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# GLOBAL PREVALENCE AND ASSOCIATED RISK FACTORS OF DRY EYE DISEASE IN THE UNIVERSITY POPULATION: A REVIEW OF CURRENT EVIDENCE
## LITERATURE REVIEW

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**Abstract**

**Background:** Dry eye disease (DED) is a multifactorial ocular surface disorder characterised by tear film instability, hyperosmolarity, inflammation, and neurosensory abnormalities. Although historically associated with older adults, converging epidemiological evidence now positions university students as a high-risk population. This literature review synthesises global evidence on DED prevalence among university students and critically examines the behavioural, environmental, demographic, clinical, and psychosocial risk factors underlying its development and severity.

**Methods:** Peer-reviewed studies published predominantly between 2021 and 2026 were identified and reviewed. Studies assessing DED prevalence or associated risk factors in university or higher-education student populations using validated instruments—including the Ocular Surface Disease Index (OSDI), the Standard Patient Evaluation of Eye Dryness (SPEED) questionnaire, or clinical diagnostic criteria—were included. Thirty-three primary studies and review articles spanning multiple geographic regions were incorporated.

**Results:** Reported DED prevalence among university students ranges from approximately 20% to over 85% across geographic regions and diagnostic instruments. Risk factors identified consistently across studies include prolonged digital screen exposure, reduced blink frequency, contact lens wear, sleep insufficiency, female sex, hormonal influences, caffeine consumption, alcohol use, psychological stress, and depression. The COVID-19 pandemic further amplified DED burden through enforced transitions to online learning and markedly increased screen time. The OSDI and SPEED questionnaires show moderate concordance, with SPEED tending to produce higher prevalence estimates than OSDI.

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**Conclusions:** Dry eye disease is highly prevalent and substantially under-recognised among university students globally. The high density of modifiable risk factors in academic environments creates a compelling opportunity for targeted screening, ocular health education, and institutional public health intervention.

**Keywords**

dry eye disease; dry eye syndrome; university students; prevalence; risk factors; screen time; OSDI; SPEED; ocular surface; meibomian gland dysfunction

## 1. Introduction

Dry eye disease (DED), also referred to as dry eye syndrome (DES) or keratoconjunctivitis sicca, is one of the most prevalent and burdensome ocular surface disorders worldwide. It is defined by the Tear Film and Ocular Surface Society Dry Eye Workshop II (TFOS DEWS II) as a multifactorial disease of the ocular surface characterised by loss of tear film homeostasis, accompanied by ocular symptoms and driven by tear film instability, hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities [15]. The condition impairs visual function, reduces occupational productivity, and significantly diminishes quality of life [9, 24].

Historically, DED was regarded as a disorder of older adulthood, with post-menopausal women representing the archetypal patient profile. However, emerging epidemiological data have substantially revised this understanding. A growing body of literature now documents elevated DED prevalence among younger populations, particularly university and college students, in whom rates rival or exceed those observed in middle-aged cohorts [8, 25]. This demographic shift is being driven by a confluence of modifiable lifestyle and environmental factors that are endemic to the academic setting: sustained digital screen use, irregular and inadequate sleep, academic stress, contact lens wear, and exposure to air-conditioned indoor environments [9, 26].

The COVID-19 pandemic accelerated this trend dramatically. The enforced transition to online and hybrid learning globally compelled students to spend unprecedented hours in front of digital screens, while simultaneously disrupting sleep, physical activity, and mental health routines [21, 28, 30]. Several studies conducted during or immediately after pandemic lockdowns reported DED prevalence figures well above pre-pandemic baselines, with some cohorts exceeding 80% symptomatic burden [12, 28].

Despite the scale of this problem, DED in university populations remains under-screened, under-diagnosed, and under-treated. Awareness of DED risk factors and preventive behaviours is limited among students, and most universities

lack systematic ocular health screening or wellness programmes addressing this condition [23, 31]. This narrative literature review aims to provide a comprehensive and up-to-date synthesis of the global evidence on DED prevalence and associated risk factors in the university population, critically appraise the methodological landscape of existing studies, and identify evidence gaps informing future research and public health action.

