Microbial Contamination of Eyeglasses among Staff and Students of Igbinedion University, Okada

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ABSTRACT

Eyeglasses are widely used optical devices that remain in close contact with the skin, hands, nose, and surrounding environment, making them potential reservoirs for microbial contamination. Poor hygiene practices and inadequate cleaning methods may increase the risk of ocular infections associated with contaminated eyeglasses. This study aimed to determine the prevalence, microbial load, distribution, and antibiotic susceptibility pattern of microorganisms contaminating eyeglasses used by staff and students of Igbinedion University. A cross-sectional study involving 200 eyeglasses was conducted between June and August 2023 in Okada, Edo State, Nigeria. Sterile saline-moistened swab sticks were used to collect samples from eyeglass lenses. Standard microbiological techniques, including serial dilution, culture, Gram staining, biochemical characterization, and antibiotic susceptibility testing using the disc diffusion method, were employed for isolation and identification of microorganisms. Data obtained were analysed using SPSS version 20.0, with statistical significance set at $p < 0.05$. Overall contamination of eyeglasses was high, with contamination rates of 90.0% among males and 96.0% among females. Age was significantly associated with contamination ($p = 0.004$), whereas sex, marital status, and occupation showed no significant association. The predominant isolates were Staphylococcus epidermidis (58×10^6 CFU/ml), Bacillus subtilis (61×10^6 CFU/ml), and Staphylococcus aureus (24×10^6 CFU/ml). Other isolates included Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Citrobacter species, molds, and non-Candida albicans. Poor eyeglass hygiene practices, lack of regular cleaning, and poor awareness of microbial contamination were significantly associated with higher contamination rates ($p < 0.05$). Cefuroxime showed the highest resistance pattern among isolates, while Gentamicin and Erythromycin demonstrated complete susceptibility. This study demonstrated a high prevalence of microbial contamination of eyeglasses among staff and students, indicating that eyeglasses may serve as potential fomites for ocular pathogens. Improved hygiene practices, regular cleaning with appropriate disinfectants, and increased awareness are necessary to reduce microbial contamination and the associated risk of eye infections.

KEYWORDS

Antibiotic resistance, Eyeglasses, Microbial contamination, Ocular infection, Staphylococcus aureus

I. INTRODUCTION

Spectacles are globally widespread optical devices that aid human vision, approximately 2.3 billion people in the world suffer from refractive disorder that causes decline in vision, Mireku and Ebenezer. The eye glass being centrally placed on the human face, and in close contact to the human skin, nose and mouth and regular contact with human hands as well as the environment, there is a risk of bacterial contamination due to their continuous use and the difficulty of disinfection of the entire surface of the glasses. This contaminant can cause Ocular infections which are common. The human eyes on a daily routine, whether in the market, schools, churches, the comfort of our homes, or even in our offices, we are unknowingly exposed to many pathogens. Unfortunately, many frequently used devices, such as eyeglasses and contact lenses, are rarely sterilized or kept clean, which increases the likelihood of bacterial contamination and colonization.

The lack of awareness of workers and students about hand hygiene, for example not washing their hands after rubbing their nose contributes to bacterial contamination of the glasses they use. In addition to hand washing habits, bacterial transmission can occur through handshakes with other people. The habit of cleaning glasses only with water or even just with a cloth is also a cause of bacterial contamination research have shown that the cleaning fluid specifically formulated to clean the lens cannot stop bacterial growth. Microbes associated with eye glass contamination include *Eschericia coli*, Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella sp., Bacillus sp., Streptococcus sp., and negative coagulase Staphylococcus, while there has been report of fungi such as Microsporium species, Penicillium species, Aspergillus species, Trichophyton species and Candida species contaminating eyeglasses in a study carried out in Southern Nigeria.This study is aimed at determining the load, frequency and distribution of bacterial contaminants present on the eye glasses used by staff and students of Igbinedion University, Okada.

II. STUDY AREA

The study was conducted in Okada, Ovia N.E. local government area of Edo state from June 20 to August 2, 2023. The area has a land mass of about 2,354.24 sq. Km, and a population of about 122,107 NPC, 2012. Geographically, it lies on on latitude 6^0 44′ N and longitude 5^0 23′ E. The climatic condition of the district is hot and the annual temperature is estimated to be between 35°C and 41°C. The Annual range of rainfall in the district is 900–1200mm.

