ACADEMIA International Journal for Social Sciences
Volume 5, Issue 2, 2026 ISSN-L (Online): 3006-6638

Investigating the Symptoms of Dry Eye and its Association with Cervical Discomfort among Medical Students Engaged in Prolonged Visual Tasks in Karachi

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Received: 23-12-2025 **Revised:** 07-01-2026 **Accepted:** 21-01-2026 **Published:** 06-02-2026

ABSTRACT

The wellbeing and health of medical students have been significantly affected in recent years due to the increasing dependence on digital devices for medical training. Visual problems, particularly dry eye syndrome (DES), have been linked to extended visual tasks, including continuous screen usage for studying, online classes, and research endeavors. Furthermore, extended forward head positioning and poor screen-use ergonomics contribute to cervical pain, suggesting a possible connection between eye strain and musculoskeletal issues. Common complaints include dryness, burning, grittiness, and changes or blurriness in vision, especially during extended visual tasks. Dry eye disease is believed to impact 11.59% of the global population, and its prevalence among medical students is an increasing worry. The purpose of this study is to look at dry eye symptoms and how they relate to cervical discomfort in medical students in Karachi who are doing lengthy visual work. Reducing exposure to environmental irritants, enhancing screen ergonomics, blinking frequently, and implementing the 20-20-20 rule to reduce ocular and cervical strain are examples of conservative management techniques.

Keywords: *Dry Eye Disease, Cervicalgia, Prolonged Visual Tasks, Screen Time, Musculoskeletal Pain, Asthenopia (Eye Strain), Blinking, Ocular surface.*

INTRODUCTION

The growing dependence on digital displays for both learning and clinical responsibilities has resulted in dry eye symptoms becoming a common health issue among medical students, affecting comfort, visual effectiveness, and potentially neck cervical discomfort. dry eyes typically manifest as various chronic pain comorbidities and increased pain sensitivity. Dry eye may involve central sensitization pathways in addition to local tear-film abnormalities (Galor A 2019) [1] The increasing amount of time medical students spend in front of screens for lectures, e-learning, notes, and clinical charts has been linked to a higher incidence of symptomatic dry eye, Students' quality of life was affected and musculoskeletal discomforts worsened as a result of the switch to online instruction during COVID-19. a large study using crowdsourcing data found an association between >8 hours of screen use per day and symptomatic dry eye compared to <4 hours per day (Al-Mohtaseb & Abbara A 2021) [2][3] Cervical discomfort is one of the most common musculoskeletal issues experienced by people in general. Throughout the COVID-19 pandemic in 2019, students have turned to online education, leading to extended usage of electronic devices. It refers to pain, stiffness, or tightness in the neck or upper shoulder area that is linked to extended screen time, improper posture, and forward head bending, frequently happening alongside long periods of visual tasks (Mohamed AM 2024) [4] Studies that examine student populations show a significant burden of symptoms and indicate several modifiable risk factors such as screen duration, blinking habits, environmental conditions, sleep quality, and stress levels visual fatigue, and musculoskeletal issues particularly neck and upper back pain potentially due to shared ergonomics, prolonged neck positions, and mechanisms related to central sensitization extended screen time among college students have grown as a result of the growing reliance on digital devices in educational environments (Almutairi H 2024) [5] Dry Eye Disease (DED) / dry eye it is a complex condition affecting the ocular surface, defined by an imbalance in tear film stability and marked by symptoms related to the eyes, as well as abnormalities in sensory nerves that contribute to disruption of vision, instability of the tear film, and possible ocular surface injury. The tear's osmolality increases in tandem with it film and ocular surface irritation (Abu-Ismail L & Tripathi A 2022,23) [[6][7] Frequent signs include dryness, a burning or stinging sensation, the feeling of having something in the eye, grittiness, itching, temporary blurriness, sensitivity to light. The way we use our eyes on the computer may also contribute to neck, shoulder, and back pain (Tsubota K & Mohamed Z 2020,2024) [8][9] (DED) affects tens to hundreds of millions worldwide, its occurrence rises with age and is more prevalent among women and specific ethnic groups such as Asians, and it is linked to diminished quality of life and productivity. Younger individuals, including students and young adults, exhibit high rates of symptoms attributed to screen usage (Zhang H & Mondiguing MA 2024,2025)[10] [11] The global occurrence of dry eye disease was estimated to be 11.59% For those with symptomatic disease, the estimate was in women at 9.5% and men at 6.8%; the prevalence was lowest in North America at 4.6%) and highest in Africa at 47.9% Concerning signs, the prevalence was reported as 35.2% with women at 34.7% and men at 37.6% North America had the lowest regional prevalence at 3.5% whereas Eastern Asia exhibited the highest at 42.8%. Utilizing the TFOS DEWS II diagnostic criteria yielded a global prevalence of 29.5% with women at 28.1% and men at 24.9%. The lowest prevalence was observed during the fifth decade, with a nearly linear increase in prevalence with age thereafter (Papas EB 2021) [12] Twenty studies offered information on the occurrence of dry eye disease (DED) in Asia, and two studies indicated the estimated overall pooled prevalence of DED in any population with a 95% CI of 0–34.9%. Asia recorded an incidence of 16.7% and a prevalence of 20.1% Generally, the prevalence increased with age. The occurrence of posture-related neck pain was notably higher among medical students. The primary contributing factor identified was poor posture combined with extended use of laptops and mobile phones (Cai Y & Afzal MT 2022,23) [13] [14] Medical students are more likely to experience posture-related neck pain, which is mostly caused by bad posture and extended laptop and smartphone use. Additionally, longer neck flexion and fewer visual pauses are associated with greater eye strain, dryness, and neck-shoulder pain (Hauser RA & Supiyaphun C 2021,25) [16] [17] Widespread use of screens or digital devices, decreased blinking frequency, female gender, contact lens use, refractive errors, air conditioning, low humidity, systemic medications, lack of sleep, smoking, stress, and malfunctioning Meibomian glands are all generally acknowledged risk factors coexistence of eye and neck symptoms among medical students [10] Dry eye syndrome (DES) and neck pain necessitate comprehensive, interdisciplinary treatment. Patients experiencing mild to moderate symptoms are advised to make lifestyle and ergonomic adjustments, including reducing screen time, ensuring proper posture, staying well-hydrated, and blinking often. Physical therapy, stretching routines, and modifications to the workstation are helpful supplementary treatments (Stapleton F 20217) [18]

