A Comparative Assessment of Dry Eye Disease Among Outdoor Street Sweepers and Indoor Office Cleaners

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Abstract

Background:

Occupational predisposition to dry eye disease is known. Simultaneous exposure to multiple factors may pose more risk. Street sweepers are exposed to sunlight in addition to dust which all sweepers are exposed to. This study aims to assess the prevalence of dry eye disease (DED) amongst Street sweepers and Office cleaners in Calabar metropolis.

Methods:

A cross sectional study was conducted among street sweepers and office cleaners. A systematic random sampling and multi-stage sampling method was used to select street sweepers (n=115) and office cleaners (n=115) respectively for the study. A pretested semi-structured interviewer administered questionnaire was used to obtain information after which the respondents had an ophthalmic examination. An assessment of DED was done with Ocular Surface Disease Index (OSDI) questionnaire, Schirmer's test and tear break up time (TBUT).

Results:

Majority of respondents were females 215(93.5%) compared to males 15 (6.5%). The overall mean age of respondents was 40.96 ± 9.8 years. The prevalence of DED among Street sweepers was 35.7% compared to 20% among office cleaners using the OSDI questionnaire. The prevalence of DED among street sweepers was 32.2% compared to 30.4% among Office cleaners using the Schirmer's test. The TBUT reported a prevalence of 38.3% of DED among Street sweepers compared to 32.2% in Office cleaners.

Conclusion:

This study concluded that street sweepers had higher odds of developing dry eye disease compared to office cleaners. This effect is possibly due to synergy of factors. Studies on dose response are warranted. Strict use of protective gears that protect from multiple risk factors are recommended.

Background

The ocular surface is a sensitive structure that includes the conjunctiva and cornea bordered by the upper and lower lids and covered by a thin layer of tear film.¹ Its main function is to enable clear vision in an open eye by contributing more than two-thirds of the total refractive power of the eye.² All parts of this surface are directly exposed to the external environment and are thus vulnerable to potential environmental insults.³

Ocular surface disorder (OSD), a broad term encompassing Dry Eye Disease (DED), blepharitis and meibomian gland dysfunction, allergic eye disease as well as chemical and thermal burns; may result in decreased visual function and poor performance of workers.⁴ Impaired visual function has been shown

to be an important factor that can adversely affect job output and quality.^{5,6} For example, Nichols et al reported that dry eye causes negligible absenteeism but markedly reduces workplace performance, and that impairment of workplace performance is more closely related to dry eye symptoms than to clinical signs.⁵

Dry eye disease is an ocular surface disease, characterized by a disorder of the tear film resulting from tear deficiency or excessive evaporation which causes damage to the inter-palpebral ocular surface and is associated with symptoms of ocular discomfort.⁷ The prevalence of dry eye disease ranges from 5–35% worldwide, in Nigeria it is at 19.2% based on the ocular surface disease index data.^{8,9} Environmental factors play an important role in the etiology of dry eye disease.¹⁰ Surface toxicity, oxidative stress and inflammation are the mechanisms implicated.¹¹ Occupational predisposition resulting from sunlight and dust exposure in outdoor workers as well as prolonged use of computers among professionals are risk factors for developing dry eye disease.¹² Most of these factors have been studied singly.

We hypothesize that working outdoors in the presence of sunlight and dust (as typified by street sweepers in Calabar) may be associated with greater prevalence of dry eyes compared with working indoors in the presence of dust but absence of direct sunlight (as typified by indoor cleaners). The aim of this was to determine and compare the prevalence of dry eye disease among street sweepers who work outdoors and indoor office cleaners in Calabar metropolis, Nigeria.

Methods

In this cross-sectional study, 230 respondents were involved in the study. A systematic random technique was used to recruit one hundred and fifteen (115) street sweepers from the Calabar Urban Development authority (CUDA), an agency responsible for maintaining environmental sanitation in the metropolis. On the other hand, one hundred and fifteen (115) office cleaners were recruited from 5 out of 28 ministries in the metropolis using a multi-stage sampling technique. Ethical approval was obtained from the Health Research Ethical Committee of University of Calabar Teaching Hospital before commencing the study.

The sample size was determined using the formula for comparison of two proportions. Average prevalence of ocular surface disorders among exposed workers ($P_1 = 14.0\%$) and average prevalence of ocular surface disorders among unexposed workers ($P_2 = 3.125\%$) from previous study¹³ conducted in Benin, Nigeria was used in the calculation. To take care attrition, 10% of the calculated sample size was added. One hundred and fifteen subjects each, were recruited into the indoor sweepers and outdoor sweepers arms respectively, totaling 230 subjects.