III. STUDY DESIGN

The study was carried out in the Medical Laboratory Science Department, Igbinedion University Okada Edo State, Nigeria from July to August 2023. Approval for the study was given by the Health Research and Ethics Committees (HREC) of Igbinedion University Teaching Hospital, Okada in accordance with the code of ethics for biomedical research involving human subjects. Consent to and rights to participate or refuse to participate in the study was acknowledged as explanation was made in simple understanding terms. Socio-demographic data such as age, gender and status of each participant were extracted by a semi-structured questionnaire. Information regarding the type of mobile phones used, a span of use by the users, the practice of handling the mobile phones such as disinfection, place of storing (if not in use) and their use in convenience such as toilets, bathrooms, kitchen or laboratory were also noted.

IV. SAMPLE SIZE DETERMINATION

The sample size was determined using the Slovin’s formula (Jaykaran & Tamoghna, 2013) using a 5% margin of error. The population proportion formula described by Charan and Biswas, (2013) was used to estimate the sample size (n) required for the study:

$$n = Z^2 PQ/d^2$$

Where; n = required sample size,
Z = Standard normal variate at 5% ($p<0.05$) error or 95% confidence interval is 1.96
P = Proportion of eyeglasses with bacterial contaminants from previous study,
Q = Proportion of eyeglasses without bacterial contaminants (1 – P) and d = Absolute error margin is 0.05

The minimal sample size needed was calculated using a 95% confidence interval, a p value of 0.934, or a prevalence rate of 93.4% from a prior study by Enitan et al., 2020 and a margin of error (d) set at 0.05. A sample size of 200 phones was for the study to enhance good statistical analysis.

V. SAMPLING AND DATA COLLECTION

Simple random sampling was used to choose the study subjects from among the students. Through the distribution of structured questionnaires to the participants, demographic and medical information on pertaining to the use of eyeglasses were noted.

VI. SPECIMEN COLLECTION, TRANSPORTATION AND LABORATORY ANALYSIS

Each participant's eyeglass lenses were swabbed with a sterile cotton tipped applicators that had been soaked with sterile normal saline using proper aseptic methods. The samples were immediately sent to the laboratory in a tightly sealed case and processed there within one hour (1 hr.) of being collected from the personnel and students.

VII. DETERMINATION OF BACTERIAL COUNT

The contents of the swab sticks were vortexed in 10 ml sterile normal saline after standing for 30 minutes. Using the vortexed suspension, a ten- fold serial dilution was made using sterile normal saline onto sets of tubes. Onto sterile molten Nutrient agar made selective with Ketoconazole (10mg/ml), MacConkey agar and Sabouraud dextrose agar made selective by addition of chloramphenicol (10mg/ml), 0.02 ml of the various dilution were added to the prepared agar plates as described by Miles et al., (1938). All plates were incubated overnight at 370C, while at room temperature for the Sabouraud dextrose agar. The numbers of colony forming units (CFU) per ml from various dilutions were counted using a colony counter.

VIII. IDENTIFICATION OF ISOLATES

Isolates were identified by colony morphology, arrangement, size and color as described by Barry (2012). The isolates were further subjected to Gram staining reaction and biochemical test as described by Cheese rough, 2006. The results of these tests were entered into IDENTAX bacterial identifier (Sun Microsystems’s Java Technology) for the taxonomical identification of bacteria isolates on the basis of their phenotypic characteristics.

Isolation of Pure Cultures: Purity plate was done for mixed cultures using the streak plate technique as described by Ochei and Kolhatkar, (2000). Aseptic streaking of the inoculum with the aid a wire loop resulted in continuous dilution of the inoculum to give well separated distinct colonies.

Susceptibility testing: The antibiotic sensitivity pattern of the bacterial isolates was determined using the Disc diffusion technique as described previously (CLSI, 2020). Using the interpretative chart, the zone of inhibition of each antibiotic was interpreted as 'resistant', 'intermediate' or 'susceptible'.

Statistical Analysis: Descriptive statistics were used to present the socio-demographic information and bacterial count analysis. The results were presented in tabular form and analysed using percentile and SPSS version 20.0 software was used to determine the differences between the bacterial loads among the eyeglasses of study participants. A p-value <0.05 was considered significant.

