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Original Article

Microbiological Profile of Ocular Infection: A Large Retrospective Study

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Abstract

Background: We aimed to elucidate the pathogenic bacterial and fungal profiles of specimens obtained from suspected ocular infections at Farabi Eye Tertiary Referral Hospital, Tehran, Iran.

Methods: In this cross-sectional study, we collected data from ocular specimens taken during the seven-year period of 2011 to 2018, and the results were then retrospectively analyzed. Samples had been obtained from patients who were investigated for ocular infections.

Results: Overall, 16,656 ocular samples were evaluated. The mean patient age was 48.31 ± 26.62 years. Most patients were men (60.33%), and men in the 7th decade of life were the largest represented group. The seasonal distributions of specimen collection sites followed the overall distribution of collection sites by year. Specimens obtained from the cornea were the most common (49.24%), also representing the largest number of specimens in all seasons. The most commonly isolated fungal microorganisms were *Fusarium* spp., followed by *Aspergillus* spp. and *Candida albicans*. Of the 6,556 specimens with positive bacterial cultures, 59% produced gram-positive bacteria, while the remainder produced gram-negative pathogens. The most commonly isolated bacteria were *Pseudomonas aeruginosa* (17.77%), *Staphylococcus epidermidis* (13.80%), *Streptococcus pneumoniae* (13.27%), *S. viridans* (12.23%), and *S. aureus* (11.18%).

Conclusion: Most submitted specimens were obtained from the cornea. The most commonly isolated fungal microorganisms were *Fusarium* spp., followed by *Aspergillus* spp. and *C. albicans*. The most commonly isolated bacteria were *P. aeruginosa*, followed by *S. epidermidis* and *S. pneumoniae*.

Keywords: Microbiological profile; Ocular infection; Bacterial; Fungal; Eye; Ocular specimen

Introduction

Ocular microbial infections are usually superficial; however, infection may spread to other ocular tissues. Alterations in the ocular surface commensals can cause infections such as blepharitis, keratitis, conjunctivitis, canaliculitis, orbital cellulitis, and endophthalmitis (1-4). Multiple microorganisms

may be involved in a specific ocular infection entity. Understanding the ocular microbial profile can lead to a more appropriate management strategy (5-9). If ocular infections are untreated, severe morbidities may arise. Isolation of the offending microorganisms is essential, as patterns vary with geographic location (9-16). In addition to geographical variations, temporal trends are likely to influence the etiology of ocular infections (4). Therefore, causative pathogen profiles must be updated regularly to inform a rational approach and proper management of potentially sight-threatening infections.

We aimed to determine the spectrum of responsible bacterial and fungal agents in patients with suspected ocular infections referred to Farabi Eye Tertiary Referral Hospital, Tehran, Iran.

Methods

In this retrospective, cross-sectional study, we assessed the bacterial and fungal profiles of ocular specimens received by the microbiological laboratory of Farabi Eye Hospital, Tehran, Iran, from Mar 21, 2011, to Dec 22, 2018. Retrieved data included patient age, sex, hospitalization status at the time of specimen collection, specimen collection sites, gram stain reports, and culture results.

The study was approved by the Ethics Committee of Tehran University of Medical Sciences, Tehran, Iran (Code: IR.TUMS.FARABIH.REC.1400.017) and complied with the tenets of the Declaration of Helsinki.

Farabi Eye Hospital is the largest eye hospital in Iran, and many patients from all regions of the country, both rural and urban, are referred (17). Study specimens were obtained from the cornea, conjunctiva, eyelid, and lacrimal drainage system, as well as from contact lens solutions, foreign bodies, buckles, and implants using a disposable #15 blade, bent needle, or disposable sterile swab. Intraocular specimens, such as vitreous humor, aqueous humor, or any specimen taken in the operating room, were contained inside the syringe and transferred to the laboratory for further investigation.

Heat-fixed smears were prepared on alcohol-cleansed microscope slides for smear and gram staining, with inoculations performed onto three culture media, including blood agar, chocolate agar, and Sabouraud's dextrose agar, unless otherwise specified by the ophthalmologist-in-charge. If necessary, we used other, more specific culture media on a case-by-case basis.

Data were initially collected using Microsoft Excel 2016 and were then entered into IBM SPSS Statistics for Windows (version 20.0; IBM Corp., Armonk, NY, USA) for analysis. In the final analysis, we excluded patients aged less than one year. Descriptive statistics are used to present data such as sex, hospitalization status, frequency of bacterial and fungal isolates in both smear and culture, specimen collection sites, and seasonal distribution. Data are presented as frequency (percentage), and mean (standard deviation).

