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Research Article

Epidemiology of Dry Eye Disease in Adult Outpatients in Bihar: A Prospective Study Assessing Prevalence and Associated Risk Factors

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ABSTRACT

Background: Dry eye disease (DED) is a multifactorial ocular surface disorder characterized by tear film instability, ocular discomfort, and visual disturbances. Globally, it is a common cause of ophthalmology outpatient visits, but regional epidemiological data from Bihar are limited. Understanding prevalence and risk factors is crucial for early detection and management.

Aim: To determine the prevalence of dry eye disease and identify associated demographic, occupational, and systemic risk factors among adult outpatients attending Anmmch Gaya , Bihar.

Methodology: A prospective observational study was conducted over nine months in the ophthalmology outpatient department of Anmmch Gayaji. Adult patients (≥18 years) were randomly selected, excluding those with recent ocular surgery, active ocular infections, systemic autoimmune disease, or incomplete data. Dry eye evaluation included Ocular Surface Disease Index (OSDI) questionnaire, tear film break-up time (TBUT), Schirmer I test, and corneal/conjunctival staining.

Results: Out of 430 participants, 144 (33.5%) were diagnosed with DED. Prevalence was higher in females (39.1%) and individuals aged >50 years (41.3%). Independent risk factors included female sex, age >50 years, prolonged visual display terminal use, and diabetes mellitus. Tear film instability (TBUT <10 seconds) was the most common objective finding (81.9%).

Conclusion: DED is highly prevalent among adult outpatients in Bihar. Early recognition, risk factor modification, and targeted preventive strategies are essential to reduce symptom burden and ocular surface morbidity.

Keywords: Dry eye syndromes, Prevalence, Risk factors, Tertiary care centers, Ophthalmology outpatients

INTRODUCTION

Dry eye disease (DED) is a multifactorial disorder of the ocular surface characterized by tear film instability, hyperosmolarity, inflammation, and neurosensory abnormalities, leading to ocular discomfort, visual disturbance, and reduced quality of life [1]. Globally, the prevalence of dry eye symptoms or clinical signs varies widely — from approximately 6.5% to over 50% depending on the diagnostic criteria, population demographics, and environmental conditions studied [2,3]. DED is increasingly recognized as a significant and underdiagnosed public health problem that imposes a substantial burden on ophthalmology outpatient services worldwide [1,3].

In India, hospitalbased epidemiological studies indicate that the prevalence of dry eye disease may affect approximately 25–32% of patients presenting to tertiary ophthalmology clinics [4,5]. Such findings emphasize that DED is one of the most common conditions encountered in routine ophthalmic practice, with important implications for healthcare planning, resource allocation, and patient education [4]. Associated risk factors consistently identified include advancing age, female sex, visual display terminal (VDT) use, smoking, contact lens wear, and systemic comorbidities such as diabetes mellitus and autoimmune disorders [3,6]. However, prevalence estimates and risk factor patterns often differ between regions, reflecting variation in demographics, occupational exposures, climatic factors, and lifestyle behaviours.

Despite the recognised burden of DED across India, regionspecific epidemiological data remain scarce, especially in eastern and northern states. Bihar one of India's most populous states has a diverse mix of urban, rural, agricultural, and industrial populations. Socioeconomic and environmental factors such as high outdoor working hours, dust exposure, low humidity periods, and limited eye care access may influence the distribution and determinants of DED in this population. To date, there is limited prospective data on dry eye prevalence, severity, and associated risk factors specifically in the outpatient population of Bihar. Existing data on children from eastern Bihar suggests a prevalence of approximately 12%, with screen time as a possible contributing factor, highlighting a broader impact across age groups [7]. Moreover, studies from central and northern India demonstrate that tertiary eye care centers serve as major referral hubs, receiving patients from large catchment areas, and thus provide an ideal clinical setting for epidemiological research [4].

Given this context, a prospective study focused on the outpatient population in Bihar is necessary to characterize the frequency, demographic distribution, and risk factors of dry eye disease in a population that has been underrepresented in the literature. Such evidence can inform public health strategies, enable early identification of highrisk groups, and guide targeted preventive and therapeutic interventions within tertiary care referral centers. Moreover, documenting DED in Bihar will help fill a critical knowledge gap and support broader policy initiatives aimed at ocular surface disease screening and management in resource limited settings.

