EFFECTIVENESS OF ERGONOMIC EXERCISE TRAINING ON ERGONOMIC RISKS USING CORNELL MUSCULOSKELETAL DISCOMFORT QUESTIONNAIRE AMONG IT PROFESSIONALS

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Abstract : **Information Technology (IT) professionals often engage in prolonged periods of sedentary computer-based work, which entails repetitive movements and awkward static postures. These occupational hazards predispose workers to ergonomic risks and work-related musculoskeletal disorders (WMSDs), primarily affecting the neck, shoulders, and lower back. Furthermore, continuous screen exposure contributes to Computer Vision Syndrome (CVS), characterized by symptoms such as eye strain, blurred vision, and headaches. To mitigate these risks and improve organizational performance, it is essential to implement evidence-based workplace interventions. This study evaluates the effectiveness of a comprehensive ergonomic exercise training program—including workstation modifications and eye relaxation techniques—in reducing musculoskeletal discomfort among IT professionals as assessed by the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ).**

IndexTerms **- Component,formatting,style,styling,insert.**

I. INTRODUCTION

The evolution of Information Technology (IT) workers mirrors the rapid advancement of technology itself. From the mid-20th-century era of mainframes and punch cards to the modern landscape of cloud computing and artificial intelligence, the IT professional's role has shifted from maintaining hardware to orchestrating complex digital ecosystems.[2] Today, these professionals are the architects of the digital world, driving global innovation and connectivity. However, this progress has introduced a new paradigm of occupational health challenges. The modern IT work environment is characterized by prolonged sedentary behaviour, repetitive movements, and awkward static postures, all of which predispose workers to significant ergonomic risks and musculoskeletal discomfort.[2]

Musculoskeletal disorders (MSDs) are intrinsically linked to ergonomic risk factors such as contact stress, awkward postures, and high-frequency repetition. In industrialized nations, these issues affect approximately 70–80% of the adult population at some stage of their lives.[11,5] For IT professionals, the neck, shoulders, and lower back are the most frequently affected anatomical sites. The World Health Organization (WHO) characterizes work-related musculoskeletal disorders (WMSDs) as multifactorial, meaning that physical, sociological, and psychosocial risks contribute to their development. These conditions, often referred to as repetitive strain injuries (RSI) or cumulative trauma disorders (CTDs), result in impairments to muscles, joints, tendons, and nerves, leading to a high proportion of workers' compensation claims and long-term disability.[2]

The sedentary nature of IT work further compounds these physical issues. Prolonged inactivity is associated with obesity and cardiovascular problems, while the high-pressure environment of project deadlines and constant technological upskilling contributes to chronic stress, anxiety, and burnout. Furthermore, the boundary between work and personal life often blurs, leading to sleep deprivation and a lack of work-life balance.[2] Ergonomics, defined as the application of human characteristics to the design of systems, offers a framework for mitigation. Effective ergonomics focuses on the user's physiological needs and behaviour, treating the office environment as a tool to support the task while maintaining the health of the individual.[2]

Physical activity is vital for maintaining the musculoskeletal system. A lack of exercise leads to joint stiffness and muscle atrophy, causing the spinal discs and soft tissues to degenerate due to malnourishment. Prolonged sitting, particularly with incorrect posture such as slouching or leaning forward, places undue strain on the intervertebral discs and spinal ligaments. Workplace-based interventions, including ergonomic adjustments and exercise protocols, have shown promise in reducing the severity of neck and back pain. Studies demonstrate that such interventions not only reduce the frequency of discomfort but also enhance worker productivity and reduce organizational costs.[4,5]

Beyond musculoskeletal issues, IT professionals frequently suffer from Computer Vision Syndrome (CVS).[6] This condition results from the eye and brain reacting differently to digital screen characters compared to printed text. Unlike paper, digital screens lack sharp contrast, forcing the eyes to constantly refocus, which leads to fatigue, headaches, and blurred vision.[6] Managing CVS requires a combination of environmental adjustments and specific ocular relaxation techniques.