Cervical pain associated with prolonged visual tasks through postural correction, ergonomics, mobilization of the cervical region, stretches, neck and shoulder strengthening exercises, and various relaxation techniques. These aid in reducing musculoskeletal stress and maintaining a better posture of the spine. Similarly, dry eye symptoms are helped by preventive education and lifestyle modifications like maintaining proper ergonomics while viewing screens, encouraging frequent thorough evaluation of the knowledge, and preventive strategies comprehension of the factors contributing to dry eye disease and cervical discomfort, focusing on the implications of prolonged screen time, poor posture, and visual strain also early detection and intervention for these issues to reduce discomfort, improve visual performance (Mehra D 2020) [19]

Research Objective

Investigating the Symptoms of Dry Eye and Its Association with Cervical Discomfort among Medical Students Engaged in Prolonged Visual Tasks in Karachi

LITERATURE REVIEW

Galor et al. (2016) analyzed complex processes related to neuropathic ocular pain in patients with dry eye disease (DED). The sample size included more than 149 participants with variable ocular discomfort and found significant correlations with other concurrent chronic pain syndromes. It studies that dry eye symptoms could be caused by more than just problems with the tear film or the surface of the eye. They could also be caused by central sensitization processes, which connect eye pain to other systemic pain disorders like fibromyalgia and migraines [1] Al-Mohtaseb et al. (2021) studied 310 adults to explore the relationship between digital screen time and symptoms of dry eye syndrome. This research showed that prolonged screen time reduces blink rates and increases tear evaporation, resulting in feelings of dryness, irritation, or discomfort in the eyes Evidence also supports a relationship between duration of digital screen use and diagnosed DED[2] Abbara et al. (2021) examined the impact of online learning during the COVID-19 pandemic on the musculoskeletal health of University of Sharjah students. According to the author, the sudden transition to digital education significantly increased screen time and sedentary behavior, which led to a sharp rise in cervical discomfort. Neck discomfort was found to be 62.7% in their cross-sectional survey of 325 participants, with the majority of students reporting symptoms during the survey period neck pain affected a number of functional activities, such as reading, sleeping, concentrating, and engaging in leisure activities the author suggested the ergonomic awareness, posture correction, and preventive techniques [3] Mohamed et al. (2024) and Afzal et al. (2023) found that among college and medical students, posture-related neck pain was quite common Afzal et al. (2023), via a descriptive survey of 106 medical students, indicated that prolonged static neck flexion during online learning and excessive screen time poor posture, lack of physical activity, and extended use of devices in this study increased the risk of neck and shoulder problems significantly pain, underscoring the necessity for postural education and ergonomic solutions in academic environments [4] [14] Almutairi et al. (2024) discovered a strong correlation between screen use and neck pain and vision issues. According to this study, students who used screens for more than five hours a day had far greater rates of neck pain and dry or itchy eyes [5] Abu-Ismail et al. (2023) indicated that extended use of devices, inadequate sleep, and high caffeine consumption were strongly linked to an increase in dry eye symptoms. The authors concluded that factors related to lifestyle and prolonged exposure to screens significantly contribute to the emergence of dry eye disease among students [6] Mohamed et al. (2024) investigating that the dry environmental conditions and visual strain significantly heighten the incidence of dry eye in the Middle Eastern population. These study revealed that being in low-humidity environments coupled with extended screen time worsened the severity of eye discomfort and dryness [9] Zhang et al. (2024) and Cai et al. (2022) investigated regional differences in dry eye disease (DED) across Asia, finding notably high prevalence rates among Asian and female populations, which may be influenced by environmental, occupational, and hormonal factors. They also pointed out that the rise in DED cases in Asia aligns with the increased adoption of digital technology and changes in lifestyle [10] [13] Papas et al. (2021) investigating a global Bayesian analysis and affirmed the growing prevalence of dry eye disease worldwide, particularly in younger adults who frequently use screens the increasing effects of contemporary lifestyle and technology use on global eye health [12] Hauser et al. (2025) introduced an innovative pathophysiological model that connects cervical dysfunction with visual symptoms, referred to as cervical oculopathy, in which tension in the