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PSYCHOMETRIC ASSESSMENT OF VISUAL FATIGUE, ACADEMIC STRESS, AND COGNITIVE PERFORMANCE AMONG MEDICAL STUDENTS WITH REFRACTIVE ERRORS IN BASRAH, IRAQ

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Abstract
Background: Refractive errors do not only reduce visual performance but also, refractive errors enhance mental load, psychological discomfort and learning challenges in students. Continuous working with digital gadgets and extended close work can lead to worsening of visual fatigue, stress and cognitive inefficiency in the exigent academic setting like in medical school.
Aim: To test the perceived stress, visual fatigue, and cognitive performance of medical students having refractive errors in Basrah, Iraq, with the help of the standard psychometric instruments.
Methods: Cross-sectional psychometric research study was carried out in medical students with and without refractive errors. The participants were required to respond to the Perceived Stress Scale (PSS-10), Visual Fatigue Scale (VFS) and Cognitive Failures Questionnaire (CFQ). The reliability of the scales and the associations among the severity of refractive error, screen time and psychological outcomes were explored using descriptive statistics, Cronbach a coefficients, Pearson correlations and multiple regression analysis.
Results: Greater severity in refractive error was linked to very high perceived stress and visual fatigue, and more common cognitive failures. The psychometric scales were all good in terms of internal consistency (Cronbach's a 0.82-0.89). Regression models revealed that both the severity of refractive error and the amount of screen time produced together explained a significant percentage of the variance in the scores on stress and fatigue.
Conclusion: The efficient screening of academic stress and visual workload through psychometric testing techniques (PSS-10, VFS, CFQ) represents an efficient alternative to be included in the health and vision programs of students.
Keywords: Refractive errors, visual fatigue, academic stress, cognitive performance, psychometric assessment.

INTRODUCTION

Refractive errors rank as the fourth leading cause of blindness worldwide and remain the second leading cause of curable blindness in many regions, after cataracts. They also represent one of the most common causes of visual impairment(1). Due to their significant social and health burden, refractive errors remain recognized as one of the five priority areas in the global initiative Vision 2020: The Right to Sight, launched by the World Health Organization (WHO) and the International Agency for the Prevention of Blindness (IAPB)(2). Several studies indicate that many individuals with uncorrected or miscorrected vision could benefit greatly from proper optical correction. This issue remains significant even in developed countries, particularly among older adults and minority populations(3, 4). Visual impairment has been linked to higher rates of morbidity and mortality, with uncorrected refractive errors specifically contributing to increased morbidity(5).
Besides the visual impairment, both uncorrected and severe refractive errors can cause more mental load and psychological stress among those students who have to maintain a long duration of near work(6,7). It is with great need of digital technology that medical students remain prone to intense academic demand, long study hours, and mental lapses, which can be significantly affected by visual fatigue, perceived stress, and cognitive failures as a result of excessive digital device use(8,9).
Refractive error happens when optical power of the eye and length of the eye do not match upto the point where the light rays do not focus exactly on the retina (10,11). Myopia, hyperopia and astigmatism cause blurred vision at either a distance or near and can usually be accompanied by sustained accommodative effort which can result in eye strain, headaches, difficulty with maintaining attention and mental fatigue during reading and tasks involving screens (12,13).

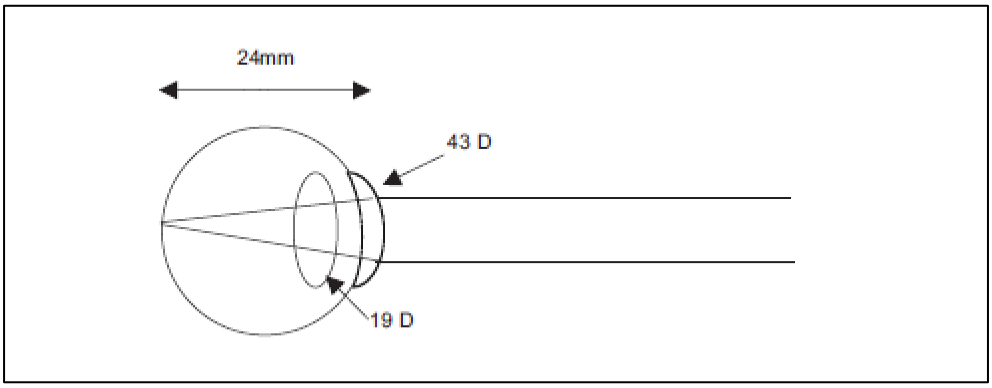

Figure 1: The human eye.

