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ASSOCIATION OF HEADACHE AND REFRACTIVE ERROR IN SCREEN USERS

Original Research

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ABSTRACT

Background: Headache has emerged as a common health complaint in the modern digital era, with its prevalence rising alongside the increasing dependence on digital screens. Young adults are particularly vulnerable due to prolonged device use, which may exacerbate visual strain and uncorrected refractive errors. Refractive errors such as myopia, hyperopia, and astigmatism are recognized contributors to visual fatigue and are suspected to play a key role in screen-related headaches, thereby impairing overall quality of life.

Objective: The objective of this study was to assess the association between refractive errors and headache severity in individuals who use digital screens regularly.

Methods: A descriptive cross-sectional study was carried out over a four-month period at Riphah International University and Ghurki Trust Teaching Hospital, Lahore. A total of 132 participants aged 18–30 years were recruited using a non-probability convenience sampling technique, with equal distribution of myopia, hyperopia, and astigmatism (44 each). Inclusion criteria required refractive error within ±0.5D to ±3.5D, daily screen use exceeding two hours, and complaints of headache. Exclusion criteria included ocular pathology, systemic conditions, prior ocular surgery, and headaches due to addiction. Headache severity was measured using the HIT-6 (Headache Impact Test-6) questionnaire, while refractive errors were assessed through Snellen visual acuity, slit-lamp biomicroscopy, fundoscopy, auto-refractometry, and subjective refraction. Data were analyzed using SPSS version 26.0, with chi-square tests applied to evaluate associations.

Results: The mean age of participants was 21.3 ± 2.07 years, with a higher proportion of females (60.6%) compared to males (39.4%). Headache severity increased with longer screen exposure: mild headaches were most common in those with 2–4 hours of screen use (56.8%), moderate headaches in those with 4–6 hours (53.2%), and severe headaches in individuals exceeding 6 hours daily (62.5%). Refractive error type showed significant associations with headache severity. Among those with severe headaches, 61.4% had astigmatism and 43.2% had hyperopia, while only 4.5% were myopic. In contrast, myopia was more commonly associated with mild (38.6%) and moderate headaches (56.8%). Statistical analysis confirmed significant associations between both screen time and refractive error with headache severity ($p<0.001$).

Conclusion: The findings highlight that, refractive errors, particularly astigmatism and hyperopia, contribute substantially to screen-related headaches in young adults. Prolonged screen exposure further intensifies headache severity. Early identification and correction of refractive errors, coupled with awareness regarding safe screen habits, may reduce the burden of headaches and improve visual comfort in this vulnerable population.

Keywords: Adult, Headache, Myopia, Hyperopia, Astigmatism, Refractive Errors, Screen Time.

INTRODUCTION

Headaches are among the most common neurological complaints worldwide, characterized by discomfort or pain above the eyes or ears, at the back of the head, or in the upper neck. They encompass a spectrum of conditions including migraines, tension headaches, cluster headaches, and medication overuse headaches, which represent some of the most disabling primary headache disorders (1). Unlike secondary headaches, which result from systemic or ocular pathologies, primary headaches arise without underlying disease (2). Globally, their prevalence is estimated to range between 46% and 79% in adults, with a significant impact on quality of life, productivity loss in working populations, and increased absenteeism among school-aged children, underscoring their importance as a public health concern (3). Ocular factors, particularly refractive errors (RE), have been implicated in headache pathophysiology. The International Headache Society recognizes headaches associated with refractive errors as ocular headaches, which are usually primary, tension-type in presentation, and functional in origin, often linked to prolonged near-vision activities (2). Uncorrected refractive errors (URE) are the second leading cause of preventable blindness worldwide, with substantial effects on visual performance, academic outcomes, and daily functioning. Studies report that 67.8% of patients attending optometry clinics exhibit some form of refractive error (4). Epidemiological research highlights astigmatism as the most common type, affecting 36.2% of the population, followed by myopia at 33.1%, while hyperopia is comparatively less frequent at 3.6% (5). Moreover, myopia shows a higher prevalence in females (39.9%) compared to males (32.6%), with overall spherical errors of ≥0.5D detected in over half of the population studied (6). There is consistent evidence linking refractive errors with headaches, where correction of URE has been shown to alleviate headache symptoms. The prevalence of headache reports in eye care practices varies widely, from 11.6% to 84% (7).