A written informed consent was obtained from the respondents and an interviewer administered questionnaire (see supplementary file) was used to obtain data on socio-demographics, work history, ocular surface disease index and ocular symptoms. All respondents underwent an ocular examination where dry eye disease was assessed using Schirmer's 1 test and tear film break up time.

Schirmer's 1 test value of 10mm in 5mins on Whatman's filter paper no. 41, and a-Tear film break up time (TBUT) value of < 10 seconds was used as a cut-off mark for assessing dry eye disease.

Statistical analysis was performed using SPSS software version 20. A P value of <0.05 was considered statistically significant. The prevalence odds ratio was used to study the strength of the association of occupational risk factors (street sweepers and office cleaners) with dry eye disease.

Results

Overall, 230 respondents participated in the study. Fifty per cent (50.0%) were outdoor street sweepers while the remaining 50.0% were indoor office cleaners. Female: male ratio was 1:0.03. Over half of the respondents (51.3%) were aged 40 years and below with a mean age of 40 ± 9.6 years.

The mean age of the outside street sweepers was 41.78 ± 10.39 years while that of the office cleaners was 40.26 ± 9.46 years (Table 1). There was no statistically significant difference between the mean ages of the different group of workers ($t = 1.187$, $p = 0.155$) Slightly less than one-third (31.7%) of the respondents had been educated up to primary school level.

Prevalence of dry eye disease using OSDI, Schirmer's Test 1, TBUT

Overall, dry eye disease was found in 64 of the 230 respondents assessed, giving a prevalence of 27.8% using the ocular surface disease index (Fig. 1). Results obtained from the OSDI ranged from 0–78, with a mean score of 26.4 ± 16.0 .

Overall, the prevalence of dry eye disease assessed by Schirmer's test was 31.3% (Fig. 1). Out of 230 respondents, 72 had abnormal Schirmer's test. Results obtained from Schirmer's test ranged 1 mm to 35 mm with a mean of 16.44 ± 9.52 .

The overall prevalence of dry eye disease assessed using the TBUT among street sweepers and office cleaners was 35.2%. 81 respondents out of 230 had abnormal TBUT. Results obtained from the TBUT ranged between 2seconds to 35seconds, with a mean of 12.12 ± 4.28 .

Comparing prevalence of dry eye disease in street sweepers and office cleaners using OSDI

Dry eye disease was found in 41 out of 115 street sweepers giving a prevalence of 35.7% (Fig. 2). On the other hand, dry eye disease was found in 23 out of 115 office cleaners resulting in a prevalence of 20%. This difference was not statistically significant (p value 0.352).

Comparing prevalence of Dry Eye disease in street sweepers and office cleaners using Schirmer's test

Comparing the prevalence of dry eye disease diagnosed using Schirmer's test in street sweepers and office cleaners showed that 37(32.2%) out of 115 street sweepers had abnormal Schirmer's test compared to 35 (30.4%) of 115 office cleaners (Fig. 3). The prevalence was higher in street sweepers compared to office cleaners. However, this difference was not statistically significant (p value = 0.73).

Comparing prevalence of dry eye disease using TBUT in street sweepers and office cleaners

Assessment of dry eye disease using TBUT shows that, out of 115 street sweepers, 44 had abnormal TBUT giving a prevalence of 38.3% (Fig. 4). On the other hand, of the 115 office cleaners, 37 had abnormal TBUT giving a prevalence of 32.2%. This difference was however not statistically significant (p value = 0.48).

Relationship between risk factors and the occurrence of dry eye disease

Logistic regression was performed to assess the impact of statistically significant factors on the likelihood of developing dry eye disease. As shown in the Table 2, the class of workers and ages of respondents had a statistically significant contribution to the occurrence of dry eye disease.

The result demonstrates that street sweepers were more likely to develop a dry eye disease compared to office sweepers with an odds ratio of 2.085 (Table 3). Another predictor observed in this study for developing dry eye disease was the age of respondents in years with a prevalence odds ratio of 1.092. This indicates that increasing age of respondents in years is a weak predictor of the occurrence of dry eye disease.