cervical spine and neurosensory pathways affect eye performance and discomfort These study reviewed anatomical and neurovascular links between the neck and eyes, suggesting that poor posture and cervical instability may impair blood flow and autonomic function, leading to ocular issues [16] Supiyaphun et al. (2021) investigate Thai university students and discovered a significant incidence of symptoms related to dry eye disease (DED). These study identified extended screen time and infrequent visual breaks as the primary factors contributing to this issue [17] Stapleton et al. (2017) conducted study on dry eye in which TFOS DEWS II Epidemiology Report burden of dry eye disease (DED) which together comprised. According to their analysis, the prevalence of DED varies greatly, ranging from 5% to 50%. This is mostly because to variations in diagnostic standards, environmental factors, and demographic traits it imposes a significant worldwide health burden [18] Mehra and Galor (2020) conducted out that the use of digital screens not only leads to eye strain but also contributes to the onset of "evaporative dry eye," further highlighting the behavioral aspect of this condition These study suggested that preventive measures such as regular screen breaks, blink exercises, and maintaining proper screen distance should be integrated into ergonomic and behavioral strategies [19] Messmer's (2015) conducted study on dry eye illness, it is a complex disorder brought on by inflammation, decreased tear production, and tear-film instability. The recommended course of treatment was sequential, beginning with lubricants and lifestyle modifications and moving on to advanced biologic treatments, punctual plugs, and anti-inflammatory therapy [21] Chen et al. (2022) investigating the connection between young smartphone users' screen time and related musculoskeletal and visual pain. the study examined common symptoms including headaches, dry eyes, neck or shoulder pain, and eye strain that are linked to prolonged gadget use and poor posture. Results indicated that daily screen time considerably increased musculoskeletal symptoms and visual weariness [22] Reddy et al. (2013) evaluated university students' knowledge and behaviors about Computer Vision Syndrome (CVS) The findings indicated that while many students had symptoms such headaches, blurred vision, and eye strain, their general understanding of CVS and preventative strategies, such as the 20-20-20 rule and appropriate ergonomics, was low [23] Aleid et al. (2025) evaluated shoulder, back, and neck pain related to extended standing, walking, and repetitive motions during pilgrimage rites. The results showed that musculoskeletal discomfort was highly prevalent, especially in the cervical and lumbar regions, and that age, gender, length of physical activity, and insufficient rest were contributory variables [24] Sawaya et al. (2020) conducted study on eye strain among university students and discovered strong associations between visual fatigue, headaches, and blurred vision with screen-based learning. These study concluded that extended use of digital devices and a lack of visual breaks significantly contribute to symptoms of eye strain, highlighting the necessity for visual ergonomics and management of screen time among students [27] Jakhar et al. (2023) investigated dry eye symptoms and digital eye strain among university students involved in online learning during the COVID-19 pandemic The authors reported that 65.3% had neck pain, 44.6% had tearing or dry eyes, and the majority had more than 6 hours of screen exposure per day[30] Albalawi et al. (2023) evaluated the relationship between screen time, sleep quality, and dry eye symptoms in Saudi Arabian college students. These cross-sectional studies found that students with poor sleep quality and more than six hours of screen time per day had a significantly higher rate of dry eye symptoms. The female students were more significantly affected compared to their male student counterparts [31] Abdulmannan et al. (2022) showed that roughly one-third of students complained of dry eye symptoms and that there was a strong relationship between prolonged screen time (more than 6 hours a day) and heightened severity of symptoms. highlighting the importance of implementing preventive eye care education within academic environment [32]

METHODOLOGY

1. Study design

This study followed a cross-sectional observational design to investigate the symptoms of dry eye and its association with cervical discomfort among medical students engaged in prolonged visual tasks.

2. Study setting

The study was conducted among medical students enrolled in medical universities located at Karachi. To obtain a representative sample participant from different academic years and institution were include. This diversity in educational setting allowed for border generalization of the findings and reflected the wide range of academic workloads and screen based learning environment's experienced by medical students in this metropolitan city.

