Original Research

Assessing Ergonomics at Computer Workstations in the Emergency Department: A Prospective, Observational Study

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Study Objectives: *The increased use of computers at work has resulted in a similar increase in the number of musculoskeletal disorders reported. These disorders involve recurrent and persistent pain, may involve disability in any body part, and may happen progressively over periods of weeks to years. The goal of this pilot study was to assess the prevalence of ergonomic risk factors in emergency department (ED) clinicians while sitting at computer workstations.*

Methods: *This was a prospective, blinded, clinical assessment analysis conducted over a 2-month study period. ED clinicians (physicians, residents, and advanced practice providers) from a children's tertiary care facility and a university-affiliated adult hospital were observed during routine computer tasks. Clinicians were blinded to the purpose of the study. Trained observers completed a Rapid Office Strain Assessment (ROSA) checklist to evaluate computer use ergonomic risk factors. ROSA final scores ranged in magnitude from 1 to 10, with higher scores representing increasing risk factors. A ROSA score of 5 is considered an action level indicating when immediate change is necessary. One-way analysis of variance tests was used to compare ergonomic assessments at each level of postgraduate training.*

Results: *Seventy-six ED providers were observed performing a total of 89 tasks on computers. Providers were residents (42.1%), faculty (30.3%), and advanced practice providers (27.6%). Computer tasks included dictation, placing orders, and reviewing digital records. The mean ROSA score for all providers was 3.4 (SD 1.0). Overall, 24.2% of clinicians were scored at high risk for musculoskeletal disorders (ROSA score was >4). ROSA scores did not differ significantly among the various levels of postgraduate training. Computer use risk factors included awkward postures of the wrist and forearm, improper sitting posture, height of chair and workstation, and lack of lumbar support.*

Conclusions: *The Rapid Office Strain Assessment (ROSA) can be used to quickly quantify ergonomic risks associated with each component of a typical computer workstation and provide information to the ED provider regarding the need for change. In this small study, almost one-quarter of providers demonstrated ergonomic risk factors that make them susceptible to musculoskeletal disorders. These results occurred irrespective of postgraduate training levels.*

Keywords: Ergonomics, computer workstations, emergency department, prospective

INTRODUCTION

The objective of ergonomics, which involves the scientific examination of individuals in work settings, is to help prevent injuries to soft tissues and musculoskeletal disorders that can arise from sudden or prolonged exposure to various factors such as force, vibration, repetitive movements, and uncomfortable postures.[1] Some occupations or work environments are more likely to lead to complaints from workers regarding localized fatigue, excessive strain or tendinits, repetitive strain injury, chronic back pain, neck strain, joint problems, headache and visual strain.[1-3] The Occupational Safety and Health Administration (OSHA) has found considerable evidence that ergonomics programs can persistent pain that persists even after a night's rest. Common injuries include carpal tunnel syndrome, increase productivity, cut workers' compensation costs, and decrease employee turnover.[2]

Hospital Emergency Departments (ED) are a dynamic, multi-disciplinary system consisting of employees who specialize in both patient care and non-patient-related tasks. Many of these workers rely on computers to complete their designated duties. The increased use of computers at work has resulted in a similar increase in the number of musculoskeletal disorders reported.[3,4] These disorders involve recurrent and

persistent pain, may involve disability in any body part, and may happen progressively over periods of weeks to years.[4] The goal of this pilot study was to assess the prevalence of ergonomic risk factors in emergency department (ED) clinicians while sitting at computer workstations.

METHODS

Study Design: This was a prospective, blinded, clinical assessment analysis conducted over a 2-month study period. ED clinicians (physicians, residents, and advanced practice providers) from a children's tertiary care facility and a university-affiliated adult hospital were observed during routine computer tasks. Clinicians were blinded to the purpose of the study.

Data Collection: All data was collected by medical students with training in research methodology and ergonomic scoring. One investigator met frequently with the students to resolve questions and ensure consistency of abstraction and coding. ED clinicians were only told that students were present in the ED to shadow them as a component of their clerkship in emergency medicine. These research students then surreptitiously observed these clinicians while they worked on a computer and completed a Rapid Office Strain Assessment (ROSA) checklist. The ROSA checklist is a picture-based posture worksheet intended to quantify ergonomic risk factors during computer use.[5] The ROSA worksheet was created for easy use without the need for equipment or specialized training in ergonomics. The worksheet was the only scoring tool needed by the research assistant.