To accurately evaluate the impact of these occupational hazards and the efficacy of interventions, a robust assessment tool is required. This study utilizes the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ), developed at Cornell University. The CMDQ is a comprehensive 54-item tool that assesses the frequency, severity, and interference of discomfort across 20 body regions. It is highly regarded for its clinical validity, with Kappa coefficients indicating substantial agreement and high internal consistency, making it a reliable metric for measuring change following training.[7]

As the IT industry continues to grow, integrating proactive ergonomic interventions is essential for a sustainable workforce. By systematically analysing the impact of structured exercises and workstation modifications, this research aims to determine the effectiveness of ergonomic exercise training on reducing ergonomic risks and musculoskeletal discomfort among IT professionals. To achieve this, the study's primary objective is to evaluate the clinical impact of an 11-week ergonomic intervention protocol specifically within the IT population, utilizing the Cornell Musculoskeletal Questionnaire to quantify improvements in physical well-being and symptom reduction.[7,8]

NEED OF THE STUDY.

3.1Population and Sample

The study population consisted of male and female Information Technology (IT) professionals aged between 24 and 45 years. To be eligible for inclusion, participants were required to have a minimum of two years of professional experience working in front of a computer, maintaining a standard work schedule of at least eight hours per shift. Clinical eligibility was determined by the presence of pre-existing musculoskeletal discomfort, defined by a score ranging from 1.5 to 90 on the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ). Additionally, participants were required to be proficient in reading and writing English to ensure accurate completion of the assessment tools.

Conversely, certain criteria were established to exclude individuals whose physical status or external activities might confound the study results. Exclusion criteria included workers with pre-existing physical disabilities or diagnosed chronic musculoskeletal disorders unrelated to occupational posture. Individuals who were already participating in other interventional health groups, professional athletes, and those who engaged in a regular, structured workout regimen were also excluded to isolate the specific effects of the ergonomic exercise training protocol.

3.2 Data and Sources of Data

Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) The primary outcome measure for this study was the change in musculoskeletal discomfort, assessed via the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) at baseline and following the 11-week ergonomic intervention. The CMDQ is a comprehensive 54-item tool featuring a body map to evaluate aches, pain, or discomfort across 20 distinct anatomical regions.[@]

Scoring and Interpretation Discomfort levels were quantified using a weighted scoring system based on three dimensions:

1. **Frequency:** Scored as Never (0), 1–2 times/week (1.5), 3–4 times/week (3.5), every day (5), or several times daily (10).
2. **Severity:** Rated as slightly uncomfortable (1), moderately uncomfortable (2), or very uncomfortable (3).
3. **Interference:** Rated as not at all (1), slightly interfered (2), or substantially interfered (3).

The total weighted score for each body part was calculated by multiplying the frequency, severity, and interference ratings. This provided a sensitive metric to determine the effectiveness of the exercise training and workstation modifications in reducing occupational physical strain.

The diagram below shows the approximate position of the body parts referred to in the questionnaire. Please answer by marking the appropriate box.

