Communication in Physical Sciences, 2026, 13(5):728-738

Ergonomic Risk Assessment as an Effective Tool in Reducing Musculoskeletal Disorders in Industrial Workplaces

Oluwaseun Ibuife Oluwaniyi* & Abiodun Adebola Omoike

Received: 17 December 2025/Accepted: 02 May 2026 /Published: 14 May 2026
https://dx.doi.org/10.4314/cps.v13i5.5

Abstract: *This paper explored the concept of ergonomic risk assessment (ERA) as a preventive measure against Musculoskeletal Disorders (MSDs) in an industrial workplace. Although there were improvements towards automation, manual repetition and awkward postures remained an important factor in occupational ill-health, incurring significant direct and indirect economic burdens. The study employed a theoretical framework that combined the Biopsychosocial Model with the Hierarchy of Controls to address the interaction among biological, psychological, and social risk factors. It was suggested that there be a systemic, three-level procedure, which includes Tier 1 subjective screenings, Tier 2, observational postural examination (with RULA, REBA, and OWAS) and Tier 3, expert biomechanical modelling. The results indicated that the transition of a reactive to a proactive safety culture with the help of ongoing cycles of identification, evaluation, intervention, and verification was an effective way to reduce risk scores and achieve positive health outcomes. Moreover, it was identified that the application of ergonomic strategies positively impacted the operational resilience because of the reduction of Days Away, Restricted, or Transferred (DART), as well as an increase in the overall shift throughput. Even though the research encountered problems in the form of cultural push-back and anthropometric diversity, it was found that human-centered work design was a strategic need that would enable sustainability of industrial production and workforce safeguarding over the long term.*

Keywords: *Biopsychosocial Model, Ergonomic Risk Assessment (ERA), Hierarchy of Controls, Industrial Productivity, Musculoskeletal Disorders (MSDs), Occupational Health and Safety, Proactive Prevention, Rapid Upper Limb Assessment (RULA).*

Oluwaseun Ibuife Oluwaniyi
Department of Occupational Risk and Safety Sciences, University of Central Missouri, United States
Email: seunibuife.oluwaniyi@gmail.com
http://orcid.org/0009-0008-1960-8442

Abiodun Adebola Omoike
Department of Occupational Risk and Safety Sciences, University of Central Missouri, United States.
Email: adebolaomoike@gmail.com
http://orcid.org/0000-0003-4082-6539

1. 0 Introduction

Musculoskeletal Disorders (MSDs) are among the leading causes of occupational ill health in modern industrial environments…, and they affect millions of workers in all parts of the world (Roy, 2022). Although the transition into high-tech working conditions has already commenced, MSD's remain highly prevalent across sectors such as manufacturing and healthcare. Akweetelela (2019) reaffirmed that they are not ordinary physical disorders, but they are a major health issue in the society that not only causes strain to the health care systems, but also leads to poor quality of life among the world workforce. Despite advances in automation, manual tasks and repetitive movements remain prevalent in many industrial processes where manual work and repetitive movement in the various production lines still exists. Previous studies consistently identify awkward postures, repetitive movements, and forceful exertions as major contributors to MSDs (Kremer *et al*., 2021; Nwanya & Achebe, 2023). Continuous physical exertion in semi-automated environments increases the risk of soft tissue injuries and compromises the fact that worker safety is inevitably threatened (although always present) (Nwanya & Achebe, 2023).

Such injuries in a manner have far much more consequences than individual and an economic impact that is substantial and far-reaching both to the organization and the economy of a nation (Anekwe, *et al*., 2025). Briggs-Megafu (2025) notes that the indirect costs such as lost productivity, high employee turnover and retraining of new employees, are multiplied by direct costs such as medical expenses and workers compensation claims. Nwankwor (2025) asserts that financial cost of MSDs is a significant constraint on organizational performance in most industries and tends to pull resources that would otherwise be used to drive innovation or growth.

