

IMPACT ASSESSMENT OF ERGONOMIC INTERVENTIONS ON MUSCULOSKELETAL DISORDERS (MSDS) IN SEDENTARY WORKERS IN PORT HARCOURT

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ABSTRACT	KEYWORDS
This study evaluated the impact of ergonomic interventions on Musculoskeletal Disorders (MSDs) among sedentary workers in Port Harcourt, Nigeria. It determined the prevalence and distribution of MSDs, assessed ergonomic risk factors, and measured the effectiveness of multi-component ergonomic interventions in improving health, posture, and productivity. A quasi-experimental pre-test and post-test control group design was adopted. A total of 270 participants were selected through stratified random sampling from five occupational sectors: public, financial, retail, education, and ICT/services. Data were collected using validated instruments, including the Nordic Musculoskeletal Questionnaire (NMQ), Rapid Upper Limb Assessment (RULA), RAND SF-36 Health Survey, Work Productivity and Activity Impairment Questionnaire (WPAI), and an ergonomic checklist. The 12-week intervention comprised four components: physical workstation modification, ergonomics education, behavioural training, and technological posture monitoring. Data were analyzed using SPSS Version 27, with descriptive statistics, t-tests, ANOVA, and correlation analyses at $p < 0.05$. Findings revealed a high baseline MSD prevalence (78.5%), with the lower back (71.5%), neck (59.6%), and upper back (52.2%) most affected. Baseline RULA results showed 63% of participants were in high-risk categories. Post-intervention, MSD symptoms significantly reduced in the intervention group— lower back (−34.1%), neck (−25.9%), and shoulder (−19.2%) pain ($p < 0.05$). Mean RULA scores improved from 5.8 to 3.2 (45% reduction), SF-36 health scores rose by 25–27%, and WPAI productivity increased by 46%. The study concluded that multi-component ergonomic interventions effectively reduce MSDs, enhance worker health, and improve productivity. It recommends institutionalizing ergonomic policies, periodic workplace assessments, and digital posture monitoring to promote occupational well-being in Nigeria’s sedentary workforce.	Musculoskeletal disorders (MSDs), Ergonomic interventions, Sedentary workers, Posture assessment, RULA, Work productivity, Port Harcourt.

Introduction

Musculoskeletal disorders (MSDs) are among the most common and costly work-related health conditions globally, accounting for a significant portion of occupational injuries, absenteeism, and reduced productivity. These disorders primarily affect muscles, tendons, ligaments, nerves, and other soft tissues, and are especially prevalent among workers engaged in prolonged sedentary tasks such as computer-based office work or desk operations. In knowledge-driven economies where office-based work is dominant, sedentary behaviours have emerged as critical risk factors. Workers often spend upwards of 8 hours per day in static postures, using poorly designed chairs, workstations, or improperly positioned monitors. These environmental and behavioural factors contribute to the development of MSDs, particularly in the neck, shoulders, lower back, and wrists.

Ergonomic interventions are among the most effective preventive strategies for addressing these risks. Ergonomics, defined as the science of fitting the workplace to the worker, seeks to optimize the interface between human capabilities and the demands of the work environment. Interventions typically comprise modifications to workstation layout, seating, screen height, and keyboard placement, alongside behavioural training, posture correction, and employee education on sitting and movement patterns.

In Nigeria, the proliferation of corporate offices, administrative agencies, retail supermarkets, and ICT firms has substantially expanded the sedentary workforce. Despite this growth, workplace ergonomics remains largely underdeveloped, with minimal institutional support and low ergonomic compliance. While workers may possess basic awareness, organizational frameworks for workstation optimization are often lacking, exposing personnel to continuous biomechanical strain.

Aim and Objectives: The overall aim of this study was to assess the effectiveness of ergonomic interventions in reducing the prevalence and severity of musculoskeletal disorders (MSDs) among sedentary workers in Port Harcourt. Specific objectives included: (1) determining the prevalence and anatomical distribution of MSDs; (2) identifying and categorizing existing workplace ergonomic interventions; (3) evaluating the effectiveness of a multi-component ergonomic intervention in reducing symptoms and improving posture; (4) assessing impacts on employee productivity, comfort, and emotional well-being; and (5) exploring the significant barriers and limitations hindering ergonomic implementation in sedentary workplaces.