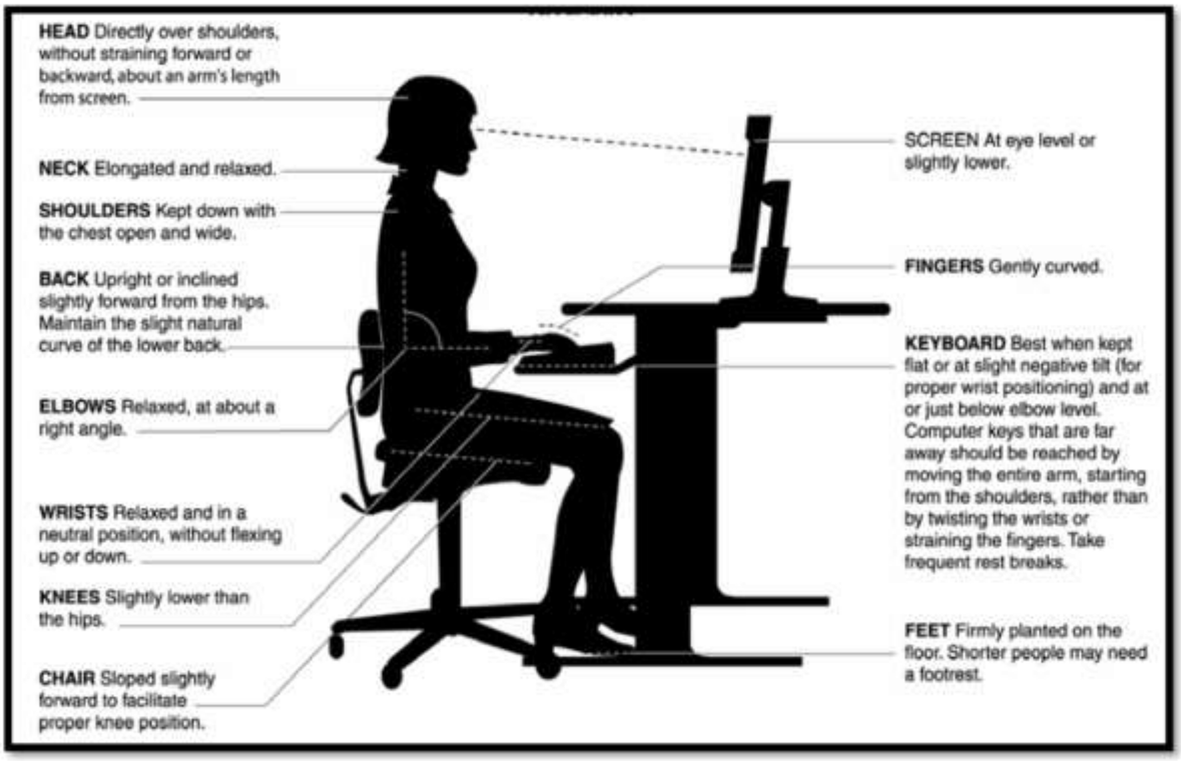
		During the last work week how often did you experience ache, pain, discomfort in:					If you experienced ache, pain, discomfort, how uncomfortable was this?			If you experienced ache, pain, discomfort, did this interfere with your ability to work?		
		Never	1-2 times last week	3-4 times last week	Once every day	Several times every day	Slightly uncomfortable	Moderately uncomfortable	Very uncomfortable	Not at all	Slightly interfered	Substantially interfered
Neck		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Shoulder	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Upper Back		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Upper Arm	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lower Back		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Forearm	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wrist	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Hip/Buttocks		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Thigh	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Knee	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lower Leg	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3.3 Theoretical framework

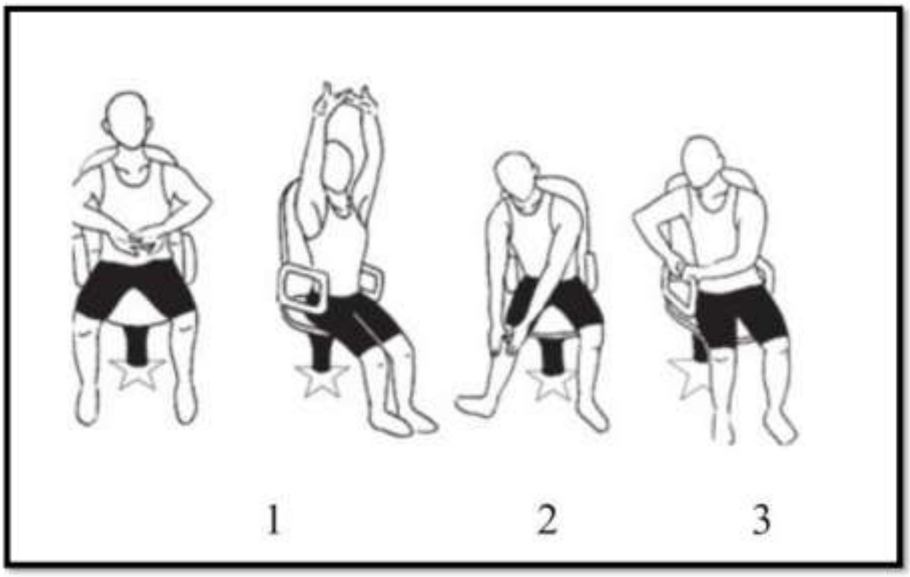
Ethical clearance was obtained from the Institutional Ethical Committee of P.E.S.Modern College of Physiotherapy, Pune, prior to the commencement of the study. Participants were screened and selected based on the predefined inclusion and exclusion criteria. After providing a detailed explanation of the study objectives, written informed consent was obtained from all participants. Baseline musculoskeletal discomfort was assessed using the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ), where the examiner assisted participants in understanding the body map and scoring parameters. Following the initial assessment, participants were instructed in a comprehensive intervention protocol. This protocol consisted of three key components:

1. Ergonomic Modifications: Instruction on optimizing workstation setup, including chair height, monitor distance, and posture alignment.
2. Exercise Protocol: A structured regimen of 13 stretching and strengthening exercises to be performed three times weekly.
3. Eye Relaxation Techniques: Specific ocular exercises designed to mitigate symptoms of Computer Vision Syndrome.

