 26.1% of cases with viral origin and 25.8% in bacterial infections. Eye pain was reported in 42.8% of all infectious agent-related cases, rising slightly to 43.9% in suspected viral cases and lowering to 37.2% in bacterial cases. Additionally, viral-associated cases displayed a higher prevalence of blurred vision (5.7%) compared to infectious agent-associated cases (5.3%) (Table 2).

3.3. Co-morbidities associated

Among the 950 suspected viral cases, 70% sought medical attention within a week. Approximately 6.9% had hypertension, 2.2% had cataracts, and 8% had diabetes mellitus. Similar patterns were observed in cases suspected of bacterial infections, with co-morbidities reported as 6.8% for hypertension, 8.0% for diabetes mellitus, and 1.6% for cataracts (Table 2).

3.4. Interrupted time deries trend analysis

The analysis of ocular infections indicated stationary processes for both viral and bacterial infections from August 2017 to August 2021, according to the Dickey-Fuller test for unit roots (Figure 1). However, the data showcased an increase in ocular infection rates during both the first and second waves of COVID-19. Notably, the second wave exhibited a higher prevalence of bacterial infections compared to viral infections, peaking in May and June 2021 (Figure 1).

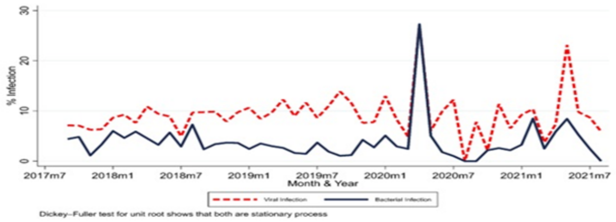

Figure 1: A time series graph showing the trends of the bacterial and viral infections observed over a period

3.5. Viral infection

The pre-COVID-19 period exhibited an ascending trend in viral ocular infections, which changed during the COVID-19 period, resulting in a 0.17% decrease in infection rates (Figure 2 - Graph A).

3.6. Bacterial infection

Trend analysis from August 2017 to August 2021 indicated a decline of 0.17% in bacterial infections. This trend remained consistent both pre and post-COVID-19 (Figure 2, Graph B).

4. Discussion

The ocular surface hosts a diverse microbial community that can be beneficial, but certain pathogens in the environment can lead to extensive infections with potentially severe clinical consequences.[15] Patients may experience either

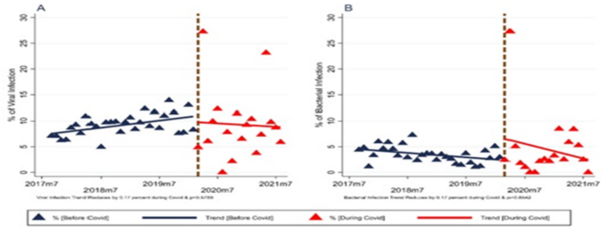

Figure 2: Interrupted time series graphs with the data points are plotted and the combination of trend lines and counterfactual allows visualization of the change in level from counterfactual to post-Covid trend as well as the change in slope. The timing of the interruption is indicated by a vertical line where Graph – A shows Viral Infection and Graph – B shows Bacterial Infection

corneal ulcers (keratitis) or conjunctivitis, depending on whether the infection affects the cornea or the conjunctiva.[15]

Conjunctivitis, whether infectious or non-infectious, frequently affects the ocular surface. Bacteria such as Streptococcus pneumoniae, Haemophilus influenzae, and viruses like Adenovirus are the primary pathogens responsible for infectious conjunctivitis.[4] In our study, around 20% of cases were linked to infectious agents, including bacteria or viruses. However, a significant portion of patients who were evaluated for possible ocular infections exhibited eye issues unrelated to infectious agents. The evolutionary cocktail of biological and immunological components comprising the eye's first line of defence plays a critical role in resolving ocular infections. Failure to appropriately manage infections can result in compromised visual acuity and severity, potentially leading to vision loss. The interaction between microbial virulence and the host stress response profoundly influences the morphological and functional consequences of ocular surface infections.[16]

In our study the prevalence of ocular infections was found to be 21.2% which were linked to any infectious agent. Additionally, male (57.7%) was more affected as compared to female. A study from Beijing, China (2011–2019) also reported the similar prevalence with the higher proportion of male (56.3%).[17] However, in late 2019, COVID-19 emerged in Wuhan, China, rapidly spreading worldwide.[18] Within a year, over 1.4 million global deaths were attributed to the disease.[19] Both humans and animals have exhibited ocular side effects due to the SARS-CoV-2 virus. Ocular symptoms experienced by COVID-19 individuals include conjunctivitis, anterior uveitis, retinitis, erythema, and optic neuritis.[20] COVID-19 patients frequently manifest ocular symptoms such as dry eyes, conjunctival hyperemia, congestion/conjunctivitis, ocular pain, irritation/itching/burning sensation, and a foreign body sensation.[21] In our study, Redness was observed the most common clinical presentation during coronavirus pandemic (49.3%) compared to the pre-COVID period (47.2%). However, SARS-CoV-2-related ocular infections are less common compared to adenovirus or influenza viruses.[20] Ocular abnormalities have been observed in 2% to 60% of SARS-CoV-2 cases.[22,23] In a study of 103 clinically confirmed SARS-CoV-2 patients, 21% exhibited eye involvement.[20] Another study reported that 64.8% of COVID-19 patients had at least one eye symptom, with prevalence correlating with disease severity.[22] Similarly, our study observed elevated cases of viral and bacterial eye infections during both the pandemic peaks with the unilaterality as the major factor. This may be attributed to mild COVID-19 exposure among the patients.