2. MATERIALS AND METHODS

2.1 Research Design and Study Area

A quasi-experimental pre-test and post-test control group design was employed. The study was carried out in Port Harcourt Metropolis, the capital of Rivers State, Nigeria (approx. 4°45'N to 4°55'N and 6°55'E to 7°05'E). Port Harcourt is an industrial and commercial nerve center hosting corporate headquarters, oil and gas administrative offices, financial institutions, educational establishments, and modern retail supermarket chains where personnel spend 6–10 hours daily seated or in static postures.

2.2 Population, Sample Size, and Sampling Technique

The target population consisted of sedentary workers who spend six (6) or more hours per day seated in computer-based, clerical, or desk-bound tasks. The sample size was calculated using Cochran's (1977) formula for large populations:

$$n_0 = (Z^2 \cdot p \cdot (1 - p)) / e^2 = (1.96^2 \cdot 0.80 \cdot 0.20) / 0.05^2 = 245.86 \approx 246$$

Adjusting for an estimated 10% attrition rate ($n_{adj} = 246 / 0.90 = 273.3$), a final sample of 270 participants was established. A multi-stage stratified random sampling procedure was utilized across five major occupational sectors in Port Harcourt. The allocation of respondents across these sectors is presented in Table 1.

Table 1: Proportional Allocation of Sample Size Across Sectors

Sector / Stratum	Sector Description & Sampled Establishments	Estimated Pop. (%)	Allocated Sample (N)
Public Sector	Rivers State Secretariat, Ministry of Health, Ministry of Education	20%	54
Financial Sector	Commercial banks (Zenith, GTB, Access, UBA), Microfinance	25%	68
Retail & Sales	Supermarket cashiers & desk sales (Shoprite, SPAR, Market Square, NEXT)	18%	49
Educational Sector	University of Port Harcourt, Rivers State University, Madonna University	17%	46
ICT & Services	Telecommunication hubs (MTN, Airtel), Logistics, Consultancy firms	20%	53
Total Sample	Stratified across 5 sectors (135 Intervention group, 135 Control group)	100%	270

Source: Field Survey & Study Sampling Framework (270 total respondents: 135 Intervention group, 135 Control group).

2.3 Data Collection Instruments and Intervention Protocol

Data were obtained using validated research instruments: (1) Nordic Musculoskeletal Questionnaire (NMQ) to identify symptoms across nine anatomical regions; (2) Rapid Upper Limb Assessment (RULA) to score postural risks (1–7 scale); (3) RAND SF-36 Health Survey to assess physical and mental well-being (0–100 scale); (4) Work Productivity and Activity Impairment (WPAI) questionnaire; and (5) a standardized Ergonomic Observation Checklist.

The 12-week multi-component intervention included: (a) physical workstation modifications (adjustable chairs, monitor risers, footrests, ergonomic keyboards); (b) educational workshops on posture and anatomy; (c) guided stretching routines implemented twice daily; and (d) behavioural goal-setting with mobile and desktop micro-break reminders (every 30–60 minutes). The control group continued customary routines.

2.4 Psychometric Properties and Data Analysis

Instrument reliability was established via pilot testing ($n = 20$), demonstrating high internal consistency (Cronbach's α between 0.70 and 0.90) and excellent inter-rater reliability (Cohen's $\kappa > 0.75$).

Quantitative data were analyzed using SPSS Version 27. Paired-samples t-tests evaluated within-group pre/post changes, independent-samples t-tests assessed between-group differences, and ANOVA examined sectoral variations at $p < 0.05$. Qualitative barrier feedback was synthesized thematically.

3. RESULTS AND DISCUSSION

3.1 Prevalence and Anatomical Distribution of MSDs

Baseline assessment using the NMQ revealed an overall 12-month MSD prevalence of 78.5% among sedentary workers. The anatomical distribution is detailed in Table 2.