ROSA Scoring: Scoring was comprised of three separate sections: section A, the chair; section B, screen and phone; and finally, section C, keyboard and mouse. Final ROSA scores range from 1 to 10, with higher scores representing increasing risk factors.[5] Investigators have shown a significant correlation between musculoskeletal discomfort and increasing ROSA scores.[5-7] Intra- and inter-rater reliability have also been shown to be very good to excellent.[5,8-10] A ROSA score of 5 or greater is considered an action level, indicating when immediate change is necessary due to increased risk of musculoskeletal discomfort.[5]

Statistical Analyses: The main study outcome was the prevalence of ergonomic risk factors in EM clinicians while working at computer workstations, as well as the incidence of awkward positioning, was determined. A sample size determination was performed apriori. Approximately 75 participants were needed to have a confidence level of 95% that the real value is within ±10% of the measured value.11 Secondary outcomes were those awkward postures and ROSA scores in relationship to the level of postgraduate training. Chi-squared and one-way analysis of variance tests were used to compare ergonomic assessments at each level of postgraduate training (resident, faculty, and advanced practice providers). Data was entered into Microsoft Excel (version 7.0; Microsoft, Redmond, WA). This study was approved by the Institutional Review Board (IRB) at Corewell Health.

RESULTS

Seventy-six ED providers were observed performing a total of 89 tasks on computers. Providers were residents (42.1%), faculty (30.3%), and advanced practice providers (27.6%). Computer tasks included dictation, placing orders, and reviewing digital records. The mean ROSA final score for all providers was 3.4 (SD 1.0). The mean (SD) section scores for the chair, monitor, telephone, and mouse and keyboard were 3.1 (1.1), 2.7 (1.3), 3.8 (1.4), and 4.2 (1.6), respectively.

ROSA scores did not differ significantly among the various levels of postgraduate training. Mean scores (SD) for residents, faculty, and advanced practice providers were 3.6 (1.1), 3.4 (1.0) and 3.1 (0.9), respectively. Overall, 24.2% of clinicians were scored at high risk for musculoskeletal disorders (ROSA score = 5 or greater). Risk factors identified were awkward postures of the wrist and forearm, improper sitting posture, height of chair and workstation, and lack of lumbar support (Table 1).

Table 1. Contributors to Postural Stress at ED Workstations (n=89)

Arms resting on any hard or square surfaces	38 (42.7%)
Height of computer screen, keyboard, or desk	31 (34.8%)
Chair height not optimal	28 (31.5%)
No lumbar support	19 (21.3%)
No padded armrests	18 (20.2%)
Workstation noisy	17 (19.1%)
Viewing distance to monitor <18 inches or > 30 inches	13 (14.6%)
Room lighting too bright or too dim	8 (9.0%)
No room between the front of the chair and knees	7 (7.9%)
Tilting head to look at monitor	6 (6.7%)
Excess glare on computer monitor	4 (4.5%)

DISCUSSION

This is the first clinical study to assess computer workstation ergonomics in the emergency department. In this pilot study, the ROSA worksheet was used to quickly measure ergonomic risks associated with each component of a typical computer workstation. ROSA is a validated, inexpensive, and practical observation-based method.[5-7] It has been used extensively in many countries, and it has been translated into several languages. ROSA scores have been correlated positively with musculoskeletal discomfort, with a significant increase in discomfort scores between scores between 3 and 5. Sonne et.al. reported that a "ROSA score of 5 or greater was associated with a significant increase in worker discomfort and may indicate an increased potential for injury".[5]

Approximately 24% of ED providers in our study had ergonomic risk factors that made them susceptible to overuse syndromes or musculoskeletal disorders. These concerning results occurred irrespective of postgraduate training levels. Signs of musculoskeletal disorders and overuse syndromes consist of sensations of numbness, limited mobility, inflammation, and reduced strength in the tendons and muscles around the neck, back, shoulders, elbows, wrists, hands, or fingers.[5-8] Three overuse syndromes associated with prolonged sitting and/or working at the computer are mouse shoulder, cervical radiculopathy, and carpal tunnel syndrome.[10]