These effects can be explained by a variety of theoretical models in a psychological perspective(14,15). The theory of Cognitive Load postulates that when the visual input is impaired, activities involving prolonged visual processing and understanding may overwhelm the working memory(16). Stress Response Model implies that ongoing visual strains can be a cause of high perceived stress and activation of stress pathways(17). Attention Resource theory also provides that discomfort and blurred vision remain a drain on limited attentional resources, and make lapses and distractions and cognitive failures in the study more likely(18).

This is since even though the prevalence of refractive error among the student population is high, most of the existing studies deal with the estimation of prevalence and the risk factors that accompany it(19). Not many studies have directly evaluated the severity of the refractive error in relation to the psychometric measures of the stress, visual fatigue, and cognitive everyday failure in medical students. In this respect, there is a specific shortage of research in which clinical measures of refractive status remain combined with validated psychological tools(20).

Objectives of the study

1. Measure visual fatigue, perceived stress, and cognitive failures among medical students with refractive errors in Basrah, Iraq.
2. Evaluate the reliability and construct validity of the Perceived Stress Scale (PSS-10), Visual Fatigue Scale (VFS), and Cognitive Failures Questionnaire (CFQ) in this population.
3. Examine the predictive relationships between refractive error severity and daily screen time and psychological outcomes, including stress, visual fatigue, and cognitive failures.

METHODS

Study Design and Setting

The psychometric study was cross-sectional and was carried out on medical students of Basra Medical College, Al-Zahraa medical college and other medical colleges in Basrah, Iraq. Participants were recruited from four institutions: Basrah Medical College, Al-Zahraa Medical College, Basrah College of Dentistry, and Basrah College of Pharmacy. The study period extended from 23 February to 27 March 2024. All registered students at these colleges were invited to participate. To compare psychometrics results between the status of visual, the study involved both students with and without clinically diagnosed refractive errors. Students who had current eye infections or a history of traumatic eye disease were excluded to avoid confounding visual impairment unrelated to refractive errors.

Ethical Approval

This study was approved by the Scientific and Ethical Committee of the College of Medicine, University of Basrah (Reference No. 030409-007-2025). Participation was voluntary, and informed consent was obtained from all students prior to data collection.

The consent was on ophthalmic examination and filling of standardized psychometric questionnaires. All the participants were able to provide informed consent in writing before data collection.

Risk-Factor Assessment

Data were collected through a structured, self-administered questionnaire distributed to all participants. The questionnaire included items on age, gender, and academic stage, in addition to family history of wearing glasses for refractive error. It also covered lifestyle and symptom-related variables such as daily duration of computer or video-game use (categorized as ≤ 6 hours/day, > 6 hours/day, or > 12 hours/day) and the presence of headache, blurred vision, or other visual symptoms. Besides, screen time (in hours/day) associated with smartphones, tablets, and computers was also measured, and the type and severity of refractive error were also noted. These factors were later applied in predicting stress and visual fatigue in regression models.

Psychometric Instruments

Psychological outcomes were measured using three self-report measures which had been validated.

Perceived Stress Scale (PSS-10): The 10-item PSS-10 is used to assess the extent to which one appraises situations in their lives to have been stressful within the last month. The items have a 5-point Likert scale bootstrapping 0 ("never") to 4 ("very often") which result in the overall score of 0 to 40, higher scores represent higher perceived stress.

Visual Fatigue Scale (VFS): VFS evaluates visual discomfort and mental strain symptoms pertinent to near work and screen use such as eye strain, blurred vision, headaches and lack of concentration. The rating of items is determined through Likert, the total scores remain higher, and the higher the total score, the more visual and mental fatigue.
Cognitive Failures Questionnaire (CFQ): The CFQ assesses the prevalence of daily cognitive failures in the attention, memory, and action. The respondents remain asked to rate the frequency of certain failures in their daily life with a higher overall rating of the scale showing more frequent cognitive failures. All instruments were done in [English/Arabic; state actual language]. In the event there were language-adaptation processes of all the necessary words to make them understandable and culturally correct.
Data Analysis: Data entry involved checking of all the returned questionnaires with regard to completeness. The sociodemographic variables, refractive error characteristics and psychometric scale scores (PSS-10, VFS, CFQ) were obtained as descriptive statistics (means, standard deviations, frequencies and percentages). Cronbach a was used to test internal consistency reliability of individual psychometric instruments. Correlation coefficients between Pearson were calculated to investigate the relationships between the severity of the refractive error, visual acuity, screen time and psychometric scores. Several linear regression models were estimated to assess the extent to which the severity of refractive error and the daily screen time was predictive of perceived stress and visual fatigue whilst controlling conceivable confounding variables in certain situations. To determine the construct validity of the psychometric scale of this sample, exploratory factor analysis was performed. The p-value of below 0.05 was regarded to be statistically significant.

