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Association Between Dry Eye Disease Symptoms and Psychological Distress Among Undergraduate Medical Students in Yemen During the Conflict Period

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Abstract

Purpose:

To investigate the association between dry eye disease symptoms and psychological distress among undergraduate medical students in Yemen during the ongoing conflict period.

Methods:

This cross-sectional study involved convenience sampling among undergraduate medical students in Yemen. Individuals with a mean age of 23.19 ± 2.88 years completed the Arab Ocular Surface Disease Index (Arab-OSDI) questionnaire and the Depression Anxiety Stress Scale-8 (DASS-8) to assess stress, anxiety, and depression levels.

Results:

A total of 487 undergraduate medical students were analysed, with a mean age of 23.19 ± 2.88 years; 267 (54.8%) were female. The mean OSDI score was 26.04 ± 19.10, while the mean DASS-8 score was 9.85 ± 5.86. DASS-8 scores differed significantly across DED severity categories ($H = 75.76$, $p < 0.001$). Post hoc analysis showed that participants in the normal DED group had significantly lower DASS-8 scores than those in the mild, moderate, and severe groups (all adjusted $p < 0.001$). Additionally, the severe DED group had significantly higher DASS-8 scores than the mild and moderate groups (adjusted $p < 0.001$ and $p = 0.002$, respectively). Adjusted linear regression further demonstrated that higher DASS-8 scores were independently associated with higher OSDI scores ($\beta = 1.10$, 95% CI: 0.79–1.41, $p < 0.001$).

Conclusion:

A significant association was observed between psychological distress and dry eye disease symptoms among undergraduate medical students in Yemen during the conflict period. Higher DASS-8 scores were moderately associated with higher OSDI scores and independently predicted both more severe dry eye symptoms and greater likelihood of OSDI-defined DED after adjustment for potential confounders.

Clinical trial registration

Clinical trial number: not applicable. This study was an observational cross-sectional survey and did not involve the prospective assignment of participants to a health-related intervention.

Introduction

Dry eye disease (DED) is a highly prevalent, multifactorial disorder of the ocular surface characterised by tear film instability, hyperosmolarity, ocular surface inflammation, and neurosensory abnormalities [1]. It impairs visual function, reduces quality of life, and constitutes a growing public health concern, particularly among young adults whose daily activities involve intensive near-work and digital screen exposure [2]. The Ocular Surface Disease Index (OSDI) is a validated, widely used instrument that captures the frequency, severity, and functional impact of dry eye symptoms and permits grading of DED severity [3].

Psychological distress—commonly conceptualised as the combined experience of depression, anxiety, and stress—is increasingly recognised as both a risk factor for and a consequence of DED. Proposed mechanisms linking psychological distress to dry eye symptoms include dysregulation of the hypothalamic–pituitary–adrenal axis, central sensitisation of ocular surface pain pathways, and neuroinflammatory processes that affect tear secretion and corneal nerve integrity [4, 5]. Several epidemiological studies have documented positive correlations between DED symptom scores and measures of psychological distress in community and clinical samples [6, 7]. Nevertheless, the directionality and contextual modifiers of this association remain incompletely understood, particularly in populations facing concurrent physical and psychological hardships.

Undergraduate medical students constitute a distinctive high-risk group for both DED and psychological distress. Long hours of reading, electronic device use, and sleep deprivation predispose them to evaporative dry eye, while academic pressure, competitive environments, and limited time for recreation heighten their vulnerability to depression, anxiety, and stress [8, 9]. In resource-limited and conflict-affected settings, these baseline vulnerabilities are magnified. Yemen has experienced a protracted humanitarian crisis, with widespread displacement, infrastructure collapse, and severe constraints on healthcare and education. Within this context, Yemeni medical students confront not only the ordinary demands of their training but also the chronic stressor of living and studying amid armed conflict, civil unrest, and economic instability [10, 11]. Recent studies have documented exceptionally high rates of depression, anxiety, and stress among Yemeni university students [11, 12], yet the interplay between these mental health burdens and physical conditions such as DED has not been examined in this population.

To date, only a small number of investigations have specifically explored the association between dry eye symptoms and psychological distress among health sciences students in conflict-affected settings. A structural equation modelling study among Gazan health sciences students during the 2023–2025 period found that psychological distress, measured with the Depression Anxiety Stress Scale-8 (DASS-8), was significantly and positively associated with DED symptom severity as measured by the OSDI [13]. That study highlights the relevance of assessing both psychological and ocular surface health in young people living under extreme adversity. However, no analogous data exist for medical students in Yemen —a population facing a distinct conflict landscape and a unique set of educational and environmental exposures. Characterising the relationship between dry eye symptoms and psychological distress in this

group is essential to inform student health services, mental health screening protocols, and ophthalmic care in similarly strained contexts.

Therefore, the present study aimed to assess the association between dry eye disease symptoms and psychological distress among undergraduate medical students in Yemen during the ongoing conflict period. A secondary objective was to identify demographic, behavioural, and clinical factors independently associated with dry eye symptom severity in this population. We hypothesised that higher psychological distress scores would be significantly correlated with more severe dry eye symptoms, even after adjustment for known confounders such as screen time, sex, and allergic comorbidity.

Methodology

Study design and setting

This cross-sectional study was conducted among undergraduate medical students in Yemen (Sanaa university, Amran university, AlRazi university, and 21st September university) during the ongoing conflict period. The study aimed to assess the association between dry eye disease symptoms and psychological distress and to identify demographic, behavioural, and clinical factors associated with dry eye symptom severity.

Study population and sampling

The target population consisted of undergraduate medical students enrolled in medical colleges in Yemen. Students were eligible to participate if they were currently studying medicine, residing in Yemen during the study period, and willing to complete the questionnaire. Participants with incomplete key outcome data were excluded from the relevant analyses. A total of 487 responses were included in the dataset. OSDI data were available for 486 participants; one participant had missing OSDI data and was therefore excluded from analyses involving OSDI score, DED status, and DED severity classification.