Discussion

Documented prevalence of dry eye disease among workers is diverse, this study sought to determine the prevalence of dry eye disease among street sweepers who are outdoor workers and office cleaners who work predominantly indoors. Both populations work in dusty environments however; street sweepers, in addition are exposed to direct sunlight

The prevalence of dry eye disease assessed subjectively using the ocular surface disease index questionnaire (OSDI) among all respondents was 27.8%. In addition, this study noted a prevalence of 31.4% and 35.3% respectively based on Schirmer's test 1 and tear break up time (TBUT) respectively (Fig. 1). This study showed a higher prevalence of dry eye disease in street sweepers compared to office cleaners with the varied clinical tests. This finding could be explained by the fact that street sweepers are slightly more symptomatic as a result of continuous and long term sweeping which exposes them more to environmental irritants such as dust and smoke. The prevalence rate in this study is higher than that reported in South East Nigeria (19.2%) using the OSDI questionnaire.⁹ The results of this study are comparable with other studies conducted among outdoor workers where the prevalence of dry eyes disease was higher amongst outdoor workers compared with indoor workers.^{14,15} Our study showed a higher prevalence of dry eye disease in Street sweepers compared to office cleaners using the OSDI, Schirmer's test and Tear Break up time respectively.(Figs. 2, 3, 4). Suchi et al reported a prevalence of 59.3% of dry eyes among outdoor jobs consisting of farmers and labourers and a prevalence of 42.6% in indoor jobs.¹⁴ Khurana et al, reported an increased risk of dry eye among farmers and laborers (32% and 28%) respectively and attributed this increase to excessive exposure of these workers to adverse environmental conditions.¹⁵

The ocular complaints among participants in this study were itching, redness of the eyes, foreign body sensation, and tearing, ocular pain and mucoid discharge. (Table 4) This may result from a disturbance of the ocular surface where sand dust acts as direct irritants to the eyes. This corroborates with the study performed in Australia by McCarty et al who reported that most of the patients with dry eyes presented with the symptoms of foreign body sensation, itching tearing and photophobia.¹⁶

This study noted that street sweepers were twice more likely to develop dry eye disease compared to office sweepers with an odds ratio of 2.085. (Table 3) Furthermore, dry eye disease was noted to be associated with the age of the workers, with increasing age, a worker was more likely to develop dry eye disease (Table 2). This finding corroborates an earlier study that noted dry eye disease to be significantly associated with increasing age.¹⁷

The findings from our study further highlights the increased risk of developing dry eye disease in outdoor workers (street sweepers) constantly exposed to combined environmental irritants like dust and sunlight. The increased burden on street sweepers is likely to be due to synergistic effect of irritants. A dose relationship between burden of dry eyes and exposure to irritant(s) warrants further studies. Earlier studies on this subject ¹⁸ documented a high level of awareness on ocular health safety among street sweepers however, there was poor utilization of personal protective devices. Hence, we recommend improved awareness and strict use of protective gears. We recommend legislative prescription of adherence to use of sunscreens and dust – proof hoods that will reduce the exposure of street sweepers to multiple occupational hazards. We also suggest that outdoor sweeping could be scheduled to take place during the evening hours when the exposure to sunlight is minimal.

Limitation Of Study

It was not possible, during this study, to standardize the exposure to dust in both groups. However, both groups are involved in sweeping, which raises dust.

Conclusion

This study showed a dry eye disease prevalence of 27.8% among street sweepers and office cleaners in Calabar metropolis. Street sweepers had higher odds of developing dry eye disease compared to office cleaners. This highlights the role of exposure to multiple environmental irritants in developing dry eye disease. We recommend improved awareness and strict use of protective gears.

Abbreviations

DED

Dry eye disease

OSDI

Ocular surface disease index

TBUT

Tear break up time

CUDA

Calabar Urban Development Authority

Declarations

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Human Research and Ethics Committee (HREC) of the University of Calabar Teaching Hospital

Consent from participants

Written consent to participate was obtained from participants who were enrolled in the study.

Competing interests

No relevant conflict of interest declared

Funding

No funding was received for this study

Authors' contributions

E. C. I. Was the principal investigator, participated in the design and execution of the project, approved the final manuscript.

E. B. A. Supervised the study, involved in the design of the study and approved the final manuscript.

E. C. P. Conceptualized the study, participated in the execution of the study and the preparation of the final manuscript.

A. J. Supervised the study, involved in the design of the study and approved the final manuscript

All authors have read and approved the manuscript.

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Availability of data and material

We are available for database repository

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Tables

Table 1: Socio-demographic characteristics of street sweepers and office cleaners in the study of dry eye disease amongst outdoor street sweepers and indoor office cleaners.

