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ERGONOMIC RISK ASSESSMENT IN AN OFFICE ENVIRONMENT USING THE CORNELL MUSCULOSKELETAL DISCOMFORT QUESTIONNAIRE (CMDQ) AND RAPID OFFICE STRAIN ASSESSMENT (ROSA)

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ABSTRACT

Prolonged sitting and suboptimal workstation design are key contributors to musculoskeletal discomfort among office workers. This study aimed to identify ergonomic risks in a sedentary office setting, focusing on discomfort patterns and workstation design deficiencies. A mixed-methods approach was adopted involving the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) and the Rapid Office Strain Assessment (ROSA). Fifty office workers completed the CMDQ, from which seven individuals with high-discomfort scores were further assessed using the ROSA method. Results indicated that the most affected body regions were the shoulders (56%), lower back (46%), and neck (44%). The ROSA evaluations revealed a high average risk score of 5.42, with poor chair ergonomics (mean score: 5.29) identified as the primary concern. Other workstation components, such as the monitor and keyboard setup, showed moderate risk levels. The study concludes that ergonomic interventions, particularly in chair design and usage, are urgently required. Recommendations include replacing non-ergonomic chairs, promoting ergonomic awareness, and incorporating physical activity into daily routines to reduce musculoskeletal risks in sedentary workplaces.

Keywords: Cornell Musculoskeletal Discomfort Questionnaire, Ergonomics, Office Workers, Rapid Office Strain Assessment, Sedentary Job.

INTRODUCTION

Prolonged sitting, commonly defined as remaining seated for more than four to six hours per day, has been consistently associated with a range of adverse health outcomes, including musculoskeletal discomfort, reduced metabolic function, and an increased risk of chronic diseases (Kett, Sichtung, & Milani, 2021). Office workers are particularly vulnerable to these effects due to the sedentary and repetitive nature of their tasks, which typically involve extended computer use, constrained postural variation, and limited opportunities for physical movement. Inadequate office ergonomics such as non-adjustable seating, poorly positioned monitors, and inappropriate workstation layouts, further exacerbate these risks. When such ergonomic issues remain unaddressed, they contribute not only to the development of musculoskeletal disorders (MSDs) but also to reduced work performance, increased absenteeism, and long-term health complications, ultimately affecting organisational productivity and sustainability (França, Fernandes, & Lima, 2021).

Considering the persistent challenges associated with office ergonomics and organisational resource constraints, prioritising workers experiencing the highest levels of discomfort through targeted ergonomic assessments represents a more effective approach to risk management. The use of validated screening tools facilitates the early identification of high-risk individuals and supports evidence-based decision-making for ergonomic interventions. In line with ISO 6385:2016 (ISO 6385 2016), which emphasises the integration of ergonomic principles to enhance occupational health, safety, and overall system performance, this study aims to (i) examine the prevalence and severity of musculoskeletal symptoms among office workers and (ii) assess workstation-related ergonomic risks using the Rapid Office Strain Assessment (ROSA) tool.

Accordingly, a structured two-tiered assessment strategy was adopted. Initially, the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) was used to identify patterns and severity of self-reported musculoskeletal discomfort among office workers. Subsequently, the ROSA tool was applied to individuals reporting higher levels of discomfort to objectively evaluate ergonomic risk factors associated with their workstations. This combined approach enables the systematic identification of critical ergonomic deficiencies and supports the development of targeted, high-impact interventions. Health, Safety, Security, and Environment (HSSE) personnel were selected as the study respondents due to the predominantly sedentary nature of their office-based work activities.

LITERATURE REVIEW

Office ergonomics aims to optimise the interaction between workers and their workstations by aligning job demands, equipment design, and work practices with human capabilities and limitations. Previous research consistently demonstrates that ergonomic improvements such as adjustable seating, appropriate monitor positioning, and the use of ergonomic input devices can reduce musculoskeletal discomfort while enhancing worker productivity and overall well-being. However, beyond subjective improvements in comfort, there is a need for objective and measurable evidence to know the effectiveness of ergonomic interventions. Quantitative indicators, such as ergonomic risk scores, are therefore increasingly used to demonstrate risk reduction in a manner comparable to other occupational safety and health improvements, ensuring that ergonomics interventions are both evidence-based and evaluable.

The prevalence of musculoskeletal disorders (MSDs) among office workers remains a significant occupational health concern. MSDs continue to rank among the most commonly reported work-related health problems, particularly among employees engaged in prolonged sitting and intensive computer use.