Ethical approval and informed consent

Ethical approval was obtained from the Al-Razi University Research Ethics Committee with approval number RU/16/FMHS/2025. The study was conducted in accordance with the principles of the Declaration of Helsinki. Participation was voluntary, and electronic informed consent was obtained from all participants before completion of the questionnaire. Participants were informed about the study objectives, the anonymous nature of data collection, and their right to withdraw at any time before submitting their responses.

Data collection procedure

Data were collected using a structured, self-administered online questionnaire distributed through the Fillout platform. The questionnaire link was shared electronically with eligible undergraduate medical students. The online format was selected to facilitate data collection across different locations in Yemen

and to allow participants to complete the survey using a smartphone, tablet, or computer. No personally identifying information was required for participation.

Questionnaire and study variables

The questionnaire consisted of four main sections. The first section collected demographic information, including age, sex, academic year, and country of residence. The second section assessed behavioural and environmental factors, including daily screen-time duration and smoking status. Screen time was categorised as 1–3 hours/day, 3–5 hours/day, 5–8 hours/day, and more than 8 hours/day.

The third section collected clinical and ocular history variables that may be associated with dry eye symptoms. These included allergic disease, contact lens use, oral contraceptive use among female participants, autoimmune disease, vitamin A deficiency, isotretinoin use, congenital cataract, antimuscarinic treatment, previous refractive surgery, and keratoconus. These variables were recorded as yes/no responses.

The fourth section assessed psychological distress and dry eye symptoms using validated instruments. Psychological distress was measured using the Depression Anxiety Stress Scale-8 (DASS-8), which includes items assessing symptoms of depression, anxiety, and stress [12]. Item scores were summed to generate a total DASS-8 score, with higher scores indicating greater psychological distress. Subscale scores for stress, anxiety, and depression were also calculated from the relevant DASS-8 items.

Dry eye symptoms were assessed using the Ocular Surface Disease Index (OSDI), a validated questionnaire for evaluating the frequency and functional impact of dry eye symptoms [3]. The OSDI score was calculated using the standard formula: the sum of completed item scores multiplied by 25 and divided by the number of answered items. The calculated OSDI score was used as the primary dry eye outcome. Dry eye disease was defined as an OSDI score of 13 or higher. Severity was classified as normal (0–12), mild (13–22), moderate (23–32), and severe (33–100).

Statistical analysis

Data were entered in Microsoft Excel (version 2603) and analysed using Python (version 3.10.1). Before analysis, the dataset was cleaned and recoded. Age was converted to a numeric variable, and sex was recoded as male or female. Academic year was coded from first to sixth year, and screen-time responses were grouped into four categories: 1–3 h/day, 3–5 h/day, 5–8 h/day, and >8 h/day. Binary clinical and behavioural variables were coded as yes/no, including smoking, allergic disease, contact lens use, oral contraceptive use, autoimmune disease, vitamin A deficiency, isotretinoin use, congenital cataract, antimuscarinic treatment, prior refractive surgery, and keratoconus.

Psychological distress was assessed using the Depression Anxiety Stress Scale-8 (DASS-8), and dry eye symptoms were assessed using the Ocular Surface Disease Index (OSDI). As both instruments had been validated previously, no additional reliability analysis was performed in the present study. DASS-8 item scores were summed to generate a total DASS-8 score. In addition, component scores were derived for

stress, anxiety, and depression using the relevant DASS-8 items. Higher scores indicated greater psychological distress.

The OSDI score used in the analysis was calculated from the 12 OSDI items using the standard formula: the sum of completed item scores multiplied by 25 and divided by the number of answered items. The calculated OSDI value was used as the primary dry eye variable in all analyses. A binary dry eye disease (DED) variable was also created, with DED defined as an OSDI score of 13 or higher. In addition, DED severity was classified as normal (0–12), mild (13–22), moderate (23–32), and severe (33–100).

Descriptive statistics were used to summarize the sample. Continuous variables were presented as mean ± standard deviation and median with interquartile range, whereas categorical variables were presented as frequency and percentage. The distribution of continuous variables was assessed using skewness, kurtosis, and the Shapiro–Wilk test. Normality was evaluated for the OSDI score, DASS-8 total score, and the DASS-8 stress, anxiety, and depression component scores.

The association between dry eye symptoms and psychological distress was examined using Spearman's rank correlation coefficient because these measures were derived from ordinal questionnaire responses and were not assumed to be normally distributed. Correlations were calculated between OSDI score and DASS-8 total score, and between OSDI score and each DASS-8 component score.

Differences in psychological distress across DED severity categories were evaluated using the Kruskal–Wallis test. When the overall comparison was significant, pairwise Mann–Whitney U tests were performed between severity groups. To account for multiple pairwise comparisons, p-values were adjusted using the Benjamini–Hochberg false discovery rate procedure. Effect size for pairwise comparisons was expressed as r.

To explore crude associations between DED status and candidate predictors, univariate analyses were performed. Age was compared between participants with and without DED using the Mann–Whitney U test, while categorical predictors were examined using the chi-square test.

To identify factors independently associated with the severity of dry eye symptoms, a multivariable linear regression model was fitted with OSDI score as the dependent variable. The main independent variable was DASS-8 total score. The model was adjusted for age, sex, academic year, screen-time category, smoking, allergic disease, contact lens use, oral contraceptive use, autoimmune disease, vitamin A deficiency, isotretinoin use, congenital cataract, antimuscarinic treatment, prior refractive surgery, and keratoconus. Regression results were reported as coefficients, 95% confidence intervals, and p-values. Model performance was summarized using adjusted R-squared.