Table 2: Baseline Prevalence of MSDs by Anatomical Body Region

Body Region	Intervention Group (%) [N=135]	Control Group (%) [N=135]	Total Prevalence (%) [N=270]
Lower Back	72.6%	70.4%	71.5%
Neck	58.5%	60.7%	59.6%
Upper Back	51.1%	53.3%	52.2%
Shoulders	44.4%	42.2%	43.3%
Wrists/Hands	35.6%	33.3%	34.4%
Knees	28.1%	26.7%	27.4%
Hips/Thighs	18.5%	20.0%	19.3%

Source: Nordic Musculoskeletal Questionnaire (NMQ) Baseline Survey. Overall 12-month MSD prevalence: 78.5%.

The lower back (71.5%), neck (59.6%), and upper back (52.2%) formed the primary triad of discomfort. This high occurrence reflects prolonged static spinal loading and repetitive forward flexion during prolonged desk and computer operations.

3.2 Baseline Workplace Ergonomic Interventions

Field surveys and observational audits indicated that pre-intervention ergonomic initiatives were largely informal, ad-hoc, and employee-driven rather than institutionally supported (Table 3).

Table 3: Categorization and Extent of Existing Ergonomic Interventions

Category	Identified Practices & Interventions	Extent of Implementation	Proportion (%)
Physical / Engineering	Minor furniture adjustments, makeshift seat cushions, personal footrests	Limited	24.0%
Behavioural	Self-initiated posture adjustment, informal shifting, stretching during idle time	Informal	60.0%
Educational	Formal ergonomic training, induction, posture awareness sessions	Minimal	16.0%
Organizational / Participatory	Supervisor involvement, ergonomic committees, health promotion policies	Rare	10.0%

Source: Baseline Workplace Ergonomic Audit & Questionnaire Data.

3.3 Postural Risk Assessment (RULA)

Baseline Rapid Upper Limb Assessment (RULA) demonstrated that 63.0% of participants operated under high or very high postural risk levels (Table 4), necessitating immediate ergonomic modification.

Table 4: Baseline Rapid Upper Limb Assessment (RULA) Risk Levels

Risk Category	RULA Action Score	Action Required / Description	Prevalence (%)
Low Risk	1–2	Acceptable posture if not maintained or repeated for long periods	14.0%
Moderate Risk	3–4	Further investigation needed; workstation changes may be required	23.0%
High Risk	5–6	Investigation and ergonomic changes required soon	45.0%
Very High Risk	7	Investigation and ergonomic changes required immediately	18.0%

Source: Baseline RULA Posture Evaluation (Total High + Very High Risk: 63.0%).

3.4 Effectiveness of the 12-Week Ergonomic Intervention

Following the 12-week intervention, the intervention group demonstrated statistically significant declines in MSD symptoms across all affected body regions (Table 5), alongside dramatic posture improvements (Table 6).

Table 5: Changes in MSD Symptom Prevalence Pre- and Post-Intervention (Intervention Group)

Anatomical Region	Pre-Intervention (%)	Post-Intervention (%)	Absolute Change (%)	Relative Reduction (%)	p-value
Lower Back	72.6%	38.5%	-34.1%	47.0%	0.001*
Neck	58.5%	32.6%	-25.9%	44.3%	0.004*
Upper Back	51.1%	30.4%	-20.7%	40.5%	0.010*
Shoulders	44.4%	25.2%	-19.2%	43.2%	0.016*
Wrists/Hands	35.6%	22.2%	-13.4%	37.6%	0.048*

*Statistically significant at $p < 0.05$ (Paired samples t-test). Control group showed no significant changes.

Table 6: Comparison of Mean RULA Scores Pre- and Post-Intervention

Study Group	Sample (N)	Baseline RULA (Mean $\pm$ SD)	Post-Intervention RULA (Mean $\pm$ SD)	Mean Difference	Improvement (%)	p-value
Intervention Group	135	5.8 $\pm$ 0.9	3.2 $\pm$ 0.7	-2.6	44.8%	0.000*
Control Group	135	5.6 $\pm$ 1.0	5.4 $\pm$ 0.8	-0.2	3.6%	0.412

*Statistically significant at $p < 0.05$. Mean RULA score in the intervention group dropped from high risk (5.8) to low/acceptable risk (3.2).

3.5 Effects on Quality of Life, Well-Being, and Work Productivity

Evaluation of health-related quality of life via the SF-36 survey and occupational efficiency via the WPAI scale demonstrated significant gains across physical and psychosocial dimensions (Table 7).