Symptoms frequently involve the neck, shoulders, lower back, and upper limbs, and are strongly associated with sustained static postures, repetitive movements, and poorly designed workstations (Dzakpasu et al. 2021). Empirical studies have reported a significant association between elevated ergonomic risk levels and increased prevalence of musculoskeletal symptoms, indicating that inadequate workstation design contributes directly to MSD development (Choobineh et al., 2011). The use of structured assessment tools alongside self-reported measures, such as the Nordic Musculoskeletal Questionnaire, has further strengthened the ability of researchers to identify MSDs risks and evaluate preventive strategies in office environments.

The Rapid Office Strain Assessment (ROSA) is a validated and practical observational tool for systematically evaluating ergonomic risk factors associated with office-based computer work. Initially developed by Sonne, Villalta, and Andrews (2012), ROSA assesses key workstation components, including chair design, monitor height and distance, keyboard and mouse placement, and telephone usage, to generate a composite risk score that reflects overall exposure to ergonomic hazards. The numerical nature of the ROSA score enables practitioners to prioritise corrective actions and quantitatively demonstrate improvements following ergonomic interventions. Due to its simplicity, low cost, and minimal training requirements, ROSA has been widely adopted in occupational ergonomics research and workplace assessments (Winners and Hapsari 2023; Er et al 2023). Empirical evidence shows that ergonomics interventions guided by ROSA findings, such as workstation redesign and ergonomic training, resulted in significant reductions in ROSA scores, thereby providing measurable proof of risk reduction (de Barros et al., 2022).

METHODOLOGY

Study Design

A mixed-methods approach was employed, involving quantitative surveys and qualitative feedback. The assessment process involved two stages: (1) Distribution of discomfort survey forms, Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) to 50 employees, and (2) workplace assessment using Rapid Office Strain Assessment (ROSA). ROSA evaluations for high-discomfort findings among respondents based on the CMDQ survey were presented in a dedicated Focus Group Discussion (FGD).

Cornell Musculoskeletal Discomfort Questionnaire (CMDQ)

The Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) is a widely used tool designed to assess musculoskeletal discomfort in various parts of the body, particularly among workers. Developed by researchers at Cornell University (Hedge, Morimoto & McCrobie 1999), it is commonly used in ergonomics research and occupational health assessments. The CMDQ is body region-specific, evaluating discomfort in 20 areas such as the neck, shoulders, upper and lower back, arms, wrists, hips, knees, and feet. It measures three key dimensions: the frequency of discomfort (e.g., never, 1–2 times per week, daily), the severity of discomfort (e.g., slight, moderate, very uncomfortable), and the degree to which discomfort interferes with work performance. Each of these dimensions is scored, and the scores are multiplied to produce a composite score for each body region. This scoring system helps prioritize areas that require ergonomic interventions, making the CMDQ a practical and reliable tool in workplace health and safety efforts.

Because of its effectiveness and widespread acceptance, the CMDQ is included in Malaysia's Ergonomic Risk Assessment (ERA) Guideline 2017 (DOSH 2017). The guideline uses CMDQ to help identify work-

related musculoskeletal disorders (WMSDs), particularly for jobs involving repetitive movements, awkward postures, or manual handling tasks.

Rapid Office Strain Assessment (ROSA)

ROSA is an ergonomic tool to evaluate the risk of MSDs among sedentary office workers, particularly those who spend long hours at computer workstations. ROSA is a screen-based observational checklist that assesses the ergonomic risk factors associated with prolonged computer use. It focuses on workstation components such as, chair (e.g., seat height, armrests, back support), monitor screen (e.g., height and distance), keyboard and mouse (e.g., position and usage) and telephone and document use while using the assessed workstation.

In the ROSA method, each component of the workstation is evaluated and scored based on its level of ergonomic risk. These individual scores are then combined to generate a final ROSA score, which typically ranges from 1 to 10 or higher. A final score of 5 or above is considered indicative of a high level of ergonomic risk and suggests the need for immediate intervention to prevent musculoskeletal issues. ROSA is particularly valuable in the study of sedentary workers, as it effectively highlights poor postures and suboptimal workstation setups that may contribute to discomfort or injury over time. By identifying these risk factors, ROSA helps prioritize corrective measures such as adjusting workstation layouts, introducing ergonomic equipment, or encouraging healthier work habits. Additionally, ROSA is a quick and cost-effective assessment tool that does not require specialized equipment, making it suitable for large-scale ergonomic evaluations in typical office environments.