A multivariable logistic regression model was then fitted with DED status (present vs absent) as the dependent variable. The same set of covariates was included, with DASS-8 total score as the primary predictor. Before fitting the model, binary predictors were screened for lack of variation and for complete or quasi-complete separation. Predictors with zero cell counts or perfect separation were excluded from

the final model to ensure stable estimation. Results were reported as odds ratios (ORs) with 95% confidence intervals and p-values. Model performance was summarized using pseudo R-squared and likelihood ratio test p-value.

All statistical tests were two-sided, and a p-value < 0.05 was considered statistically significant.

Results

A total of 487 undergraduate medical students were included in the analysis. The mean age was 23.19 ± 2.88 years, and 267 (54.8%) were female. The mean OSDI score was 26.04 ± 19.10, while the mean DASS-8 total score was 9.85 ± 5.86. Based on the OSDI score, DED severity was classified as normal in 126 (25.9%), mild in 117 (24.0%), moderate in 81 (16.6%), and severe in 162 (33.3%) participants (Table 1).

The distribution of OSDI scores was right-skewed, as shown in Fig. 1. Formal normality testing demonstrated that OSDI score (Shapiro-Wilk W = 0.939, p < 0.001), DASS-8 total score (W = 0.972, p < 0.001), stress score (W = 0.940, p < 0.001), anxiety score (W = 0.926, p < 0.001), and depression score (W = 0.957, p < 0.001) all deviated significantly from normality (Table 2).

There was a moderate positive correlation between DASS-8 total score and OSDI score (rho = 0.414, p < 0.001), indicating that higher psychological distress was associated with more severe dry eye symptoms (Table 3, Fig. 2). Similar positive correlations were observed for the DASS-8 stress subscore (rho = 0.386, p < 0.001), anxiety subscore (rho = 0.414, p < 0.001), and depression subscore (rho = 0.320, p < 0.001) (Table 3).

DASS-8 total scores differed significantly across DED severity categories (Kruskal-Wallis H = 75.76, p < 0.001) (Table 4). As shown in Fig. 3, median DASS-8 scores increased progressively from the normal group to the severe DED group. Post hoc pairwise comparisons showed that the normal DED group had lower DASS-8 scores than the mild, moderate, and severe groups (all adjusted p < 0.001), and the severe group had higher DASS-8 scores than the mild and moderate groups (adjusted p = < 0.001 and p = 0.002, respectively). There was no significant difference between the mild and moderate groups after multiple-comparison adjustment (adjusted p = 0.109) (Table 4).

In univariate analyses comparing participants with and without DED, age was not associated with DED status (Mann-Whitney U = 25676, p = 0.754). However, DED status differed significantly according to sex, study year, screen time, allergy, contact lens use, and vitamin A deficiency (Table 5). Smoking, oral contraceptive use, autoimmune disease, isotretinoin use, congenital cataract, antimuscarinic treatment, refractive surgery, and keratoconus were not significantly associated with DED in univariate analyses (Table 5).

In the adjusted linear regression model, higher DASS-8 total score remained independently associated with higher OSDI score (beta = 1.10, 95% CI 0.79 to 1.41, p < 0.001). Allergy was also independently

associated with a higher OSDI score (beta = 5.37, 95% CI 1.55 to 9.19, p = 0.006), and screen time > 8 h/day was associated with a higher OSDI score compared with the reference category (beta = 6.51, 95% CI 0.50 to 12.51, p = 0.034) (Table 6). The model explained 26.4% of the variance in OSDI score (adjusted R-squared = 0.229; Table 6).

In the multivariable logistic regression model, higher DASS-8 total score was independently associated with greater odds of DED (OR = 1.12, 95% CI 1.07 to 1.17, p < 0.001). Contact lens use was also independently associated with DED (OR = 3.04, 95% CI 1.08 to 8.55, p = 0.035) (Table 7). Allergy and vitamin A deficiency showed borderline associations with DED in the adjusted model (OR = 1.71, p = 0.059; OR = 2.34, p = 0.062, respectively). The logistic model showed a pseudo R-squared of 0.157 and a highly significant likelihood ratio test (p < 0.001) (Table 7). Predictors showing perfect separation or zero cell counts, namely congenital cataract and antimuscarinic treatment, were excluded from the final logistic model (Table 7).

Table 1
Participant characteristics and key study variables.

Variable	Value
Sample size	487
Age, mean ± SD	23.19 ± 2.88
Age, median (IQR)	23.00 (21.00, 25.00)
OSDI score, mean ± SD	26.04 ± 19.10
OSDI score, median (IQR)	21.53 (10.42, 39.58)
DASS-8 total score, mean ± SD	9.85 ± 5.86
DASS-8 total score, median (IQR)	9.00 (5.00, 14.00)
Female sex, n (%)	267 (54.8%)
DED severity - Normal, n (%)	126 (25.9%)
DED severity - Mild, n (%)	117 (24.0%)
DED severity - Moderate, n (%)	81 (16.6%)
DED severity - Severe, n (%)	162 (33.3%)
DED severity – Missing, n (%)	1 (0.2%)

Table 2
Normality assessment of OSDI and DASS-8 scores.

Variable	N	Mean	SD	Skewness	Kurtosis	W	p
OSDI score	486	26.04	19.10	0.803	0.108	0.939	< 0.001
DASS-8 total score	487	9.85	5.86	0.331	-0.693	0.972	< 0.001
DASS-8 stress score	487	2.89	1.74	0.145	-0.930	0.940	< 0.001
DASS-8 anxiety score	486	3.07	2.41	0.648	-0.322	0.926	< 0.001
DASS-8 depression score	486	3.90	2.45	0.282	-0.719	0.957	< 0.001

Table 3
Correlations between OSDI and DASS-8 scores.