Results

We included the microbiology laboratory registry of 16,656 patients over the seven-year study period. The mean age (± standard deviation) was 48.31 ± 26.62 years, and men accounted for 60.33% of patients. Most specimens were obtained from the 60–69-year age group (13.62%) (Table 1). Table 2 lists the specimen collection sites. Most specimens were obtained from the cornea (49.24%), also accounting for the largest number of specimens in all seasons (ranging from 43.88% of specimens in winter to 51.83% in summer). Of the 8,201 cornea specimens, only 600 (7.3%) were accompanied by a sample of contact lens solution. No documentation was available to confirm that all patients had presented their contact lens cases for sampling over the entire study period. Therefore, we could not conclude that in more than 90% of keratitis cases, the patient had a non-contact lens-related risk factor. Conjunctiva and vitreous humor were most commonly sampled after the cornea (Table 2), a consistent pattern when considering seasonal distributions of specimens (specimens from conjunctiva and vitreous humor ranged from 15.19% in fall to 19.91% in

winter and from 12.87% in spring to 14.58% in winter, respectively). The seasonal distributions of specimen collection sites followed the same order as the overall distribution of collection sites by year.

Table 1: Age and Sex of 16,656 Participants whose ocular specimens were submitted to the Microbiological Laboratory of Farabi Eye Hospital, Tehran, Iran

Age Group (yr)	***N (%)***
1–9	2,211 (13.27)
10–19	462 (2.77)
20–29	1,738 (10.43)
30–39	2,258 (13.56)
40–49	1,563 (9.38)
50–59	1,600 (9.61)
60–69	2,269 (13.62)
70–79	2,197 (13.20)
80–89	1,930 (11.59)
≥ 90	428 (2.57)
Sex	N (%)
Female	6,607 (39.67)
Male	10,049 (60.33)
Total, n (%)	16,656 (100.00)
Mean ± standard deviation of age	48.31 ± 26.62 Years

Table 2: Collection sites and culture results of 16,656 ophthalmic specimens submitted to the Microbiological Laboratory of Farabi Eye Hospital, Tehran, Iran

Microbiology Specimen Collection Sites	***N (%)***	***Culture***		
		No Growth	Bacteria	Fungi
Cornea	8,201 (49.24)	4,780 (58.29)	2,782 (33.92)	639 (7.79)
Conjunctiva	2,876 (17.27)	1,179 (40.99)	1,687 (58.66)	10 (0.35)
Vitreous humor	2,336 (14.02)	1,612 (69.00)	682 (29.20)	42 (1.80)
Aqueous humor	1,667 (10.01)	1,359 (81.52)	293 (17.58)	15 (0.90)
Contact lens solution	600 (3.60)	91 (15.17)	505 (84.16)	4 (0.67)
Lacrimal drainage system	299 (1.79)	96 (32.11)	199 (66.55)	4 (1.34)
Non-specified	248 (1.49)	124 (50.00)	115 (46.37)	9 (3.63)
Lacrimal sac	210 (1.26)	39 (18.57)	169 (80.48)	2 (0.95)
Eyelid ulcer	133 (0.79)	47 (35.34)	84 (63.16)	2 (1.50)
Orbit	27 (0.16)	14 (51.85)	13 (48.15)	0 (0.00)
Foreign body	26 (0.16)	20 (76.92)	5 (19.23)	1 (3.85)
Orbital Implant	26 (0.16)	7 (26.92)	18 (69.23)	1 (3.85)
Buckle	6 (0.04)	1 (16.67)	4 (66.66)	1 (16.67)
Dermoid cyst	1 (0.01)	1 (100.0)	0 (0.00)	0 (0.00)
Total	16,656 (100.00)	9,370 (56.26)	6,556 (39.36)	730 (4.38)

Table 3 shows the hospitalization status of patients at the time of specimen collection, along with the gram staining results. Most cases were outpatients (56.87%), and in more than 56% of all specimens, microorganisms were not observed in the smear. Of the 7,224 positive gram staining results, 90% were bacterial (Table 3), of which 56.5% demonstrated gram-positive cocci.