Focus Group Discussion (FGD)

A FGD was also held with the Occupational Health Doctor and Senior Medical Officer to validate findings and discuss interventions. Key ergonomic improvements were explored, including physical training and workstation modifications.

RESULT AND DISCUSSION

Stage 1: Musculoskeletal Discomfort Survey (CMDQ)

This study employed the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) to examine the prevalence and distribution of musculoskeletal discomfort among 50 sedentary office workers. Of the respondents, 62% were male, and 38% were female, with the majority aged between 26 and 40 years (46%). The CMDQ findings revealed that musculoskeletal discomfort was most frequently reported in the shoulders (56%), followed by the lower back (46%) and neck (44%). These body regions are commonly associated with prolonged sitting, sustained static postures, and intensive computer-based work, and the observed pattern is consistent with previous studies on office-related musculoskeletal strain.

Although discomfort was reported across multiple body regions, the majority of respondents experienced symptoms of mild to moderate intensity. Based on CMDQ scoring criteria, seven respondents reported discomfort of sufficient severity and frequency to warrant further ergonomic evaluation. These individuals were therefore selected for further workstation assessment using the Rapid Office Strain Assessment (ROSA) tool. This targeted selection approach ensured that subsequent ergonomic evaluations focused on workers with the greatest potential exposure to workstation-related risk factors, thereby supporting an efficient and risk-based assessment strategy.

A detailed breakdown of musculoskeletal discomfort among the seven selected respondents is presented in Table 1, which illustrates the distribution of pain across specific body regions. The results indicate a higher concentration of discomfort in the upper body, particularly the neck, shoulders, upper back, and lower back. This pattern suggests potential ergonomic deficiencies related to monitor positioning, inadequate chair support, and prolonged static sitting postures, factors previously identified as key contributors to musculoskeletal disorders in office environments (van Vledder & Louw, 2015). The findings from the CMDQ are in line with the recent findings of Pearse et al (2024) and provide a clear empirical basis for conducting subsequent ROSA assessments, enabling a focused evaluation of workstation-related ergonomic risks corresponding to the reported discomfort patterns.

Table 1
Seven respondents with significant pain scores

Body Parts	R 1		R 2		R 3		R 4		R 5		R 6		R 7	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Neck	/	/		/	/		/	/	/	/	/	/		
Shoulder	/	/		/	/	/	/	/	/	/	/	/	/	/
Upper back	/	/		/	/	/	/	/	/	/			/	/
Lower back			/	/					/	/	/	/	/	/

Body Parts (left and right)	R 1		R 2		R 3		R 4		R 5		R 6		R 7	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	L	R	L	R	L	R	L	R	L	R	L	R	L	R
Upper arm					/		/	/	/	/				/
Elbow					/		/	/	/	/				
Lower arm					/		/	/	/	/				/
Wrist						/		/		/				/
Hand						/			/	/	/	/		/
Thigh			/		/									
Knee			/		/				/	/				
Calf			/		/		/	/	/	/	/	/	/	/
Ankle	/	/	/	/	/				/	/	/	/	/	/
Feet			/		/				/	/	/	/		

Note:

- R: Respondent
- A: Pain/discomfort in the following body parts.
- B: Pain/discomfort comes from work.
- L: Left
- R: Right
- /: Yes, feel the pain.

Stage 2: ROSA Evaluation Results

The ROSA evaluation revealed the ergonomic risks among the seven respondents who reported high levels of musculoskeletal discomfort during the CMDQ screening stage. Overall, the findings indicate that the existing office workstations pose a significant risk for the development or aggravation of MSDs (Table 2).

The mean overall ROSA score was 5.42, which falls within the high-risk category, indicating that ergonomic intervention is required soon. Scores at this level suggest that the current workstation configurations are likely contributing to sustained postural strain and musculoskeletal discomfort if left unaddressed.

Analysis by ROSA sections showed that Section A (Chair) recorded the highest mean score of 5.29, identifying chair design and seating posture as the primary contributors to ergonomic risk. Observed issues commonly associated with elevated chair scores include inappropriate seat height, insufficient lumbar support, limited adjustability, and non-ergonomic armrests. These factors are known to promote poor sitting posture and increase spinal loading during prolonged seated work.

In contrast, Section B (Monitor and Phone) recorded the lowest mean score of 2.43, indicating a lower ergonomic risk, though still classified as room for improvement. While monitor height and phone placement were generally acceptable, suboptimal positioning may still contribute to neck and upper-back strain over extended working periods.