Variables	Spearman rho	Spearman p
OSDI score vs DASS-8 total score	0.414	< 0.001
OSDI score vs DASS-8 stress score	0.386	< 0.001
OSDI score vs DASS-8 anxiety score	0.414	< 0.001
OSDI score vs DASS-8 depression score	0.320	< 0.001

Table 4
Comparison of DASS-8 total score across DED severity categories.

Comparison	Statistic	Adjusted p
Overall Kruskal-Wallis test	H = 75.76	< 0.001
Normal (0–12) vs Mild (13–22)	U = 5364.5; r = 0.235	< 0.001
Normal (0–12) vs Moderate (23–32)	U = 3126.0; r = 0.327	< 0.001
Normal (0–12) vs Severe (33–100)	U = 4506.5; r = 0.479	< 0.001
Mild (13–22) vs Moderate (23–32)	U = 4103.5; r = 0.114	0.109
Mild (13–22) vs Severe (33–100)	U = 6128.0; r = 0.301	< 0.001
Moderate (23–32) vs Severe (33–100)	U = 4960.5; r = 0.199	0.002

Table 5
Univariate analyses of factors associated with DED status.

Predictor	Test	Statistic	p
Age (years)	Mann-Whitney U	25676	0.754
Sex	Chi-square	11.44	< 0.001
Study year	Chi-square	25.52	< 0.001
Screen time	Chi-square	12.89	0.005
Smoking	Chi-square	0.14	0.710
Allergy	Chi-square	6.23	0.013
Contact lens use	Chi-square	6.78	0.009
Oral contraceptive use	Chi-square	0.13	0.720
Autoimmune disease	Chi-square	0.71	0.400
Vitamin A deficiency	Chi-square	8.28	0.004
Isotretinoin	Chi-square	0.15	0.695
Congenital cataract	Chi-square	0.67	0.412
Antimuscarinic treatment	Chi-square	0.04	0.843
Refractive surgery	Chi-square	1.93	0.165
Keratoconus	Chi-square	0.00	0.989

Table 6
Multivariable linear regression for OSDI score.

Term	Beta	95% CI	p
Male sex	-1.80	-5.46 to 1.85	0.334
Study year 2	5.85	-2.13 to 13.83	0.151
Study year 3	4.95	-3.10 to 13.01	0.228
Study year 4	-4.17	-11.24 to 2.91	0.248
Study year 5	3.20	-4.70 to 11.09	0.427
Study year 6	3.78	-4.32 to 11.89	0.360
Screen time: 3–5 h/day	4.14	-1.03 to 9.32	0.117
Screen time: 5–8 h/day	5.12	-0.50 to 10.75	0.074
Screen time: >8 h/day	6.51	0.50 to 12.51	0.034
DASS-8 total score	1.10	0.79 to 1.41	< 0.001
Age (years)	0.26	-0.53 to 1.05	0.517
Smoking	1.36	-4.02 to 6.74	0.620
Allergy	5.37	1.55 to 9.19	0.006
Contact lens use	3.09	-3.89 to 10.08	0.386
Oral contraceptive use	-1.56	-11.52 to 8.40	0.759
Autoimmune disease	0.97	-9.94 to 11.87	0.862
Vitamin A deficiency	5.13	-1.21 to 11.47	0.113
Isotretinoin use	-1.78	-13.32 to 9.75	0.762
Congenital cataract	16.49	-14.50 to 47.47	0.297
Antimuscarinic treatment	-0.17	-99.57 to 99.24	0.997
Refractive surgery	2.98	-8.59 to 14.55	0.614
Keratoconus	1.84	-16.02 to 19.71	0.840
Model fit	R^2=0.264	Adj R^2=0.229	< 0.001

Table 7
Multivariable logistic regression for presence of DED.

Term	OR	95% CI	p
Male sex	1.03	0.64 to 1.66	0.892
Study year 2	1.37	0.45 to 4.14	0.583
Study year 3	1.25	0.40 to 3.96	0.701
Study year 4	0.48	0.17 to 1.35	0.163
Study year 5	1.45	0.45 to 4.67	0.535
Study year 6	1.69	0.53 to 5.38	0.373
Screen time: 3–5 h/day	1.45	0.73 to 2.88	0.291
Screen time: 5–8 h/day	1.89	0.94 to 3.83	0.076
Screen time: >8 h/day	1.51	0.70 to 3.25	0.289
DASS-8 total score	1.12	1.07 to 1.17	< 0.001
Age (years)	0.98	0.90 to 1.08	0.708
Smoking	1.21	0.60 to 2.46	0.598
Allergy	1.71	0.98 to 2.99	0.059
Contact lens use	3.04	1.08 to 8.55	0.035
Oral contraceptive use	0.89	0.21 to 3.75	0.869
Autoimmune disease	1.87	0.44 to 7.99	0.398
Vitamin A deficiency	2.34	0.96 to 5.72	0.062
Isotretinoin use	0.47	0.15 to 1.50	0.203

Term	OR	95% CI	p
Refractive surgery	3.04	0.60 to 15.27	0.178
Keratoconus	1.41	0.21 to 9.45	0.725
Model fit	Pseudo R^2=0.157	LLR p = < 0.001	
Dropped predictors	cataract (Perfect separation / zero cell count); antimuscarinic (Perfect separation / zero cell count)		

Discussion

In this cross-sectional study of undergraduate medical students in Yemen during the conflict period, dry eye symptoms were common and were significantly associated with psychological distress. Nearly three-quarters of participants met the OSDI-based threshold for DED, and one-third were classified as having severe symptoms. Psychological distress showed a moderate positive correlation with OSDI score, and the association was consistent across the stress, anxiety, and depression components of the DASS-8. Importantly, DASS-8 total score remained independently associated with both higher OSDI score and greater odds of DED after adjustment for demographic, behavioural, and clinical covariates. These findings support the hypothesis that psychological distress is closely linked to dry eye symptom burden in Yemeni medical students and suggest that ocular surface symptoms in this population should be interpreted within a broader biopsychosocial context.

