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Full Length Research Article

PREVALENCE AND ASSOCIATED RISK FACTORS OF SYMPTOMATIC DRY EYE DISEASE AMONGST ADULTS ATTENDING A TERTIARY HOSPITAL IN KADUNA METROPOLIS, NORTH-WESTERN NIGERIA

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ABSTRACT
The study aims to determine the prevalence of dry eye disease (DED) and risk factors among adults based on the Ocular Surface Disease Index (OSDI) questionnaire. This study was conducted at the Outpatient Clinic of Barau Dikko Teaching Hospital in July 2024. The prevalence of symptomatic Dry Eye Disease (DED) was assessed using the Ocular Surface Disease Index (OSDI) questionnaire. Based on the OSDI scores, DED was classified into three categories: mild (13-22 points), moderate (23-32 points), and severe (33-100 points). The study also examined associations with other risk factors. Four hundred and two participants aged 18 years and above were analysed; 61.2% were female, and 48.8% had a tertiary level of education. The prevalence of symptomatic dry eye disease was found to be 30.1%. A high OSDI score was associated with age ($p < 0.01$), history of allergies, use of medications, and a history of ocular surgery were significantly associated with DED ($p < 0.01$). The prevalence of DED among general outpatients at BDTH, Kaduna, is comparatively high, with a prevalence of patients reporting any level of symptoms of dry eyes to approximately 1 in 3.

Keywords: Dry eye disease, Ocular surface disease index, Prevalence.

INTRODUCTION

The tears lubricate and protect the cornea, thereby maintaining the health of the ocular surface by providing a smooth and refractive surface for good vision. They are made up of three layers; namely the lipid layer, which is the superficial layer deposited by the meibomian glands, and seals the tear film to reduce tear evaporation; the middle aqueous layer, secreted by the lacrimal and accessory lacrimal glands, which constitutes 90% of the tear film volume; and *the* innermost mucous layer, made up of membrane-adherent mucins, which interacts with the corneal epithelial cells (Willcox *et al*, 2017; Matossian *et al*, 2019). Insufficient tear production or function can lead to ocular surface disorders.

Dry eye disease (DED) encompasses two primary categories; namely (i) evaporative, resulting from an unstable or low-quality tear film owing to dysfunctional lipid components, and (ii) aqueous-deficient, arising from a reduction in the tear film's aqueous component volume (Osae *et al*, 2017) Poor tear stability leads to an uneven tear film between blinks, causing optical aberrations, which is the primary cause of poor tear function in dry eyes (Koh *et al*, 2018).

The global estimated prevalence of dry eye ranges from 5% to 50% (Stapleton *et al*, 2017) and in Africa, 42.0% to 53.8%.(Osae *et al*, 2017; Akowuah and Kobia-Acquah, 2020) In Nigeria, the prevalence is 41.4% (Akowuah and Kobia-Acquah, 2020). The prevalence of dry eye in women increases with age from 8.50% in individuals under 50 years of age to 15.89% in those aged 50 and above. The occurrence in women is nearly 2 to 3 times higher than in men, both below and above 50 years, at 2.80% and 7.02%, respectively (Dana, 2019). Dry eye often leads to patient referrals to ophthalmologists, leading to strain within the healthcare sector.

Common dry eye symptoms include itching, irritation, pain, redness, blurred vision, grittiness, and a burning sensation. This condition impacts various age groups and significantly demands resources and labour. It may decrease productivity, impair visual performance, and diminish overall quality of life (Bakkar *et al*, 2016; Palikhey *et al*, 2022). Sex hormones and blood prolactin are vital in maintaining tear production, ocular surface integrity, and regulating meibomian gland function (Mathers *et al*, 1998). In the context of post-menopausal syndrome, decreased levels of sex hormones can lead to inflammation of the lacrimal gland and disruption of the ocular surface (Maurya *et al*, 2019).

Even in the absence of apparent abnormalities on the surface of the eye, patients frequently experience moderate to severe symptoms of dry eye. Currently, there are no reliable tests to categorise the signs and symptoms of this condition. In some cases, patients may lose sensitive receptors in the cornea, resulting in moderate symptoms with severe clinical signs. These differences emphasise the need for a deeper understanding of ocular surface indicators and symptom analysis (Barabino *et al*, 2016; Nonkula, 2019).

