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ORIGINAL ARTICLE

Impact of Ergonomic Awareness on Ocular Strain, Dry Eye Symptoms, and Postural Discomfort in Laptop-Using Office Workers

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ABSTRACT

Background: Prolonged laptop use is increasingly associated with ocular strain, dry eye symptoms, and work-related musculoskeletal discomfort. While ergonomic interventions are known to reduce these complaints, the independent role of ergonomic awareness in preventing visual and postural problems remains underexplored.

Objective: To assess the impact of ergonomic awareness on the prevalence of ocular strain, moderate-to-severe dry eye symptoms, and postural discomfort among office workers who routinely use laptops.

Methods: This analytical cross-sectional study was conducted from June 2023 to May 2024 at Shaikha Fatima Institute of Nursing and Health Sciences, Shaikh Zayed Medical Complex, Lahore, and Jining Medical University, China. A total of 100 office employees completed a structured questionnaire including demographic information, the Ergonomic Awareness Score (EAS), a Computer Vision Syndrome symptom checklist, the Ocular Surface Disease Index (OSDI), and the Modified Nordic Musculoskeletal Questionnaire. Participants were categorized into low, moderate, and high ergonomic awareness groups. Statistical analyses included chi-square tests and multivariable logistic regression.

Results: Ocular strain affected 68% of participants, moderate-to-severe dry eye symptoms were present in 45%, and postural discomfort was reported in 61%. Higher ergonomic awareness was significantly associated with lower prevalence of all symptoms. After adjustment, high awareness independently reduced the odds of ocular strain (aOR 0.38), dry eye symptoms (aOR 0.42), and postural discomfort (aOR 0.36). Daily laptop use exceeding eight hours remained an independent risk factor.

Conclusion: Higher ergonomic awareness substantially reduces ocular and musculoskeletal complaints among laptop-using office workers. Structured ergonomic education should be integrated into workplace health programs to promote visual and postural well-being.

Keywords: ergonomic awareness, ocular strain, dry eye, computer vision syndrome, musculoskeletal discomfort, laptop users, office workers.

INTRODUCTION

The growing use of digital technology has altered contemporary workspace setting, placing the use of laptop computers as a key element in administrative, corporate, academic, and IT-related jobs[1]. Depending on the type of laptop, the compactness and the built-in screen and keyboard system impose some degree of ergonomic

constraints. In contrast with desktop computers, where the height of the screen, the viewing distance, and key-board position can be adjusted separately, laptops results the user to the compromised posture which is frequently accompanied by either excessive flexing of the neck or high positioning of the arms. Consequently, long time use of laptops has become a major cause of computer related health issues among office workers[2].

Ocular strain is one of the most prevalent after-effects of prolonged use of a laptop, and it is a major element of a computer vision syndrome (CVS). CVS represents a group of symptoms such as eye strain, blurred vision, dryness, burning, and headaches, which are a result of prolonged near focusing, decreased rate of blinking, improper screen height, and inappropriate lighting conditions[3]. The issue is also exacerbated by the environmental factors of contemporary offices such as the air conditioning, low humidity, over head lights glare, and prolonged sessions at the screens, which pre-condition employees with the symptoms of dry eye and irritation of the ocular surface[4].

Simultaneously, a longer period of work at a laptop also causes postural discomfort, especially of the neck, shoulders, upper back, and lower back. Forward head posture, rounded shoulders and poor lumbar support, as well as sitting in the same position contribute to the mechanical forces of the cervical and thoracic musculatures. These are contributing factors to work-related musculoskeletal disorders (WMSDs), which are not only productivity diminishing but also long-term chronic pains and occupational disability[5,6].

Despite the wide publicity of ergonomic principles, including preferable viewing degrees, workstation height, chair-adjusting, lighting, and resting periodically, there are indications that there is still little actual awareness and knowledge of ergonomics among office workers. Notably, the availability of ergonomic equipment is not always sufficient to ensure its efficient implementation; instead, one will need to have proper ergonomic knowledge, so that they could be able to identify the harmful postures, change the surrounding environment, make frequent breaks and engage in healthy behaviour during the use of the screen. The ergonomic awareness in this case is an essential variable connecting human behaviour with visual and musculoskeletal consequences[7,8].