IX. RESULTS

The analysis showed that contamination of eye glasses was high across all demographic groups studied (Table 1). Out of the 200 eye glasses examined, contamination was observed in 90.0% of males and 96.0% of females. However, there was no statistically significant association between sex and contamination of eye glasses (P = 0.424), indicating that contamination occurred similarly among both sexes. With respect to age distribution, the highest contamination rate was observed among participants aged 16–20 years where all examined eye glasses were contaminated (100.0%), while the lowest contamination rate was recorded among participants aged 46 years and above (60.0%). Statistical analysis revealed a significant association between age group and eye glass contamination (P = 0.004). This suggests that age significantly influenced the rate of contamination among participants. Regarding marital status, contamination rates were highest among married participants (96.7%), followed closely by single participants (94.2%), and whereas no contamination was observed among divorced participants. Nevertheless, the association between marital status and contamination was not statistically significant (P = 0.726), indicating that marital status did not significantly affect contamination rates.

Similarly, contamination was slightly higher among staff (97.5%) compared with students (94.4%). However, no statistically significant association was observed between occupation and eye glass contamination (P = 0.685). This implies that occupation was not a determinant factor in the contamination of eye glasses among the study population. Overall, age group was the only demographic characteristic significantly associated with eye glass contamination in this study.

Table 2 indicates a statistically significant difference in mean microbial counts among the different microbial species isolated from eye glasses (One-way ANOVA, P < 0.001). This indicates that microbial load varied significantly depending on the organism type. Bacillus subtitles showed the highest mean microbial count (61×10^6 CFU/ml), followed by

Staphylococcus epidermis's (58×10^6 CFU/ml), while *Pseudomonas aeruginosa* had the lowest count (0.1×10^6 CFU/ml).

Table 3 assessed the association between eyeglass hygiene practices and microbial contamination among the participants. A higher proportion of contamination was observed among participants who did not clean their eyeglasses regularly (85.7%) compared to those who cleaned them regularly (58.3%). This association was statistically significant (χ^2 = 8.421, p = 0.004), indicating that regular cleaning practices may reduce microbial contamination of eyeglasses. Regarding cleaning materials used, participants who left their eyeglasses unclean recorded a high contamination rate (78.0%), while those who used lens cleaning solution had the lowest contamination rate (50.0%). The association between cleaning material and microbial contamination was statistically significant (χ^2 = 12.116, p = 0.007), suggesting that the method or material used for cleaning influences the level of contamination.

Most participants stored their eyeglasses in eyeglass cases (87.5%), although contamination was still observed among many of them. However, the relationship between storage location and contamination was not statistically significant (χ^2 = 4.205, p = 0.240), implying that storage location may not have had a major influence on contamination in this study. Participants who shared their eyeglasses had a contamination rate of 100% compared to 76.3% among those who did not share eyeglasses. Although this finding suggests increased contamination with sharing practices, the association was not statistically significant (χ^2 = 3.781, p = 0.052).

Awareness regarding the ability of eyeglasses to harbour microorganisms showed a statistically significant association with contamination (χ^2 = 10.524, p = 0.001). Participants who lacked awareness exhibited higher contamination rates (84.4%) than those who were aware (50.0%). Similarly, belief that poor eyeglass hygiene could contribute to eye infections was significantly associated with contamination status (χ^2 = 9.316, p = 0.009).

Overall, the findings indicate that poor eyeglass hygiene practices and inadequate awareness are important factors associated with increased microbial contamination of eyeglasses among the study participants. Table 4 gives an insight on the susceptibility profile, Cefuroxime exhibited the highest resistance pattern among the bacterial isolates, particularly among Staphylococcus aureus, Staphylococcus epidermis's, and *Escherichia coli*. Conversely, all isolates demonstrated complete susceptibility to Gentamicin and Erythromycin. These findings suggest emerging resistance to commonly used antibiotics among microorganisms isolated from eyeglasses.

Table 1: Frequency of bacterial contamination of eye glasses according to the demographic characteristics of the study participants

Characteristics	**Category**	**Number Examined (n)**	**Number Contaminated n (%)**	**P-value**
Sex	Male	100	90 (90.0%)	0.424
	Female	100	96 (96.0%)	

Age group (years)	16–20	30	30 (100.0%)	0.004
	21–25	80	70 (87.5%)	
	26–30	20	18 (90.0%)	
	31–35	25	20 (80.0%)	
	36–40	25	22 (88.0%)	
	41–45	25	18 (72.0%)	
	≧46	20	12 (60.0%)	
Marital status	Single	138	130 (94.2%)	0.726
	Married	60	58 (96.7%)	
	Divorced	2	0 (0.0%)	
Occupation	Student	160	151 (94.4%)	0.685
	Staff	40	39 (97.5%)	