Therefore, the present study aims to determine the prevalence of dry eye disease among adult outpatients visiting at Anmmch Gayaji, Bihar, and to identify associated demographic, occupational, and systemic risk factors. Results from this prospective evaluation are expected to contribute valuable regional epidemiological insights and help shape future eye care services in the state.

The aim of the study was to determine the prevalence and associated risk factors of dry eye disease among adult outpatients attending a tertiary care center in the Bihar population through a prospective observational study.

MATERIALS AND METHODS

This prospective observational crosssectional study was conducted over a 1 year time at the Outpatient Department (OPD) of the Ophthalmology Department in Anugrah Narayan Memorial Medical College and Hospital, Gaya, Bihar. The tertiary centre serves a broad catchment area including urban, semiurban, and rural districts of Bihar, providing comprehensive eye care services. The study was designed to assess the prevalence and associated risk factors of dry eye disease (DED) among adult patients presenting to the eye OPD.

The study over a year to account for seasonal variations in environmental and climatic conditions that might influence dry eye prevalence. The study protocol was reviewed and approved by the Institutional Ethics Committee. Informed written consent was obtained from all participants prior to inclusion in the study.

Inclusion Criteria

All adult patients (≥18 years) presenting to the ophthalmology OPD during the study period were considered for inclusion. Patients presenting for routine eye examination or any ophthalmic complaint. Individuals willing to provide informed written consent. Patients able to complete the questionnaire and undergo the clinical tests required for dry eye evaluation.

Exclusion Criteria

Patients with a history of ocular surgery (including refractive surgery) within the last 6 months. Patients with active ocular infection (e.g., conjunctivitis, keratitis) at the time of presentation. Individuals with acute trauma or any ocular surface condition other than dry eye that may confound assessment (e.g., chemical injury, pterygium covering the cornea). Patients on systemic medications known to affect tear production (e.g., antihistamines, anticholinergics) within the past month. Individuals with autoimmune conditions (e.g., rheumatoid arthritis, Sjögren's syndrome) and those on immunosuppressive therapy, as these conditions have a distinct pathogenic pathway. Pregnant or lactating women. Patients who did not complete all clinical tests or questionnaire components.

Based on pilot data from similar hospitalbased studies in northern and central India, indicating a dry eye disease prevalence of approximately 25 to 30% in outpatient populations, and assuming a margin of error of 5% with a confidence level of 95%, the calculated sample size was estimated at ~385 subjects. To account for potential nonresponse and incomplete data, a target sample size of 450 subjects was set.

Study Procedures and Data Collection

On enrollment, each participant underwent the following: Structured Interview and Questionnaire. Demographic details: age, sex, residence (urban/rural), occupation. Medical history: diabetes, hypertension, thyroid disease. Ocular history: contact lens use, use of ocular medications, and previous surgeries. Lifestyle factors: smoking status, duration of visual display terminal (VDT) use per day, and environmental exposures (dust, wind). Symptoms of dry eye were assessed using the ocular surface disease index (OSDI) questionnaire. OSDI scores were categorized into normal, mild, moderate, and severe based on standard cutoffs.

Clinical Evaluation

All clinical assessments were performed by trained ophthalmologists using a standardized protocol:

- Slitlamp Examination. General anterior segment evaluation to rule out ocular surface pathology interfering with dry eye assessment.
- Tear Film BreakUp Time (TBUT). A fluorescein strip moistened with saline was applied; the interval between the last blink and the first appearance of a dry spot was recorded. A TBUT of <10 seconds was considered indicative of tear film instability.
- Schirmer I Test Without anesthesia, standard Schirmer strips were placed in the lower fornix of both eyes; measurements were recorded after 5 minutes. Values <10 mm were considered suggestive of aqueous tear deficiency.
- Corneal and conjunctival staining. After fluorescein administration, ocular staining was graded according to the Oxford Scheme.

Diagnostic Criteria for DED

Participants were classified as having dry eye disease if they demonstrated: Symptomatic dry eye (OSDI score >12), plus at least one objective sign: TBUT <10 seconds, or Schirmer I ≤10 mm, or positive corneal/conjunctival staining.