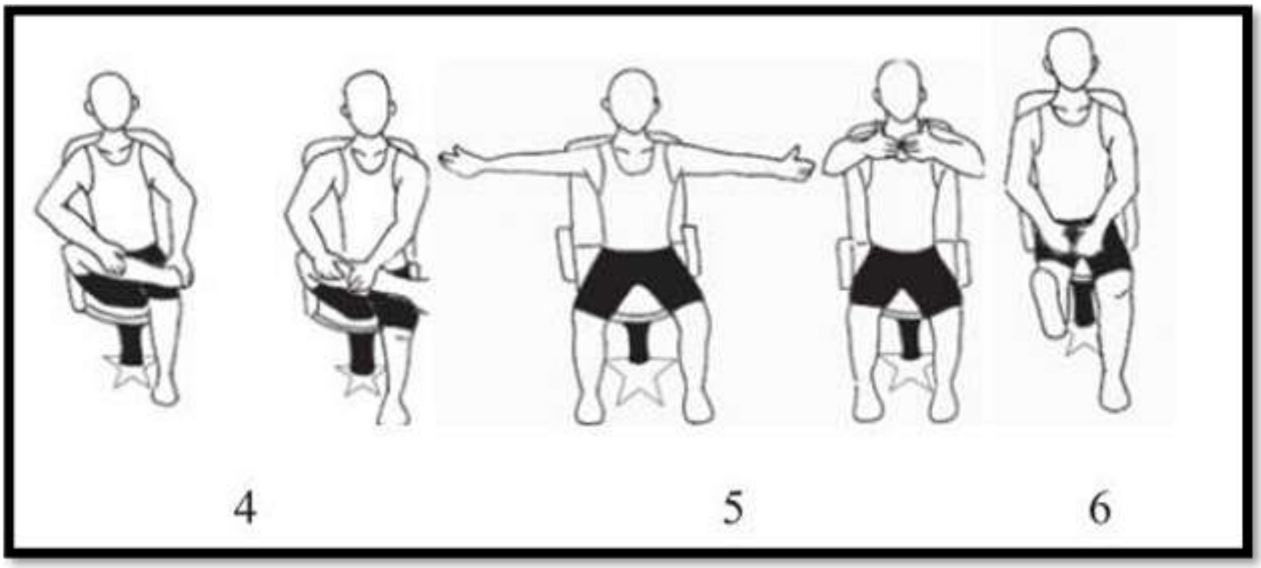
Participants were followed for the duration of the 11-week study, after which a post-intervention CMDQ assessment was conducted to evaluate the effectiveness of the training.