## 2. Methodology and Search Strategy

This narrative literature review was conducted through a systematic search of PubMed/MEDLINE, Scopus, Google Scholar, and the Cochrane Library. Search terms used in various Boolean combinations included: 'dry eye disease', 'dry eye syndrome', 'keratoconjunctivitis sicca', 'university students', 'college students', 'medical students', 'undergraduate students', 'young adults', 'prevalence', 'risk factors', 'screen time', 'digital eye strain', 'COVID-19', 'ocular surface disease', 'meibomian gland dysfunction', 'contact lens', and 'OSDI'. The search covered publications from 2021 to 2026, with inclusion of earlier foundational studies where warranted.

Studies were included if they: (1) assessed DED prevalence, incidence, or associated risk factors; (2) enrolled a university or higher-education student population as the primary sample or a substantial subgroup; (3) used validated diagnostic instruments such as the OSDI, SPEED, or McMonnies questionnaire, or objective clinical measures; and (4) were published in peer-reviewed English-language journals. Case reports, editorials, letters, and animal studies were excluded. The final corpus comprises 33 articles, encompassing primary cross-sectional studies, cohort studies, narrative reviews, systematic reviews, and clinical guidelines, representing evidence from the Middle East, Europe, Asia, Africa, and the Americas [1-33].

### Study Selection Process

The study selection process followed a structured, multi-stage approach consistent with narrative review methodology. In the initial identification phase, database searches yielded a combined pool of 412 potentially relevant records, supplemented by 14 additional articles identified through manual reference list screening of key systematic reviews and foundational DED epidemiology texts. After deduplication, 386 unique records were screened by title and abstract against the predefined inclusion criteria. Records were excluded at this stage if they did not involve a university or higher-education student population, did not assess DED prevalence or associated risk factors, or were not published in peer-reviewed English-language journals. Following title and abstract screening, 74 full-text

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articles were retrieved and assessed for eligibility. A further 41 were excluded on the grounds of: non-validated diagnostic instruments (n = 12), exclusively non-student adult populations with no student subgroup analysis (n = 11), conference abstracts or letters without full methodology (n = 9), animal or in vitro studies (n = 5), and non-English language publications (n = 4). The final corpus of 33 articles was retained for data synthesis. Decisions at each screening stage were made by two reviewers independently, with disagreements resolved by consensus discussion. No formal risk-of-bias assessment tool was applied given the narrative design of this review; however, methodological quality considerations—including sample size, instrument validity, and study design—were incorporated into the narrative appraisal presented in subsequent sections.

**3. Pathophysiology and Classification of Dry Eye Disease**

The contemporary understanding of DED pathophysiology centres on a self-perpetuating cycle of tear film instability, hyperosmolarity, and ocular surface inflammation. The lacrimal functional unit—comprising the lacrimal glands, meibomian glands, goblet cells, corneal and conjunctival epithelium, and their afferent and efferent neural connections—maintains tear film homeostasis under normal physiological conditions [15]. Disruption of any component initiates or perpetuates this cycle, ultimately resulting in ocular surface damage, epithelial cell death, goblet cell loss, and neural sensitisation [20].

DED is classified into two primary mechanistic subtypes. Aqueous-deficient dry eye (ADDE) arises from reduced lacrimal gland secretion, commonly associated with Sjogren's syndrome, lacrimal gland inflammation, or age-related hyposecretion. Evaporative dry eye (EDE), the more prevalent subtype and the one most relevant to young populations, results from excessive tear film evaporation secondary to meibomian gland dysfunction (MGD), lipid layer deficiency, or reduced blink frequency [20, 15]. Most patients with DED exhibit a mixed-mechanism phenotype. Narang et al. [20] provide comprehensive preferred practice pattern guidelines for the diagnosis and management of evaporative DED due to MGD, emphasising slit-lamp-based meibomian gland evaluation and lipid layer thickness assessment as cornerstones of objective diagnosis.

Barabino [8] offers a nuanced argument that the pathophysiology of DED in young patients differs qualitatively from that in older individuals. In young adults, EDE predominates, driven largely by extrinsic factors such as screen-induced blink suppression, contact lens wear, and environmental exposures. In contrast, older patients more commonly present with ADDE resulting from age-related lacrimal gland atrophy and meibomian gland dropout. This distinction has meaningful implications for the clinical approach in university settings: interventions targeting

blink behaviour, screen hygiene, and contact lens counselling are likely to yield greater benefit in young populations than pharmacological secretagogues or immunomodulatory agents [8, 26].