Table 3: Gram staining results and patient hospitalization status for 16,656 ophthalmic specimens submitted to the Microbiological Laboratory of Farabi Eye Hospital, Tehran, Iran

Smear/ Gram staining		***Hospitalization status***	***N (%)***
Total, n = 16,656		Inpatient	7,184 (43.13)
		Outpatient	9,472 (56.87)
Smear, n = 16,656	Microorganism not seen, n = 9,432	Inpatient	4,999 (53.00)
		Outpatient	4,433 (47.00)
	Microorganism seen, n = 7,224	Inpatient	2,185 (30.25)
		Outpatient	5,039 (69.75)
Gram Staining, n = 7,224	Fungi, n = 672	Inpatient	232 (34.52)
		Outpatient	440 (65.48)
	Bacteria, n = 6,515	Inpatient	1,948 (29.90)
		Outpatient	4,567 (70.10)
	Both, n = 37	Inpatient	5 (13.51)
		Outpatient	32 (86.49)

Tables 2, 4, 5, and 6 display the specimen culture results. Most positive culture results were bacterial, and only approximately 10% of cases were fungal; in both groups, patients were mostly male (Table 4). The microorganisms reported in more than 70% of fungal infections were *Fusarium* spp. (41.10%), *Aspergillus* spp. (23.70%), and *C. albicans* (14.80%) (Table 5). In the 730 specimens with positive fungal culture, 43 (5.89%) results did not mention the exact type of fungus, 10 (1.37%) were recorded as sterile mycelium, and 3 (0.41%) were identified as pseudomycelium (Table 5). Of the 6,556 specimens with positive bacterial cultures, 3,862 (59%) were gram-positive and 2,694 (41%) were gram-negative. The most common bacterial microorganisms, reported in approximately 70% of culture-positive specimens, were *P. aeruginosa* (17.77%), *S. epidermidis* (13.80%), *S. pneumoniae* (13.27%), *S. viridans* (12.23%), and *S. aureus* (11.18%). Among 733 cases with cultures positive for *S. aureus,* 22 were reported as methicillin-resistant (MRSA) (Table 6).

Table 4: Culture Results of 16,656 Ophthalmic Specimens Submitted to the Microbiological Laboratory of Farabi Eye Hospital, Tehran, Iran

Culture		***Sex***	***N (%)***
No Growth		Female	3,483 (37.17)
		Male	5,887 (62.83)
		Total	9,370 (100.00)
Growth	Bacteria	Female	2,918 (44.51)
		Male	3,638 (55.49)
		Total	6,556 (100.00)
	Fungi	Female	206 (28.22)
		Male	524 (71.78)
		Total	730 (100.00)

Table 5: Fungal Distribution Pattern of 730 Positive Cultures among Ophthalmic Specimens Submitted to the Microbiological Laboratory of Farabi Eye Hospital, Tehran, Iran

No	*Fungi Name*	*N (%)*	*C*	*VH*	*AH*	*Conj*	*NS*	*CLS*	*LDS*	*LS*	*EU*	*FB*	*OI*	*B*
1	*Fusarium* sp.	300 (41.10)	288	3	5	1	-	1	2	-	-	-	-	-
2	*Aspergillus* sp.	173 (23.70)	156	7	4	1	2	1	-	1	-	-	-	1
3	*Candida albicans*	108 (14.80)	77	25	-	2	1	2	1	-	-	-	-	-
4	*Non-specified*	43 (5.89)	38	-	-	-	5	-	-	-	-	-	-	-
5	*Candida* sp.	35 (4.79)	21	1	3	6	-	-	-	1	1	1	1	-
6	*Alternaria* sp.	11 (1.51)	11		-	-	-	-	-	-	-	-	-	-
7	*Sterile mycelium*	10 (1.37)	5	3	1	-	-	-	1	-	-	-	-	-
8	*Bipolaris* sp.	7 (0.96)	5	2	-	-	-	-	-	-	-	-	-	-
9	*Aspergillus niger*	6 (0.82)	6	-	-	-	-	-	-	-	-	-	-	-
10	*Aspergillus fumigatus*	5 (0.68)	4	-	1	-	-	-	-	-	-	-	-	-
11	*Penicillium* sp.	5 (0.68)	4	1	-	-	-	-	-	-	-	-	-	-
12	*Pseudallescheria boydii*	5 (0.68)	4	-	-	-	-	-	-	-	1	-	-	-
13	*Nattrassia mangiferae*	3 (0.41)	3	-	-	-	-	-	-	-	-	-	-	-
14	*Pseudomycelium*	3 (0.41)	3	-	-	-	-	-	-	-	-	-	-	-
15	*Acremonium* sp.	2 (0.27)	1	-	-	-	1	-	-	-	-	-	-	-
16	*Cladosporium* sp.	2 (0.27)	1	-	1	-	-	-	-	-	-	-	-	-
17	*Colletotrichum* sp.	2 (0.27)	2	-	-	-	-	-	-	-	-	-	-	-
18	*Curvularia lunata*	2 (0.27)	2	-	-	-	-	-	-	-	-	-	-	-
19	*Cephalosporium acremonium*	1 (0.14)	1	-	-	-	-	-	-	-	-	-	-	-
20	*Aspergillus flavus*	1 (0.14)	1	-	-	-	-	-	-	-	-	-	-	-
21	*Colletotrichum gloeosporioides*	1 (0.14)	1	-	-	-	-	-	-	-	-	-	-	-
22	*Engyodontium album*	1 (0.14)	1	-	-	-	-	-	-	-	-	-	-	-
23	*Geotrichum* sp.	1 (0.14)	1	-	-	-	-	-	-	-	-	-	-	-
24	*Mucor* sp.	1 (0.14)	1	-	-	-	-	-	-	-	-	-	-	-
25	*Rhizopus* sp.	1 (0.14)	1	-	-	-	-	-	-	-	-	-	-	-
26	*Rhodotorula* sp.	1 (0.14)	1	-	-	-	-	-	-	-	-	-	-	-
	Total	730 (100)	639	42	15	10	9	4	4	2	2	1	1	1