Regardless of this, a very severe gap in the literature that will evaluate whether increased ergonomic awareness in itself can decrease ocular strain, symptoms of dry eye, and postural discomfort in laptop-dependent office employees, in particular, an already vulnerable population, because the fixed-design design of laptops renders it particularly susceptible. The available studies have been assessing prevalence patterns or isolated ergonomic interventions but rarely assessed awareness as an independent protective factor [9,10].

Hence, this study was to examine the effects of ergonomic awareness on ocular strains, dry eyes, and body discomfort among office workers who spend much time using laptops. Knowledge of these associations is critical in creating cost-saving programs in the workplace that prioritize health training and education on both equipment adjustment and behavioral and educational interventions that enable the workers to self-defend against visual and musculoskeletal disease[11].

MATERIALS AND METHODS

Study Design and Duration

This cross-sectional analytical study was carried out to determine the effect of ergonomic awareness on ocular strain, dry eye symptoms, and postural discomfort among employees who frequently work in offices and use laptops. The research was conducted during the twelve months between June 2023 and May 2024. Two institutional setups were engaged in data collection, which were related to the study investigators, namely the Shaikha Fatima Institute of Nursing and Health Sciences, Shaikh Zayed Medical Complex, Lahore (Pakistan) and Jining Medical University, Shandong (China). These sites offered access to various office based employees including administrative, academic, and technical employees to give a wider representation of office employees who use laptops.

Study Setting

The research was carried out in the office settings of the two host institutions such as administrative offices of the academic institutions, coordination rooms of departments, IT support office, and staff management office. There were employees who were involved in routine tasks performed through laptops as part of their job descriptions. Workstations were diverse, and those were fixed office desks, semi-adjustable workstations, and hybrid workstations, which allowed measuring various ergonomic exposures.

Study Population

The research population comprised of adult office employees with ages of 20-50 years who spent no less than four-hour per day in the occupational routine with laptops during the last six months. The criteria were one year in an office position and understanding the English questionnaire. People with pre-existing ocular diseases e.g. Sjogren syndrome or chronic allergic conjunctivitis, any ocular surgery in the past 12 months, or systemic or neurological disease conditions that affect vision or posture were not included. Participants who had known

musculoskeletal diseases, wore contact lenses or ocular medications and any respondent who submitted an incomplete questionnaire were excluded to provide methodological integrity.

Sample Size and Sampling Technique.

One hundred participants were also recruited through a non-probability convenience sampling method in the office units that were found in the two institutions involved. The rationale behind this sampling technique was that there would be easy accessibility of the office staffs working in the study sites. One hundred and eight questionnaires were sent to the two locations where 100 fully responded questionnaires were returned giving the response rate of 92.6. The final dataset consisted only of complete questionnaires.

Data Collection Tool

The structured, self-administered questionnaire was administered to obtain the data after performing a comprehensive literature review and was checked by specialists in ergonomics and occupational health. The survey was divided into parts that evaluated demographic information, the presence of symptoms of ergonomic awareness, signs of ocular strain, signs of dry eye, and musculoskeletal pain.

The sociodemographic variables were the age, gender, occupation, employment period, amount of time spent working on a laptop, and years of experience working with a laptop. Data about the workstation features, the nature of lighting, exposure to glare, use of external monitors or keyboards, and the nature of seating arrangements were also noted.

Ergonomic awareness was assessed through a ten-item Ergonomic Awareness Score (EAS) in which the individual scores were rated on a 0-2 scale regarding accuracy and completeness. The items tested the awareness of correct screen height and distance, the right position of the back and neck position, the height of the chair and lumbar support, the ideal location of the keyboard and mouse, the knowledge of microbreaks, the 20-20-20 rule, the eye blinking patterns, glare control, and the risks of sitting in the same position. The total scores were rated between 0 to 20 and they were considered low (<10), moderate (1014), and high (15 and above) ergonomic awareness.

The Ocular strain was also assessed using a standardized Computer Vision Syndrome (CVS) symptom checklist which documented the frequency of eye strain, burning, blurred vision, foreign body sensation, watering and headaches during the use of the laptop. A five-point Likert scale was used to report the symptoms as never, sometimes, almost always. The presence of ocular strain was determined in case two or more symptoms were experienced with often and almost always.