Environmental and lifestyle factors further complicate this association. Stress, poor sleep, and most notably, prolonged screen exposure are well-established headache triggers (8). With digital technology becoming integral to modern life, approximately half of the global population owns smartphones, particularly concentrated in the younger age groups of 18–24 years, who spend the most time engaged with digital devices (9–11). The COVID-19 pandemic amplified these trends, with children's screen time nearly doubling and remote work practices increasing dramatically, exposing larger portions of the population to screen-related ocular strain (12). Extended use of digital devices contributes to digital eye strain, also termed computer vision syndrome, which manifests as headaches, blurred vision, and ocular discomfort (13). Blue light emitted from screens has additionally been suggested to disrupt circadian rhythms and contribute to headache onset, although evidence remains inconclusive (14). Importantly, reading from digital screens induces more ocular strain compared to printed materials, even under equivalent visual conditions, further establishing the burden of screen-related eye strain in the modern era. Despite this evidence, gaps remain in understanding the precise relationship between refractive errors, digital device use, and headache occurrence. Existing studies are often limited by small sample sizes, narrow age ranges, or geographic constraints, reducing their generalizability (15). Given the rising reliance on digital technology across all age groups and the high global prevalence of both refractive errors and headaches, further investigation into this link is crucial. The objective of the present study is therefore to investigate the relationship between refractive errors and headaches in the context of modern digital lifestyles, with the aim of clarifying their association and highlighting the importance of early diagnosis and correction of refractive errors to reduce headache burden.

METHODS

The present research was conducted as a descriptive cross-sectional study, finalized within a period of four months following the approval of the synopsis by the institutional ethical review committee. Ethical approval was obtained prior to data collection, and informed consent was secured from all participants to ensure adherence to ethical standards of research. A total of 132 participants were recruited through a non-probability convenience sampling technique. The study population comprised young adults aged between 18 and 30 years, distributed equally into three groups based on type of refractive error: 44 myopic, 44 hyperopic, and 44 astigmatic patients. Both male and female participants were included. Eligibility criteria required patients to have a refractive error ranging between ±0.5D and ±3.5D, a self-reported complaint of headache, and an average daily screen time of more than two hours. Exclusion criteria eliminated individuals with ocular pathologies, systemic illnesses, history of ocular or refractive surgeries, or headaches attributable to addiction or substance use. Data were collected from two sites: Riphah International University and Ghurki Trust Teaching Hospital, Lahore. Each participant underwent a comprehensive ophthalmic evaluation. Visual acuity was measured using the Snellen chart, while slit-lamp

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biomicroscopy with fundoscopy was performed to rule out ocular pathologies. Refractive status was further assessed using an auto-refractometer, followed by confirmation through subjective refraction. The severity and impact of headaches were evaluated using the standardized Headache Impact Test (HIT-6) questionnaire, a validated tool widely used in clinical research to quantify headache-related disability. Data analysis was performed using SPSS version 26.0. Descriptive statistics, including mean, median, and standard deviation, were calculated for demographic variables such as age and gender. The Chi-square test was employed to assess the association between refractive errors, headache occurrence, and screen time, with a p-value <0.05 considered statistically significant.

RESULTS

The study enrolled 132 participants with ages ranging from 18 to 30 years. The mean age was 21.3 years with a standard deviation of ±2.07. The sample comprised 52 males (39.4%) and 80 females (60.6%), indicating a higher representation of females in the study population. Analysis of headache severity in relation to screen time revealed that 37 participants (28.0%) reported mild headaches, 47 participants (35.6%) experienced moderate headaches, and 48 participants (36.4%) suffered from severe headaches. Among those with mild headaches, the majority (n=21) reported screen exposure of 2–4 hours daily, while 9 had 4–6 hours, and 7 exceeded 6 hours. Moderate headaches were most frequently reported in participants with 4–6 hours of daily screen exposure (n=25), followed by 10 with 2–4 hours and 12 with more than 6 hours. Severe headaches were predominantly associated with prolonged screen exposure, with 30 individuals in the group using screens for more than 6 hours daily, 10 with 4–6 hours, and 8 with 2–4 hours. Statistical analysis demonstrated a significant association between screen time and headache severity ($p<0.001$). When examining the association between refractive errors and headache severity, it was found that among participants with mild headaches, 17 had myopia, 12 had hyperopia, and 8 had astigmatism. In those with moderate headaches, 25 participants were myopic, 13 hyperopic, and 9 astigmatic. Severe headaches were most frequently reported among individuals with astigmatism (n=27) and hyperopia (n=19), while only 2 cases were observed in myopic participants. This distribution indicated a significant association between type of refractive error and severity of headache ($p<0.001$).