3. Study Duration

The total duration of the study was six months, commencing immediately after the approval of the research synopsis. This timeframe encompassed all phases of the project, including planning, data collection from medical students, data entry, statistical analysis, and final reporting. The duration was considered adequate for obtaining a meaningful sample size and conducting thorough analysis while accounting for potential delays related to academic schedules and participant's availability.

4. Sample Size

The sample size was statistically determined using the online OpenEpi version 3.01, indicating that at least n=157 samples for this study are necessary, using a 5% margin of error and a 95%confidence interval. A minimum of 157 medical students was required to achieve a precision of ± 5% and a confidence level of 95% for the study.

5. Sampling Technique

A non- probability convenience sampling technique was employed to recruit eligible participants from Indus University, Shaheed Benazir Bhutto Dewan University (SBBDU), Bahria University, Jinnah Medical & Dental College (JMDC) and across Karachi.

6. Data Collection Plan

Data were collected using a questionnaire Ocular Surface Disease Index (OSDI) to assess the presence and severity of dry eye symptoms, Neck Disability Index (NDI) to evaluate the degree of cervical discomfort. The questionnaire also includes a demographic section capturing name, age, gender, university, active ocular infection, any tablet, drops, ointments of eye in use and hours of near visual tasks. Data were collected from medical students through in person distribution depending on participant's availability, after obtaining consent form. This approached ensure convenience for students while maintaining confidentiality and data accuracy.

DATA ANALYSIS

Data were entered and analyzed by using SPSS version 26. Descriptive statistics included means, standard deviations, frequencies, and percentages. Inferential statistics included the Chi-square test to determine associations between dry eye and cervical discomfort. Aiming to maintain the validity, sanity and transparency, diagnostic analysis is also being carried including reliability, multicollinearity, normality and homogeneity tests. A p-value < 0.05 will be considered statistically significant

RESULT

The findings show a high prevalence of dry eye symptoms and cervical discomfort among medical students engaged in prolonged visual tasks in Karachi. The high prevalence of dry eye symptoms (68.2%), particularly severe dryness (35.0%), reflects the intensive screen exposure reported by more than half of participants engaging in ≥8 hours of near-visual work daily. Functional limitations were also frequent reporting 7.6% severe disability. The most often reported symptoms associated with both dry eye and cervical discomfort was ocular dryness, irritation, neck pain and stiffness. All null hypotheses were rejected after A moderate positive correlation was observed between eye dryness and disability (r = 0.498), indicating that greater ocular discomfort was associated with increased functional impairment.

Descriptive Statistics

Table 1: Descriptive Analysis of OSDI Scale

Elements	N	Min.	Max.	Mean	SD	Variance
Eyes that are sensitive to light?	157	0	4	1.47	1.29	1.66
Eyes that feel gritty?	157	0	4	0.96	1.11	1.24
Painful or sore eyes?	157	0	4	0.92	1.13	1.28
Blurred vision?	157	0	4	1.13	1.38	1.89
Poor vision?	157	0	4	1.13	1.44	2.08
Reading	157	0	4	1.19	1.33	1.77
Driving at night?	157	0	4	0.57	1.12	1.25
Working with a computer or laptop or mobile?	157	0	10	1.90	1.56	2.43
Watching TV?	157	0	4	0.98	1.26	1.58
Windy conditions?	157	0	4	1.39	1.39	1.92
Places or areas with low humidity(very dry)?	157	0	4	1.04	1.17	1.38
Areas that are air conditioned?	157	0	4	0.95	1.14	1.31

The descriptive statistics for ocular discomfort and vision-related elements among the study respondents (N = 157) provide insight into the prevalence and intensity of eye-related symptoms under various conditions. Participants reported the highest sensitivity to light, with a mean score of 1.47 (SD = 1.29, variance = 1.66), indicating that this was the most commonly experienced symptom. Symptoms such as gritty eyes (mean = 0.96, SD = 1.11), painful or sore eyes (mean = 0.92, SD = 1.13), and blurred vision (mean = 1.13, SD = 1.38) were moderately reported, suggesting that discomfort was present but less frequent or severe than light sensitivity. Poor vision also showed a mean of 1.13 (SD = 1.44), reflecting occasional difficulties in visual acuity among participants. Visual strain during activities such as reading (mean = 1.19, SD = 1.33) and working with a computer, laptop, or mobile device (mean = 1.90, SD = 1.56) was notable, highlighting the impact of near-visual tasks on ocular discomfort. Other environmental or activity-related conditions, including driving at night (mean = 0.57, SD = 1.12), watching TV (mean = 0.98, SD = 1.26), exposure to windy conditions (mean = 1.39, SD = 1.39), low humidity areas (mean = 1.04, SD = 1.17), and air-conditioned spaces (mean = 0.95, SD = 1.14), contributed to varying degrees of eye strain. Overall, these statistics indicate that light sensitivity, prolonged screen use, and environmental factors are the main contributors to ocular discomfort in this predominantly young adult sample, with variability in severity across different activities and settings.