Beyond the physical health implications, MSDs also impose significant economic burdens as the old methods of ensuring workplace safety were typically reactive and only after an injury has taken place the issue is addressed (Ozobu, *et al*., 2023). Yet, a paradigm shift is necessary to effectively counter the emergence of MSDs; a paradigm shift that will not focus on managing these injuries but the prevention design. As Omokpariola and Daramola (2025) pointed out, the introduction of safety measures into the working process in a way that they become its part will make companies identify potential ergonomic risk factors before they develop into clinically diagnosed conditions. This change requires a methodical process where a human element is given precedence in the mechanical process. However, despite growing awareness of ergonomic interventions, there remains a lack of integrated and systematic approaches that combine multi-level ergonomic risk assessment with proactive safety management in industrial settings. This study aims to evaluate ergonomic risk assessment (ERA) as an effective and proactive tool for reducing musculoskeletal disorders in industrial workplaces. ERA provides an evidence-based framework for evaluating and redesigning workstations and tasks by assessing posture, force, and movement frequency. ERA belongs to the primary strategic models, and the industry uses it to determine some stressors and implement engineering or administration control. Finally, the practice makes ergonomics a more proactive measure that protects the health of the workers, as well as enhances their economic security. The significance of this study lies in its potential to enhance worker health, reduce organizational costs associated with MSDs, and promote a proactive safety culture. Additionally, it contributes to the development of sustainable and human-centered industrial systems.

1.1 Theoretical Framework

The theoretical foundation for reducing Musculoskeletal Disorders (MSDs) is grounded in the integration of holistic health models and structured safety frameworks… (Price, 2021).This approach shifts focus from symptom management to addressing the underlying causes of physical strain by aligning the framework with established ergonomic principles. According to Onovughe (2025), the key to this strategy is the fact that workplace injuries are hardly ever caused by a single isolated factor but the outcome of the intricate interplay that exists between the individual and their environment.

2.0 The Biopsychosocial Model of MSDs

Figure 1 presents the Biopsychosocial Model of Musculoskeletal Disorders, illustrating the interaction between biological, psychological, and social determinants of occupational health outcomes.

The Biopsychosocial Model offers an all-encompassing perspective in which to observe how occupational injuries develop and continue to persist. As Igwesi-Chidobe, *et al*. (2024) noted, the biopsychosocial model is so much unlike traditional biomedical frameworks, which only consider physical tissue damage, because this framework considers that psychological stressors (high work demands or low perceived support) and social factors (workplace culture) also play a crucial role in pain perception and recovery outcomes among workers. Omojunikanbi, *et al*., (2022) confirmed that in this model when Ergonomic Risk Assessment (ERA) is used, it becomes possible to have a more targeted and comprehensive interventions that takes into account how mental fatigue and organizational pressure might make the physical risks of manual handling w