Table 1: Age Distribution of the Participants

	Minimum	Maximum	Mean	Std deviation
Age	18	30	21.3308	2.06630

Table 2: Gender Distribution of the Participants

Gender	Frequency	Percentage
Male	52	39.4
Female	80	60.6

Table 3: Association of Headache with Screen Time

		2 to 4 hours	4 to 6 hours	More than 6 hours	Total
Headache	Mild	21	9	7	37
	Moderate	10	25	12	47
	Severe	8	10	30	48
	Total	39	44	49	132

Table 4: Association of Headache with Refractive Error

Headache	Myopia	Hyperopia	Astigmatism	Total
Mild	17	12	8	37
Moderate	25	13	9	47
Severe	2	19	27	48
Total	44	44	44	132

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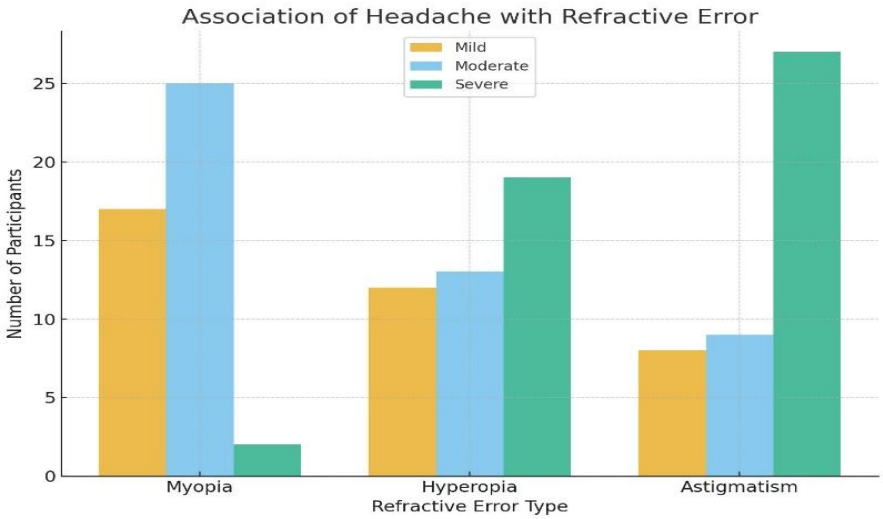

