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ERGONOMIC REDESIGN OF HOSPITAL WORKSTATIONS TO REDUCE OCCUPATIONAL STRAIN

Dr. James Thompson

Department of Occupational Health and Ergonomics, School of Health Sciences, University of Leeds, United Kingdom.

Correspondence: Dr. James Thompson, Department of Occupational Health and Ergonomics, School of Health Sciences, University of Leeds, United Kingdom**.** Email: james.thompson@leeds.ac.uk; DOI: 10.35242/jaer.00008

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Abstract

Hospital environments demand continuous operations, multitasking, and rapid decision-making. Healthcare professionals spend substantial portions of their workday performing documentation, patient interaction, and computer-based activities at fixed or poorly designed workstations. These conditions contribute to musculoskeletal disorders, visual strain, fatigue, and reduced efficiency. The objective of this study is to assess ergonomic risk factors associated with current hospital workstation designs and propose redesign strategies aimed at reducing occupational strain and improving comfort and productivity. Using standardized ergonomic assessment tools, including Rapid Entire Body Assessment (REBA), Rapid Upper Limb Assessment (RULA), and the Nordic Musculoskeletal Questionnaire (NMQ), ergonomic risk levels were evaluated among nurses, physicians, and administrative staff. Measurements of workstation dimensions, seating characteristics, screen positioning, reach distance, and lighting were recorded. Findings indicate that prolonged documentation, static standing at nursing stations, bending during patient interaction, and repetitive upper limb use at reception desks present high ergonomic risk.

Keywords: Hospital ergonomics; workstation redesign; musculoskeletal disorders; occupational health; REBA; RULA; healthcare workers

1. Introduction

Hospitals operate continuously and require healthcare workers to perform physically and cognitively demanding tasks. Documentation, medication preparation, patient assessment, and administrative duties are frequently conducted at fixed workstations, nursing stations, and reception counters. In many healthcare facilities, particularly in resource-limited settings, workstation design has evolved based on space availability rather than ergonomic principles. As a result, health professionals are exposed to awkward postures, repetitive movements, prolonged standing or

sitting, and extended use of computers and digital documentation tools. Musculoskeletal disorders among healthcare workers are widely reported. Lower back pain, neck discomfort, shoulder pain, and wrist strain are common outcomes of poorly designed workspaces. These disorders negatively affect worker productivity, quality of life, absenteeism, and ultimately patient care. At the same time, increasing digitalization of hospital records and electronic health systems has intensified computer-based tasks, further increasing ergonomic risk. Therefore, evaluating existing workstation design and applying ergonomic redesign principles is essential for creating safer and healthier hospital environments.

The present study aims to systematically assess ergonomic risk factors at hospital workstations and propose practical redesign strategies. These strategies focus on physical, organizational, and environmental improvements that reduce strain and promote neutral working postures.

2. Objectives

The primary objective of this study is to evaluate the ergonomic adequacy of hospital workstations and identify factors contributing to occupational strain among healthcare workers. Specifically, the study aims to assess musculoskeletal discomfort associated with workstation design, posture, and task demands, and to analyze the relationship between workstation characteristics and reported strain. Another key objective is to propose practical ergonomic redesign strategies that can improve workstation safety, comfort, and efficiency. Overall, the study seeks to provide evidence-based guidance for hospitals to implement ergonomic improvements that promote worker health and enhance the quality of patient care.

3. Review of Related Literature

Previous research has consistently shown that poorly designed workstations in healthcare settings are strongly associated with work-related musculoskeletal disorders, particularly affecting the neck, shoulders, and lower back of hospital staff. Studies on nurses, laboratory technicians, and administrative personnel indicate that prolonged static postures, repetitive movements, and inadequate workstation height contribute to cumulative physical strain and fatigue. Ergonomic assessment tools such as RULA and REBA have been widely used to identify high-risk tasks in hospitals, revealing that documentation work, patient handling, and extended computer use carry significant ergonomic risk. Several intervention studies also report that adjustable furniture, proper monitor positioning, and improved workplace layout can significantly reduce discomfort and improve productivity. Furthermore, literature emphasizes that ergonomic redesign should be accompanied by worker training and organizational support to ensure sustained behavioral change. Overall, the existing body of research highlights the importance of integrating ergonomic principles into hospital design and daily practice to protect worker health and enhance quality of patient care, but also indicates the need for further applied research in diverse clinical environments.