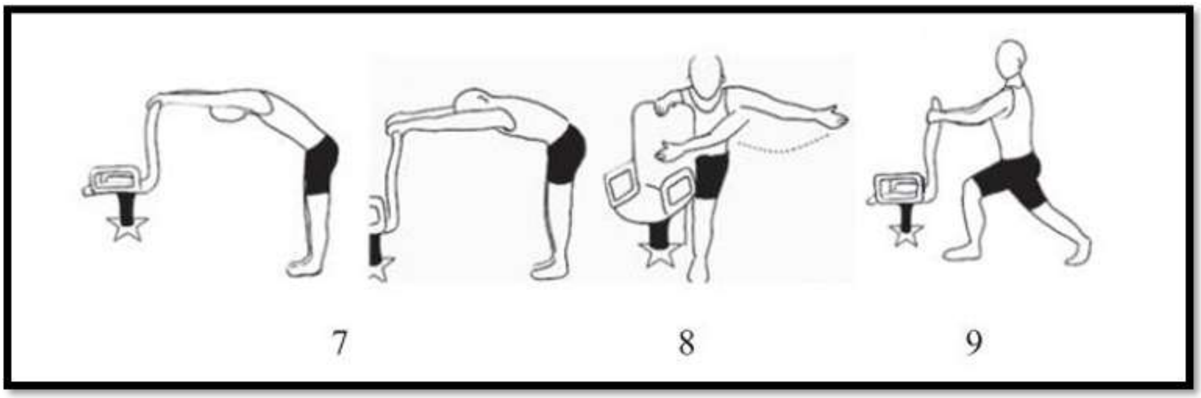
Chair and table ergonomics



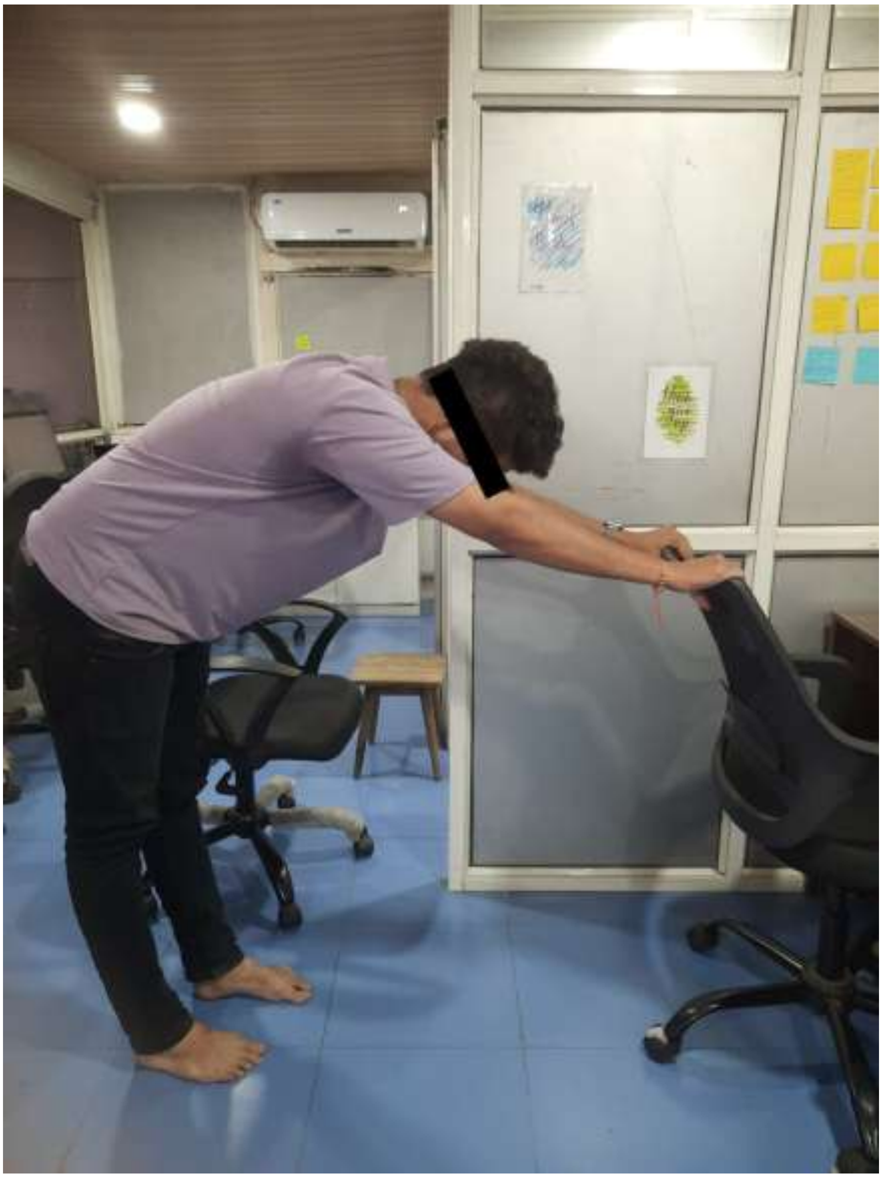
chair exercises 1, 2, 3

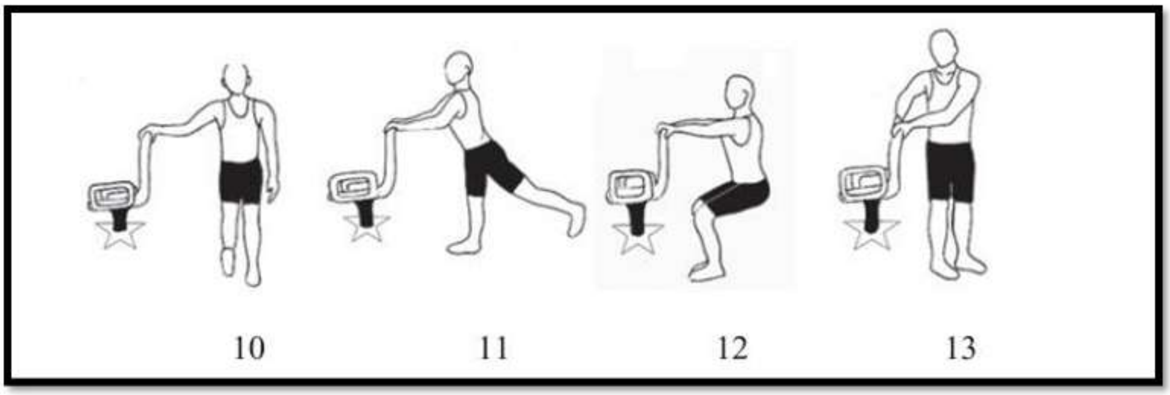


chair exercises 4, 5, 6