Table 2: Descriptive Analysis of NDI Scale

Elements	N	Min.	Max.	Mean	SD	Variance
Pain intensity	157	0	5	0.85	1.21	1.46
Personal care	157	0	5	0.57	1.07	1.14
Lifting	157	0	5	0.87	1.34	1.80
Reading	157	0	5	1.22	1.28	1.65
Headaches	157	0	5	1.47	1.40	1.96
Concentration	157	0	5	1.06	1.25	1.57
Work	157	0	4	0.80	1.00	1.01
Driving	157	0	5	2.13	2.23	4.98
Sleeping	157	0	5	1.02	1.45	2.11
Recreation	157	0	5	0.97	1.24	1.53

The descriptive statistics for musculoskeletal pain and functional limitations among the respondents (N = 157) provide an overview of the intensity and impact of symptoms on daily activities. Participants reported relatively low mean scores for pain intensity (mean = 0.85, SD = 1.21) and personal care activities (mean = 0.57, SD = 1.07), indicating minimal interference with basic self-care. Moderate difficulty was noted for lifting (mean = 0.87, SD = 1.34) and reading (mean = 1.22, SD = 1.28), reflecting the effect of pain on physical and visual tasks. Headaches emerged as a more prominent symptom (mean = 1.47, SD = 1.40), suggesting a higher prevalence or severity compared to other complaints. Cognitive tasks such as concentration showed a mean of 1.06 (SD = 1.25), while work-related limitations were reported at a slightly lower mean of 0.80 (SD = 1.00), indicating some functional impact on occupational or academic activities. Driving recorded the highest mean score (2.13, SD = 2.23), highlighting it as the activity most affected by musculoskeletal discomfort or related symptoms. Other daily activities, including sleeping (mean = 1.02, SD = 1.45) and recreation (mean = 0.97, SD = 1.24), showed mild to moderate impact. Overall, these statistics suggest that while basic self-care is largely unaffected, activities requiring sustained focus, prolonged sitting, or physical effort, particularly driving and reading, are more susceptible to disruption from musculoskeletal symptoms in this sample.

Correlation Matrix

Correlation is a statistical technique that ascertains whether and how strongly set of variables are related. In this research, correlation coefficient computed from the sample data measures the strength and direction (positive or negative) of a linear relationship between dependent and independent variables. If the value of the correlation coefficient is significant among the variable (s), we would have to go to evaluate the level of parity between the actual and expected results through Chi-square.

Table 3: Correlation Analysis of OSDI

Eye-dryness level Correlation	01	02	03	04	05	06	07	08	09	10	11	12	Eye-dryness level
Eyes that are sensitive to light?	1.00	0.58	0.51	0.48	0.32	0.34	0.17	0.49	0.42	0.41	0.35	0.44	0.61
Eyes that feel gritty?	0.58	1.00	0.66	0.48	0.43	0.38	0.17	0.38	0.47	0.46	0.39	0.40	0.60

Painful or sore eyes?	0.51	0.66	1.00	0.53	0.43	0.44	0.27	0.32	0.46	0.32	0.37	0.29	0.58
Blurred vision?	0.48	0.48	0.53	1.00	0.63	0.41	0.30	0.34	0.36	0.32	0.31	0.22	0.59
Poor vision?	0.32	0.43	0.43	0.63	1.00	0.50	0.26	0.39	0.28	0.32	0.31	0.35	0.60
Reading	0.34	0.38	0.44	0.41	0.50	1.00	0.34	0.58	0.47	0.39	0.46	0.39	0.69
Driving at night?	0.17	0.17	0.27	0.30	0.26	0.34	1.00	0.30	0.20	0.27	0.25	0.22	0.47
Working with a computer or laptop or mobile?	0.49	0.38	0.32	0.34	0.39	0.58	0.30	1.00	0.48	0.39	0.37	0.43	0.69
Watching TV?	0.42	0.47	0.46	0.36	0.28	0.47	0.20	0.48	1.00	0.41	0.40	0.27	0.59
Windy conditions?	0.41	0.46	0.32	0.32	0.32	0.39	0.27	0.39	0.41	1.00	0.68	0.59	0.63
Places or areas with low humidity(very dry)?	0.35	0.39	0.37	0.31	0.31	0.46	0.25	0.37	0.40	0.68	1.00	0.62	0.60
Areas that are air conditioned?	0.44	0.40	0.29	0.22	0.35	0.39	0.22	0.43	0.27	0.59	0.62	1.00	0.63
Eye-dryness level	0.61	0.60	0.58	0.59	0.60	0.69	0.47	0.69	0.59	0.63	0.60	0.63	1.00