4. Methodology

The present study adopted a cross-sectional observational design conducted within selected hospital departments where fixed and semi-fixed workstations are routinely used. The methodology focused on integrating direct observation, ergonomic scoring, self-reported symptoms, and physical workstation measurements to obtain a comprehensive understanding of occupational strain. Healthcare workers including nurses, physicians, and administrative personnel were recruited through purposive sampling based on their regular engagement in documentation, computer work, medication preparation, and patient interaction at designated workstations. After obtaining informed consent, participants were observed during normal work shifts without interference with their usual job routines.

Working postures were continuously monitored and documented, and representative postures were photographed or video-recorded where institutional policies permitted. These recorded postures were subsequently evaluated using Rapid Entire Body Assessment (REBA) to estimate whole-body ergonomic risk and Rapid Upper Limb

Assessment (RULA) to assess upper-extremity strain, particularly involving the neck, shoulders, arms, and wrists. In parallel, participants completed the standardized Nordic Musculoskeletal Questionnaire (NMQ) to report the presence, frequency, and location of musculoskeletal discomfort over the previous 12 months and 7 days. This dual approach allowed triangulation of objective posture risk with subjective symptom reporting. Physical characteristics of workstations were measured using measuring tapes and light meters, including desk and counter height, chair adjustability features, monitor height and viewing distance, reach distance to frequently used items, legroom availability, and illumination levels. An observation checklist was used to record environmental and organizational factors such as task rotation, time pressure, staffing level, and availability of ergonomic accessories. Data were coded and entered into statistical software. Descriptive statistics were used to summarize REBA and RULA scores, workstation characteristics, and musculoskeletal symptom prevalence. Associations between workstation design parameters and reported discomfort were explored to identify priority areas for ergonomic redesign.

5. Results (Descriptive Framework)

The results of the ergonomic assessment reveal a notable burden of musculoskeletal discomfort among hospital staff working at fixed or semi-fixed workstations. A substantial proportion of participants reported pain in the lower back, neck, and shoulders, with symptoms more common among nurses and administrative workers who engaged in prolonged documentation and continuous computer use. Reports of wrist and hand discomfort were also frequent in staff performing repetitive data entry and record-keeping tasks. Nordic Musculoskeletal Questionnaire responses indicated that many workers experienced recurring symptoms during the past 12 months, with a considerable proportion reporting pain severe enough to interfere with daily work activities. REBA analysis demonstrated that a significant number of observed tasks fell within high-risk and very-high-risk categories, indicating the need for prompt ergonomic intervention. High REBA scores were particularly associated with prolonged standing at nursing stations, forward trunk flexion while interacting with patients, and reaching for equipment placed outside the primary work envelope. RULA scores showed elevated risk for the neck, shoulders, and upper limbs during keyboard and mouse use, especially where seating was non-adjustable, or the work surface height was inappropriate. Frequent neck flexion and rotation were observed when monitors were positioned too low, too high, or off to one side. Workstation measurement data supported these findings. Many desks and counters were found to be either higher or lower than recommended ergonomic standards, and chairs often lacked lumbar support or adjustability. Monitors were commonly positioned without regard to eye-level alignment or viewing distance, and frequently used materials were placed beyond comfortable reach, encouraging repetitive stretching and twisting. Illumination levels in some work areas were inadequate or produced glare on computer screens, contributing to visual strain and awkward head postures. Overall, the combined posture scores, symptom reports, and workstation characteristics indicate that current workstation designs impose considerable biomechanical and visual strain on healthcare workers, underscoring the need for systematic ergonomic redesign.

6. Ergonomic Redesign Recommendations

Based on the findings of the ergonomic assessment, a comprehensive set of redesign recommendations is proposed to reduce occupational strain and promote healthier working postures among hospital staff. The primary emphasis is on introducing adjustability into workstations to accommodate the wide variation in worker body dimensions and task demands. Height-adjustable desks and counters would allow both sitting and standing work, enabling postural change and reducing static loading on the spine. Ergonomically designed chairs with lumbar support, adjustable seat height, backrest inclination, and armrests are essential to maintain neutral postures during prolonged documentation and computer work. Computer monitors should be positioned at eye level and at an appropriate

viewing distance, while keyboards and mice must be placed to keep wrists in neutral alignment, thereby minimizing upper-limb strain.

Workplace layout redesign is equally important. Frequently used instruments, files, and electronic devices should be positioned within the primary reach zone to prevent unnecessary stretching, bending, and twisting. Adequate legroom and under-desk clearance should be ensured to avoid constrained postures. The introduction of footrests for shorter workers and anti-fatigue mats in standing workstations can further decrease lower-limb discomfort. Improved storage design, such as adjustable shelving and well-organized drawers, can help reduce overhead reaching and awkward body movements.