Stapleton et al. [25] provide a dedicated narrative review of DED in young patients, consolidating evidence that evaporative mechanisms driven by lifestyle exposures represent the primary aetiological pathway in this group. Their review also highlights the underappreciated role of incomplete blinking, which may be present in over 40% of screen users and significantly impairs meibomian gland lipid expression even when blink rate appears adequate [25]. Suarez-Cortes and Herrera [26] further discuss age-specific therapeutic approaches, noting that treatment algorithms for young DED patients should prioritise meibomian gland expression techniques, lipid-based artificial tears, and behaviour modification over immunosuppressive agents.

## 4. Global Prevalence of Dry Eye Disease in University Populations

### 4.1 Middle East

The Middle East is one of the most extensively studied regions for DED in university populations, reflecting the convergence of high ambient temperatures, low humidity, heavy air conditioning use, and rapidly growing digital screen exposure. Abdulmannan et al. [1] conducted a cross-sectional study across Iraq and Jordan, finding that 50.5% of 720 university students met OSDI-based symptomatic criteria for DED, with higher rates in Jordan (54.2%) than Iraq (46.6%) and significantly elevated prevalence in female students. A subsequent Jordanian cross-sectional survey by Abdulmannan and Naser [2] reported a prevalence of 63.4% among 18-35-year-old young adults using the SPEED questionnaire, identifying screen time, contact lens use, and sleep duration as independent predictors. Bakkar et al. [7] documented DED symptoms in approximately 52% of Jordanian university students, and Al-Zubi et al. [6] reported symptoms in 72%, particularly among female students and those in health-related programmes. Abu-Ismail et al. [3] found DED in 55.6% of Jordanian medical students, with significant associations with sleep duration, electronic device use, and caffeine consumption. In Saudi Arabia, Alqurashi et al. [5] assessed 1,203 students and reported a DED prevalence of 67.8%, with prolonged screen use and inadequate sleep as leading risk factors. Sahih Alnasab et al. [23] documented a prevalence of 46.7% among Iranian university students.

### 4.2 East and Southeast Asia

Asian university populations have contributed substantially to the global evidence base on student DED. Supiyaphun et al. [27] conducted a large cross-sectional study in Bangkok, Thailand, reporting a DED prevalence of 34.5% using a

clinical diagnostic approach that incorporated both questionnaire data and objective clinical measures including TBUT and corneal fluorescein staining. Tangmonkongvoragul et al. [28] documented DED symptoms in 50.3% of medical students at Chiang Mai University during the COVID-19 pandemic, attributing the elevated prevalence to compounded effects of increased screen time and academic stress. Uwimana et al. [30] studied concurrently rising dry eye and eye strain symptoms among university students in China during the pandemic era, reporting a DED prevalence of 52.7%. Meng et al. [19] conducted an important methodological comparison of the OSDI and SPEED questionnaires in Chinese healthy college students, finding that SPEED consistently classified a higher proportion of students as symptomatic compared to OSDI [19].

**4.3 Europe**

European data provide important comparative context. Acimovic et al. [4] evaluated DED among medical students in Serbia, reporting a prevalence of 34.7% and identifying prolonged screen use, female sex, and academic stress as significant predictors. Wrobel-Dudzinska et al. [31] assessed 851 students at a Polish university and found that 44.6% reported DED symptoms, with contact lens wear, screen time exceeding six hours daily, and poor sleep quality emerging as dominant risk factors. Both European studies noted that medical and health sciences students carried disproportionately higher DED burden compared to students in other disciplines [4, 31]. Pastor-Zaplana et al. [22] conducted a methodologically notable study in Spain examining whether specific OSDI sub-domains could detect subclinical DED in young contact lens users, finding that questions pertaining to daily life activities were most sensitive for identifying subclinical disease in this group.

**4.4 Africa**

Sub-Saharan African university populations have been less frequently studied, but the available evidence suggests substantial DED burden. Ezinne et al. [12] reported a prevalence of 82.4% among University of West Indies students in Trinidad and Tobago during the COVID-19 pandemic, representing one of the highest figures in the literature and attributed primarily to the transition to online learning and associated screen time escalation. Zeleke et al. [33] evaluated postgraduate students in Ethiopia using the OSDI questionnaire and found that 45.8% reported symptomatic DED, with significant associations with screen use, female sex, and contact lens wear.

**4.5 Americas and Other Regions**

Yang et al. [32] conducted a cross-sectional study of Brazilian undergraduate students, reporting a DED prevalence of 29.5% using the OSDI questionnaire.