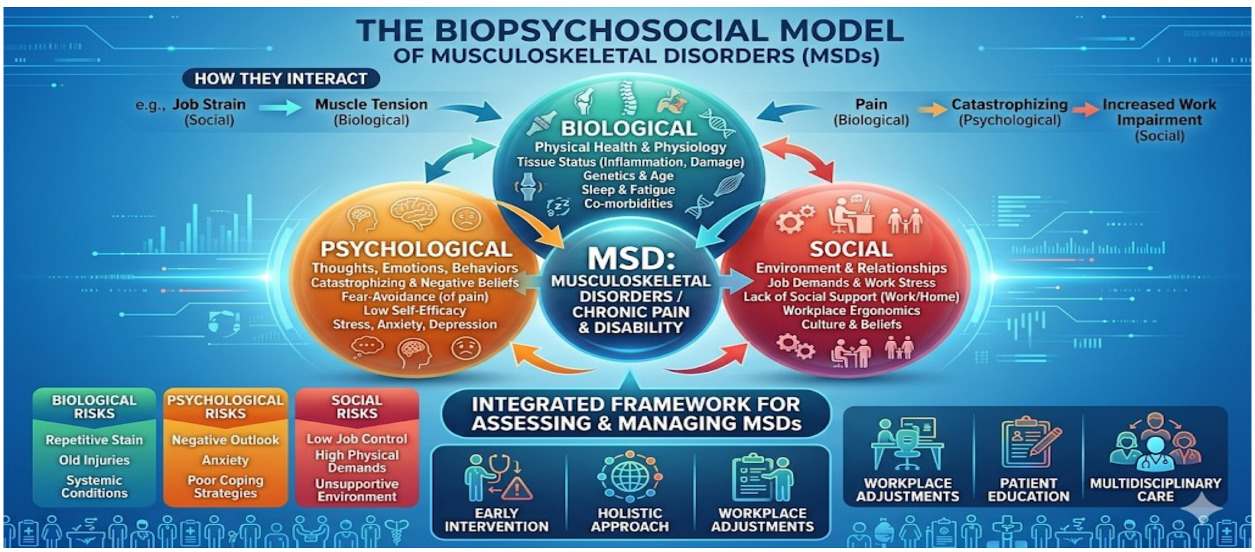

Fig. 1: Infographic of the Biopsychosocial Model of Musculoskeletal Disorders (Google Gemini, 2026)

2.1 Implementing the Hierarchy of Controls

Fig. 2 illustrates the Hierarchy of Controls framework used in occupational safety management to prioritize hazard reduction strategies according to effectiveness.

To translate these theoretical principles into practical safety measures, the Hierarchy of Controls is the main strategic tool of risk reduction. Oluka, *et al*. (2020) stated that this model prioritizes interventions based on their effectiveness, starting with removing or replacing dangerous operations using engineering solutions or automation. Although the use of personal protective equipment (PPE) is the most apparent type of safety measure, it is theoretically the least effective, which is why a solid ergonomic framework prioritizes interventions based on their effectiveness that can either eliminate the stressor or isolate the worker against the physical demand by designing the workstation more effectively (Forbes & Ahmed, 2020).

2.2 Integration of Theory and Practice

The formulation of the Biopsychosocial Model and the Hierarchy of Controls forms a proactive atmosphere in which ERA serves as the critical link between theory and practical intervention. The framework can use the hierarchy to reduce the risk profile of a specific task systematically by determining high-risk postures and repetitive cycles. This theoretical alignment makes sure that the interventions are not superficial but fully integrated into the organizational workflow and therefore ultimately results in a robust workforce and decreases the economic cost of occupational ill-health in the long-term.

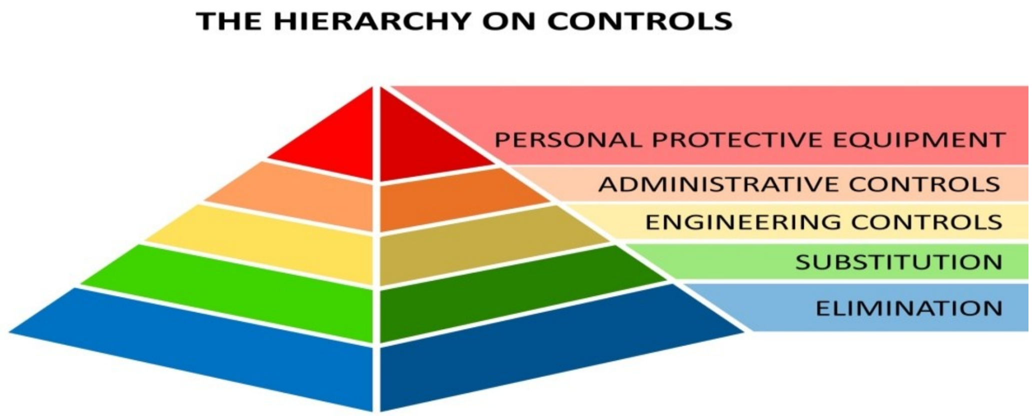

Fig. 2: Hierarchy of Controls used to visualize the effectiveness of occupational safety and health coordination strategies (Ajslev *et al*., 2022).

3.0 Ergonomic Risk Assessment (ERA) Methodologies.

The ERA framework is structured into three hierarchical levels, each increasing in analytical complexity and precision with the first level being the simplest and the last level becoming more technical with more precise data. Tier 1: Screening is the first level of diagnosis, which mainly makes use of self-report and standardized checklists such as the Nordic Musculoskeletal Questionnaire (Tveten, *et al*., 2025). This tier is critical to capturing workers' perceptions and reported discomfort. and their perceived discomfort. Since the data is subjective and qualitative, it gives a general picture of the trouble spots within an organization enabling the safety managers to determine which departments or tasks need to be investigated more intensively without requiring significant technical or financial investment.