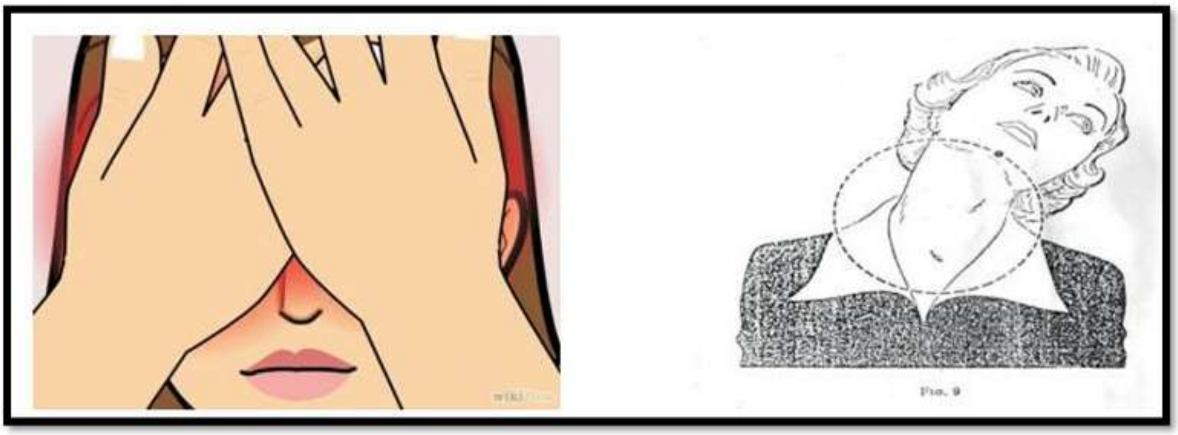


chair exercises 7, 8, 9





chair exercises 10, 11, 12, 13.



Eye relaxation exercises

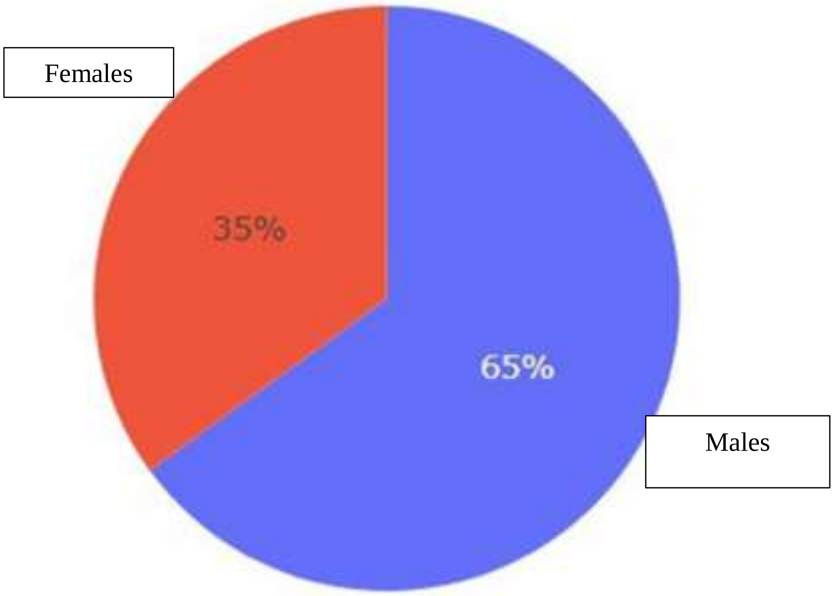
INTERVENTION PROTOCOL:

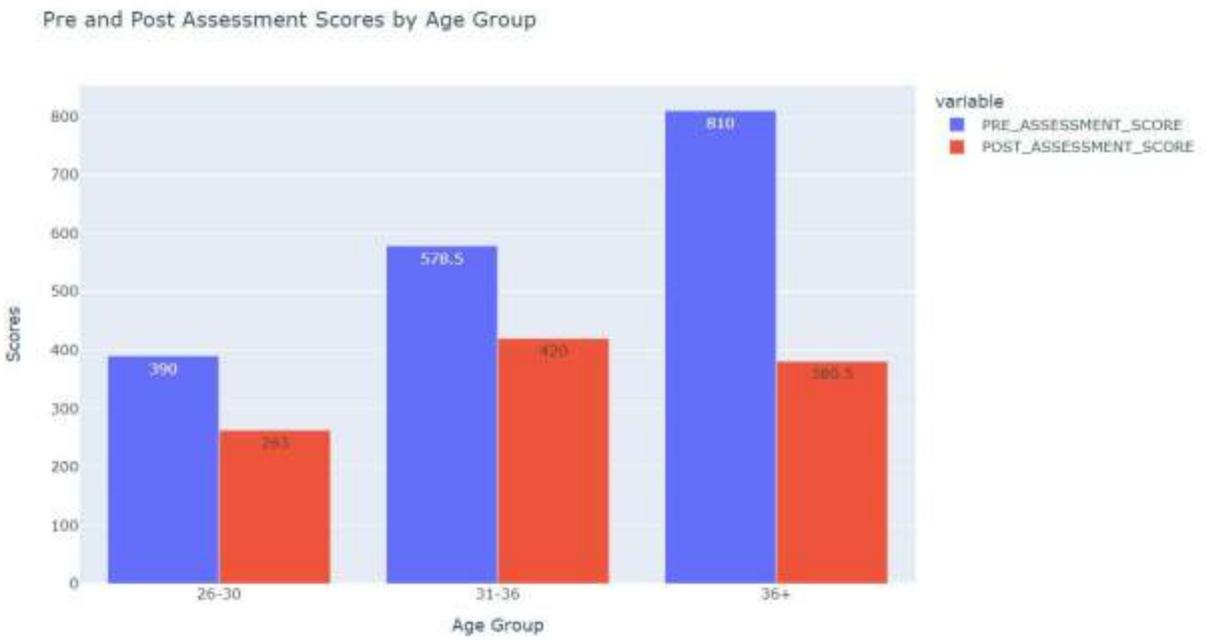
The intervention consisted of a multi-modal ergonomic and exercise program. Initially, participants received comprehensive education on workstation ergonomics, focusing on optimized chair and table configurations to support neutral posture. The exercise regimen featured a structured protocol of 13 specific stretches and strengthening exercises, modified from McKenzie and William's principles to enhance spinal flexibility and reduce pain. This 10-minute routine was performed in three sets daily, three times a week, for 11 consecutive weeks, with an emphasis on slow and controlled movements suitable for an office environment.
Additionally, an ocular relaxation protocol was implemented to combat digital eye strain. This included "palming" to rest the optic nerve, increased blinking frequency to maintain tear film stability, and multi-directional eye movements (up, down, left, right) to relax extraocular muscles. Complementary neck mobilizations, including rotations and multi-planar movements, were performed every three hours to alleviate tension in the cervical and scalp musculature resulting from prolonged static positioning**.**

RESEARCH METHODOLOGY

3.Statistical tools and econometric models

The above fig. show gender distribution of participants which include 28 females and 52 males.





IV. RESULTS AND DISCUSSION

The normality of the data distribution for all age categories was assessed using the Shapiro-Wilk test. The results indicated that for all age groups (26–30, 31–36, and 37 years and above), the differences between the pre-intervention and post-intervention scores did not follow a normal distribution. Consequently, the Wilcoxon signed-rank test, a robust non-parametric alternative for paired data, was employed to analyse the effectiveness of the intervention.

Statistical analysis revealed that across all three age cohorts, the intervention resulted in a significant reduction in musculoskeletal discomfort scores. The Wilcoxon signed-rank test yielded a p-value of less than 0.05 ($p < 0.05$) for each group, demonstrating a statistically significant difference between baseline and post-assessment measures. These findings suggest that the 11-week ergonomic exercise training and workstation modification protocol had a measurable and positive impact on reducing physical discomfort among IT professionals, regardless of their age group.