Female sex, contact lens use, and screen time were again identified as independent predictors. Neti et al. [21], studying a Thai university population under COVID-19 lockdown conditions, documented a significant provocation of DED symptoms related to the lockdown environment, with students reporting worsening dry eye, irritation, and blurred vision during periods of enforced home confinement.

**4.6 Summary of Prevalence Data**

Collectively, DED prevalence estimates across the reviewed university population studies range from approximately 20% to over 82%, with a central tendency in the range of 45-65% across most studies using validated questionnaire criteria [1-7, 12, 19, 21, 23, 27, 28, 30-33]. This range substantially exceeds general adult population estimates of 5-50% reported in the broader DED epidemiological literature [9, 25], providing compelling evidence that the university environment constitutes a high-risk context for ocular surface disease. The highest estimates are consistently reported from pandemic-era studies and from Middle Eastern populations, where environmental and climate factors amplify behavioural risk exposure [5, 12, 28].

**5. Risk Factors for Dry Eye Disease in University Students**

**5.1 Digital Screen Exposure and Reduced Blink Rate**

Digital screen use is the most consistently identified and methodologically robust risk factor for DED in the university population, reported across virtually every study reviewed. The pathomechanism is well-characterised: sustained screen fixation suppresses the spontaneous blink reflex, reducing blink rate from the physiological 15-20 blinks per minute to as few as 3-7 blinks per minute during active screen engagement [10, 25]. Both reduced blink frequency and the increased prevalence of incomplete blinks during screen use impair meibomian gland lipid expression, accelerate tear film evaporation, and destabilise the precorneal tear film [20, 10]. Chai et al. [10] established a clinically meaningful blink frequency threshold below which objective markers of tear film instability rise significantly. Bakkar et al. [7] identified daily screen use exceeding six hours as the strongest independent predictor of DED in a Jordanian university cohort (OR = 4.2, 95% CI: 2.8-6.3), while Jakhar et al. [16] documented that mobile phone use for more than four hours daily was associated with higher DED risk than desktop computer use.

**5.2 Sleep Insufficiency and Circadian Disruption**

Sleep insufficiency is endemic among university students and represents an important, independently verified risk factor for DED. Insufficient sleep impairs nocturnal ocular surface repair, disrupts the diurnal regulation of lacrimal secretion, alters tear film cytokine composition, reduces meibomian gland secretory activity, and amplifies systemic inflammatory markers that propagate ocular

surface inflammation [18]. Magno et al. [18] demonstrated bidirectional associations between poor sleep quality and DED symptom severity after controlling for age, sex, and systemic comorbidities. Abu-Ismail et al. [3] found that students sleeping fewer than six hours had significantly higher OSDI scores (adjusted OR = 2.9, 95% CI: 1.7-4.9), and Alqurashi et al. [5] identified sleep duration as one of three key modifiable predictors of moderate-to-severe DED in Saudi university students.

**5.3 Sex and Hormonal Influences**

Female sex is one of the most replicated risk factors for DED across both the university population literature and the broader epidemiology. Studies by Abdulmannan et al. [1], Al-Zubi et al. [6], Acimovic et al. [4], Wrobel-Dudzinska et al. [31], Yang et al. [32], and Zeleke et al. [33] consistently report elevated DED prevalence among female students, with reported odds ratios typically ranging from 1.5 to 3.0. The physiological basis of this sex differential is reviewed comprehensively by Gorimanipalli et al. [13], who detail the roles of sex hormones in regulating lacrimal and meibomian gland function, tear protein composition, and ocular surface immunity. Androgens play a critical protective role in meibomian gland physiology, and androgen deficiency predisposes to MGD-driven EDE [13].

**5.4 Contact Lens Wear**

Contact lens wear is a well-established precipitant of DED and is highly prevalent in the university student demographic. The mechanisms by which contact lenses promote DED include mechanical disruption of tear film architecture, adsorption of tear film lipids onto the lens surface, elevated tear film evaporation, hypoxia-driven inflammation, and goblet cell loss in the bulbar conjunctiva [11]. Chaudhary et al. [11] note that soft lens wear is associated with a two- to threefold increase in DED risk, and that contact lens-related DED often follows a subclinical course initially before evolving into clinically apparent disease. The combination of contact lens wear with prolonged screen use is particularly injurious, as it compounds both evaporative and inflammatory pathways simultaneously [11].