At Tier 2, the assessment shifts to observational analysis: Observational, the objective postural analysis becomes the focus. The validated tools used at this stage include RULA (Rapid Upper Limb Assessment), REBA (Rapid Entire Body Assessment) and OWAS (Ovako Working Posture Analysis System). These tools can be used to have a semi-quantitative assessment, in which particular body position and force needs were rated on a numerical scale to identify the urgency of corrective intervention (John *et al*., 2025). This level performs the functional intermediary role in the model, offering sufficient detail to warrant engineering modifications and at the same time being easily available to trained safety personnel for implementation on the shop floor.

The most advanced level of analysis is Tier 3: Expert, which entails high-level biomechanical modelling. Computational aids like the NIOSH Lifting Equation and Liberty Mutual (Snook) Tables are utilized in the generation of high-fidelity and quantitative information on the physical limits of human performance. These methodologies will compute accurate variables, including the Recommended Weight Limit (RWL) to avoid overstrain during manual handling activities. According to Oloketuyi (2019), incorporating such data at this level of expertise means the framework has ensured that interventions are based on physiological reality and the decisions are grounded in robust physiological and biomechanical evidence rather than observational assumptions/simplistic observation which is no longer the basis of scientific foundation on workplace redesign.

Table 1: Ergonomic Risk Assessment (ERA) Methodologies

Assessment Level	Methodology	Common Tools	Data Type
Tier 1: Screening	Self-reports & Checklists	Nordic Musculoskeletal Questionnaire	Subjective/Qualitative
Tier 2: Observational	Postural Analysis	RULA, REBA, OWAS	Semi-Quantitative
Tier 3: Expert	Biomechanical Modeling	NIOSH Lifting Equation, Liberty Mutual Tables	Quantitative

*****Management of musculoskeletal disorders (MSDs)*** **(Caple, 2011)**

4.0 The Conceptual Model

The proposed conceptual model is a dynamic Cycle of Prevention, which positions ergonomic safety as a continuous improvement process rather than a static set of rules to be followed, but a process of continuous improvement. According to Odujobi, *et al*. (2024), the first step of the cycle is called Identification, during which historical data and current workplace conditions are analyzed". Through the examination of injury records, absenteeism history, and employee discomfort questionnaires, organizations will be able to identify particular high-risk workstations that need urgent action (Adriaensen, *et al*., 2019). This step is to make sure that resources are not squandered on areas that do not have high impacts, but rather they are directed in areas that the job demands exceed human physiological capacity and as soon as a high-risk area is determined, the model goes to the Assessment phase. Gasperini, *et al*. (2023) have demonstrated that objective measures are implemented with the help of validated observational instruments like RULA (Rapid Upper Limb Assessment). The step goes beyond anecdotal data to measure an actual risk score which relies on the joint angles, muscle activity and force exertion. Measuring the degree of risk, the assessment provides a scientific ground, which supports the necessity of change, and creates a definite reference point of what a safe score would appear to be in that particular task.

The last steps of the model are concerned with the loop closure with Intervention and Verification. The engineering or administrative controls during the intervention phase include the installation of lift-assist devices, height-adjustable workstations with different body types (Kawaja, 2022). The process is only complete when the Verification stage reveals that these changes are successful. Re-estimating the modified task on the basis of the same RULA criteria, the framework offers the empirical evidence that the risk score is lower. Fray and Davis (2024) demonstrated that this step-by-step methodology guarantees that the intervention was indeed the resolution to the problem, and it did not introduce new and unanticipated sources of stress.

5.0 Anticipated Impact & Metrics

The last step of the suggested framework is the multidimensional evaluation of intervention effectiveness of the intervention, which is divided by the categories of specific metrics that indicate human and organizational health. The first ones are the Health Outcomes that monitor the rates of clinical occurrence of the most prevalent conditions, including Carpal Tunnel Syndrome and Lower Back Pain (Bardhan, *et al*., 2020). "A significant reduction is expected although for a large reduction will have been achieved, it is the strongest indicator that Ergonomic Risk Assessment (ERA) is successfully countering the physical stress factors that cause chronic tissue damage.