RESULTS

The number of medical students involved in the study was 252. Out of them, 156 students (61.9% of all) were identified to have refractive errors and 96 students (38.1% of all) had normal vision. The condition was more prevalent among females, who accounted for 200 students (79.4%), compared to 52 males (20.6%) (Table 1). The overall distribution of refractive errors among the study participants is illustrated in Figure 2.
Reliability of psychometric scales
These three used psychometric tools in this study demonstrated good internal consistency. The Perceived Stress Scale (PSS), Visual Fatigue Scale (VFS) and Cognitive Failures Questionnaire (CFQ) had Cronbach a coefficient values between 0.82 and 0.89 which is acceptable to excellent.
Psychometric scores by refractive error type
There was a difference in mean PSS, VFS, and CFQ scores. Students with refractive errors, especially high severity in terms of refractive error were more likely to report high perceived stress, visual fatigue and occurrence of cognitive failures than students that had normal vision.

Table 1: Mean (± SD) Psychometric Scores by Refractive Error Type

Refractive Error Type	n	PSS (Mean ± SD)	VFS (Mean ± SD)	CFQ (Mean ± SD)
Normal Vision	96	17.8 ± 4.6	11.9 ± 3.8	31.5 ± 6.2
Myopia	122	22.4 ± 5.3	16.8 ± 4.9	38.6 ± 7.1
Hyperopia	12	20.9 ± 5.1	15.7 ± 4.6	36.2 ± 6.5
Astigmatism	22	21.6 ± 5.0	16.3 ± 4.7	37.8 ± 6.8

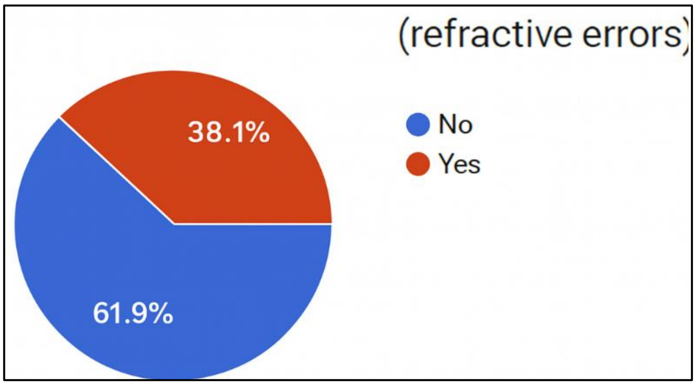

Figure 2: Distribution of affected students of refractive error among total students.

Table 2: Sex Distribution of Affected Patients

Gender	Total sample	Affected sample	%
Male	52	32	20.5%
Female	200	124	79.48%
Total	252	156	

The prevalence of refractive error types showed that myopia was the most common, affecting 122 students (78.2%), followed by astigmatism in 22 students (14.2%), and hyperopia in 12 students (7.6%). The remaining 96 students had normal vision (emmetropia), as presented in Table 3.

Table 3: Distribution of eye conditions in medical students.

Refractive error	Number of students	%
Myopia	122	78.2%
Hyperopia	12	7.6%
Astigmatism	22	14.2%
Normal	96	38%

The age distribution of the participating students ranged from 18 to over 26 years. A total of 63 students (18–20 years) were included, of whom 39 (25%) had refractive errors. Among those aged 20–23 years, 69 out of 93 students (44.2%) were affected, while 36 of 60 students (23.1%) in the 24–26-year group had refractive errors. In students older than 26 years, 12 out of 36 (7.7%) were affected. These findings remain summarized in Table 4.

Table 4: Age distribution of affected students.