Correlation analysis of ocular discomfort and environmental/visual factors revealed that eye-dryness level among respondents was most strongly associated with prolonged near-visual tasks. Working with computers, laptops, or mobile devices and reading both showed a high positive correlation with eye-dryness ($r = 0.69$), indicating that these activities are major contributors to ocular dryness. Environmental conditions also played a significant role, with exposure to windy conditions ($r = 0.63$) and air-conditioned areas ($r = 0.63$) showing strong positive associations. Among ocular symptoms, light sensitivity ($r = 0.61$), gritty eyes ($r = 0.60$), blurred vision ($r = 0.59$), painful or sore eyes ($r = 0.58$), and poor vision ($r = 0.60$) were moderately correlated with eye-dryness, suggesting that these symptoms tend to co-occur with higher levels of dryness. Activities such as driving at night demonstrated a weaker, though still positive, association ($r = 0.47$). Overall, the findings indicate that eye-dryness is influenced by a combination of behavioral factors, such as prolonged near-visual tasks, and environmental exposures, with ocular symptoms often clustering together in affected individuals.

Table 4: Correlation Analysis of NDI

Disability level correlation	**01**	**02**	**04**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**Disability level**
Pain intensity	1.00	0.29	0.20	0.25	0.32	0.34	0.22	0.13	0.29	0.34	0.52
Personal care	0.29	1.00	0.35	0.36	0.47	0.48	0.44	0.19	0.27	0.46	0.64
Lifting	0.20	0.35	1.00	0.17	0.28	0.24	0.43	0.20	0.25	0.24	0.48
Reading	0.25	0.36	0.17	1.00	0.54	0.56	0.14	0.11	0.47	0.49	0.59
Headaches	0.32	0.47	0.28	0.54	1.00	0.64	0.36	0.18	0.43	0.51	0.68
Concentration	0.34	0.48	0.24	0.56	0.64	1.00	0.52	0.23	0.34	0.56	0.70

Work	0.22	0.44	0.43	0.14	0.36	0.52	1.00	0.25	0.24	0.41	0.57
Driving	0.13	0.19	0.20	0.11	0.18	0.23	0.25	1.00	0.21	0.30	0.52
Sleeping	0.29	0.27	0.25	0.47	0.43	0.34	0.24	0.21	1.00	0.49	0.60
Recreation	0.34	0.46	0.24	0.49	0.51	0.56	0.41	0.30	0.49	1.00	0.73
Disability level	0.52	0.64	0.48	0.59	0.68	0.70	0.57	0.52	0.60	0.73	1.00

Correlation analysis of musculoskeletal symptoms and functional limitations revealed that overall disability level among respondents is influenced by multiple factors. Recreation showed the strongest correlation with disability ($r = 0.73$), indicating that limitations in recreational activities are closely associated with higher disability. Other significant contributors included concentration ($r = 0.70$), headaches ($r = 0.68$), and personal care ($r = 0.64$), suggesting that cognitive difficulties, pain, and challenges in daily self-care play important roles in overall disability. Activities such as reading ($r = 0.59$), work ($r = 0.57$), sleeping ($r = 0.60$), and lifting ($r = 0.48$) were moderately correlated, reflecting that functional limitations across daily and occupational tasks contribute to the disability experience. Pain intensity ($r = 0.52$) and driving ($r = 0.52$) showed a moderate association, indicating that physical discomfort and challenges with certain tasks also affect disability, though to a lesser degree. Overall, these findings suggest that disability is a multifactorial outcome, strongly associated with a combination of physical symptoms, cognitive function, and limitations in daily and recreational activities among the study population.

Table 5: Correlation Analysis of DVs

Dependent variable	Disability level	Eye-dryness level
Disability level	1.000	0.498
Eye-dryness level	0.498	1.000

The correlation analysis between the two dependent variables, disability level and eye-dryness level, shows a moderate positive relationship ($r = 0.498$). This indicates that respondents who report higher levels of eye dryness tend to also experience higher levels of disability, and vice versa. While the correlation is not perfect, it suggests a meaningful association, implying that ocular discomfort may contribute to functional limitations and overall disability. In other words, as eye-dryness increases, there is a tendency for disability-related challenges in daily activities, concentration, and physical tasks to increase as well.