Section C (Keyboard and Mouse) yielded a mean score of 4.14, reflecting a moderate level of ergonomic risk. This finding suggests potential issues related to wrist posture, input device height, and repetitive upper-limb movements. Although not as critical as chair-related factors, improvements in keyboard and mouse positioning remain necessary to reduce cumulative strain.

Overall, the ROSA results clearly demonstrate that chair ergonomics represent the most critical risk factor within the assessed workstations. While other workstation components exhibited moderate risk levels, corrective actions should prioritise improvements in seating design and postural support to achieve the greatest reduction in musculoskeletal risk.

Table 2

ROSA results based on the recorded high-risk CMDQ respondents

ROSA Item	Respondent							Mean Value	Risk (level)
	1	2	3	4	5	6	7		
Section A Score (Chair)	4	5	5	6	8	4	5	5.29	High (2)
Section B Score (Monitor / Phone)	2	2	3	3	2	3	2	2.43	Room for improvement (1)
Section C Score (Keyboard /Mouse)	5	3	4	5	4	3	5	4.14	Room for improvement (1)
Monitor and Peripherals Score	5	3	4	5	4	3	5		
ROSA score	5	5	5	6	8	4	5	5.42	High (2)

Further Assessment: Chair

The combined application of the CMDQ and ROSA provides a two-tiered ergonomic assessment framework, in which self-reported discomfort is systematically linked to objectively measured workstation risk factors. This integrative approach strengthens the validity of the findings and supports the prioritisation of targeted ergonomic interventions (Sohrabi, Ferasati and Jalilian 2014).

Physical inspection of the chairs used by respondents was also done and revealed limited adjustability and inadequate lumbar support, as illustrated in Figure 1. Fixed backrests and armrests restrict posture variation and hinder the maintenance of neutral spinal alignment. Prolonged use of such seating increases static

muscle loading, reduces blood circulation, and contributes to spinal compression, particularly during extended periods of seated work.



Figure 1
Workers' type of chair

Focus Group Discussion (FGD)

The Focus Group Discussion (FGD) involving an Occupational Health Doctor and a Senior Medical Officer provided practical recommendations for improving office ergonomics. These included conducting regular ergonomic awareness sessions to educate employees on proper sitting posture, workstation setup, and the health risks of prolonged sedentary work, to promote self-awareness and proactive adjustment of working habits. The FGD also emphasised the inclusion of brief daily stretching and mobility exercises to reduce muscle stiffness, improve circulation, and counteract the effects of static sitting (Sortino et al., 2024). In addition, the replacement of non-adjustable chairs with ergonomically designed seating that provides adequate lumbar support and adjustability was identified as a priority, with the Occupational Health Executive confirming that these interventions are both feasible and urgently needed and can be readily integrated into existing workplace health programmes to support long-term employee health and productivity.

CONCLUSION

This study highlights the ergonomic risks faced by sedentary office workers, particularly those associated with prolonged sitting and suboptimal workstation design. Based on the CMDQ, the most frequently reported areas of discomfort were the shoulders, lower back, and neck, which are commonly affected in office-based work. These findings are consistent with previous studies that associate extended static

postures and inadequate ergonomic support with an increased risk of work-related musculoskeletal disorders in office environments.

The ROSA further demonstrated a high mean risk score of 5.42 among seven respondents reporting severe discomfort, indicating the need for immediate ergonomic intervention. Among the assessed workstation components, the chair recorded the highest mean score (5.29), identifying poor seating design, particularly insufficient lumbar support and limited adjustability, as the primary contributor to ergonomic risk. Although the monitor, phone, keyboard, and mouse configurations were associated with moderate risk levels, these factors were of secondary concern compared to the pronounced seating-related issues.

To address the identified risks, a FGD involving an Occupational Health Doctor and a Senior Medical Officer was conducted to identify feasible and workplace-ready interventions. Key recommendations included the replacement of non-ergonomic chairs with adjustable, ergonomically designed seating, alongside the implementation of regular ergonomic training programmes to improve posture awareness and workstation practices. Additionally, encouraging physical movement through short, structured breaks was highlighted as an effective strategy to counteract the adverse effects of prolonged sedentary work. Noted that these low-cost and practical interventions have the potential to enhance employee well-being, improve productivity, and reduce absenteeism associated with musculoskeletal disorders.

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