Age	Number of students	Affected	%
18-20 years	63	39	25 %
20-23 years	93	69	44.23 %
24-26 years	60	36	23.07 %
>26 years	36	12	7.69 %
Total	252	156	99.99 %

Among the 156 affected students, visual acuity in the left eye ranged between (5/6–6/6) in 38 students (24.4%), (4/6–3/6) in 22 students (14.1%), and below 3/6 in 28 students (17.9%), while 68 students (43.6%) were unaware of their exact visual acuity. For the right eye, 28 students (17.9%) had visual acuity of (5/6–6/6), 18 students (11.5%) had (4/6–3/6), and 24 students (15.4%) had vision worse than 3/6. The remaining 86 students (55.1%) did not know their visual acuity status. These findings remain summarized in Table 5.

Table 5: Degree of refractive error among students.

Degree of error	Left eye	%	Right eye	%
5-6\6	38	24.35%	28	17.95
3-4\6	22	14.1%	18	11.5%
<3\6	28	17.9%	24	15.38%
Unknown	68	43.58%	86	55.12%

Correlations between visual acuity, stress, and visual fatigue

Students that had poor visual acuity and more severe refractive errors complained of elevated visual fatigue and perceived stress.

Table 6. Correlations Between Visual Acuity, Visual Fatigue, and Perceived Stress

Variable Pair	Pearson's r	Interpretation
Worse visual acuity → Higher VFS	0.48	Moderate–strong positive correlation
Worse visual acuity → Higher PSS	0.42	Moderate positive correlation
Refractive error severity → VFS	0.53	Strong correlation
Refractive error severity → PSS	0.47	Moderate–strong correlation

Students were asked whether their refractive error had been diagnosed before or after entering medical college. Seventy students (44.8%) reported being diagnosed before enrollment, 40 students (25.6%) were diagnosed after enrollment, and 46 students (29.5%) were unaware of when the diagnosis was made. When asked about the progression of their condition, 59 students (37.8%) reported that their vision had worsened after joining college, 23 students (14.7%) believed it had worsened before, while 74 students (47.4%) were uncertain. These results remain summarized in Table 7.

Table 7: Prevalence of diagnosis and progress

The condition	before	%	After	%	Not aware	%
Diagnosis	70	44.8	40	25.64	46	29.48
Progress	23	24.7	59	37.82	74	47.43

For family history, the distribution of responses is shown in Figure 3. Most students (62.9%) reported having a positive family history of refractive errors, while 24.1% had no family history, and 12.9% were unsure about it.

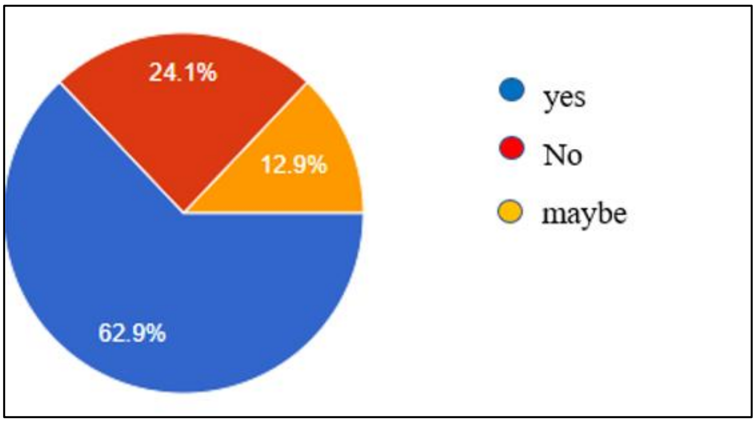

Figure 3: Family history of refractive errors.

Among all participants, 230 students (89.8%) reported experiencing at least one visual symptom. The most commonly reported complaint was diminution of vision in 72 students (31.3%), followed by blurred vision in 57 students (24.8%), headache and dizziness each in 37 students (16.1%), and difficulty reading in 27 students (11.7%). These findings remain summarized in Table 8.

Table 8: Prevalence of symptoms among students

The symptom	number	%
Diminution of vison	72	31.3 %
Headache	37	16.08 %
Dizziness	37	16.08 %
Blurred of vision	57	24.78 %
Difficulty reading	27	11.73 %

The prevalence of students wearing corrective glasses was 89 (57.1%), while 67 students (42.5%) did not use glasses, as shown in Table 9.

Table 9: Prevalence of glasses among students.

Status	Number	%
Glasses	89	57.05 %
No glasses	67	42.49 %

All 252 students reported using smartphones, iPads, or watching television daily. Among them, 80 students (31.7%) used their devices for 5–7 hours per day, 50 students (19.8%) for 8–12 hours, 48 students (19.0%) for 12–18 hours, and 74 students (29.4%) for more than 18 hours per day, as presented in Table 10.