Table 2: Distribution of Microbial isolates on Eye glasses

Characteristics	**Isolates**	**n**	**Mean ± SD (CFU/ml)**	**P-value**
Gram positive cocci	*Staphylococcus aureus*	126	$24 \times 10^6 \pm 3.2 \times 10^6$	0.0001
	Staphylococcus epidermidis	132	$58 \times 10^6 \pm 0.2 \times 10^6$	
Gram negative and positive bacilli	*Bacillus subtilis*	41	$61 \times 10^6 \pm 5.2 \times 10^6$	0.0001
	Escherichia coli	8	$0.8 \times 10^6 \pm 0.02 \times 10^6$	
	Klebsiella pneumoniae	4	$0.3 \times 10^6 \pm 0.01 \times 10^6$	
	Pseudomonas aeruginosa	2	$0.1 \times 10^6 \pm 0.01 \times 10^6$	
	Citrobacter species	2	$0.4 \times 10^6 \pm 0.01 \times 10^6$	
Fungi	*Molds*	41	$4.5 \times 10^6 \pm 1.1 \times 10^6$	0.0001
	Non-Candida albicans	12	$0.3 \times 10^6 \pm 0.01 \times 10^6$	

Table 3: Risk factors associated with bacterial contamination of eye glasses

Variable	**Responses**	**Contaminated n (%)**	**Not Contaminated n (%)**	**Total n (%)**	**χ^2**	**P-value**
Regular cleaning of eyeglasses	Yes	35 (58.3)	25 (41.7)	60 (30.0)	8.421	0.004*
	No	120 (85.7)	20 (14.3)	140 (70.0)		
Material used for cleaning	Tissue paper	50 (83.3)	10 (16.7)	60 (30.0)	12.116	0.007*
	Handkerchief/ cloth	22 (73.3)	8 (26.7)	30 (15.0)		
	Left unclean	78 (78.0)	22 (22.0)	100 (50.0)		

	Lens cleaning solution	5 (50.0)	5 (50.0)	10 (5.0)		
Storage location of eyeglasses	Eyeglass case	130 (74.3)	45 (25.7)	175 (87.5)	4.205	0.240
	Shirt pocket	20 (100.0)	0 (0.0)	20 (10.0)		
	Car dashboard	5 (100.0)	0 (0.0)	5 (2.5)		
Sharing of eyeglasses	Yes	10 (100.0)	0 (0.0)	10 (5.0)	3.781	0.052
	No	145 (76.3)	45 (23.7)	190 (95.0)		
Awareness that eyeglasses can harbor microorganisms	Yes	20 (50.0)	20 (50.0)	40 (20.0)	10.524	0.001*
	No	135 (84.4)	25 (15.6)	160 (80.0)		
Belief that poor hygiene contributes to eye infection	Yes	50 (62.5)	30 (37.5)	80 (40.0)	9.316	0.009*
	No	45 (90.0)	5 (10.0)	50 (25.0)		
	Not sure	60 (85.7)	10 (14.3)	70 (35.0)		

χ^2 = Chi-square value; statistically significant at $p < 0.05$.

Table 4: Antibiotic Resistance Pattern of Bacterial Isolates Recovered from Eyeglasses

Gram-Positive Bacterial Isolates

Isolates	n	TET	BA	ERY	LEV	AS	CX	RD	P-value
Staphylococcus epidermidis	132	7.6	11.5	0.0	0.0	7.5	80.7	23.0	<0.0001*
Staphylococcus aureus	126	8.3	16.6	0.0	0.0	16.6	83.3	41.6	<0.0001*
Bacillus spp.	41	10.7	3.5	0.0	3.5	7.1	57.1	25.0	<0.0001*

Gram-Negative Bacterial Isolates

Isolates	n	CF	CP	OF	S	GK	P-value
Klebsiella spp.	4	0.0	40.0	0.0	20.0	0.0	0.0004*
Escherichia coli	8	25.0	12.5	12.5	12.5	0.0	<0.0001*
Citrobacter spp.	2	20.0	20.0	20.0	20.0	0.0	0.699

TET = Tetracycline; BA = Bacitracin; ERY = Erythromycin; LEV = Levofloxacin; AS = Ampicillin-sulbactam; CX = Cefuroxime; RD = Rifampicin; CF = Ciprofloxacin; CP = Chloramphenicol; OF = Ofloxacin; S = Streptomycin; GK = Gentamicin.