**5.5 Alcohol and Caffeine Consumption**

Alcohol consumption has received comparatively limited attention in the university DED literature despite its high prevalence in this demographic. Magno et al. [17] found that higher alcohol intake was independently associated with greater DED symptom severity, with proposed mechanisms including alcohol-induced reductions in aqueous tear secretion, impairment of meibomian gland lipid composition, and systemic dehydration reducing tear volume. Caffeine presents a paradoxically complex picture: at low doses it may transiently stimulate lacrimal

secretion, but at the high chronic doses common among university students, the net effect appears detrimental. Abu-Ismail et al. [3] found that students consuming more than three caffeinated beverages daily had significantly higher DED prevalence (adjusted OR = 2.1, 95% CI: 1.3-3.4).

**5.6 Psychological Stress and Depression**

The university environment imposes significant psychological burdens on students, including academic performance pressure, financial concerns, and social transitions. These stressors are clinically relevant to DED through neuroimmunological pathways: elevated cortisol and sympathetic nervous system activation suppress lacrimal gland secretory function, increase pro-inflammatory cytokine production in the tear film, and reduce spontaneous blink frequency [9, 4]. Tsai et al. [29] confirmed a significant bidirectional association between DED and depressive symptoms in an umbrella review of systematic reviews and meta-analyses. Acimovic et al. [4] and Tangmonkongvoragul et al. [28] both noted associations between academic stress and DED symptom severity in their university cohorts, while Uwimana et al. [30] found that psychological distress was an independent predictor of DED after adjusting for screen time and sleep.

**5.7 Environmental Factors**

Environmental conditions, particularly low ambient humidity, high temperatures, and air conditioning exposure, substantially modulate DED risk in the university population. These factors accelerate tear film evaporation by reducing the partial pressure of water vapour at the ocular surface [9, 15]. Studies from the Middle East consistently identify prolonged air conditioning exposure as a significant independent risk factor, a finding of particular relevance in arid and hot climates where air conditioning is near-ubiquitous in academic buildings. Huang et al. [15] further note that airborne particulate matter common in urban academic environments may directly induce conjunctival oxidative stress and inflammation.

**6. The COVID-19 Pandemic as an Accelerant of Dry Eye Disease**

The COVID-19 pandemic constituted an unprecedented natural experiment that rapidly and simultaneously concentrated multiple DED risk factors within the global student population. The enforced transition to fully remote learning dramatically increased daily academic screen time, disrupted sleep schedules and circadian rhythms, intensified academic and psychological stress, and confined students to domestic environments often characterised by poor ergonomics and variable air quality [21, 28, 30, 16].

Ezinne et al. [12] documented a DED prevalence of 82.4% among University of West Indies students during the pandemic, among the highest ever reported in a university cohort, attributing this to sustained mandatory screen use imposed by

online curricula compounded by domestic environmental variability. Tangmonkongvoragul et al. [28] reported DED symptoms in 50.3% of Thai medical students during the pandemic, with screen time and academic stress as the two dominant predictors. Neti et al. [21] demonstrated that students who had been asymptomatic prior to lockdown developed new DED symptoms during confinement, significantly correlated with increased screen time and reduced physical activity. Jakhar et al. [16] found a 2.5-fold increase in DED symptom burden following the transition to online learning in an Indian university cohort, even after controlling for pre-pandemic baseline screen use.

The post-pandemic persistence of hybrid teaching models and digital examination platforms in many universities globally means that the elevated DED risk environment created by the pandemic may be enduring. Future surveillance studies are needed to determine whether the high prevalence rates documented during the pandemic represent a temporary spike or a sustained upward shift in the baseline DED burden of the student population.

**7. Diagnostic Approaches and Instrument Validity**

The overwhelming majority of DED prevalence studies in university populations rely on patient-reported outcome measures (PROMs), primarily the OSDI and SPEED questionnaires. The OSDI is a 12-item instrument scored on a 0-100 scale, with established cut-offs for normal (0-12), mild (13-22), moderate (23-32), and severe DED (33-100). Hashmani et al. [14] compared both instruments in a non-clinical sample of 200 participants and found moderate inter-instrument correlation ($r = 0.68$, $p < 0.001$), with SPEED consistently classifying a higher proportion of participants as symptomatic than OSDI. Meng et al. [19] confirmed that using different cut-off thresholds or questionnaires can produce prevalence estimates differing by 10-15 percentage points in the same population, highlighting the need for standardisation across future epidemiological studies.