Variables	Street Sweepers (n=115) Freq. (%)	Office Cleaners (n=115) Freq. (%)	Total (N= 230) Freq. (%)	p- value
Age (years)				
<=20	1(0.9)	1(0.9)	2(0.9)	0.267
21-30	14(12.2)	21(18.3)	35(15.2)	
31-40	44(38.3)	37(32.2)	81(35.2)	
41-50	34(29.6)	38(33.0)	72(31.3)	
51-60	19(16.5)	18(15.7)	37(16.0)	
>60	3(2.6)	0(0.0)	3(1.3)	
Mean Age ±SD	41.78 ± 10.39	40.26±9.46	40.96 ± 9.8	0.155
Sex				
Male	3(2.6)	12(10.4)	15(6.5)	0.016*
Female	112(97.4)	103(89.6)	215(93.5)	
Level of education				
None	3(2.6)	1(0.9)	4(1.7)	<0.047*
Primary	40(34.8)	29(25.2)	69(30.0)	
Secondary	57(49.6)	55(47.8)	112(48.7)	
Tertiary	15(13.0)	30(26.1)	45(19.6)	
Duration of years on the job				
1-5 years	46 (40.0)	45(39.1)	93(38.60)	<0.001*
6-10 years	31(27.0)	32(27.8)	69(28.6)	
11-15 years	24(20.9)	9(7.8)	35(14.5)	
16-20 years	13(11.3)	10(8.7)	25(10.0)	
21-25 years	0(0)	5(4.3)		
26-30years	1(0.9)	9(7.8)		
>30years	0(0.0)	5(4.3)	21(8.3)	

Table 2. Association of Dry eye with study variables.

Variable	Dry Eye disease present		Dry Eye disease absent		Total		Chi square	p-value
	N	(%)	N	(%)	n	(%)		
Age of Respondents (years)								
<=20	0	0	2	100	2	100	31.335	0.000*
21-30	3	8.6	32	91.4	35	100		
31-40	16	19.8	65	80.2	81	100		
41-50	22	30.6	50	69.4	72	100		
51-60	20	54.1	17	45.9	37	100		
>60	3	100	0	0.0	3	100		
Duration of work on the present job (years)								
1-5	19	20.9	72	79.1	91	100	5.285	0.071
6-10	17	27.0	46	73.0	63	100		
>=11	28	36.8	48	63.2	76	100		
Group of Respondents								
Outdoor Street sweepers	41	35.7	74	64.3	115	100	7.014	0.008*
Indoor office cleaners	23	20.0	92	80.0	115	100		

Table 3. Logistic regression analysis showing association of various factors with the occurrence of dry eye disease.

Variable	Odds ratio	95% confidence Interval	p-value
Study Group			
Office cleaners	1		
Street sweepers	2.085	1.106-3.929	0.023*
Age of respondents	1.092	1.054-1.132	0.000*

* Statistically significant

p<0.05

Table 4. Distribution of ocular complaints among workers.

Variables	Street Sweepers	Office Cleaners		p-Value
	Freq. (n=115) (%)	Freq. (n=115)	(%)	
Itching				
Yes	88(76.5)	64(55.7)		0.001*
No	27(23.5)	51(44.3)		
Tearing				
Yes	70(60.9)	33(28.7)		<0.001*
No	45(39.1)	82(71.3)		
Redness				
Yes	54(47.0)	19(16.5)		<0.001*
No	61(53.0)	96(83.5)		
Foreign body sensation				
Yes	42(36.5)	24(20.8)		0.007*
No	73(63.5)	91(79.2)		
Mucoid discharge				
Yes	25(21.7)	13(11.3)		0.033*
No	90(78.2)	102(88.7)		
Gritty Sensation				
Yes	19(16.5)	11(9.6)		0.122
No	96 (83.5)	104(90.4)		
Pains in the eyes				
Yes	12(10.4)	4 (3.5)		0.897
No	103(89.6)	111(96.5)		

*statistically significant

P<0.05

Figures

Figure 1

Bar chart showing the prevalence of dry eye disease using the OSDI, Schirmer's test 1 and Tear break up time. (TBUT) respectively.

Figure 2

Bar chart comparing the OSDI Scores among street sweepers and office cleaners

Figure 3

Bar chart comparing the prevalence of dry eye disease among street sweepers and office cleaners using Schirmer's test.

Figure 4

Bar chart comparing the prevalence of dry eyes by TBUT in street sweepers and office cleaners.

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