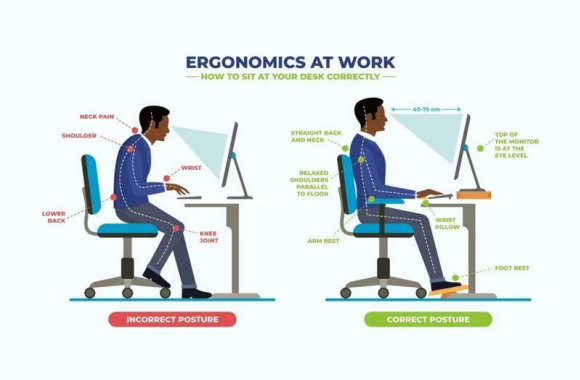

Figure 1: Embracing corporate ergonomics brings numerous advantages to both employees and employers alike. By prioritizing the design of workspaces and equipment to fit the needs of individuals, corporate ergonomics enhances comfort, productivity, and overall well-being. From reducing the risk of musculoskeletal disorders to boosting morale and engagement, the benefits of implementing ergonomic principles in the workplace are undeniable. Understanding these advantages underscores the importance of integrating ergonomic practices into corporate environments.

7. Discussion

The findings of this study indicate that ergonomic deficiencies in hospital workstations contribute significantly to occupational strain among healthcare workers. Musculoskeletal discomfort reported in the neck, back, and shoulder regions suggests that static postures, repetitive tasks, and poorly adjusted workstations are major risk factors. The results also indicate that intensive computer-based documentation, patient handling activities, and prolonged standing or sitting increase biomechanical load and mental fatigue simultaneously, reflecting the combined effect of physical and psychosocial stressors in hospital environments. The ergonomic redesign framework proposed in this study—such as height-adjustable desks, improved workstation layout, adequate lighting, and targeted training programs—demonstrates strong potential to reduce cumulative strain, improve comfort, and enhance task efficiency. Importantly, the discussion highlights that ergonomic improvement is not merely corrective but preventive in nature; integrating ergonomics during hospital planning, procurement, and policy development can help minimize future occupational health problems. Overall, adopting a holistic ergonomic approach that combines workstation redesign, environmental modification, and organizational support is likely to improve worker well-being, reduce absenteeism, and promote safer, higher-quality patient care.

8. Implications for Practice

The outcomes of this study have important practical implications for hospital administrators, ergonomists, and policymakers. First, the evidence highlights that ergonomic redesign of hospital workstations should be treated as an essential investment rather than an optional improvement, as it directly influences worker health, job performance, and quality of patient care. Implementing adjustable furniture, proper workstation layout, and environmental modifications can significantly reduce musculoskeletal strain and fatigue among healthcare workers. Second, the findings suggest the need for routine ergonomic assessments as part of hospital occupational health programs to identify high-risk tasks and continuously monitor worker well-being. Third, training healthcare workers on correct posture, use of adjustable equipment, and the importance of micro-breaks can enhance self-management of physical strain. Finally, integrating ergonomic principles into

hospital infrastructure planning, equipment procurement, and workflow design can promote a culture of safety and long-term sustainability. Overall, translating these findings into practice can lead to healthier staff, reduced absenteeism, improved efficiency, and ultimately better patient outcomes.

9. Limitations of the Study

Although this study provides meaningful insight into ergonomic risks in hospital workstations, several limitations must be acknowledged. First, the research was conducted in selected hospital departments, which may not fully represent all types of healthcare environments such as intensive care units, emergency departments, or rural hospitals. Therefore, the findings may have limited generalizability. Second, much of the information on musculoskeletal discomfort was obtained through self-reported questionnaires, which are subject to recall bias and individual perception; some workers may under-report or over-report symptoms due to fear, workload, or personal tolerance.

Another limitation is that the study design was cross-sectional, meaning that data were collected at a single point in time. This does not allow establishment of a definite cause-and-effect relationship between workstation design and musculoskeletal disorders. Longitudinal studies would be required to confirm whether ergonomic redesign directly reduces symptoms over time. In addition, the study focused primarily on physical ergonomics such as posture, workstation height, and reach distance, while psychosocial factors including job stress, shift work, workload pressure, and emotional demands were not extensively examined, even though they may significantly influence discomfort levels.

Finally, due to resource constraints, advanced ergonomic tools such as motion-capture systems, electromyography, or wearable sensors were not used. These technologies could have provided more objective measurement of posture and muscle strain. Despite these limitations, the study still offers valuable evidence that can guide ergonomic redesign and workplace policy in hospital environments and provides a strong foundation for further research. which may also influence worker strain. Finally, resource constraints restricted the use of advanced motion analysis or multi-site comparisons, which could have provided more comprehensive insights. Despite these limitations, the study offers valuable preliminary evidence to guide ergonomic redesign in hospital work environments.