The high frequency of OSDI-defined DED observed in this study is consistent with evidence that medical students represent a vulnerable group for dry eye symptoms because of prolonged reading, extensive digital device use, irregular sleep, and academic pressure [2, 6, 7, 16]. In the present sample, the mean OSDI score was 26.04, corresponding to moderate symptom severity, and severe DED was present in 33.3% of participants. These findings are comparable with studies of medical students in other settings. For example, Utlu et al. reported that only 36.1% of medical students had normal OSDI scores, while 26.3% had severe symptoms [2]. Similarly, Tangmonkongvoragul et al. found a high prevalence of symptomatic DED among medical students during a period of increased screen time and psychological stress [16]. The burden observed in the Yemeni cohort may reflect not only routine educational exposures but also additional environmental and psychosocial stressors related to prolonged conflict, disrupted living conditions, and limited access to healthcare.

The central finding of this study was the independent association between psychological distress and dry eye symptoms. The Spearman correlation between DASS-8 total score and OSDI score was moderate and statistically significant, and median DASS-8 scores increased progressively across DED severity categories. In adjusted linear regression, each one-point increase in DASS-8 total score was associated with a 1.10-point increase in OSDI score, while the logistic model showed that each one-point increase in

DASS-8 score was associated with 12% higher odds of DED. This pattern is consistent with previous systematic reviews and meta-analyses showing that depression and anxiety are more prevalent and more severe among individuals with DED, and that psychological symptoms are more closely related to subjective dry eye symptoms than to objective ocular signs [14, 15]. It is also consistent with a large population-based study that reported significant associations between DED and both depression and anxiety [17].

The present results extend this literature by focusing on medical students in Yemen, a conflict-affected and resource-limited setting. They also align closely with the recent study among Gazan undergraduate health sciences and nursing students, which found that DED symptoms were common and associated with psychological distress measured by the DASS-8, particularly stress and depression [13]. The similarity between findings from Yemen and Gaza suggests that the relationship between psychological distress and DED may be especially relevant in student populations exposed to chronic adversity. However, differences in conflict context, educational disruption, environmental exposure, and healthcare access mean that the Yemeni findings should not be considered merely a replication. Rather, they provide population-specific evidence that mental health and ocular surface symptoms may cluster among medical students living under prolonged instability.

Several mechanisms may explain the observed association. Psychological distress may contribute to DED through neuroendocrine dysregulation, autonomic imbalance, inflammatory activation, altered pain processing, and sleep disturbance [4, 14, 15]. Stress and anxiety may amplify ocular discomfort through central sensitisation and heightened symptom perception, even when ocular surface signs are not proportionally severe. Conversely, dry eye symptoms may worsen psychological distress by interfering with reading, screen-based learning, concentration, sleep, and daily functioning. This bidirectional framework is particularly plausible in medical students, for whom ocular discomfort during near-work may directly affect academic performance and perceived coping ability. In a conflict setting, this cycle may be intensified by persistent uncertainty, economic hardship, and limited opportunities for rest or clinical care.

Among the DASS-8 components, anxiety showed the strongest correlation with OSDI score, followed closely by stress, while depression showed a weaker but still significant association. This pattern may indicate that arousal-related psychological states, such as anxiety and stress, are particularly relevant to symptom perception and ocular discomfort in this population. Anxiety may heighten vigilance toward bodily sensations, while stress may influence tear film stability through inflammatory and autonomic pathways. Nevertheless, the depression component also showed a significant relationship with OSDI, supporting the broader concept that DED is associated with multiple dimensions of psychological distress rather than a single emotional domain [14, 15].

Screen time greater than 8 hours per day was independently associated with higher OSDI score in the linear regression model. This finding is biologically plausible and consistent with previous studies linking digital display exposure to dry eye symptoms among students and young adults [2, 16]. Prolonged

screen use can reduce blink frequency and blink completeness, increase tear evaporation, and intensify visual fatigue. In the Yemeni medical-student context, long screen exposure may reflect both academic demands and compensatory reliance on electronic materials when access to stable educational infrastructure is disrupted. Although screen time was not independently associated with binary DED status in the logistic model, its association with continuous OSDI score suggests that it may contribute more strongly to symptom severity than to crossing a diagnostic threshold.

Allergic disease was independently associated with higher OSDI score, and showed a borderline association with DED in the logistic model. This finding is clinically important because allergic conjunctivitis and DED share symptoms such as irritation, burning, tearing, and foreign-body sensation, and the two conditions may coexist. In settings where specialist ophthalmic assessment is limited, allergic symptoms may inflate subjective OSDI scores or contribute directly to ocular surface inflammation and tear film instability. Similarly, vitamin A deficiency showed a borderline adjusted association with DED. Although the confidence interval included the null, this finding may be relevant in a humanitarian context where nutritional insecurity can affect ocular surface health. Future studies should assess nutritional status more objectively and evaluate whether micronutrient deficiencies contribute to dry eye symptoms among students in conflict-affected settings.

Contact lens use was independently associated with threefold higher odds of DED in the logistic regression model. This is consistent with the known relationship between contact lens wear, tear film disruption, ocular discomfort, and dryness symptoms [18]. The finding is notable because contact lens use was associated with binary DED status but not with continuous OSDI score after adjustment. This may indicate that contact lens wear helps distinguish participants above the DED threshold, while psychological distress, allergy, and screen exposure better explain gradations of symptom severity. From a practical perspective, contact lens wearers in this setting may benefit from targeted counselling on wearing time, lens hygiene, replacement schedules, and early evaluation when dryness symptoms occur.