Studies of tear function employ tests such as Schirmer's test, tear film break-up time, fluorescein staining, or rose bengal staining to detect dry eye. These tests have a lower prevalence than surveys based on questionnaires about dry eye symptoms, which include a history of contact lens wear, previous dry eye treatment, frequency of symptoms, sensitivity to triggers, use of systemic medications, and other health conditions (Alves *et al*, 2014; Bhatnagar et al., 2014).

Symptomology, which involves surveys such as the Ocular Surface

Disease Index (OSDI) and Symptom Assessment in Dry Eye (SANDE), is widely used in clinical practice to assess the severity of DED. The OSDI is the most employed survey tool for evaluating symptoms related to DED; it is known for its simplicity, acceptable test-retest repeatability, and high reliability and validity (Recchioni *et al*, 2021; Martin and Emo Research, 2023). The aim is to determine the prevalence and severity of dry eye symptoms by using the Ocular Surface Disease Index (OSDI) as developed by the Outcomes Research Group at Allergan Inc, Irvine, California, USA (Walt *et al*, 1997). It is a 12-item questionnaire designed to quickly assess symptoms of ocular irritation consistent with dry eye disease and its impact on vision-related performance.

The objective of this study is to determine the prevalence of symptomatic dry eye among adult patients attending Barau Dikko Teaching Hospital and to assess the risk factors associated with dry eye among them.

MATERIALS AND METHODS

Study Area

The study was conducted at Barau Dikko Teaching Hospital, a tertiary health facility in Kaduna metropolis, north-western Nigeria. This hospital, with a capacity of 240 beds, represents the apex of the healthcare delivery system established by the Kaduna State government and caters to patients from Kaduna city and surrounding regions, offering a wide range of specialized services.

Study Population

The subjects of this study were patients aged 18 years or older who visited the General Out-Patient Department/Clinic (GOPC) of Barau Dikko Teaching Hospital.

Study Design

This was a hospital-based, descriptive, cross-sectional study

Study Period

The data was collected from the 1st of July 2024 to the 28th of July 2024.

Sample Size

The following formula was utilised to calculate the sample size (Daniel, 1978)

$$n = \frac{Z^2 p(1-p)}{d^2}$$

where,

n = minimum sample size

p = prevalence of dry eye disease among adults from a previous similar study, which was 48% (0.48)(Lamba *et al*, 2023)

1- p = q (i.e, 1 – 0.48 = 0.52)

d = level of significance = 0.05

z = standard normal deviation at 95% confidence interval = 1.96

$$n = \frac{(1.96)^2 \times 0.48 \times (1-0.48)}{(0.05)^2} = 0.9588/0.0025 = 384$$

Therefore, the minimum sample size was 384

Exclusion Criteria

The study excluded patients with ocular surface infections, foreign bodies in the eye and extensive ocular surface pathologies.

Sampling Technique

A systematic random sampling method was used for this study. An average of 160 patients per day was seen at the General Outpatient Clinic of Barau Dikko Teaching Hospital, Kaduna. Data collection was estimated to last for ten days, covering Mondays to Fridays, giving a total of two weeks. The average daily patient load multiplied by the number of days estimated for data collection (i.e, 160 x 10), which gave 1600 participants to be sampled. The sample interval was obtained by dividing the total number of participants to be sampled (1600) by the calculated sample size (384), i.e, 1600/384 = 4. A table of random numbers was used to obtain the starting point from1-4, and the sample interval was maintained. If the selected patient was ineligible, the next patient, if eligible, was selected, and the sample interval was maintained subsequently.

Data Collection Tool

A semi-structured interview administered questionnaire was developed electronically using Open Data Kit (ODK).

Data Collection Process

Three ophthalmic nurses were recruited and trained for a day on the use of ODK. The trained nurses, with an ophthalmologist, collected the data daily from the eligible adult patients attending the Outpatient Clinic.

Data Management

The collected data were imported into SPSS version 23 for analysis. Electronic data cleaning was done to identify errors during collection and entry. Data were analyzed. Results were represented in tables and graphs. Chi-square test was used to determine association, while binary logistic regression was used to find determinants of dry eye disease. A p-value of less than or equal to 0.05 was considered statistically significant.

Ethical

Before conducting this study, informed consent was obtained from all participants after ethical approval was obtained from Barau Dikko Teaching Hospital, Kaduna, Health Review Ethics Committee (BDTH-HREC). The research was conducted as per the tenets of the Helsinki Declaration

Questionnaire and Ocular Surface Disease Index (OSDI) Assessment

The questionnaire gathered information on patients' socio-demographic characteristics and also computer and non-computer desk jobs, cigarette/alcohol use, contact lens use, ocular or systemic allergy, and ocular or systemic medications.