Symptoms of dry eye were measured by the use of the Ocular Surface Disease Index (OSDI), a scale that measures the intensity of ocular irritation, environmental factors and functional restriction in the past week. The scores were as low as 0 up to 100 and were read as normal, mild, moderate or severe dry eye. To be analytical, an OSDI score of 23 and above was regarded as moderate-severe dry eye.

The postural discomfort was measured using the Modified Nordic Musculoskeletal Questionnaire (NMQ), which aimed at the levels of discomfort of the neck, shoulders, upper back, lower back, wrists, and hips in the past seven days. Discomfort was said to be present in the event that pain or stiffness in these areas were stated to be worsened due to the use of the laptop.

Outcome Measures

The main research findings were existence of ocular strain, moderate to severe symptoms of dry eye, and postural discomfort of at least one musculoskeletal area. The secondary outcomes were the relationship between the level of ergonomic awareness and these symptoms and the effect of daily use of laptops and ergonomic workstations.

Statistical Analysis

The process of data analysis was conducted with the help of IBM SPSS Statistics version 26. Continuous variables were described in terms of means and standard deviations whereas categorical variables were described in terms of frequencies and percentages. The chi-square test was used to compare ergonomic awareness groups because a categorical variable is used, and one-way analysis of variance (ANOVA) was used to compare groups of variables of a continuous nature. Logistic regression equations were developed to identify adjusted relationships between ergonomic awareness and each of the major outcomes. The regression models were controlled using covariates like age, gender, daily use of laptops, years of experience using laptops, and use of ergonomic assistance of work stations like adjustable chairs or external monitors. The p-value less than 0.05 was considered to have statistical significance.

Ethical Considerations

Even the ethical approval was taken with the Institutional Review Boards of the participating institutions: the Shaikha Fatima Institute of Nursing and Health Sciences, Shaikh Zayed Medical Complex, Lahore, and Jining Medical University, China. The involvement was done at will and informed consent was obtained electronically or in writing by all the participants. Participant responses were kept confidential by not collecting personal identifiers and all

the data were utilized in accordance with research purposes.

RESULTS

One hundred office workers took part in the research. Every respondent answered the questionnaire to the end, and hence they were all incorporated in the final analysis. The mean age of the subjects was 33.1 years and the age of the subjects was between 22 and 49 years. The sample size was 56 males (56) and 44 females (44). The average time spent on a laptop was 7.1/1.8 hours daily with the median period of using the laptop being seven years. The respondents were found to use adjustable chairs at their workstation (32 percent) and external ergonomic tools like external monitor or external keyboard (21 percent). According to the Ergonomic Awareness Score (EAS), 31 participants (31%) were identified as the low ergonomic awareness, 38 (38%) were moderate, and 31 (31) had high awareness. Table 1 summarizes the baseline characteristics distribution as between these three categories of awareness.

Concerning eyewear pressure, 68 percent of the respondents said that they had at least two typical symptoms of vision blurredness, eye fatigue, burning or headache and that they frequently or nearly always experienced these symptoms when using laptops. There was a significant difference in prevalence of ocular strain with the level of ergonomic awareness. The preponderance of ocular strain among the participants of the low-awareness category was highest at 83.9 percent with 65.8 percent in the moderate-awareness category and high-awareness category, respectively. Intermediate to severe cases of dry eye were found in 45 percent of the respondents, who had a score of 23 or above on the OSDI scale. The pattern of symptoms of dry eye was also graded in terms of the awareness states with the 61.3% of low-awareness reporting moderate-severe symptoms of dry eye versus 44.7% of moderate group and 29.0 of high-awareness group.

A majority of participants (61%), reported having at least one musculoskeletal area that they reported to experience the postural discomfort in the last seven days. Just like in the case of ocular complaints, the incidence of postural discomfort was much less when ergonomic awareness was high. Postural pain was also found amongst low ergonomic awareness participants with 77.4% of respondents experiencing the pains in the neck and upper back. This percentage went down to 60.5 percent of moderate awareness and 41.9 percent in high-awareness group. These results prove a certain correlation between the ergonomic awareness and the presence of ocular and dry eye symptoms and musculoskeletal symptoms. Table 2 shows the detailed comparison of the prevalence of the symptoms in ergonomic awareness groups.