The clinical and public health implications of these findings are important. First, screening for DED among medical students should not be limited to ocular risk factors alone. Students reporting substantial dry eye symptoms may also warrant brief assessment for psychological distress, particularly where academic or conflict-related stressors are prominent. Second, student health services in conflict-affected settings should consider integrated interventions that address screen ergonomics, breaks during near-work, sleep hygiene, allergy management, contact lens practices, and access to basic ocular lubricants alongside mental health support. Third, the moderate size of the association between DASS-8 and OSDI suggests that psychological distress is clinically meaningful but not the only determinant of DED; therefore, both ocular and psychosocial contributors should be evaluated.

This study has several strengths. It addresses an understudied population of medical students in Yemen during an ongoing conflict period and uses validated instruments to assess both dry eye symptoms and psychological distress. The sample size was relatively large, and the analysis examined both continuous OSDI score and binary DED status. The use of non-parametric correlation and group comparisons was

appropriate because OSDI and DASS-8 scores were not normally distributed. The multivariable models adjusted for a wide range of demographic, behavioural, and clinical factors, allowing assessment of the independent association between psychological distress and DED symptom burden.

Several limitations should also be acknowledged. The cross-sectional design prevents causal inference; therefore, it cannot be determined whether psychological distress contributed to dry eye symptoms, whether dry eye symptoms worsened psychological distress, or whether both were influenced by unmeasured contextual factors. The study relied on self-reported questionnaire data, and DED was defined using OSDI rather than objective clinical tests such as tear break-up time, Schirmer testing, ocular surface staining, tear osmolarity, or meibomian gland assessment. As a result, the study primarily reflects symptomatic DED rather than clinically confirmed disease. Self-reported exposures such as screen time, allergy, vitamin A deficiency, and contact lens use may also be subject to recall or misclassification bias. In addition, unmeasured factors such as sleep quality, medication use, hydration, air conditioning, environmental dust, humidity, socioeconomic hardship, trauma exposure, and access to eye care may have confounded the observed associations. Finally, because the participants were undergraduate medical students, the findings may not be generalisable to non-medical students, older adults, or the general Yemeni population.

Future research should use longitudinal designs to clarify the directionality of the relationship between psychological distress and dry eye symptoms. Studies combining OSDI and DASS-8 with objective ocular surface measures would help determine whether psychological distress is more strongly associated with symptoms, signs, or symptom–sign discordance. Further work should also examine potential mediators such as sleep disturbance, digital screen exposure, blink behaviour, academic stress, post-traumatic stress symptoms, and inflammatory markers. In conflict-affected settings, intervention studies are needed to test whether combined ocular health education, digital ergonomics, allergy management, and mental health support can reduce both DED symptom severity and psychological distress among students.

This study demonstrates a significant independent association between psychological distress and dry eye symptoms among undergraduate medical students in Yemen during the conflict period. Higher DASS-8 scores were associated with greater OSDI severity and higher odds of OSDI-defined DED, while allergy, prolonged screen time, and contact lens use also contributed to symptom burden. These findings highlight the need for integrated student health approaches that recognise the overlap between mental health and ocular surface symptoms, particularly in young adults studying under conditions of prolonged adversity.

Conclusion

This study found a significant association between psychological distress and dry eye disease symptoms among undergraduate medical students in Yemen during the conflict period. Higher DASS-8 scores were moderately correlated with higher OSDI scores and remained independently associated with

both greater dry eye symptom severity and higher odds of OSDI-defined DED after adjustment for demographic, behavioural, and clinical factors. These findings suggest that psychological distress is an important correlate of dry eye symptom burden in this population.

In addition to psychological distress, prolonged screen time, allergic disease, and contact lens use were associated with dry eye outcomes. Screen time exceeding 8 hours per day and allergic disease were independently associated with higher OSDI scores, while contact lens use was independently associated with the presence of DED. These results highlight the multifactorial nature of dry eye symptoms among medical students and suggest that both psychosocial and ocular-surface-related factors should be considered in student health assessments.

Overall, the findings support the need for integrated approaches that combine dry eye screening, digital eye-strain prevention, allergy management, contact lens counselling, and mental health support. Such interventions may be particularly important in conflict-affected settings, where academic stress, psychological distress, limited healthcare access, and adverse living conditions may interact to increase the burden of symptomatic DED. Longitudinal studies incorporating objective ocular surface tests are needed to clarify causal pathways and to determine whether reducing psychological distress can improve dry eye symptoms in this population.

Declarations

Declaration of AI Use

ChatGPT (version 5.5) was used to refine sentence structure, grammar, and clarity. The authors reviewed and approved the final text and take full responsibility for the content.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethics approval and consent to participate

Ethical approval was obtained from the Al-Razi University Research Ethics Committee (approval number: RU/16/FMHS/2025). The study was conducted in accordance with the principles of the Declaration of Helsinki. Participation was voluntary, and electronic informed consent was obtained from all participants before completion of the questionnaire.

Clinical trial registration

Clinical trial number: not applicable. This study was an observational cross-sectional survey and did not involve the prospective assignment of participants to a health-related intervention.

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Data availability statement

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

Author contributions

[Mohammed Aljarousha, Tariek Aldoais, Mohd Zulfaezal Che Azemin, Noor Ezailina Badarudin, Husni Ahmed Abdullah Al-Goshae, Ebrahim Shaddad, Khaled Al-Hemyari]: Conceptualization, Methodology, Data curation, Formal analysis, Writing – original draft.
[Maged Albeshary, Mahfouth A Bamashmus, Ebrahim Nangarath Kottakal Cheriya, May M. Bakkar, Kariman Gamal Tamam, Reem Mohammed Alfakih, Jalal Hadi]: Supervision, Validation, Writing – review & editing.
All authors read and approved the final manuscript.