The second section of the questionnaire is on subjective assessment based on the OSDI criteria. This is a 12-item tool comprising three sub-fields, addressing (i) vision-related symptoms (questions 1–5), (ii) ocular symptoms (questions 6–9), and (iii) environmental triggers (questions 10–12) of dry eye disease (DED). Each of the 12 variables in the OSDI questionnaire was rated on a scale of 0–4, with 0 indicating "none of the time," 1 indicating "some of the time," 2 indicating "half of the time," 3 indicating "most of the time," and 4 indicating "all the time." The total OSDI score was determined using the formula:

OSDI = [(sum of scores for all questions answered) × 100] / [(total number of questions answered) × 4]

The resulting OSDI score ranges from 0 to 100, with higher scores representing greater disability. Based on the OSDI scores, DED is

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classified as normal (0-12 points) or as having mild (13-22 points), moderate (23-32 points) or severe (33-100 points) disease.(Miller *et al*, 2010)

RESULTS

Table 1: Social demographics of the respondents (n = 402)

Variables	Frequency	Percentage (%)
Age Group (in years)		
18-25	81	20.1
26-35	131	32.6
36-45	91	22
46-55	50	12
56-65	34	8.5
>65	15	3.7
Sex		
Male	156	38.
Female	246	61.
Level of education		
None	47	11.
Primary	15	3.7
Secondary	144	35.
Tertiary	196	48.
Nature of Occupation		
Computer desk job	39	9.7
Non-computer desk job	363	90.
Total	**402**	**10.**

The highest proportion of the study participants was within the age group 26-35, 131 (32.6%), and were mostly females, 246 (61.2%). Those with a tertiary education had the highest proportion, 196 (48.8%), with the majority of them doing non-computer desk jobs.

Table 2: Social Habits and Medical/Health Status of the Respondents

Variable	Frequency (N = 402)	Percentage (%)
Smoking		
Yes	**13**	**3.2**
No	**389**	**96.8**
Ocular allergies		
Yes	58	14.4
No	344	85.6
Systemic allergies		
Yes	73	18.2
No	329	81.8
Topical medications		
Yes	34	8.5
No	368	91.5

Less than far less than one-third of the participants, 13 (3.2%), smoked cigarettes, and less than one-third of the respondents, 58 (14.4%), had ocular allergies. similarly, less than one-third of the respondents, 73 (18.2%) had systemic allergies, with even far less being on topical eye medications, 34 (8.5%).

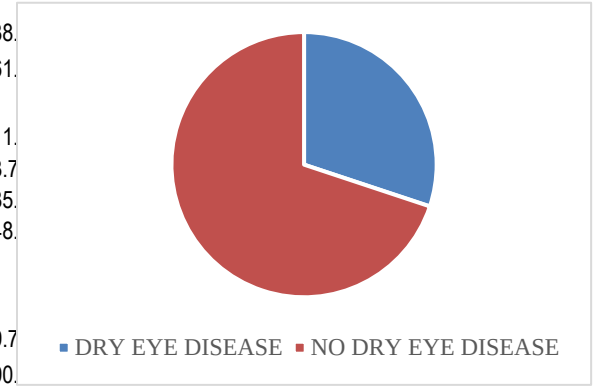

Figure 1: Prevalence of Dry Eye Disease among the respondents in BDTH

Just about one-third of the respondents, 121 (30.1%) had dry eye disease.

Table 3: Distribution of DED among the respondents by Sex (n = 402)

Sex	DED Status				Total
	No DED (%)	Mild DED (%)	Moderate DED (%)	Severe DED (%)	
Female	165 (67.1)	48 (19.5)	14 (5.7)	19 (7.7)	246
Male	116 (74.4)	25 (16.0)	9 (5.8)	6 (3.8)	156
Total	281(69.9)	73 (18.2)	23 (5.7)	25 (6.2)	402

Of those with dry eye disease, 121 (30.1%), two-thirds of them 73 (60.0%) had mild dry eye disease. More females, 19 (76.0%), than males, 6 (24.0%), had severe dry eye disease.