In addition to personal wellbeing, the framework also tracks Operational and Economic indicators to reflect the business resilience (Ugwu, 2025). The operational measures, namely Days Away, Restricted or Transferred (DART), will reduce since employees will be healthy and at work. This stability directly improves organizational financial performance, with the decreased number and intensity of the injuries, the organizations can expect the declining trend of the Workers' Compensation claims and insurance payments (WHO, 2024). "This shift positions ergonomics as a strategic driver of financial sustainability rather than a cost center".

The final confirmation of a properly adopted ergonomic strategy lies in the Productivity measures. According to Adeyoyin, *et al*. (2024), unlike some safety interventions that may reduce operational speed, proper ergonomic interventions are meant to maximize the interface between the task and the worker. The throughput per shift will be improved by minimizing physiological fatigue and awkward postures. Ogbuefi, *et al*. (2025) confirm that this not only makes the workforce safer but also more efficient and, as such, the decrease in musculoskeletal risk is the key driver of overall industrial performance.

Table 2: Proposed Impact Matrix

Metric Category	Indicator	Expected Trend
Health Outcomes	Incidence rate of Carpal Tunnel, Lower Back Pain	Decrease
Operational	Days Away, Restricted, or Transferred (DART)	Decrease
Economic	Workers' Compensation claims / Insurance premiums	Decrease
Productivity	Throughput per shift (due to reduced fatigue)	Increase

******Efficacy of ergonomic interventions on work-related musculoskeletal pain: A systematic review and meta-analysis (Santos *et al*., 2025)**

6.0 Discussion: Challenges in Implementation

Though the theoretical advantages of Ergonomic Risk Assessment (ERA) are obvious, there is usually a lot of obstacles in its practical implementation in an industrial environment. As demonstrated by Adegbite and Govender (2022), the Cultural Resistance is the first significant barrier, which occurs both at the managerial and frontline level. The management can also perceive ergonomic intervention to be a hindrance on lean manufacturing objectives since there is the fear that the new guidelines or machinery will reduce the production rates. At the same time, the more seasoned employees might be opposed to the shift in the habits they have always had, as they consider ergonomic modifications as unneeded or annoying, as Ejiro and Omoile (2023) explains. To overcome this, a complete change of perspective is needed, where the organizational culture is reoriented towards seeing safety as a prerequisite to, and not an obstacle to, high-speed output. The other major challenge is Anthropometric Variability. There are no two employees who are the same in terms of height, reach, or physical performance, but the workstations in industries are historically configured to suit an average or a normal person. Onawumi, *et al*. (2023) has demonstrated that such inflexibility leads to a one-size-fits-none situation in which shorter or taller employees are subjected to incredibly awkward poses that ERA is intended to prevent. A framework that considers such diversity would entail a dedication to universal design - the use of adjustable furniture and modular equipment; making the early planning and purchasing stages of the intervention more difficult as described by Nwanya, *et al*. (2023). Cost-Benefit Gap is the obstacle that is probably the longest to come by. The cost of the material to purchase high-quality ergonomic furniture, lift-assist equipment, and professional consultation is short-term and can be quite high. Unegbu, *et al*. (2025), on the other hand, assume that the monetary benefits, including lower insurance premiums, less claims on compensations and long-term gains on productivity, are not only longitudinal but also take years before they are reflected on the balance sheet. To organizations that are more concerned about short term quarterly profits, this delayed payback period may require a lot of effort to get the required budget to undertake a holistic cycle of prevention.

Nevertheless, the argument should end up with the conclusion that the risks of not doing it are much greater as compared to the challenges of the implementation. When there is no mitigation of ergonomic risks, the cycle of chronic injury, high turnover and operational inefficiency compound (Essien, *et al*., 2025). By recognizing these barriers, cultural, physical, and financial, organizations can now devise more advanced methods of circumventing them, including gradual roll-outs or pilot programs that can prove early "quick wins" as Benson (2021) says. Finally, these issues of implementation are a required process of transitioning to a proactive and sustainable safety culture rather than a reactive one.

7.0 Conclusion

The shift in the reactive to the proactive safety culture is an essential shift in the management of industry. The conventional approach to Musculoskeletal Disorders has been too long seen as treating the symptoms once a worker complains of pain or when a clinical injury has taken place. This is an unsustainable method of responding to physical strain, because it does not treat the environmental and mechanical causes of physical strain, and results in a vicious cycle of injury, medical intervention, and subsequent exposure to the same risky situation. By moving the emphasis on the identification and reduction of risks before they become the symptom, organizations will be able to end this cycle and create a genuinely proactive work environment.