Statistically significant at $p < 0.05$.

X. DISCUSSION

Eye glasses may serve as a fomite for the transmission of microbes and possibly a carrier of infectious agents associated with eye infections. In this study, bacteria isolated include Staphylococcus aureus, *Staphylococcus epidemidis*, *Escherichia coli*, *Kebsiella* specie, *Citrobacter* specie, Bacillus specie and mold. However, the bacteria with the highest number of occurrence was *Bacillus subtilis*. Which were found in 41 samples (20.5%). Bacillus species are highly ubiquitous and are spread in nature with high concentrations in soil, water, and plants derived food (Schultz et al., 2017). According to research conducted by Ruth et al. (2015), *Bacillus subtilis*. Appear on the surface of the glasses because these bacteria that can form spores. This causes them to survive in all types of environments and can colonize various types of surface objects. Bacillus sp., except Bacillus anthracis, is considered to have a less significant role in the context of human infection. However, in the eye, Bacillus sp. are known to cause infections such as conjunctivitis, dacryocystitis, and endophthalmitis. Endophthalmitis caused by Bacillus cereus can cause vision loss in just a few days. The occurrence was in in agreement with studies of Osaro-Mathew et al., 2015, the possible reason for the high rate could be the humidity of the area of study.

The second highest number of bacteria in this study were *Staphylococcus epidemidis* and *Staphylococcus aureus* which were found in 126 samples (63%). Staphylococcus. Is a bacterium that can grow well in a variety of environments? Likewise, S. *epidemidis* is a skin flora, and as a result of the position of the eye glass on the human body that often becomes the site of S. aureus is the front nasal cavity or anterior nares. These bacteria are often found in the area around the eyes (Tacconelli et al., 2011). *Staphylococcus aureus* can cause various kinds of infections in human, including infections of the eye. The study suspected that *Staphylococcus aureus* contaminate glasses through handkerchief used to clean the nose and the fingers as a result of close proximity to the nasal which is highly flourished with the organism... In addition, transmission of *Staphylococcus aureus* can also occur if someone does not wash his hands and shakes hands with others (Osaro-Matthew et al., 2015). Other researches conducted found that Staphylococcus epidermidis was the most common bacterial contaminant in glasses (Fritz et al., 2018). Staphylococcus epidermidis is a common flora of the skin and is one of the pathogenic bacteria that is often found in nosocomial infections (Huan et al., 2025). According to research conducted by Anjani et al, this bacterium of the genus Staphylococcus is a contaminant on glasses that can cause keratitis. In addition, Staphylococcus epidermidis can also cause conjunctivitis, blepharitis, corneal ulcer, and endophthalmitis (Ather and Conrady, 2026). Contrary, a study carried out on lenses worn by Medical students in Iran found, the Gram negative bacilli constitute the most prevalent organism. The other category of bacteria identified in this study were of the family Enterobacteriaceae comprising of Escherichia coli, *Citrobacter* and *Klebsiella* specie, which were found in in about 4.4% of the total isolates. The possible reasons could be contamination from convenience such as toilets as users of eyeglasses make use of their glasses in such places.

Contamination of eyeglasses occurred in 93% of the glasses assayed, a pointer to the risk of eye diseases, and confirms that glasses may serve as the site for the growth of pathogenic bacteria that can transmit disease or infection to the eyes, especially in the clinical environment. However, in this study, there was not any participants that has eye infection, under normal circumstances, the eye has a natural defence system on the ocular surface and tear fluid that are constitute 90% of IgD immunoglobulin (Ryan et al., 2026). This shows that in normal and healthy eyes that are not traumatized or injured, eye infections by bacteria can be prevented by the natural defence mechanism of the body. Anjani et al., (2020) stated in their research that the instruments used to clean the glasses played a role in the contamination of the glasses. Clothes or veils that are used as instruments for cleaning glasses can carry bacterial contaminants. The cloth that is rarely washed can also be a site for bacteria to grow and transfer of bacteria to the surface of the glasses. In addition, unsterile water can also be the agent for bacterial transmission.

IV. CONCLUSION

The results of this study indicated that there was bacterial contamination on glasses used by students and workers of Igbinedion University Okada. The contaminants all have the potential to initiate an eye infection, the isolate include Staphylococcus aureus, Staphylococcus epidermidis, Escherichia coli, *Citrobacter* specie, *Klebsiella* specie, *Bacillus subtilis*, and Mold.

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