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Table 4: Relationship between dry eye disease and some risk factors among the respondents (n = 402)

Variables	Dry Eye Status				Df	χ^2	P-value
	No DED (%)	Mild DED (%)	Moderate DED (%)	Severe DED (%)			
Sex							
Female	165 (58.7)	48 (65.8)	14 (60.9)	19 (76.0)	3	3.673	0.299
Male	116 (41.3)	25 (34.2)	9 (39.1)	6 (24.0)			
Nature of Occupation							
Computer desk job	22 (7.8)	12(16.4)	3 (13.0)	2 (8.0)	3	5.282	0.152
Non-computer desk job	259(92.2)	61(83.6)	20 (87.0)	23 (92.0)			
Age group (in years)							
18-25	63(22.4)	10(13.7)	4 (17.4)	4 (16.0)			
26-35	107(38.1)	15(20.5)	3 (13.0)	6 (24.0)	15	**41.330**	**0.0001**
36-45	60 (21.4)	22 (30.1)	4 (17.4)	5 (20.0)			
46-55	27 (9.6)	14(19.2)	7 (30.4)	2 (8.0)			
56-65	15 (5.3)	10 (13.7)	3 (13.0)	6 (24.0)			
>65	9 (3.2)	2 (2.7)	2 (8.7)	2 (8.0)			
Smoking cigarette							
No	273(97.2)	72(98.6)	21 (91.3)	23 (92.0)	3	4.952	0.175
Yes	8 (2.8)	1 (1.4)	2 (8.7)	2 (8.0)			
Having ocular allergy							
Yes	33 (11.7)	14(19.2)	3 (13.0)	8 (32.0)	3	**9.262**	**0.026**
No	248 (88.3)	59(80.8)	20 (87.0)	17 (68.0)			
Having systemic allergy							
Yes	41(14.6)	20(27.4)	6 (26.1)	6 (24.0)	3	**8.146**	**0.043**
No	240(85.4)	53(72.6)	17 (73.9)	19 (76.0)			
Had ocular surgery							
Yes	4 (1.4)	3 (4.1)	1(4.3)	6 (24.0)	3	**34.991**	**0.0001**
No	277 (98.6)	70(95.9)	22 (95.7)	19 (76.0)			
On topical medications							
Yes	12 (4.3)	12 (16.4	4 (17.4)	6 (24.0)	3	**22.539**	**0.0001**
No	269 (95.7)	61(83.6)	19 (82.6)	19 (76.0)			

Age group (χ^2 =41.330, P =0.0001), having ocular allergy (χ^2 =9.262, P =0.026), having had ocular surgery (χ^2 =34.991, P =0.0001), and being on topical eye medications (χ^2 =22.539, P =0.0001) were statistically significant

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Table 5: Binary logistic regression of dry eye disease among the respondents (n = 402)

Predictors	B	SE B	P-value	OR	95% CI	
					Lower	Upper
Age group (in years)						
18-25	0.381	0.666	0.567	1.464	0.397	5.398
26-35	0.998	0.506	**0.049**	**2.701**	**1.003**	**7.275**
36-45	1.297	0.497	**0.009**	**3.657**	**1.382**	**9.680**
46-55	0.337	0.483	0.485	1.401	0.544	3.610
56-65	-0.272	0.508	0.592	0.762	0.281	2.061
>65	-0.378	0.665	0.570	0.685	0.186	2.524
Having ocular allergy	-0.063	0.377	0.868	0.939	0.449	1.967
Having systemic allergy	0.110	0.346	0.751	1.116	0.567	2.197
Had ocular surgery	0.886	0.730	0.225	2.246	0.580	10.154
On topical medications	1.236	0.459	**0.007**	**3.442**	1.400	8.462

Key: p ≤ 0.05 = Significant level, B = Regression coefficient, SE B = standard error, OR = Odds ratio; CI = Confidence Interval

Binary logistic regression analysis showed that the age groups of between 26-35 and 36-45 years were more likely to have dry eye (OR 2.071; P =0.049) and (OR 3.657, p =0.009) respectively. Equally, those on topical eye medications were about 3 times more likely to suffer from dry eye disease (OR 3.442, P = 0.007) compared to those not on topical eye medications.