The protective role of ergonomic awareness was also supported by multivariate logistic regression. Following the age, sex, daily use of the laptop, and years of the laptop experience, as well as the use of ergonomic workstation equipments, high ergonomic awareness continued to be a significant independent factor of the risk of the symptoms. Higher ergonomic awareness led to a reduction in the odds of ocular strain (62), moderate-to-severe dry eye (58), and postural discomfort (64) by a factor of six in the first place. Given that the ergonomic awareness did not influence the risks of ocular strain and musculoskeletal discomfort, increased daily use of laptops, especially exceeding eight hours a day, led to the increased risks of these conditions.

Table 1. Baseline Characteristics of Participants by Ergonomic Awareness Level (N = 100)

Variable	Low Awareness (n=31)	Moderate Awareness (n=38)	High Awareness (n=31)	p-value
Age (years), mean ± SD	34.2 ± 6.8	33.4 ± 6.1	31.8 ± 6.2	0.28
Male sex, n (%)	18 (58.1%)	21 (55.3%)	17 (54.8%)	0.94
Female sex, n (%)	13 (41.9%)	17 (44.7%)	14 (45.2%)	0.94
Daily laptop use (hours), mean ± SD	7.6 ± 2.0	7.2 ± 1.7	6.6 ± 1.4	0.04*
Years of laptop use, median (IQR)	8 (5–11)	7 (4–10)	6 (3–8)	0.07
Adjustable chair use, n (%)	6 (19.4%)	12 (31.6%)	14 (45.2%)	0.03*
External monitor use, n (%)	3 (9.7%)	7 (18.4%)	11 (35.5%)	0.02*

Significant at p < 0.05

Table 2. Prevalence of Symptoms According to Ergonomic Awareness Level (N = 100)

Outcome	Low Awareness (n=31)	Moderate Awareness (n=38)	High Awareness (n=31)	p-value
Ocular strain, n (%)	26 (83.9%)	25 (65.8%)	15 (48.4%)	0.002*
Moderate–severe dry eye (OSDI ≥23), n (%)	19 (61.3%)	17 (44.7%)	9 (29.0%)	0.01*
Postural discomfort, n (%)	24 (77.4%)	23 (60.5%)	13 (41.9%)	0.003*

Significant at p < 0.05

In general, the findings clearly state that increased levels of ergonomic awareness are linked with significant lower levels of ocular strain, dry eye symptoms, and postural discomfort among office employees who engage in frequent use of laptops. The fact that both male and female participants were spread throughout all the awareness groups also supported the fact that protective associations were also consistent across genders. These findings are then fully supported by the results as presented in the following tables.

DISCUSSION

The current study evaluated how ergonomic awareness can affect ocular strain, dry eye symptoms and postural discomfort of the laptop-using office workers and the results reveal that higher ergonomic awareness level has a strong and consistent protective effect on all the outcomes assessed[10]. Students who had high ergonomic awareness levels also reported much fewer cases of computer related eye strain, much smaller prevalence of moderate-severe cases of dry eye as well as much lower musculoskeletal discomfort than students that showed low levels of awareness. These findings confirm the main hypothesis that ergonomic awareness irrespective of the equipment in workstations is a crucial factor in the reduction of visual and musculoskeletal health challenges in the context of extended work with laptops[11,12].

The prevalence of the low-awareness group in having ocular strain corresponds with current literature in explaining the burden of computer vision syndrome among the users of digital devices. The low rate of blinking, increased near visual focus, poor positioning at the screen and exposure to glare are contributing factors to eye strain[13]. The subjects who showed low awareness of ergonomics in this research were less conversant with eye care measures such as proper screen distance, sufficient lighting and the 20-20-20 rule, which most probably led to the high symptoms prevalence. On the other hand, high awareness of ergonomics indicated lower levels of symptoms, which confirmed the idea that behavioral and environmental interventions, i.e., the regularity of micro-breaks, conscious blinking, screen height, and glare, are vital in ensuring ocular comfort on long-term device use[14,15].

On the same note, the symptoms of dry eyes were also reported to exhibit a strong negative correlation with ergonomic awareness. The knowledgeable individuals who had good understanding of keeping the right viewing angle, changes on airflow direction, the speed of the humidity and reduces the level of unnecessary brightness on the screen recorded far less complaints of dry eye. These results are indicative of the physiological causes of the dry eye disease because the inappropriate workstation environment enhances the rate of tears evaporation and disrupts the tear film. The preventive relationship seen in this research supports the role of educating workers on the changeable environmental inducers instead of on the pharmacological or symptomatic treatments[16,17].