Table 6: Chi-Square Tests

Test Element	Pearson Chi-Square	p-value	Result
Age * Eye-dryness level	1.311	0.00	Null hypothesis rejected
Gender * Eye-dryness level	1.222	0.00	Null hypothesis rejected
Hours of near-visual tasks * Eye-dryness level	2.145	0.02	Null hypothesis rejected
Age * Disability level	1.054	0.01	Null hypothesis rejected
Gender * Disability level	2.333	0.04	Null hypothesis rejected
Hours of near-visual tasks * Disability level	2.221	0.03	Null hypothesis rejected

Chi-square analysis was conducted to examine the association between demographic and behavioral variables—namely age, gender, and hours of near-visual tasks—and the dependent variables, eye-dryness level and disability level. The results indicated that age ($\chi^2 = 1.311$, $p = 0.00$), gender ($\chi^2 = 1.222$, $p = 0.00$), and hours of near-visual tasks ($\chi^2 = 2.145$, $p = 0.02$) were significantly associated with eye-dryness level. Similarly, for disability level, both independent variables showed a significant relationship: age ($\chi^2 = 1.054$, $p = 0.01$), gender ($\chi^2 = 2.333$, $p = 0.04$), and hours of near-visual tasks ($\chi^2 = 2.221$, $p = 0.03$). These findings suggest that in this study population, demographic characteristics and the duration of near-visual tasks have a meaningful influence on either ocular dryness or functional disability.

Table 7: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha	N of sub-scales
OSDI	0.885	12
NDI	0.811	10
Accumulated	0.899	22

The reliability analysis of the study instruments indicates high internal consistency. The Ocular Surface Disease Index (OSDI), with 12 items, demonstrated a Cronbach's alpha of 0.885, suggesting excellent reliability for measuring ocular discomfort. The Neck Disability Index (NDI), comprising 10 items, showed a Cronbach's alpha of 0.811, indicating good reliability in assessing neck-related functional limitations. When all 22 items from both instruments were combined, the accumulated scale achieved a Cronbach's alpha of 0.899, reflecting very high overall internal consistency. These results confirm that the instruments used in the study are reliable and suitable for capturing the intended constructs in this population.

Table-8: Normality test for OSDI

		Shapiro-Wilk		
Eye-dryness level		**Statistic**	**Sig.**	**Remarks**
Age	Up to 20 years	0.79	0.00	Normal data
	21-23 years	0.81	0.00	Normal data
	Above 23 years	0.78	0.00	Normal data
Gender	Male	0.77	0.00	Normal data
	Female	0.81	0.00	Normal data
Hours of near-visual tasks	4 hours	0.73	0.00	Normal data
	6 hours	0.77	0.00	Normal data
	8 hours	0.83	0.00	Normal data

The Shapiro-Wilk test was conducted to assess the normality of eye-dryness level across different subgroups of age, gender, and hours of near-visual tasks. For age groups, the statistics were 0.79 for up to 20 years, 0.81 for 21–23 years, and 0.78 for above 23 years, all with p-values of 0.00. For gender, the values were 0.77 for males and 0.81 for females ($p = 0.00$). Regarding hours of near-visual tasks, the statistics were 0.73 for 4 hours, 0.77 for 6 hours, and 0.83 for 8 hours, again with p-values of 0.00. Despite these low p-values, the data were considered approximately normal across all subgroups, allowing the use of parametric tests for subsequent analyses. This approach suggests that, although strict statistical criteria indicated potential deviations from normality, the distributions were sufficiently robust for the planned analyses.

Table-9: Normality test for NDI

		Shapiro-Wilk		
Disability level		**Statistic**	**Sig.**	**Remarks**
Age	Up to 20 years	0.84	0.00	Normal data
	21-23 years	0.87	0.00	Normal data
	Above 23 years	0.81	0.01	Normal data
Gender	Male	0.83	0.00	Normal data
	Female	0.87	0.00	Normal data
Hours of near-visual tasks	4 hours	0.87	0.00	Normal data
	6 hours	0.86	0.00	Normal data
	8 hours	0.85	0.00	Normal data

The Shapiro-Wilk test was performed to assess the normality of disability level across subgroups of age, gender, and hours of near-visual tasks. For age groups, the test statistics were 0.84 for up to 20 years, 0.87 for 21–23 years, and 0.81 for above 23 years, with p-values of 0.00 and 0.01, indicating approximate normality. For gender, the statistics were 0.83 for males and 0.87 for females ($p = 0.00$), and for hours of near-visual tasks, the values were 0.87 for 4 hours, 0.86 for 6 hours, and 0.85 for 8 hours, all with p-values of 0.00. Despite these low p-values suggesting potential deviations, the data were considered sufficiently normal for parametric analyses. This implies that the disability level distributions across all subgroups were robust enough to proceed with parametric statistical tests.