Abbreviations: N: number; %: percentage; C: Cornea; VH: Vitreous humor; AH: Aqueous humor; Conj: Conjunctiva; NS: Non-specified; CLS: Contact lens solution; LDS: Lacrimal drainage system; LS: Lacrimal sac; EU: Eyelid ulcer; FB: Foreign body; OI: Orbital Implant; B: Buckle

Table 6: Bacterial Distribution Pattern of 6,556 Positive Cultures Among Ophthalmic Specimens Submitted to the Microbiological Laboratory of Farabi Eye Hospital, Tehran, Iran

No	*Name of Bacteria*	*N (%)*	*C*	*Conj*	*VH*	*CLS*	*AH*	*LDS*	*LS*	*NS*	*EU*	*OI*	*O*	*FB*	*B*
1	*Pseudomonas aeruginosa*	1,165 (17.77)	843	56	80	113	39	9	10	8	5	-	2	-	-
2	*Staphylococcus epidermidis*	905 (13.80)	346	203	188	3	65	33	30	19	13	1	1	2	1
3	*Streptococcus pneumoniae*	870 (13.27)	470	206	96	-	63	12	8	12	2	1	-	-	-
4	*Streptococcus viridans*	802 (12.23)	228	367	104	-	28	22	29	14	5	2	1	1	1
5	*Staphylococcus aureus*	733 (11.18)	284 (8*)	283 (3*)	43 (5*)	1	19 (4*)	34 (1*)	30	4	28 (1*)	4	1	-	2
6	*Haemophilus* sp.	340 (5.19)	21	267	8	-	4	18	15	5	2	-	-	-	-
7	*Klebsiella* sp.	191 (2.91)	49	32	7	78	1	7	7	7	2	1	-	-	-
8	*Serratia* sp.	176 (2.68)	36	18	2	113	2	-	2	2	1	-	-	-	-
9	*Coagulase-negative staphylococci*	163 (2.49)	67	21	31	1	10	7	-	22	2	1	1	-	-
10	*Diphtheroids*	148 (2.26)	69	47	4	3	1	6	4	5	3	3	2	1	-
11	*Moraxella* sp.	127 (1.94)	120	3	1	1	-	-	1	1	-	-	-	-	-
12	*Non-fermentative gram-negative bacilli*	121 (1.84)	30	9	14	28	12	10	10	1	3	3	1	-	-
13	*Citrobacter* sp.	113 (1.72)	37	20	15	14	7	9	3	5	3	-	-	-	-
14	*Alcaligenes* sp.	102 (1.56)	6	6	6	79	4	-	1	-	-	-	-	-	-
15	*Escherichia coli*	92 (1.40)	17	33	12	15	2	5	4	1	2	-	1	-	-
16	*Staphylococcus* sp.	58 (0.88)	23	1	6	22	3	-	1	1	1	-	-	-	-
17	*Streptococcus* sp.	57 (0.87)	12	21	9	-	1	8	1	-	4	1	-	-	-
18	*Enterobacter* sp.	55 (0.84)	11	16	2	19	1	4	-	-	1	-	1	-	-
19	*Enterococcus* sp.	55 (0.84)	11	14	15	-	7	3	2	2	-	1	-	-	-
20	*Bacillus* sp.	40 (0.61)	10	1	17	1	6	-	-	-	3	-	2	-	-
21	*Neisseria* sp.	39 (0.59)	8	26	-	-	-	2	3	-	-	-	-	-	-
22	*Staphylococcus saprophyticus*	27 (0.41)	11	3	8	2	3	-	-	-	-	-	-	-	-
23	*Nocardia* sp.	26 (0.40)	23	-	-	-	-	-	1	2	-	-	-	-	-
24	*Acinetobacter* sp.	24 (0.37)	4	-	3	5	6	3	1	1	1	-	-	-	-