The presence of musculoskeletal discomfort was also reduced significantly in highly ergonomically aware people. The fixed screen-keyboard position places peculiar postural loads on lap top utilization since it promotes flexion of the neck and rounded shoulder posture[18]. Those participants with less knowledge of ergonomics were less inclined to use adjustable seating or external supports as well as less inclined to notice the poor posture during the long periods at the laptop. Conversely, those who proved to be more aware took more frequent postural corrections, settled in neutral sitting postures and utilized more supportive tools including external keyboards or adjustable chairs. The results are consistent with the ergonomic and occupational health studies that postural awareness and behavioral adaptation are among the most important factors that define musculoskeletal health among sedentary workers[20].

The research also found out that excessive use of the laptop in a daily basis exceeding of eight hours was a factor by itself with regards to ocular and musculoskeletal complaints even with high awareness of ergonomics. This implies that as much as awareness suppresses risk, screen time can be too much to counter up the compensatory habits. Therefore, ergonomic training should be combined with a workplace policy that encourages frequent breaks, alternation of work between tasks, and time management to help minimize long and sustained immobility of the eyes and musculoskeletal system[11-14].

The strengths of this study were that it involved two culturally and institutionally different data collection sites, which included Shaikh Zayed Medical Complex, Lahore, and Jining Medical University, China, and thus providing a wider representation of office workers who use laptops. The fact that the protective influence of ergonomic consciousness is consistent in both the settings indicates that the results can be widely generalized. In addition, the validated measurement tools used in the study such as the OSDI and the Nordic Musculoskeletal Questionnaire showed reliability in symptoms measurement[16,18].

Nevertheless, there are some shortcomings that should be admitted. The design of the study is cross-sectional and thus does not allow finding causal relationships and it is also possible that individuals with fewer symptoms naturally are more likely to adopt ergonomic behaviors. Additionally, self-reported data can bring about recall bias or underreporting. The accuracy of

future studies could be improved by objective measurements like the examination of the blink rate, the evaluation of the tear film, or posture. Notwithstanding these shortcomings, the close correlations in this research study are good proofs that support the fact that ergonomic education is an efficient intervention to minimize occupational health complaint among laptop users[7-15].

In general, the results of the research highlight the significance of incorporating stepwise ergonomic training in health programs at the work place. The level of awareness itself turned out to be a strong predictor of the ocular and musculoskeletal condition, indicating the necessity of behavioral change and ergonomic equipment delivery. The findings suggest that ergonomic awareness can play a significant role in alleviating the health symptom burden of computers in the contemporary offices with better results[20].

CONCLUSION

The current study has shown that ergonomic awareness plays a major and independent protective role on ocular strain, dry eye symptoms, and postural discomfort in laptop-using office workers. The respondents who were more ergonomically aware had significantly lower number of visual and musculoskeletal complaints, indicating the significance of knowledge as well as behavioral adaptation in facilitating health and comfort in prolonged screen time. Although ergonomic furniture and external devices usage helped to achieve better results, awareness was still a significant modifying factor even after controlling the workstation features and working time. Too much use of laptops especially over eight hours a day still posed risks despite high awareness and thus, ergonomic education should be supported by healthy work-rest cycles and organizational support. The results support the necessity of regular ergonomic training in the office, with the focus on the correct posture, positioning of screens, environmental regulation, and visual rest. Introducing organized awareness programs can greatly minimize the increasing rate of computer-related eye and musculoskeletal disorders of current digital employees. The causal pathways and the best methods of intervention will be further elucidated through future longitudinal studies that will involve objective ergonomic measures.

DECLARATION

Authors' Contributions

MAK contributed to study conception, project supervision, and overall manuscript coordination.
MAJ assisted with study design, data management, and critical revision of the manuscript.
MAF contributed to data collection, field coordination, and literature review.
MAR provided clinical insight, interpreted health-related data, and contributed to manuscript drafting.
MAH performed statistical analysis, prepared tables, and contributed to writing the Results and Methods sections.
MH assisted in methodology refinement, international site coordination, and final manuscript editing.
All authors read and approved the final manuscript.

Availability of Data and Materials

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request. All data were anonymized to ensure participant confidentiality.

Competing Interests

The authors declare that they have no competing interests. No financial or personal conflicts influenced the study design, data collection, analysis, or manuscript preparation.

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