Figure 1 Association of Headache with Refractive Error

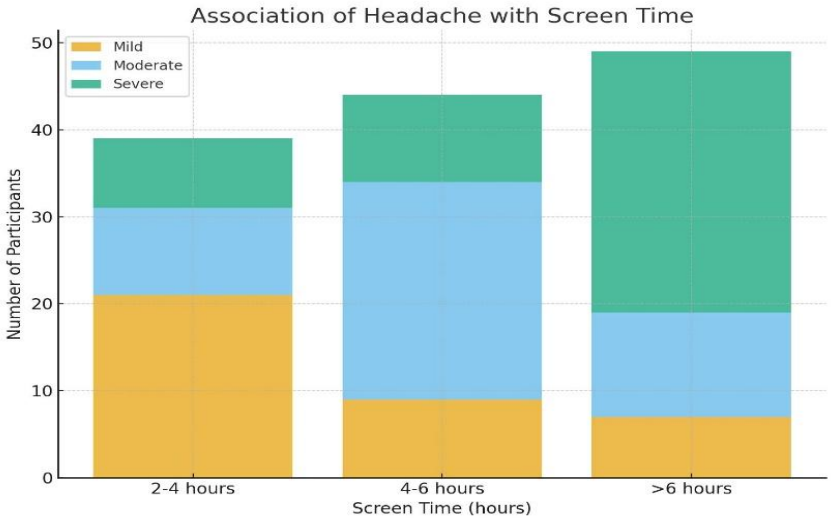

Figure 2 Association of Headache with Screen Time

DISCUSSION

The findings of this study demonstrated a clear association between refractive errors, digital screen use, and the severity of headaches in young adults. Participants with longer screen exposure, particularly beyond six hours per day, reported more severe headaches compared to those with shorter usage. This aligns with existing literature where excessive digital screen time was strongly correlated with increased headache frequency and intensity, suggesting that prolonged exposure contributes to digital eye strain, reduced blink rate, and visual fatigue, all of which can exacerbate headache symptoms (16,17). The results also indicated that the type of refractive error played a significant role in headache severity. Individuals with hyperopia and astigmatism were more likely to experience severe headaches, whereas those with myopia predominantly reported mild to moderate symptoms. This trend supports the concept that hyperopia and astigmatism require greater accommodative effort, particularly during near work, which is amplified by continuous digital screen use. Previous research similarly highlighted the burden of uncorrected refractive errors on ocular health, with refractive strain recognized as a contributing factor in persistent headache complaints (18). However, not all studies have established a direct causal

relationship. Some reported the coexistence of refractive errors and headaches in the general population without proving a definitive link, indicating that the observed association may also be influenced by confounding factors such as lifestyle and environmental exposures (19).

Evidence from clinical and epidemiological studies reinforces the findings of this research. Headaches in younger age groups, particularly those aged 18–30 years, have been reported at higher frequencies in earlier studies (20), while digital screen exposure in both children and adults has been strongly associated with ocular discomfort, headache, and myopia progression (21). The observed relationship between screen time and myopia prevalence in younger populations lends additional weight to the concern that increased reliance on digital devices may accelerate ocular problems and contribute to the headache burden (22,23). The influence of blue light exposure from screens further compounds these risks, potentially affecting ocular development and sleep regulation, both of which are implicated in headache pathophysiology (24). The implications of these findings are clinically relevant. They highlight the importance of regular eye examinations and correction of refractive errors in reducing headache frequency, especially in populations with prolonged screen exposure. Interdisciplinary collaboration between eye care specialists and neurologists may help identify and manage vision-related headache triggers more effectively. Preventive strategies such as public education campaigns to promote the 20-20-20 rule, proper ergonomic adjustments, and healthy digital habits can also reduce the risk of digital eye strain and associated headaches.

This study had several strengths, including the use of validated instruments such as the HIT-6 questionnaire to measure headache severity and the incorporation of objective refractive assessments through both auto-refractometer and subjective refraction techniques. Collecting data from two different clinical sites also enhanced the representativeness of the sample. Nevertheless, there were notable limitations. The reliance on convenience sampling may have introduced selection bias, limiting the generalizability of findings. Data were collected cross-sectionally, preventing conclusions about the temporal progression of headaches or their response to interventions. The use of self-reported measures for screen time and headache characteristics introduced the possibility of recall bias. Furthermore, the study population was restricted to young adults aged 18–30 years, limiting its applicability to other age groups. The short study duration also constrained the ability to evaluate longer-term associations between refractive error correction, screen time modification, and headache outcomes. Future research should focus on larger and more diverse populations, incorporating longitudinal designs to assess the persistence and evolution of headache symptoms over time. Including objective measures of screen time and sleep patterns may further strengthen the evidence base. Interventional studies aimed at correcting refractive errors and modifying digital habits could provide more robust insights into the effectiveness of preventive and therapeutic strategies. In summary, this study reinforced the link between uncorrected refractive errors, prolonged digital screen use, and headache severity in young adults. While the evidence supports the role of visual strain as a key contributor to headache burden, further research is required to disentangle causal pathways and develop comprehensive management approaches that integrate ocular and neurological perspectives.

CONCLUSION

This study concluded that headaches in young adults are strongly influenced by uncorrected refractive errors and prolonged digital screen use. Astigmatism and hyperopia were found to be more frequently associated with severe headaches, while myopia contributed to milder forms, underscoring the role of accommodative strain in near-vision tasks. Extended screen exposure further intensified headache severity, emphasizing the impact of digital eye strain in modern lifestyles. These findings highlight the importance of regular eye examinations, timely correction of refractive errors, and the adoption of healthy screen habits to reduce the burden of headaches and improve overall visual and neurological well-being.

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AUTHOR CONTRIBUTION

Author	Contribution
Ruhullah*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Aswad Ali	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Muhammad Subhan	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Muhammad Rehman	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Ahsan Ali Khan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Umara Gul	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Sameen Anwar Rao	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Mehwish Ali	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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