Table 7: Changes in SF-36 Quality of Life and WPAI Work Productivity Scores

Assessment Parameter	Pre-Intervention Mean	Post-Intervention Mean	Overall Change (%)	p-value
SF-36 Physical Health Composite	62.3 $\pm$ 7.4	79.1 $\pm$ 6.2	+27.0%	0.001*
SF-36 Mental Health Composite	66.7 $\pm$ 8.1	83.5 $\pm$ 5.9	+25.1%	0.003*
WPAI Work Productivity Impairment	28.5% (baseline loss)	15.4% (post-loss)	+46.0% (efficiency gain)	0.002*

*Significant at $p < 0.05$. Work productivity increased by 46% through marked reductions in presenteeism and absenteeism.

3.6 Institutional Barriers to Ergonomic Implementation

Qualitative responses and institutional audits identified key financial, managerial, and regulatory bottlenecks that impede the widespread adoption and sustainability of ergonomics in Port Harcourt workplaces (Table 8).

Table 8: Perceived Barriers and Limitations to Ergonomic Implementation

Identified Barrier / Limitation	Reported Frequency (%)	Contextual Impact in Sedentary Workplaces
Low Ergonomic Awareness & Training Deficits	68.0%	Lack of continuous posture training, ergonomic literacy, and knowledge of desk alignment.
Financial & Budgetary Constraints	62.0%	Management reluctance to invest in adjustable seating, sit-stand desks, and accessories.
Lack of Management Commitment & Institutional Support	55.0%	Ergonomics viewed as a non-essential overhead rather than a productivity driver.
Cultural & Habitual Resistance to Change	42.0%	Employee reluctance to take micro-breaks; belief that sitting long hours equates to dedication.
Absence of Regulatory Enforcement	30.0%	Lack of enforceable national ergonomic standards within occupational safety inspection frameworks.

Source: Qualitative feedback and thematic analysis of participant interviews and management surveys.

3.7 Discussion

The high baseline prevalence of MSDs (78.5%) confirms that sedentary work in Port Harcourt poses substantial occupational risks. The concentration of symptoms in the lower back (71.5%), neck (59.6%), and upper back (52.2%) aligns directly with the biomechanics of prolonged seated work, where static loading on the lumbar and cervical spine restricts disc nutrient supply and creates chronic muscular strain.

The dramatic 45% reduction in RULA scores and substantial drop in MSD complaints confirm the efficacy of multi-component interventions. Interventions targeting only physical equipment often fail longitudinally because they neglect behavioural compliance. In contrast, integrating physical furniture modifications with behavioural micro-break reminders and employee education fostered sustained habit formation, aligning with the Transtheoretical Model and Participatory Ergonomics Theory.

Moreover, the 46% increase in work productivity and 25–27% gains in SF-36 physical and mental health affirm that ergonomic comfort directly influences cognitive efficiency, presenteeism, and morale. Sectoral analysis demonstrated that while financial and ICT firms experienced superior improvements due to stronger institutional resources, public institutions and retail supermarkets showed more modest progress, highlighting structural inequalities in workplace wellness.

4. CONCLUSIONS AND RECOMMENDATIONS

This study demonstrates that musculoskeletal disorders represent a widespread occupational health burden among sedentary workers in Port Harcourt, predominantly affecting the lower back and neck due to prolonged sitting and poorly configured workstations. Multi-component ergonomic interventions combining physical redesign, educational workshops, behavioural reinforcement, and digital monitoring are highly effective in alleviating symptoms, improving postural risk, and boosting workplace productivity.

Based on these empirical findings, the following recommendations are offered:

1. Organizational Implementation: Establish structured workplace ergonomic programs featuring adjustable seating, monitor risers, scheduled micro-breaks, and guided stretching routines.
2. Policy and Regulatory Enforcement: Incorporate enforceable ergonomic benchmarks into national occupational safety regulations, including the Nigerian Labour Act and Federal Ministry of Labour inspection protocols.
3. Digital & Behavioural Monitoring: Leverage mobile reminder applications, self-monitoring checklists, and peer champions to sustain postural compliance and overcome behavioural resistance.
4. Continuous Education: Institutionalize regular ergonomic training during employee onboarding and professional development to bridge the knowledge-practice gap.

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