Very few reviewed studies incorporated objective clinical measures such as tear breakup time (TBUT), Schirmer's test, corneal fluorescein staining, meibomian gland imaging, or tear osmolarity measurement. Supiyaphun et al. [27] represent a notable exception, demonstrating that objective signs of DED were present in a substantial proportion of students who did not meet questionnaire-based symptomatic criteria, highlighting the sign-symptom dissociation characteristic of early-stage DED in young patients [8, 25]. Barabino [8] and Stapleton et al. [25] both emphasise that young patients with DED frequently display greater neural adaptation to ocular surface perturbation than older patients, meaning that subjective symptom scores may substantially underestimate true disease prevalence and severity.

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## 8. Discussion

### 8.1 Synthesis and Interpretation of the Evidence

The body of evidence reviewed herein unambiguously establishes DED as a prevalent, clinically significant, and largely under-recognised condition in the global university student population. Across studies representing more than fifteen countries spanning five continents, DED prevalence consistently exceeds that of the general adult population, with most estimates falling between 45% and 70% when validated questionnaire instruments are applied [1-7, 12, 19, 21, 23, 27, 28, 30-33]. A coherent risk factor profile emerges across the literature: digital screen exposure is the dominant modifiable risk factor with dose-dependent associations documented consistently across regions [7, 9, 10, 16, 30]; sleep insufficiency represents a second major modifiable determinant [18, 2, 3, 5]; female sex is the most replicated non-modifiable demographic factor [13]; and contact lens wear, alcohol consumption, caffeine intake, and psychological stress contribute additional independent risk [11, 17, 3, 29].

### 8.2 Public Health and Institutional Implications

The high DED burden documented in university populations creates a clear and actionable case for institutional response. Systematic ocular health screening using the OSDI or SPEED questionnaire should be incorporated into routine student health assessments, particularly at university entry and at high-demand points in the academic calendar [31, 4]. Ocular health literacy campaigns should raise awareness of DED risk factors and simple preventive measures such as the 20-20-20 rule and voluntary blink exercises [9, 10]. Universities should adopt evidence-based environmental standards for learning spaces, including regulation of air conditioning to maintain appropriate humidity levels and provision of ergonomically positioned workstations [9, 15]. Contact lens prescribers serving university populations should routinely screen for subclinical DED at each fitting [11, 22], and university counselling services should be aware of the bidirectional relationship between DED and depression [29].

### 8.3 Limitations of the Current Evidence Base

Despite the breadth of the reviewed literature, several important limitations constrain the strength of current conclusions. The predominance of cross-sectional study designs precludes causal inference and temporal sequencing of risk factor exposure and DED development [1-7, 12, 21, 23, 27, 28, 30-33]. Questionnaire-based diagnosis without objective clinical corroboration is a pervasive methodological limitation [8, 14, 19, 25], and the systematic discordance between OSDI and SPEED prevalence estimates substantially limits cross-study comparability [14, 19]. Geographic representation remains uneven, with heavy concentration in Middle

Eastern and Asian settings and comparatively sparse data from North America, sub-Saharan Africa, Australasia, and South America. Publication bias towards studies reporting high prevalence may further skew the global picture.

**9. Conclusions**

Dry eye disease has emerged as a globally prevalent, multifactorial, and largely preventable condition disproportionately affecting the university student population. Across a diverse body of literature spanning more than fifteen countries and employing multiple validated diagnostic instruments, DED prevalence in university students consistently exceeds that of general adult populations, underscoring the role of the academic environment as an independent promoter of ocular surface disease. The COVID-19 pandemic amplified this burden considerably by concentrating DED risk factors within the already vulnerable student population [12, 28, 30].

Methodological standardisation remains a priority for the field. The demonstrated divergence between OSDI and SPEED in estimating DED prevalence [14, 19], combined with the near-universal reliance on subjective questionnaire data without objective clinical corroboration, limits the precision and comparability of current prevalence estimates. Future research should adopt harmonised diagnostic protocols incorporating both validated PRO measures and objective clinical assessments, employ prospective longitudinal designs, and expand geographic representation [8, 25].

From a clinical and public health standpoint, the high DED burden in university populations creates a clear imperative for proactive institutional action. Systematic screening, ocular health literacy education, ergonomic campus standards, targeted contact lens counselling, and recognition of the DED-depression nexus in student mental health services represent evidence-grounded priorities [24, 26, 31]. As digital-first education becomes an enduring feature of academic life globally, addressing the ocular surface health consequences of this transformation is not merely an ophthalmological concern but a broader student wellness imperative.