DISCUSSION

The results of this study underscore the critical role that multi-modal ergonomic interventions—specifically optimized sitting posture and structured workplace stretching—play in mitigating musculoskeletal discomfort among IT professionals. In modern IT work environments, prolonged sitting and static postures are well-documented risk factors for the development of work-related musculoskeletal disorders (WMSDs), primarily affecting the neck, shoulders, lumbar region, and wrists.[21] The findings of this research align with existing literature, which emphasizes the necessity of proactive workplace interventions to address these ergonomic risks and promote long-term musculoskeletal health.[21]

A primary focus of this study was the implementation of ergonomic sitting, which involves positioning the body to minimize mechanical strain on the musculoskeletal system. Maintaining a neutral spine and ensuring the alignment of the head, shoulders, and pelvis are essential for distributing body weight evenly.[22] Such alignment reduces excessive pressure on the intervertebral discs and prevents the muscular imbalances that occur when individuals slump or hunch forward during prolonged tasks. In this study, participants were educated on specific postural adjustments, such as maintaining a 90-degree angle at the hips and knees and using appropriate lumbar support.[19] These adjustments counteract the undue stress placed on the spinal structures, likely contributing significantly to the observed reduction in CMDQ discomfort scores.[23]

Furthermore, the integration of workstation modifications played a vital role in symptom reduction. Positioning the computer monitor at eye level is a fundamental ergonomic principle that prevents cervical strain, while keeping the arms close to the body and maintaining the wrists in a neutral position reduces the risk of upper extremity disorders. By adopting these corrective postures, IT professionals in the study were able to minimize the risk of exacerbating existing discomfort. These simple yet effective modifications address the root causes of cumulative trauma and provide a more sustainable environment for long-duration computer work.

Beyond static postural corrections, the implementation of a structured workplace exercise protocol was a significant factor in enhancing participant health. Static postures cause specific muscle groups to become chronically tight and fatigued, while others weaken due to underuse. The 13 stretching and strengthening exercises prescribed in this study served to counteract these imbalances by elongating tight tissues, promoting relaxation, and enhancing circulation.[7] Improved blood flow to the soft tissues is essential for flushing out metabolic waste products that accumulate during static loading, thereby reducing the perception of pain.

The exercises specifically targeted areas most prone to discomfort in the IT population, including the neck, shoulders, and back. Stretches focusing on the upper back and pectoral muscles help relieve the tension associated with "rounded shoulders," a common consequence of poor posture.[7] Similarly, lower back and hip-flexor stretch alleviate the stiffness associated with prolonged sitting, which often leads to lumbar discomfort. By combining these targeted movements with ergonomic education, the study provided a comprehensive approach to managing occupational health. These results suggest that integrating such protocols into the daily routine of the IT industry can lead to a significant decrease in the incidence and severity of musculoskeletal discomfort. [6,7]

LIMITATIONS

While this study provides valuable insights, it is subject to several limitations. First, the use of the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) relies on self-reported data, which introduces the potential for recall or social desirability bias regarding symptom severity. Second, although the protocol was standardized, there was inherent variability in participant adherence to the ergonomic advice and stretching frequency outside of supervised sessions. Finally, the study focused primarily on individual interventions and did not account for external workplace variables—such as workstation design diversity, high-pressure project cycles, or lighting conditions—which may have independently influenced musculoskeletal and ocular comfort outcomes.

CONCLUSION

This study demonstrates that an 11-week integrated ergonomic intervention—consisting of workstation optimization, structured McKenzie and William's-based exercises, and ocular relaxation techniques—significantly reduces musculoskeletal discomfort among IT professionals. The consistent improvement in Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) scores across all age groups (26 to 37+ years) indicates that these strategies are universally effective in mitigating the physical strain of sedentary, computer-intensive work.

The results highlight that addressing the multifactorial nature of work-related musculoskeletal disorders through both postural education and active movement is essential for long-term health. By implementing these cost-effective and accessible protocols, organizations can effectively combat the prevalence of chronic pain and Computer Vision Syndrome within the IT workforce. Ultimately, this research advocates for the integration of proactive ergonomic training as a standard component of occupational health to enhance the physical well-being and productivity of digital professionals.

II. ACKNOWLEDGMENT

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