The only way to achieve industrial resilience in the long run is through a proactive culture, which is based on the systematic implementation of Ergonomic Risk Assessment (ERA). The combination of objective data such as RULA and the Hierarchy of Controls proves that making safety a primary engineering consideration and not a secondary administrative issue are achieved (Maduagwu, *et al*., 2022). The process will not only keep the physiological health of the workforce secure but will stabilize the operational and economic base of the firm as well. When the design stage of a workstation includes the aspect of risk minimization, the necessity of expensive medical treatment and the cost of missed time is inherently reduced.

Finally, contemporary industry MSDs management must be based on the principle of human-centric work design. Although obstacles like resistance to change due to culture and preliminary expenses are true, they are overshadowed by the immense benefits of a healthy, productive and engaged workforce. Switching to a proactive ergonomic model is not only a compliance issue or corporate social responsibility, but it is also a strategic requirement. Industries can achieve a sustainable future where human health and mechanical productivity will find a mutually reinforcing and thriving relationship by focusing on musculoskeletal risk prevention.

8.0 References

Adegbite, W. M., & Govender, C. M. (2022). Management barriers to innovation performance in Nigerian manufacturing sector. *African Journal of Science, Technology, Innovation and Development*, 14, 7, pp/ 1959-1969.

Adeyoyin, O., Awanye, E. N., Morah, O. O., & Ekpedo, L. (2024). A Model for Operational Resilience and Financial Agility through Data Analytics. Doi: 10.32628/GISRRJ247323

Adriaensen, A., Decré, W., & Pin, doi:telon, L. (2019). Can complexity-thinking methods contribute to improving occupational safety in industry 4.0? A review of safety analysis methods and their concepts. *Safety*, 5, 4, 65, https://ndoi.org/10.3390/safety5040065

Ajslev, J. Z. N., Møller, J. L., Andersen, M. F., Pirzadeh, P., & Lingard, H. (2022). The hierarchy of controls as an approach to visualize the impact of occupational safety and health coordination. International *Journal of Environmental Research and Public Health*, 19, 5, 2963. https://doi.org /1 0.3390/ijerph19052963

Akweetelela, A. (2019). *Investigation of the prevalence, risk factors and impact of musculoskeletal disorders among nurses at Katutura Intermediate Hospital, Khomas region, Namibia* (Doctoral dissertation, University of Namibia).

Anekwe, E. A., Onuorah, A., & Okeke, O. C. (2025). A Qualitative Study on Indirect Compensation within the Nigerian Civil Service. *Journal of Emerging trends in Management Sciences and Entrepreneurship*, 7, 2, pp. 270-284.

Bardhan, I., Chen, H., & Karahanna, E. (2020). Connecting systems, data, and people: A multidisciplinary research roadmap for chronic disease management. *MIS Quarterly*, 44, 1, pp. 185-200.

Benson, C. (2021). *Occupational Health and Safety Implications in the Oil and Gas Industry, Nigeria* (Doctoral dissertation, European University of Cyprus (Cyprus)).

Briggs-Megafu, T. E. (2025). *Assessing the Relationship Between the Informal Sector, Out-of-Pocket Healthcare Expenses, and Their Associations with Maternal and Infant Mortality in Nigeria* (Doctoral dissertation, The University of Texas at Dallas).

Caple, D. (2011). Management of musculoskeletal disorders (MSDs). In G. Salvendy (Ed.), Handbook of Human Factors and Ergonomics (4th ed., pp. 1195–1213). John Wiley & Sons. https://doi.org/10.1002/9781118131350.ch41

Ejiro, E. J. O. H., & Omoile, P. A. (2023). Managing Change In Nigeria National Petroleum Company: Stakeholders' Concerns, Challenges and the Way Forward. *Editorial Board*, 108.

Essien, U. B., Acha, S., Orhuebor, E. N., Ibanga, F. I., Udoh, U., Momoh, P. O. & Micheal, P. U. (2025). Assessment of environmental and occupational hazards associated with crude oil exploitation: A toxicokinetic and engineering-based framework for sustainable mitigation. *Journal of African Innovation and Advanced Studies* 8, 5, pp. 59-71.