25	*Group D Streptococcus*	22 (0.34)	4	9	2	-	2	-	3	-	1	-	-	1	-
26	*Moraxella Catarrhalis*	20 (0.31)	3	15	-	-	-	2	-	-	-	-	-	-	-
27	*Morganella* sp.	16 (0.24)	4	1	4	-	4	1	-	2	-	-	-	-	-
28	*Serratia marcescens*	13 (0.20)	7	-	1	4	1	-	-	-	-	-	-	-	-
29	*Proteus* sp.	11 (0.17)	2	2	2	-	2	1	1	1	-	-	-	-	-
30	*Proteus mirabilis*	8 (0.12)	6	1	-	-	-	-	-	-	1	-	-	-	-
31	*Actinomyces* sp.	6 (0.09)	4	1	-	-	-	1	-	-	-	-	-	-	-
32	*Klebsiella oxytoca*	6 (0.09)	4	-	-	2	-	-	-	-	-	-	-	-	-
33	*Stenotrophomonas maltophilia*	6 (0.09)	1	2	-	1	-	-	1	-	1	-	-	-	-
34	*Citrobacter Freundii*	5 (0.08)	2	2	1	-	-	-	-	-	-	-	-	-	-
35	*Providencia* sp.	4 (0.06)	2	-	-	-	-	1	1	-	-	-	-	-	-
36	*Morganella morganii*	3 (0.05)	2	-	-	-	-	1	-	-	-	-	-	-	-
37	*Micrococcus* sp.	2 (0.03)	1	1	-	-	-	-	-	-	-	-	-	-	-
38	*Group A Streptococcus*	2 (0.03)	2	-	-	-	-	-	-	-	-	-	-	-	-
39	*Acinetobacter baumannii*	1 (0.02)	1	-	-	-	-	-	-	-	-	-	-	-	-
40	*Klebsiella pneumoniae*	1 (0.02)	1	-	-	-	-	-	-	-	-	-	-	-	-
41	*Listeria* sp.	1 (0.02)	-	-	1	-	-	-	-	-	-	-	-	-	-
	Total	6,556 (100)	2,782	1,687	682	505	293	199	169	115	84	18	13	5	4

Abbreviations: N: number; %: percentage; C: Cornea; Conj: Conjunctiva; VH: Vitreous humor; CLS: Contact lens solution; AH: Aqueous humor; LDS: Lacrimal drainage system; LS: Lacrimal sac; NS: Non-specified; EU: Eyelid ulcer; OI: Orbital Implant; O: orbit; FB: Foreign body; B: Buckle. * MRSA: Methicillin-resistant *Staphylococcus aureus*

Discussion

To our knowledge, this is the largest study on the bacterial and fungal profiles of ocular infection in the literature. Overall, 16,656 ocular specimens were evaluated. The mean patient age was 48.31 years, and most patients were male. When the data were analyzed by sex and decade of life, men in the 7th decade were the largest represented group, and the seasonal distributions of culture sites were compatible with the overall distribution by year. Most specimens were obtained from the cornea, also accounting for the largest number of samples in all seasons. Conjunctiva and vitreous humor were the most commonly sampled after the cornea. The most commonly isolated fungal microorganisms were *Fusarium* spp., followed by *Aspergillus* spp. and *C. albicans*. Of the 6,556 bacterial culture-positive specimens, 59% were gram-positive, while the remainder were gram-negative. The most commonly isolated bacteria were *P. aeruginosa*, *S. epidermidis*, *S. pneumoniae*, *S. viridans*, and *S. aureus*.