The distinctive climatic conditions, geography, and lifestyle on the Andaman Islands may contribute to the widespread occurrence of eye infections in the local population. Many participants in our study reported conjunctival hyperaemia, likely resulting from prolonged sunlight exposure. Research suggests that ocular infections are linked to heat and UV light. The past five years, starting from 2016, have marked the warmest globally on record.[24] The escalating global temperature due to climate change has adverse health effects, including an increased prevalence of ocular conditions such as corneal issues, cataracts, glaucoma, and retinal problems.[25–27] High temperatures are associated with a greater occurrence of bacterial, fungal, and amoebic keratitis, which can cause significant ocular discomfort and even threaten vision.[28–30] An inflammatory response in the eye involving increased levels of cytokines like IL-1 and IL-6 has been linked to thermal energy exposure near the eye.[31] Damage to the eye's thermal structures can be attributed to elevated corneal temperature due to environmental factors and an overall rise in body temperature associated with adapting to warmer climates.[32]

Raising public awareness about potential risk factors and preventive measures against vision loss and sunlight-induced damage is crucial. Additionally, given the perception of ocular infections as a neglected condition, routine eye health surveys are vital for the Andaman population. Symptoms resembling eye allergies may actually be indicative of infectious agent-related ocular issues. Therefore, proper surveillance and laboratory diagnosis are imperative to address the complications arising from ocular infections.

Our comprehensive analysis of ocular infections on the Andaman Islands highlights the complex interplay between infectious agents, environmental factors, and individual health. Ocular infections, whether caused by viruses or bacteria, pose a significant health concern. Our study revealed that a considerable portion of suspected ocular infections were not attributable to infectious agents, underscoring the need for accurate diagnosis and proper management. The emergence of COVID-19 brought additional challenges to the realm of ocular health. While ocular symptoms associated with COVID-19 were observed, they remained relatively less frequent compared to other viral infections. The shifts in infection patterns during the COVID-19 peaks emphasize the intricate relationships between infectious diseases and the larger healthcare landscape. Climate change, as evidenced by rising temperatures, has been identified as a potential contributing factor to the prevalence of ocular infections. The association between high temperatures and ocular discomfort underscores the need for heightened awareness and protective measures, particularly in regions like the Andaman Islands.

Future prospects in ocular health encompass a multifaceted approach. Public education campaigns focusing on the risks of ocular infections and the importance of timely diagnosis and treatment are essential. Regular eye health surveys could provide valuable insights into the evolving dynamics of ocular infections and their underlying causes. Additionally, collaboration between ophthalmologists, epidemiologists, and environmental experts is crucial to better understand the connections between climate change and ocular health, allowing for more targeted interventions and preventive strategies. Incorporating advanced diagnostic techniques, such as molecular and genetic analyses, could enhance our understanding of ocular infections and their origins. Moreover, ongoing research into the interactions between microbial virulence and host responses is essential for developing effective therapeutic interventions. As the world faces ongoing challenges posed by infectious diseases and climate change, our study underscores the importance of a holistic approach to ocular health. By integrating medical, environmental, and public health efforts, we can strive to minimize the impact of ocular infections and ensure a brighter future for eye health in the Andaman Islands and beyond.

5. Conclusion

Ocular infections among the population of the Andaman Islands involve a complicated interaction of infectious organisms, environmental variables, and ocular health. Most of the cases were suspect to have the association of infectious agents but by analyzing the data majority of cases found to have the association of non-infectious agents, underscoring the need for accurate diagnosis and treatment. COVID-19 elevated the ocular health complications. Though rare, COVID-19 caused eye symptoms which were similar to the infectious in origin. The complex link between infectious diseases and healthcare is shown by COVID-19 peak infection trends in this study. Rising climate change temperatures, pollution etc., may also be responsible to cause eye infections. Proper surveillance and diagnosis is needed in the Andaman Islands because extreme temperatures might cause ocular pain, one of the clinical manifestation among the cases of ocular infection. Regular eye exams can reveal ocular infection dynamics and causes in more detail. Ophthalmologists, epidemiologists, and environmentalists must work together to study how climate change affects ocular health and develop better treatments and prevention. Molecular and genetic analyses can further help the researchers to explain the actual cause of eye infections. Additioanlly, understanding the microbial pathogenicity and host responses is essential for effective treatment. A comprehensive ocular health strategy is needed despite viral diseases and climate change, according to the study. Integrated medical, environmental, and public health actions can minimize ocular infections and improve eye health in the Andaman Islands and beyond.

6. Source of Funding

None.

7. Conflicts of Interest

The authors declares that they have no competing interests.

8. Author's Contributions

Conceptualization and study design were contributed by N.B. and N.M. Data and sample collection were performed by N.B. Data analysis, interpretation and critical evaluation were all contributed by N.B., N.M., B.S. and K.N. Manuscript writing and review were done by all the authors. All authors reviewed the manuscript.

9. Availability of Data and Materials

The data that support the findings of this study are not openly available due to reasons of sensitivity and are available from the corresponding author upon reasonable request.

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