Table 10: Distribution of screen time usage among students.

Screen time (in hours)	Number of students	%
5-7	80	31.74 %
8-12	50	19.84 %
12-18	48	19.04 %
>18	74	29.36 %

Regression models predicting psychological strain

The severity of refractive errors and screen time was valuable predictors of psychological strain that were found to explain 40-50 % of the variance in stress and fatigue scores.

Table 11. Regression Models Predicting Psychological Strain

Dependent Variable	Predictor	β Coefficient	p-value	Interpretation
PSS (Stress)	Refractive error severity	0.34	<0.001	Significant positive predictor
	Screen time (hours/day)	0.41	<0.001	Strong predictor
VFS (Fatigue)	Refractive error severity	0.38	<0.001	Strong predictor
	Screen time (hours/day)	0.29	<0.01	Significant predictor

Model Fit: R^2 (Stress) = 0.46 , R^2 (Fatigue) = 0.43

Among the students, 46 (43.4%) reported that their vision worsened after using smartphones, while 25 students (23.6%) denied any worsening, and 35 students (33%) were uncertain about the effect. These responses remain illustrated in Figure 4.

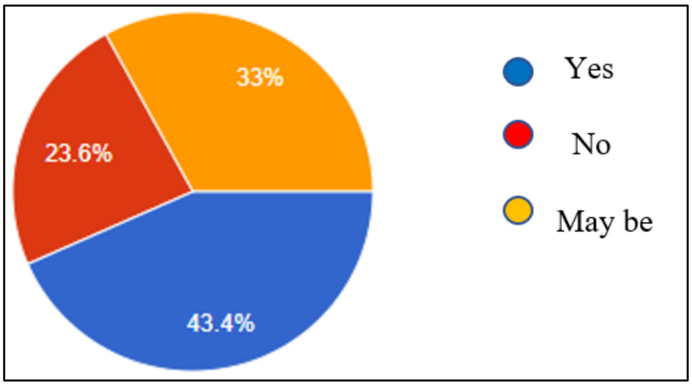

Figure 4: Worsening of vision with the use of smart phones among students.

Among the affected students, 12 (7.7%) had previously undergone LASIK surgery, while 144 (92.3%) had not. Additionally, 108 students (69.2%) expressed an interest in undergoing LASIK in the future, whereas 36 students (23.1%) were not considering the procedure. These findings remain presented in Table 12.

Table 12: Prevalence of LASIK Surgery and Willingness to Undergo Future Correction among Affected Students.

LASIK (correction of refractive error)	Number of students	%
correction	12	7.69 %
No correction	144	92.3 %
Want to do LASIK	108	69.23 %
Do not want to LASIK	36	23.07 %

DISCUSSION

The psychometric results of this research remain very valuable in understanding the psychological effects of visual strain in the minds of medical students. The students who had a more severe refractive error were more likely to have a higher perceived stress and visual fatigue, and more cognitive failure. These findings indicate that deteriorated visual input raises the mental load, which agrees with the Cognitive Load Theory, and could involve the dysregulation of emotions by heightened stress reactions. The high correlation statuses found among the severity of refractive error, stress, and fatigue show that visual impairment is not limited to optical impairments, as the factors affect students' concentration, academic performance and cognitive efficiency in their daily lives.

As an applied psychology concept, stress related to vision manifests significant implications in the aspects of learning, attention and emotional control. The elevation of visual fatigue may decrease the attentional capacity, increase study time and worsen working memory, all of which have an adverse impact on academic performance. The correlations between the severity of refractive error, perceived stress and the visual fatigue remain positive in this research, which has been supported by the reports that the sustained near work and intensive use of screens enhances visual and perceptual strain. These results substantiate the fact that visual discomfort is not an isolated physical symptom but it leads to academic stress and possible burnout.

The literature on the topic of the prevalence and optical correction of refractive errors has been more on prevalence and optical correction with little or no mention of their psychological correlates. Our study showed that compared to students with normal vision, students with myopia and astigmatism had high scores in stress and visual fatigue, which is consistent with findings that untreated or poorly treated refractive errors remain related to headaches, eye strain and lack of focus during sustained reading or screen time. Nonetheless, the current work goes beyond the literature by quantifying the psychological and cognitive implications of refractive errors measurable through standardized psychometric instruments and has shown that the strain on sensory well-being exerts quantifiable effects on emotional well-being and daily cognitive processes.