Ho et al. (18) published one of the largest microbiological profile investigations regarding fungal keratitis—a 10-year study at a tertiary referral center in the United States—and found that most cases were male, with a mean patient age of 56.1 years. Of the 4,651 culture-positive corneal ulcers identified, 63 (1.4%) indicated fungal keratitis, with 69 isolated fungal organisms. In their study, most cases produced filamentous species, and the most commonly isolated organism was *Curvularia*. Furthermore, the most commonly associated risk factors were contact lens wear and prior penetrating keratoplasty (18). In the current study, when the data were analyzed by sex and decade of life, men in the 7th decade were the largest represented group, and *Fusarium* spp. were found as the most

frequent fungi, illustrating the importance of demographic and geographical variation on microbial profile. Furthermore, as a limitation of our study, we were unable to identify the associated risk factors for ocular infections.

Bharathi et al. conducted a retrospective analysis of 4,417 consecutive samples from patients with a clinical diagnosis of ocular infection treated at a tertiary eye center in south India within a six-year period. They reported that 2,599 (58.8%) patients had bacterial isolation, 456 (10.3%) fungal, 15 (0.34%) *Acanthamoebae*, 14 (0.32%) mixed microbial growth, and the remaining 1,333 (30.2%) had negative results (1). However, we found that out of 16,656 specimens submitted over a seven-year period, 6,556 (39.36%) had bacterial isolation, 730 (4.38%) fungal, and the remaining 9,370 cases (56%) had negative culture results. Because we only assessed bacterial and fungal pathogens, different results were obtained.

In a systematic review of bacterial ocular infections, *S. aureus,* coagulase-negative *Staphylococci*, *S. pneumoniae*, and *P. aeruginosa* were the principal isolates (19). Their findings were nearly identical to ours regarding the isolation of *P. aeruginosa*, *S. epidermidis*, *S. pneumoniae*, *S. viridans*, *and S. aureus*; however, the percentages were dissimilar.

A local monocentric study reporting the characteristics and laboratory findings of 182 patients with bacterial keratitis diagnosed at Farabi Eye Hospital showed that the most common bacterial microorganisms were *P. aeruginosa*, followed by *S. pneumoniae*, *S. viridans*, and *S. epidermidis* (17). However, in our long-term study, we noted a higher percentage of *S. epidermidis* when compared to those of *S. pneumoniae* and *S. viridans*.

Zare et al. recently reported microorganisms associated with suspected corneal ulcers in 123 patients admitted to a local hospital in Tehran, Iran. They found that in 79% of the 34 culture-positive corneal ulcers, bacteria were offending microorganisms, whereas in 21% of samples, fungi were reported. Of the bacterial corneal ulcers, most produced gram-positive bacteria, of which 50% were *S. pneumoniae*, and of the gram-negative bacterial corneal ulcers, most were caused by *P. aeruginosa*. The most common fungus was *C. albicans*, followed by *A. flavus* (20). However, their study sample size was very small compared to ours.

A major limitation of the current study was that it failed to measure the incidence of ocular infections. Although Farabi Eye Hospital is considered the major eye hospital in Iran and even the Middle East, there are other local eye hospitals in the region. Another limitation is the retrospective study design, as the exact collection sites were not recorded in 248 (1.49%) of the specimens, of which 124 (50.0%) had no growth in culture, 115 (46.37%) produced bacteria, and 9 (3.63%) produced fungi; we have reported these as non-specified in Table 2. In addition, in 43 (5.89%) of the 730 specimens with positive fungal culture, the exact type of fungi was not mentioned; we have also reported these as non-specified in Table 5. The lack of data on clinical diagnosis, antibiotic susceptibility, and concomitant medical reports of cases were other potential limitations of this study. However, the large sample size and long study duration can be considered strengths of this research. Therefore, we recommend future studies incorporating clinical examinations and predisposing factors such as occupational exposure, history of trauma, or contact lens wear, while underlining comorbidities and clinical outcomes.

Conclusion

Specimens obtained from the cornea were the most common, also representing the largest number of specimens in all seasons. The most commonly isolated fungal microorganisms were *Fusarium* spp., followed by *Aspergillus* spp. and *C. albicans*. The most commonly isolated bacteria were *P. aeruginosa*, followed by *S. epidermidis* and *S. pneumoniae*.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

Non-declared.

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