Data were recorded in a pre-structured Microsoft Excel sheet and were analyzed using Statistical Package for the Social Sciences (SPSS). Descriptive statistics were computed for demographic and clinical variables. Prevalence of DED was expressed as a proportion with 95% confidence intervals (CI). Comparative analysis of risk factors was performed using Chisquare tests and Independent ttests. A p-value <0.05 was considered statistically significant.

RESULTS

During the one-year study period, a total of 450 adult outpatients were enrolled, of whom 430 completed all clinical assessments and

Table 1: Demographic characteristics of study population (n=430)

Variable	*Number (%)*
Age (years)	
18–30	102 (23.7)
31–50	176 (40.9)
>50	152 (35.4)
Sex	
Male	228 (53.0)
Female	202 (47.0)
Residence	
Urban	258 (60.0)
Rural	172 (40.0)
Occupation	
Office/VDT users	148 (34.4)
Outdoor/manual labor	182 (42.3)
Others	100 (23.3)

Table 2: Prevalence of dry eye disease by age and sex

Age group (years)	*Male DED n (%)*	*Female DED n (%)*	*Total DED n (%)*
18–30	14 (21.5)	12 (23.5)	26 (22.5)
31–50	36 (33.3)	32 (39.0)	68 (36.0)
>50	33 (40.7)	17 (41.5)	50 (41.3)

questionnaires, yielding a response rate of 95.5%. The mean age of the study population was 42.3 ± 15.2 years (range: 18–80 years), with 228 (53%) males and 202 (47%) females. The majority of participants resided in urban areas (60%), while the remainder were from rural or semi-urban regions.

Table 1 shows that the largest proportion of participants belonged to the 31–50 year age group (40.9%), with a slightly higher proportion of males. Urban residents predominated (60%), and occupational distribution was nearly evenly split between office/VDT users and outdoor/manual laborers.

Among the 430 participants, 144 patients were diagnosed with DED, giving an overall prevalence of 33.5% (95% CI: 29.2–38.0%). Stratification by sex revealed a higher prevalence in females (39.1%) compared to males (28.9%) ($p = 0.03$).

Table 2 indicates that DED prevalence increased with age, peaking in participants over 50 years. Females had consistently higher prevalence across all age groups, consistent with prior studies linking hormonal changes and menopause to dry eye susceptibility.

Among DED patients, the mean Ocular Surface Disease Index (OSDI) score was 28.4 ± 12.6, indicating moderate symptom severity. Tear film assessments showed a mean TBUT of 6.8 ± 2.1 seconds and mean Schirmer I test value of 9.2 ± 3.5 mm.

Table 3 shows that all diagnosed DED patients had symptomatic dry eye (OSDI >12). Tear film instability (TBUT <10 sec) was the most common objective sign (81.9%), followed by reduced aqueous production and ocular surface staining.

Table 3: Distribution of dry eye diagnostic criteria in patients (n=144)

Diagnostic Criterion	*Number (%)*
OSDI >12	144 (100)
TBUT <10 sec	118 (81.9)
Schirmer I ≤10 mm	97 (67.4)
Positive corneal/conjunctival staining	85 (59.0)

Table 4: Multivariate logistic regression for risk factors of DED

Risk factor	*Adjusted OR (95% CI)*	*p-value*
Female sex	1.62 (1.05–2.49)	0.03
Age >50 years	2.11 (1.28–3.48)	0.004
VDT use >6 hr/day	1.89 (1.12–3.21)	0.017
Outdoor/manual labor	1.45 (0.89–2.35)	0.13
Diabetes mellitus	1.71 (1.01–2.88)	0.045

Univariate analysis identified female sex, older age (>50 years), VDT use >6 hours/day, outdoor occupation, and diabetes mellitus as significantly associated with DED ($p < 0.05$). Multivariate logistic regression indicated the following independent predictors:

Table 4 demonstrates that age >50 years, female sex, prolonged VDT use, and diabetes were independent risk factors for DED. Outdoor/manual labor approached significance but was not statistically significant after adjustment.