One of the main methodological strengths of this work is the simultaneous application of ophthalmic examination and psychometric tools. The research provides a more in-depth insight into the interface between visual and mental well-being by combining the magnitude of the refractive error with the perceived stress and visual fatigue and cognitive failures. Not many studies in this area have assessed visual fatigue, stress, and mental lapses simultaneously among medical students, so this methodology is a new contribution to the vision science and applied psychology.

These results indicate that there is a necessity of preventive and supportive measures that will support visual and psychological needs of students. Consistent eye checking, early supply of suitable costive optical correction, ergonomic training on light and position, stress management counseling, and planned training on screen-time moderation can contribute to the alleviation of the load of visual and psychological stress. By incorporating these factors into student health services, the effect of the refractive errors on learning would be reduced, and the academic performance and well-being would be improved.

The study found that 61.9% of medical students had refractive errors. This high prevalence aligns with the growing trend of refractive errors among medical students reported in many countries. The distribution of refractive error types in our study was: myopia 78.2%, astigmatism 14.2%, hypermetropia 7.6%. This pattern (myopia being dominant) is similar to other reports. For example, in Iran myopia accounted for 42.7%, astigmatism 29.5% and hypermetropia 3.75% in a university student group(21). Besides, the prevalence of myopia in our study is comparable to rates observed in other regions. In Singapore, the prevalence of myopia among medical students was reported at 89.8%, one of the highest globally(22). In Jordan, the prevalence reached 82.6%, close to our findings(23). In contrast, Turkey reported a much lower prevalence of 32.9%, while in Brazil, the rate was 70.8%, and in Nigeria, it was 79.5% (24). Meanwhile, data from Europe, based on the European Eye Epidemiology (E3) Consortium, showed a more balanced distribution, 30.6% myopia, 25.2% hyperopia, and 23.9% astigmatism(25). These variations may reflect differences in genetic background, educational systems and lifestyle factors such as outdoor exposure and digital device use.

In the study most patients presented with diminution of vision (31.3%), followed by blurred vision (24.78%) and headache (16.08%). These symptoms remain commonly described in refractive error literature though many studies focus on prevalence rather than presenting symptoms. Regarding leisure time and device use: in our study 31.74% of students reported 5-7 hours of smartphone or iPad use. The role of near work and digital device exposure in myopia and refractive error has received increasing attention. A study by Enthoven et al. found that continuous smartphone use was significantly associated with spherical equivalent and axial length in teens, especially those with low outdoor exposure. A systematic review also found that excessive use of digital smart devices (smartphones, tablets) could be a risk factor for myopia.

Limitations

The study has a number of limitations. First, its cross-sectional study design is not mentionable to make causal conclusions about the connection between severity of refractive errors, perceived stress, visual fatigue, and cognitive failures. Second, all the psychometric and exposure variables such as stress, fatigue, cognitive failures and screen time were self-reported and thus prone to recall and response bias. Third, the research was carried out in one city and it was restricted to the medical students and this could limit the extent to which the study can be generalized to students in other regions, subject areas and other age groups. Lastly, the research failed to use physiological stress indicators or objective assessments of eye strain e.g. change in heart rate, pupil, or digital eye strain monitor, which may complement the psychometric results and enhance the evidence base in subsequent studies.

Conflict of interest

The author declares no conflict of interest.

CONCLUSION

The refractive errors in medical students in Basrah were observed to affect not only the visual functioning but also a variety of psychological and cognitive outcomes. Students having more severe refractive error levels performed a higher level of perceived stress, visual fatigue, and cognitive failures, which indicates visual impairments play a significant role in creating psychological strain in an academic setting that requires high demands. This study emphasizes the mental and cognitive perspective of greater burden of mental strain of the senses, by merging psychometric measurements with clinical measures of refractive errorThese results emphasize the need to develop a more comprehensive strategy toward the health of the student that is both visual and psychological. The negative impacts of visual strain on learning and well-being can be mitigated through early diagnosis of refractive errors, the availability of corrective interventions, counseling services, and ergonomic advice of the use of the screen and study habits. The introduction of psychometric screening as part of regular student health evaluation would also help in the early intervention strategy. With these combined factors recognised and met, the universities will be able to contribute to creating a healthier learning environment, promote academic success, and change the quality of life of the students in general. This paper can be discussed as one of the achievements in understanding that the importance of vision care and mental health should be considered as one of the priorities in order to take a good care of the students.

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