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Figures

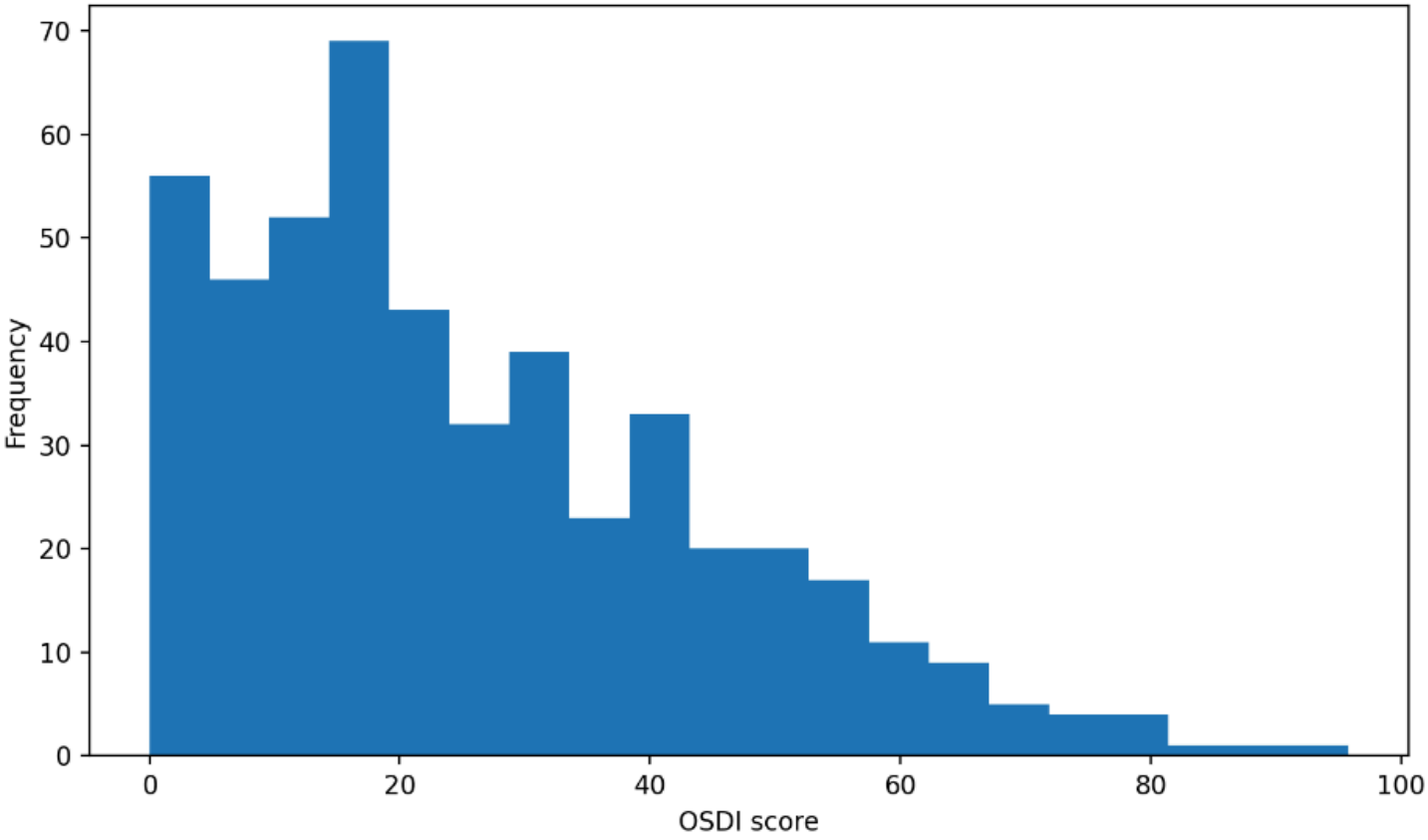


Figure 1

Distribution of OSDI scores.