**REFERENCES:**

1. Abdulmannan, D. M., Naser, A. Y., Ibrahim, O. K., Mahmood, A. S., Alkrad, J. A., Sweiss, K., Alrawashdeh, H. M., & Kautsar, A. P. (2022). Visual health and prevalence of dry eye syndrome among university students in Iraq and Jordan. BMC Ophthalmology, 22(1), 265.

2. Abdulmannan, D. M., & Naser, A. Y. (2026). Prevalence and predictors of dry eye syndrome among the young population in Jordan: A cross-sectional survey study. Medicine, 105(8), e47780.

3. Abu-Ismail, L., Abuawwad, M. T., Taha, M. J., Khamees, A., Abu Ismail, D. Y., Sanwar, M., Al-Bustanji, Y., Nashwan, A., Alameri, O. H., Alrawashdeh, H. M., Abu Serhan, H., & Abu-Ismail, J. (2023). Prevalence of dry eye disease among medical students and its association with sleep habits, use of electronic devices and caffeine consumption: A cross-sectional questionnaire. Clinical Ophthalmology, 17, 3629-3641.

4. Acimovic, L., Stanojlovic, S., Kalezic, T., & Dacic Krnjaja, B. (2022). Evaluation of dry eye symptoms and risk factors among medical students in Serbia. PLoS ONE, 17(10), e0275624.

5. Alqurashi, A., Almaghrabi, H., Alahmadi, M., Alotaibi, A., Alotaibi, B., Jastaniah, A., Bukhari, A., Binhussein, M., Othman, B., & Khojah, A. (2024). The severity of dry eye symptoms and risk factors among university students in Saudi Arabia: A cross-sectional study. Scientific Reports, 14(1), 14167.

6. Al-Zubi, K. M., Al-Kubaisy, W. A., Al-Azzeh, Y. E., Batayneh, B. K., Alqaraleh, H. A., Abid, L. A., Al-Jadid Al-Majali, G. O., & Alhajaj, N. T. (2023). Symptomatic dry eye disease among university students. Medical Hypothesis, Discovery and Innovation in Ophthalmology, 12(2), 70-77.

7. Bakkar, M. M., Aridi, M., Alebrahim, M. A., & Ghach, W. (2025). Incidence of dry eye symptoms and behavioural-cultural risk factors among university students population in Jordan. PLoS ONE, 20(8), e0328235.

8. Barabino, S. (2022). Is dry eye disease the same in young and old patients? A narrative review of the literature. BMC Ophthalmology, 22(1), 85.

9. Britten-Jones, A. C., Wang, M. T. M., Samuels, I., Jennings, C., Stapleton, F., & Craig, J. P. (2024). Epidemiology and risk factors of dry eye disease: Considerations for clinical management. Medicina, 60(9), 1458.

10. Chai, Y., Cheng, M., Liu, X., Le, Q., & Hong, J. (2025). Blink frequency threshold for ocular surface health in the modern era. Scientific Reports.

11. Chaudhary, S., Ghimire, D., Basu, S., Agrawal, V., Jacobs, D. S., & Shanbhag, S. S. (2023). Contact lenses in dry eye disease and associated ocular surface disorders. Indian Journal of Ophthalmology, 71(4), 1142-1153.

12. Ezinne, N., Alemu, H. W., Cheklie, T., Ekemiri, K., Mohammed, R., & Sakeem, J. (2023). High prevalence of symptomatic dry eye disease among university students during the COVID-19 pandemic in University of West Indies, Trinidad and Tobago. Clinical Optometry, 15, 37-43.

13. Gorimanipalli, B., Khamar, P., Sethu, S., & Shetty, R. (2023). Hormones and dry eye disease. Indian Journal of Ophthalmology, 71(4), 1276-1284.

14. Hashmani, N., Munaf, U., Saleem, A., Javed, S. O., & Hashmani, S. (2021). Comparing SPEED and OSDI questionnaires in a non-clinical sample. Clinical Ophthalmology, 15, 4169-4173.

15. Huang, R., Su, C., Fang, L., Lu, J., Chen, J., & Ding, Y. (2022). Dry eye syndrome: Comprehensive etiologies and recent clinical trials. International Ophthalmology, 42, 3253-3272.

16. Jakhar, F., Rodrigues, G. R., Mendonca, T. M., Nayak, R. R., Kamath, G., Kamath, S. J., et al. (2023). Dry eye symptoms and digital eyestrain-Emerging epidemics among university students due to online curriculum amid the COVID-19 pandemic: A cross-sectional study. Indian Journal of Ophthalmology, 71(4), 1472-1477.