In hospital EDs, computer station ergonomics are essential to ensure the comfort, safety, and productivity of healthcare professionals, particularly those who spend extended hours working at computer workstations. According to a 2020 study in the Annals of Internal Medicine, researchers found that physicians spend greater than 16 minutes on electronic health records (EHR) for each patient seen.[12] Most of this time was spent on reviewing medical records (33%), chart documentation (24%), and test ordering (17%). Similar studies have reported that primary care physicians spend at least half of their day interacting with EHR while emergency clinicians spend most of their time on indirect patient care activities, such as reviewing records, charting, and diagnostic tests.[13,14]

By incorporating ergonomic principles into the design of the clinic or hospital environment, equipment, and workflows, healthcare institutions can create a safer and more comfortable working environment for clinicians (Table 2). This, in turn, can help reduce the incidence of work-related injuries, improve productivity, and enhance overall job satisfaction among clinicians, ultimately leading to better patient care.[2-4] Numerous studies have demonstrated that ergonomic interventions in office settings can lead to a reduction in musculoskeletal disorders (MSDs).[15-20] Properly designed workstations, adjustable furniture, and ergonomic accessories have been associated with lower rates of discomfort, pain, and MSDs in the neck, shoulders, back, and wrists. When employees are comfortable and their workstations are optimized for efficiency, they are less likely to experience fatigue, distraction, or discomfort, contributing to better overall performance.[21]

Studies have also found that employees who work in ergonomically optimized environments report higher levels of job satisfaction and well-being.[21-23] Feeling comfortable and

Table 2. Computer Workstation Ergonomics Self-Assessment Checklist [5-9,16,18-21]

• Your chair should provide lower back support.
• Seat height is adjusted so that feet are flat on the floor or on a footrest.
• Knees and hips should be at 90 degrees when sitting.
• Desk height is adjusted so that elbows are at a 90-degree angle when typing.
• Maintain good posture with shoulders relaxed, and elbows close to the body.
• Armrests are adjusted to support the arms with shoulders relaxed.
• The keyboard is at a height that allows for a neutral wrist position.
• Mouse is placed close to the keyboard.
• Document holder should be at the same height and distance as your monitor.
• Keep your wrists straight (not bent up or down) when typing.
• Wrists are not resting on a hard surface while typing or using the mouse.
• Lighting is positioned to minimize glare on the screen and other reflective surfaces.
• Distance from the eyes to the screen is approximately arm's length.
• The top of the monitor is at or slightly below eye level.
• The workspace is well-lit with adjustable lighting.
• Follow the 20-20-20 rule to reduce eye strain: every 20 minutes, look at something 20 feet away for at least 20 seconds.
• Take regular breaks or stretch when sitting for a long duration.
• Use ergonomic accessories such as a laptop stand, external keyboard, and mouse if working on a laptop for an extended period.

supported in the workplace contributes to a positive work experience and may reduce the likelihood of stress-related injuries.[23,24] And finally, ergonomics is associated with long-term health benefits for many workers.

Properly designed workstations can help prevent chronic conditions such as tendonitis, carpal tunnel syndrome, and other repetitive strain injuries that may develop over time due to poor ergonomic conditions.[10] Various organizations, including government agencies and occupational health associations, have established guidelines and standards for workstation ergonomics.[25-27] These guidelines are based on research evidence and best practices, providing a framework for creating work environments that promote health and safety (Table 3).

Table 3. Prevention of Repetitive Strain Injuries (RSIs) and Musculoskeletal Disorders (MSDs) in Clinical Settings Involving Prolonged Computer Use [16,19,25-27]