DISCUSSION

The prevalence of dry eye disease (DED) in this study is 30.1% (Fig. 1). This is slightly higher than the finding of a similar study conducted in Kaduna, north-western Nigeria, which reported a prevalence of 24% (Lamba *et al*, 2023) and another study in south-western Nigeria, which reported 32.5% prevalence (Olaniyan *et al*, 2019). On the contrary, in Ghana, a high prevalence of 44.3% was reported (Asiedu *et al*, 2017). This disparity could be due to the difference in the population studied. While the present study was hospital-based, the Ghanaian study was among undergraduate students ages 18-34 years. It is also not clear which time of the year the Ghanaian study was carried out, as a dry season study would give a higher prevalence of dry eye. Studies conducted in India reported 29.25% (Gupta *et al*, 2010), and 28.7% in Canada (Doughty *et al*, 1997); thus, agreeing with our finding. Additionally, a meta-analysis of hospital-based studies on the prevalence of DED in Africa indicated an average prevalence of 38% (Akowuah and Kobia-Acquah, 2020). While the similarities in prevalence rates can be attributed to the similar hospital-based design of these studies, the current figure is notably higher than a study conducted in the United States, which found a prevalence of 8.6% (Farrand *et al*, 2017) and a study in China that reported a prevalence of 21% and 12.3% in Singapore (Tan *et al*, 2015) which are mainly population-based studies. Conversely, it is lower than the prevalence of 55% reported in a study conducted in Egypt (Sahai and Malik, 2005), and 87% reported in another study in Lagos, south-western Nigeria (Bashorun *et al*, 2024). Variability within a country could be due to various climatic and ecological variables between regions.

Most studies indicate a higher prevalence of dry eye in females than in males (Gupta *et al*, 2010; Mostafa, 2016; Farrand *et al*, 2017; Lamba *et al*, 2023). Our research found that More females, 19 (76.0%), than males, 6 (24.0%) had severe dry eye disease (table 3). While this gender difference was not statistically significant, it aligns with some symptomatic studies that also reported no significant discrepancies between the sexes (Alshamrani, A. A *et al*, 2017; Onwubiko *et al*, 2014). The increased prevalence of dry eye in females relative to males is largely attributed to menopause, which is associated with reduced tear production due to lower levels of androgens, which are known to enhance secretion from the Meibomian glands and influence tear osmolarity (Za, 2021).

Dry eye disease was significantly associated with age in this study, with age groups 26-45 having higher odds of having dry eye disease. This finding points to the fact that dry eye disease is an environmental health issue not genetic. Hence, the higher the age, the higher the odds of exposure to the risk factors and therefore the more the chances of developing the dry eye disease as one ages. Several eye studies, including the Henan Eye Study, Salnes Eye Study, Beijing Eye Study, and others, have demonstrated a clear association between age and DED (Guo *et al*, 2010). Conversely, studies, such as the Salisbury Eye Evaluation Study, Blue Mountains Eye Study, Shihpai Eye Study, and Koumi Study in Japan, have found no significant correlation between age and dry eye disease (Uchino *et al*, 2011; van Landingham *et al*, 2014; Tan *et al*, 2015). However, in a large, population-based study in the Netherlands, dry eye symptoms were prevalent, particularly among 20–30-year-olds (Vehof *et al*, 2021). A similar Korean study among young adults found that 50.6% of them had dry eye symptoms (Yun *et al*, 2012a). This may be because the number of hours spent on the use of phones and computers has increased over the years, leading to an increased number of young people with dry eye symptoms due to visual display terminal syndrome.

Ocular and systemic allergies, the use of topical medications, and a history of ocular surgery were found to have a significant association with dry eye disease in this study, a finding similar to the one reported in a study by Vehof and colleagues in the Netherlands (Vehof *et al*, 2021). Allergic conjunctivitis is also reportedly linked to DED in another study (Yun et al., 2012b). Furthermore, a systematic review in the Middle East found that factors such as the use of eye drops, allergies, systemic diseases, ocular surgery, and the use of anti-allergy drugs increase the risk of developing DED (Mohammed *et al*, 2024), with medication

history being associated with dry eye (Betiku *et al*, 2022). This may be due to some of these studies are carried out in Africa, with a similar geographical location to our study population

This study focused solely on dry eye symptoms among subjects in the General Out-Patient Department of our hospital, which may limit its representation of the broader population in Kaduna city. Dry eye syndrome could be quite prevalent in this area and may significantly impact socio-economic factors. Additional research with objective assessment, such as ocular surface examination, tear film break-up time, and Schirmer test, is essential to identify associated risk factors, and population-based studies would be more advantageous in determining the prevalence of dry eye syndrome in our context, particularly since most previous studies conducted in our region have also been hospital-based. Symptomatic evaluation of dry eye usually has a higher prevalence than the combined subjective and objective (Betiku *et al*, 2022; Mohammed *et al*, 2024).

Conclusion

This research highlights a significant prevalence of dry eye disease (DED) among adult outpatients in north-western Nigeria. Age, ocular and systemic allergies, and use of topical medications were found to be associated risk factors for dry eye.

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