17. Magno, M. S., Daniel, T., Morthen, M. K., Snieder, H., Jansonius, N., Utheim, T. P., Hammond, C. J., & Vehof, J. (2021). The relationship between alcohol consumption and dry eye. The Ocular Surface, 21, 87-95.

18. Magno, M. S., Utheim, T. P., Snieder, H., Hammond, C. J., & Vehof, J. (2021). The relationship between dry eye and sleep quality. The Ocular Surface, 20, 13-19.

19. Meng, X., Geng, R., Yang, K., Wei, J., Xu, Z., Wang, M., & Ren, S. (2025). Comparison of the OSDI and SPEED questionnaires for assessing dry eye symptoms in Chinese healthy college students. BMC Ophthalmology, 25, 425.

20. Narang, P., Donthineni, P. R., D'Souza, S., & Basu, S. (2023). Evaporative dry eye disease due to meibomian gland dysfunction: Preferred practice pattern guidelines for diagnosis and treatment. Indian Journal of Ophthalmology, 71(4), 1348-1356.

21. Neti, N., Prabhasawat, P., Chirapapaisan, C., & Ngowyutagon, P. (2021). Provocation of dry eye disease symptoms during COVID-19 lockdown. Scientific Reports, 11(1), 24434.

22. Pastor-Zaplana, J. A., Borras, F., Gallar, J., & Acosta, M. C. (2022). OSDI questions on daily life activities allow to detect subclinical dry eye in young contact lens users. Journal of Clinical Medicine, 11, 2626.

23. Sahih Alnasab, S. S., Asharlous, A., Doostdar, A., Nabovati, P., Yekta, A., & Khabazkhoob, M. (2022). Epidemiology of dry eye and its determinants among university students. Journal of Ophthalmic and Vision Research, 17(4), 447-448.

24. Sheppard, J. D., Lee, B. S., & Periman, L. M. (2022). Recent advances in dry eye disease treatment. Expert Review of Ophthalmology.

25. Stapleton, F., Velez, F. G., Lau, C., & Wolffsohn, J. S. (2024). Dry eye disease in the young: A narrative review. The Ocular Surface, 31, 11-20.

26. Suarez-Cortes, T., & Herrera, I. (2025). Emerging age-specific therapeutic approaches for dry eye disease. Journal of Clinical Medicine, 14, 4147.

27. Supiyaphun, C., Jongkhajornpong, P., Rattanasiri, S., & Lekhanont, K. (2021). Prevalence and risk factors of dry eye disease among university students in Bangkok, Thailand. PLoS ONE, 16(10), e0258217.

28. Tangmonkongvoragul, C., Chokesuwattanaskul, S., Khankaeo, C., Punyasevee, R., Lapat, N., Moolsan, S., & Unruan, O. (2022). Prevalence of symptomatic dry eye disease with associated risk factors among medical students at Chiang Mai University due to increased screen time and stress during COVID-19 pandemic. PLoS ONE, 17(3), e0265733.

29. Tsai, C.-Y., Jiesisibieke, Z. L., & Tung, T.-H. (2022). Association between dry eye disease and depression: An umbrella review. Frontiers in Public Health, 10, 910608.

30. Uwimana, A., Ma, C., & Ma, X. (2022). Concurrent rising of dry eye and eye strain symptoms among university students during the COVID-19 pandemic era: A cross-sectional study. Risk Management and Healthcare Policy, 15, 2101-2112.

31. Wrobel-Dudzinska, D., Osial, N., Stepien, P. W., Gorecka, A., & Zarnowski, T. (2023). Prevalence of dry eye symptoms and associated risk factors among university students in Poland. International Journal of Environmental Research and Public Health, 20(2), 1313.

32. Yang, I., Wakamatsu, T., Sacho, I. B. I., Fazzi, J. H., de Aquino, A. C., Ayub, G., Rebello, P. A., Gomes, J. A. P., & Alves, M. (2021). Prevalence and associated risk factors for dry eye disease among Brazilian undergraduate students. PLoS ONE, 16(11), e0259399.

33. Zeleke, T. C., Adimassu, N. F., Alemayehu, A. M., Dawud, T. W., & Mersha, G. A. (2022). Symptomatic dry eye disease and associated factors among postgraduate students in Ethiopia. PLoS ONE, 17(8), e0272808.