✓	Design workspaces to ensure that computer users are positioned comfortably. This includes the arrangement of desks, chairs, monitors, and input devices to promote natural and relaxed body postures.
✓	Adjustable ergonomic desks and chairs allow users to customize their workspace based on their individual preferences and body dimensions.
✓	Positioning the monitor at eye level to reduce neck strain. Additionally, the monitor should be placed at arm's length away to prevent eye fatigue. Tilt and swivel options can further accommodate individual needs.
✓	Ergonomic keyboards and mice are designed to reduce stress on the wrists and hands. Keyboards with a slight tilt and split design can promote a more natural hand position, while ergonomic mice support comfortable hand and wrist postures.
✓	Taking regular breaks and incorporating changes in posture. Prolonged periods of sitting or maintaining the same position can contribute to RSIs and MSDs. Simple stretching exercises and brief walks can help alleviate muscle tension.
✓	Training programs can teach individuals how to set up their workstations correctly, adopt healthy postures, and recognize early signs of discomfort or strain.
✓	Ergonomic accessories, such as lumbar supports, footrests, and wrist rests, can enhance comfort and reduce the risk of strain. These accessories are designed to provide additional support to specific areas of the body, promoting a more natural and relaxed posture.
✓	Eye strain is a common issue in prolonged computer use. Proper lighting, anti-glare screens, and the 20-20-20 rule (looking at something 20 feet away for 20 seconds every 20 minutes) can help reduce eye fatigue.
✓	Utilizing ergonomic software and tools can assist in monitoring computer usage patterns and reminding users to take breaks. These tools can also provide feedback on ergonomic adjustments and suggest improvements.
✓	Ergonomic assessments conducted by professionals can help identify specific issues related to an individual's workstation setup and work habits. These assessments can lead to personalized recommendations for improving ergonomics and reducing the risk of RSIs and MSDs.

There were a few limitations to our study. Since this was a pilot (or exploratory) study, no formal sample size analysis was run. Based on previous studies showing poor ergonomic scores in most office workers,[16-18] data collected over a two-month study period was considered sufficient to accurately determine the prevalence of ergonomic risk factors and awkward positioning. There is a need for larger, more diverse studies to enhance the generalizability of the findings to a broader population of healthcare professionals. Although ergonomic analyses are widely used in industry, they have been conspicuously absent in health care. We are currently studying the prevalence and type of ergonomic risk factors in emergency department (ED) clinicians during clinical procedures, such as intubation and laceration repair.[28]

We did not assess the inter or intra-rater reliability of the ROSA worksheet since that has been shown to be good to excellent in prior studies.[5,8-10] Other investigators have also reported previously on the construct validity, internal consistency, and accuracy of ROSA's risk score.[8] We also did not correlate complaints of musculoskeletal disorders with ROSA scores in our study population. This would require a much larger sample size and previous research has demonstrated a significant link between discomfort levels and increasing ROSA scores.[5-7] We gathered data exclusively from two academic centers: a pediatric tertiary care facility and an adult hospital affiliated with a university. These findings might vary in other settings, such as an urgent care center or a rural emergency department. Lastly, our study identified specific risk factors such as awkward postures, incorrect sitting posture, workstation and chair height, and inadequate lumbar support. However, there may be additional ergonomic risk factors that were not addressed in this study.

While this study identified ergonomic risk factors, there is a gap in research assessing the efficacy of interventions to mitigate these risks. Further prospective studies could explore the impact of ergonomic interventions on decreasing musculoskeletal disorders in ED clinicians. ED clinicians were blinded to the purpose of our study to decrease bias. Further research should investigate the impact of awareness and education programs on clinicians' ergonomic practices and whether increased awareness leads to a reduction in ergonomic risk factors.[29] Finally, we focused on a 2-month period, providing a snapshot of ergonomic risk factors. There

is a gap in understanding the long-term impact of these risk factors and how they may contribute to the development of musculoskeletal disorders over extended periods.

CONCLUSIONS

This is the first attempt to assess the ergonomics of ED clinicians working at computer stations. The ROSA worksheet was utilized to measure ergonomic risks associated with each component of a typical computer workstation. Notably, risk factors included awkward wrist and forearm postures, improper sitting, chair, and workstation height, and inadequate lumbar support. The mean ROSA score across all providers was 3.4, with 24% deemed at high risk for musculoskeletal disorders. These concerning results occurred irrespective of postgraduate training levels. Implementing ergonomic practices in the hospital ED is an ongoing process. Regular assessments and feedback from staff can help identify and address potential issues to create a more comfortable and efficient workspace for healthcare professionals**.**

Conflict of interest and funding

There was no external funding source for this study. The authors declare no conflicts of interest

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