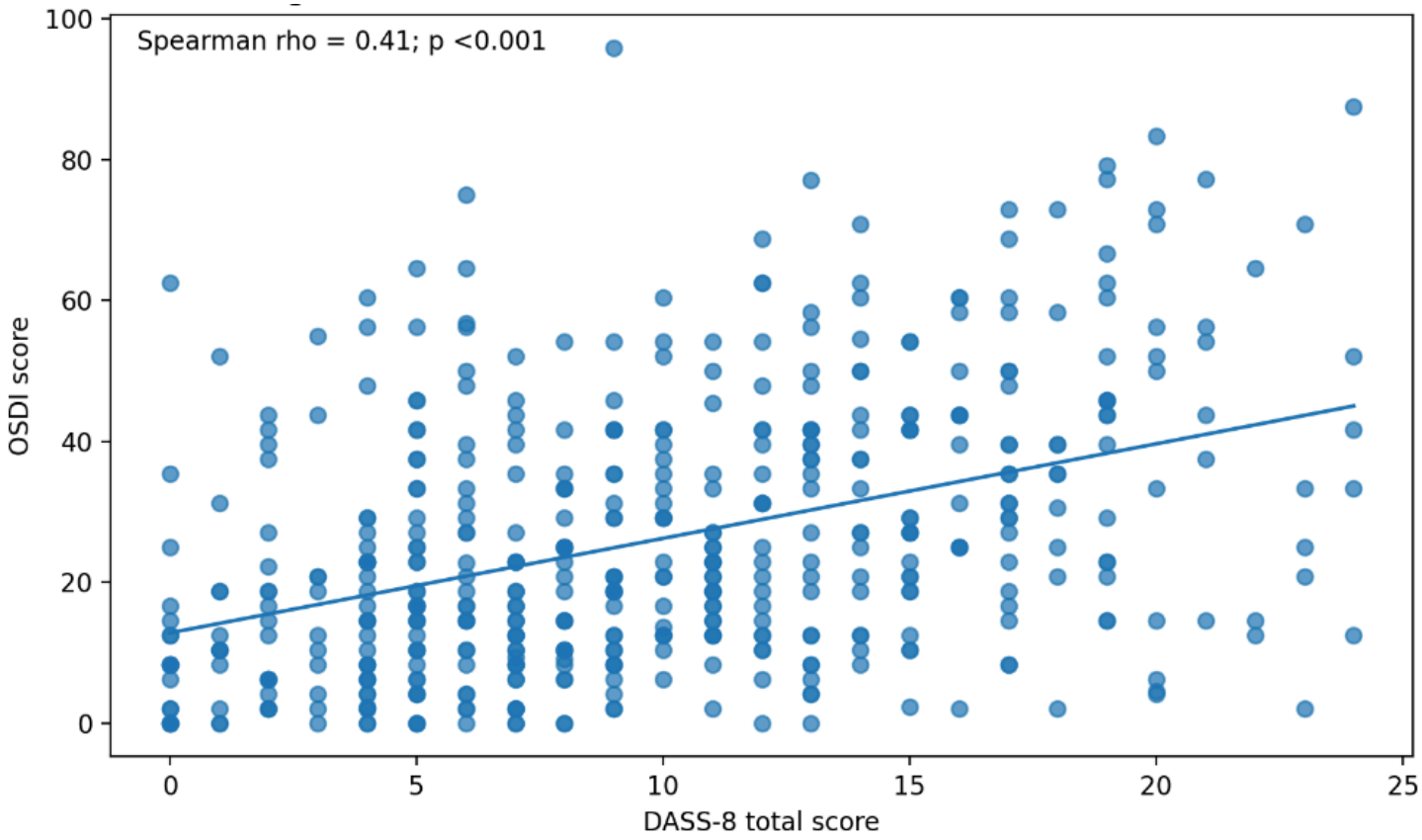


Figure 2

Association between DASS-8 total score and OSDI score.

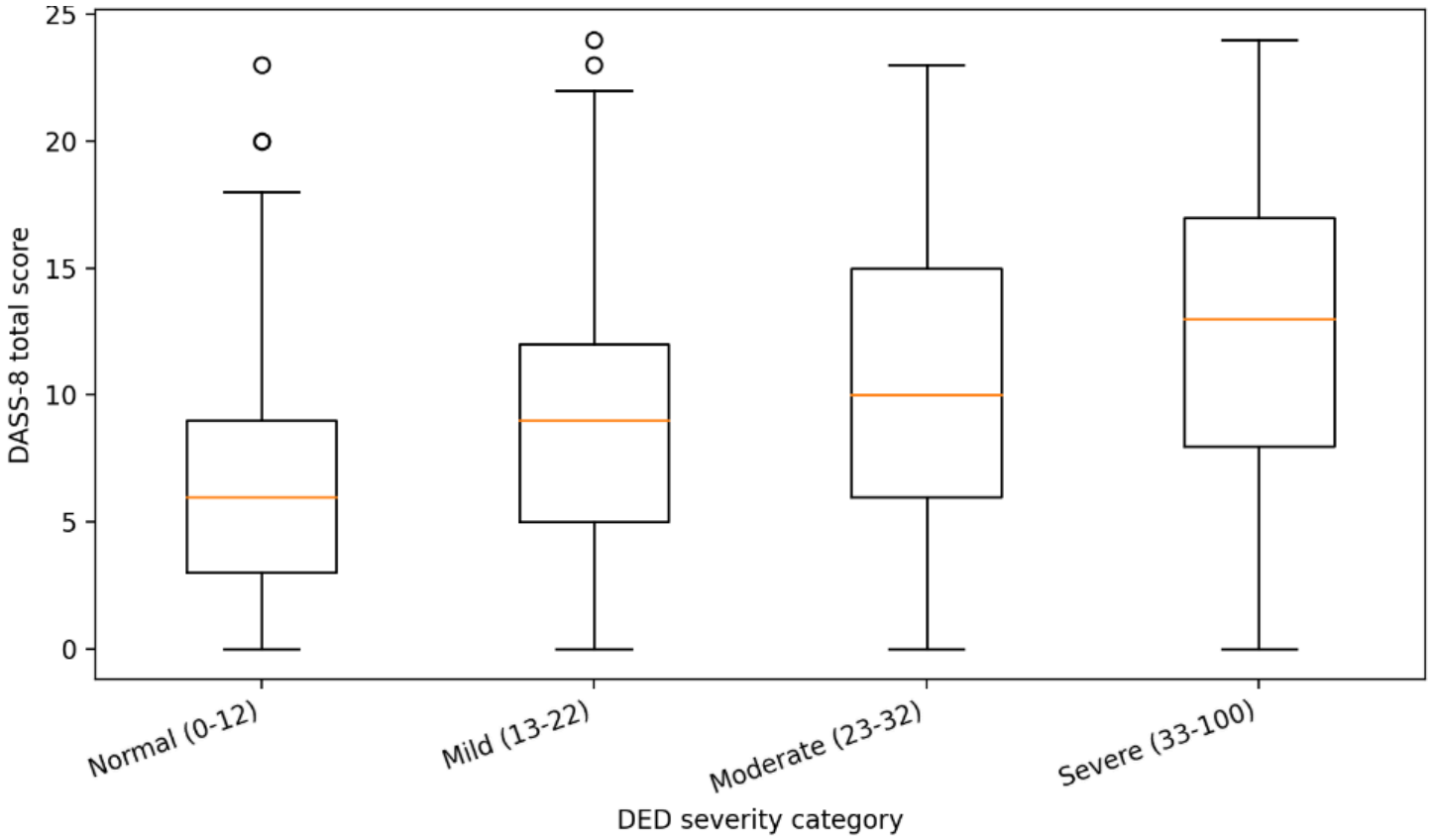


Figure 3

DASS-8 total score across DED severity categories.