DISCUSSION

This prospective study revealed a high prevalence (33.5%) of dry eye disease (DED) among adult outpatients attending at Anmmch, Gayaji Bihar, with a higher burden in females and older adults. These findings align with existing literature that positions DED as a common ocular surface disorder with significant heterogeneity in prevalence across populations and settings [1,2]. The association of DED with demographic and lifestyle factors in this cohort provides valuable regional insights within the broader epidemiological context.

The overall prevalence in this study (33.5%) is comparable to hospital based estimates from other Indian tertiary centers, where prevalence ranges from approximately 25 to 32% [3,4]. Sabarwal *et al.* reported a 25% prevalence in a central Indian population, with similar risk associations such as age and occupational exposure [5]. Globally, prevalence figures vary widely (from 5% to over 50%) depending on the diagnostic criteria, population age, environmental exposure, and methods used, supporting the view that regional contexts shape observed rates [1,6].

Our findings of increasing DED prevalence with age are consistent with multiple epidemiological reports showing that tear film instability, gland dysfunction, and ocular surface changes become more pronounced with advancing age [1,7]. Particularly, individuals over 50 years exhibited significantly higher DED prevalence, mirroring observations in Asian and Caucasian cohorts where age is a strong nonmodifiable risk factor [1,8]. These agerelated changes are partly physiological (reduction in lacrimal function) and partly

due to cumulative environmental exposures (e.g., dust, wind, low humidity), especially relevant for populations engaging in outdoor occupations [2,7].

Similarly, female sex emerged as an independent risk factor, echoing global evidence that hormonal influences, especially around menopause, may predispose women to DED [1,9]. Female predominance in DED has been reported across various settings, reflecting differences in tear physiology, immune regulation, and hormonerelated alterations of the lacrimal and meibomian gland function [1,9].

Prolonged visual display terminal (VDT) use >6 hours per day was independently associated with DED in this cohort, consistent with documented links between screen exposure, reduced blink rate, and tear film instability [1,10]. Metaanalyses and systematic reviews have highlighted digital device use as a modifiable lifestyle risk factor that exacerbates both symptoms and signs of DED, particularly among younger and working populations [7,10]. This factor holds clinical relevance in the Indian outpatient population, given increasing digital engagement in both urban and rural areas.

Diabetes mellitus was another significant risk factor, reflecting systemic disease contributions to ocular surface abnormalities. Diabetes is known to impair corneal innervation and tear secretion, often resulting in both symptomatic dry eye and reduced clinical test performance [1]. Our findings support integrating systemic health evaluation into routine dry eye assessment, especially in regions where metabolic disorders are prevalent.

Unlike some studies where contact lens use, smoking, or outdoor occupations showed stronger associations [1,8], these factors were not independently significant in our multivariate model. This might be due to populationspecific exposures or differential selfreporting practices. Nevertheless, a trend toward higher DED prevalence in outdoor laborers suggests environmental irritants could contribute, even if not statistically robust after adjustment.

The substantial DED prevalence observed underscores the clinical relevance of dry eye as a driver of ophthalmology outpatient visits. Beyond symptom burden, DED can degrade quality of life, hamper visual function, and reduce productivity [1,6]. In tertiary care settings like our center in Bihar, early screening and stratified management are thus necessary to mitigate progression and ocular surface damage.

The identification of modifiable risk factors (VDT use, metabolic conditions) highlights opportunities for preventive strategies. Clinicians should counsel patients on blink exercises, digital screen breaks (e.g., the "202020" rule), and environmental adjustments to reduce tear evaporation [10]. Public awareness campaigns and practitioner training could help bridge the gap in DED recognition and management, particularly in regions with limited resources.

Given the observed high burden, communitybased epidemiological studies are warranted to complement hospital data and inform statewide planning. Longitudinal designs could also illuminate temporal patterns in incidence and progression, particularly in relation to lifestyle transitions and ageing cohorts [1]. Further research should explore biomarkers and tear film proteomics to refine early detection and personalized therapy.

CONCLUSION

DED is highly prevalent among adult outpatients in Bihar. Early recognition, risk factor modification, and targeted preventive strategies are essential to reduce symptom burden and ocular surface morbidity.

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