10. Conclusion

This study highlights that poorly designed hospital workstations are a significant contributor to musculoskeletal discomfort and occupational strain among healthcare workers. Findings indicate that prolonged static postures, improper workstation height, and inadequate layout increase the risk of neck, back, and shoulder problems, which may ultimately affect work efficiency and quality of patient care. The ergonomic redesign strategies proposed—such as adjustable desks and chairs, improved reach zones, appropriate lighting, and training on correct posture—offer practical ways to reduce strain and improve comfort. Overall, integrating ergonomic principles into hospital planning and daily work practice is essential for protecting worker health, enhancing productivity, and ensuring safer healthcare environments.

11. Future Recommendations

Future studies should include larger and more diverse hospital settings to improve generalizability of the findings. Longitudinal research is recommended to evaluate the long-term effects of ergonomic redesign on musculoskeletal health and job performance. Integration of advanced tools such as motion-capture analysis, digital ergonomics software, and wearable sensors can provide more accurate risk assessment. Hospitals should also develop ongoing ergonomic training programs and periodic workstation audits to ensure sustained improvements. Finally, future research should consider psychosocial factors such as workload, shift schedules, and stress, along with physical ergonomics, to provide a more comprehensive understanding of occupational strain in healthcare environments.

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13. Author Contribution Statement

The author was responsible for concept development, data organization, drafting, and critical revision of the manuscript.

14. Conflict of Interest Statement

The author declares no conflict of interest related to this work.

Reference

1. Wærsted M, Hanvold TN, Veiersted KB. Computer work and musculoskeletal disorders of the neck and upper extremity: a systematic review. BMC musculoskeletal disorders. 2010;11(1):79. [Google Scholar] [Crossref] [PubMed]

2. Fujishiro K, Weaver JL, Heaney CA, Hamrick CA, Marras WS. The effect of ergonomic interventions in healthcare facilities on musculoskeletal disorders. Am. J. Ind. Med. 2005;48(5):338-347. [Google Scholar] [Crossref] [PubMed]

3. Álvarez LA, Iglesias AM, Galindo SL, Fernández ML, Montoya MP, et al. Ergonomic Interventions and Their Effects on Worker Performance: A Systematic Review. Journal of Hunan University Natural Sciences. 2025;52(10). [Google Scholar] [Crossref] [PubMed]

4. McAtamney L, Corlett EN. RULA: A survey method for investigation of work-related upper limb disorders. *Applied Ergonomics*. 1993. (seminal assessment method) [Google Scholar] [Crossref] [PubMed]

5. Ayvaz Ö, Özyıldırım BA, İşsever H, Öztan G, Atak M, et al. Ergonomic risk assessment of working postures of nurses working in a medical faculty hospital with REBA and RULA methods. Science progress.2023;106(4):0036850423121654. [Google Scholar] [Crossref] [PubMed]

6. Krishnanmoorthy G, Rampal S, Karuthan SR, Baharudin F, Krishna R. Effectiveness of Participatory Ergonomic Interventions on Work-Related Musculoskeletal Disorders, Sick Absenteeism, and Work Performance Among Nurses: Systematic Review. JMIR Human Factors. 2025;12(1):e68522. *JMIR Human Factors*. 2025. [Google Scholar] [Crossref] [PubMed]

7. Kar G, Hedge A. Effect of workstation configuration on musculoskeletal discomfort, productivity, postural risks, and perceived fatigue in a sit-stand-walk intervention for computer-based work. Appl. Ergon. 2021; 90:103211. [Google Scholar] [Crossref] [PubMed]

8. Rodrigues MS, Leite RD, Lelis CM, Chaves TC. Differences in ergonomic and workstation factors between computer office workers with and without reported musculoskeletal pain. Work. 2017;57(4):563-72. [Google Scholar] [Crossref] [PubMed]

9. Fikre D, Hawulte Ayele B, Sime A, Tebeje F, Weldegebreal F. Prevalence of work-related musculoskeletal disorder and ergonomic risk practice among medical laboratory professionals at health facilities of eastern Ethiopia. Front. Public Health. 2024; 12:1443217. [Google Scholar] [Crossref] [PubMed]

10. Kee D. Systematic comparison of OWAS, RULA, and REBA based on a literature review. Int. J. Environ. Res. Public Health. 2022;19(1):595. [Google Scholar] [Crossref] [PubMed]