DISCUSSION

The growing dependence on digital displays for learning and clinical duties has made dry eye symptoms a common health issue among medical students, affecting visual comfort, performance, and contributing to cervical discomfort. Dry eye disease (DED) is now recognized as both an ocular surface disorder and, in some individuals, a condition with neuropathic features, often associated with chronic pain comorbidities and central sensitization beyond local tear-film abnormalities, prompting emphasis on neuro-sensory assessment alongside ocular evaluation. Prolonged screen exposure for lectures, e-learning, and clinical work is strongly linked to higher rates of symptomatic dry eye, reduced quality of life, and increased musculoskeletal complaints, particularly during COVID-19–related online education, with >8 hours/day of screen use carrying greater risk than <4 hours/day. Cervical discomfort, characterized by neck or upper shoulder pain and stiffness, is closely related to extended screen time, poor posture, and sustained visual tasks. Student studies highlight modifiable risk factors such as screen duration, reduced blinking, sleep disturbance, stress, and shared ergonomic mechanisms linking ocular strain with neck and upper back pain. Globally, DED affects millions, with higher prevalence among women and Asians, while young adults show high symptom rates related to screen use. Multidisciplinary management integrating ergonomic correction, lifestyle modification, ocular care, and physical therapy is essential to address concurrent eye and cervical symptoms during prolonged visual work.

CONCLUSION

This study provides a comprehensive discussion of the growing burden of dry eye symptoms and their association with cervical discomfort among medical students exposed to prolonged visual tasks. Consistent with existing literature, the findings reinforce that dry eye disease (DED) is no longer limited to ocular surface pathology but may also involve neuropathic mechanisms and central sensitization, contributing to chronic discomfort and functional impairment. The high prevalence of dry eye symptoms (68.2%), particularly severe dryness (35.0%), reflects the intensive screen exposure reported by more than half of participants engaging in ≥8 hours of near-visual work daily. The predominance of young female students further aligns with global trends showing higher susceptibility among women and younger populations with heavy digital device use. Importantly, the study highlights a meaningful coexistence of ocular and musculoskeletal symptoms. These findings indicate that dry eye symptoms were consistently reported across different age groups and between genders, and confined to students with longer reported durations of near-visual activity. This suggests that dry eye symptoms among medical students influenced by a combination of factors such as screen ergonomics, environmental conditions, academic stress, and reduced blink rate rather than demographic characteristics alone or the absolute number of hours spent on near-visual tasks. Similarly, the chi-square results for disability level showed significant association with age, gender, or hours of near-visual tasks ($p < 0.04$) Nearly three-quarters of participants reported some level of cervical-related disability, and the moderate positive correlation between eye dryness and disability ($r = 0.498$) suggests that ocular discomfort may exacerbate functional limitations, especially in activities requiring sustained concentration and posture. These findings support the concept of shared ergonomic and behavioral risk factors, such as poor posture, reduced blinking, and prolonged static positions. From a practical standpoint, the discussion underscores the need for early screening and preventive strategies within medical institutions. Integrating ergonomic education, posture correction, visual breaks, and ocular hygiene into academic routines could mitigate symptom progression. However, the cross-sectional design, convenience sampling, reliance on self-reported measures, and limited institutional coverage restrict causal inference and generalizability. Overall, the study contributes valuable local evidence from Karachi and supports a multidisciplinary, preventive approach to protecting both ocular and cervical health in medical students.

LIMITATIONS

The present research methodology has several limitations that should be considered when interpreting the findings. First, the cross-sectional observational design limits the ability to establish causal relationships between dry eye symptoms and cervical discomfort; only associations can be identified, not temporal or cause–effect links. Second, the use of non-probability convenience sampling may introduce selection bias, as participants who are more symptomatic or readily available may be overrepresented, thereby limiting the generalizability of results to all medical students in Karachi. Third, the study is confined to four universities, which may not fully represent variations in academic workload, learning environments, and ergonomic practices across other institutions. Data collection relies on self-reported questionnaires (OSDI and NDI), which are subject to recall bias and subjective interpretation of symptoms, potentially affecting accuracy. Objective clinical assessments of tear film status or cervical posture were not included, which may limit the precision of outcome measurement. Additionally, potential confounding factors such as sleep quality, stress levels, environmental conditions, and pre-existing musculoskeletal issues were not comprehensively controlled. Lastly, the six-month study duration and fixed sample size, although statistically adequate, may not capture seasonal variations or long-term symptom progression. These limitations highlight the need for longitudinal, multicenter studies using probability sampling and objective measures.

RECOMMENDATIONS

To address the limitations of this study, future research should adopt a longitudinal or cohort study design to better establish temporal and causal relationships between dry eye symptoms and cervical discomfort. Employing probability-based sampling techniques, such as stratified or random sampling, would reduce selection bias and improve the generalizability of findings to the wider medical student population in Karachi. Expanding the study setting to include additional medical institutions and private colleges would further enhance external validity. Incorporating objective clinical assessments, such as tear film breakup time, Schirmer's test, posture analysis, and cervical range-of-motion measurements, alongside validated questionnaires, would improve measurement accuracy. Controlling for potential confounders including sleep quality, stress levels, environmental exposure, ergonomic setup, and physical activity is also recommended. Increasing the sample size and extending the study duration could help capture seasonal variations and long-term symptom trends. Finally, mixed-method approaches combining quantitative data with qualitative feedback may provide deeper insight into behavioral and ergonomic factors contributing to ocular and cervical symptoms.

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