Forbes, L. H., & Ahmed, S. M. (2020). Management and worker factors. In *Lean Project Delivery and Integrated Practices in Modern Construction* (pp. 197-227). Routledge.

Fray, M., & Davis, K. G. (2024). Effectiveness of safe patient handling equipment and techniques: A review of biomechanical studies. *Human Factors*, 66(, 10, pp. 2283-2322.

Gasperini, G., Rota, M., Guanziroli, E., Bissolotti, L., Balestrieri, F., Chisari, C. & Molteni, F. (2023). Development and Rasch validation of an observational assessment tool of upper limb functional impairment in stroke survivors: functional assessment test for upper limb. *Archives of Physical Medicine and Rehabilitation*, 104, 4, pp. 597-604.

Google Gemini. (2026, March 24). Infographic of the Biopsychosocial Model of Musculoskeletal Disorders [Gemini 3 Flash Image]. https://gemini.google.com/

Igwesi-Chidobe, C. N., Sorinola, I. O., Ozumba, B. C., & Godfrey, E. L. (2024). Challenges of measuring Self-Reported exposure to occupational Biomechanical risk factors amongst people with low literacy engaged in manual labour: findings from a Cross-Cultural adaptation and psychometric investigation in an African population with chronic low back pain. *Journal of occupational rehabilitation*, 34, 4, pp. 847-862.

John, J. N., Okonkwo, U. V., Ibeneme, S. C., Fortwengel, G., Okpagu, B. C., Nwosu, E. O. & Ekowa, J. L. (2025). Smartphone Addiction, Nomophobia, and Text Neck Syndrome: Predictors of Digital Dependence among Young Adults in a Nigerian University Community.

Kawaja, K. (2022). *Patient Lifting Device Use by Caregivers in a Hospital Setting: A proposed research program* (Doctoral dissertation).

Kremer, M., Went, R., & Engbersen, G. (2021). *Better work: The impact of automation, flexibilization and intensification of work* (p. 204). Springer Nature.

Maduagwu, S. M., Galadima, N. M., Umeonwuka, C. I., Ishaku, C. M., Akanbi, O. O., Jaiyeola, O. A., & Nwanne, C. A. (2022). Work-related musculoskeletal disorders among occupational drivers in Mubi, Nigeria. *International journal of occupational safety and ergonomics*, *28*(, 1, pp. 572-580.

Nwankwor, E. E. (2025). Examination of the Employees' Rights and Employers' Liabilities under the Employees' Compensation Act 2010. *AJLHR*, *9*, 1-36.

Nwanya, S., & Achebe, C. (2023). Human factors issues at selected workplaces in Nigeria: practice, status and future research needs. *International Journal of Occupational and Environmental Safety*, 7, 1, pp. 33-54.

Odujobi, O., Onyeke, F. O., Ozobu, C. O., Adikwu, F. E., & Nwulu, E. O. (2024). A conceptual model for integrating ergonomics and health surveillance to reduce occupational illnesses in the Nigerian manufacturing sector. *International Journal of Multidisciplinary Research and Growth Evaluation*, 5, 1, pp. 1425-1437.

Ogbuefi, E., Aifuwa, S. E., Olatunde-Thorpe, J., & Akokodaripon, D. (2025). Resilience in Critical Infrastructures: Conceptual Frameworks Addressing Convergence of Communication, Energy, Finance, and Healthcare Systems. *convergence (Ngonso et al., 2025; Oni, 2025)*, 33, pp. 54-69.

Oloketuyi, A. (2019). *Ergonomic Analysis Of Multiple Lifting Tasks In An Automotive Operation and the Risk Of Developing Low Back Pain*. Texas A&M University-Kingsville.

Oluka, C. D., Obidike, E., Ezeukwu, A. O., Onyeso, O. K., & Ekechukwu, E. N. D. (2020). Prevalence of work-related musculoskeletal symptoms and associated risk factors among domestic gas workers and staff of works department in Enugu, Nigeria: a cross-sectional study. *BMC Musculoskeletal Disorders*, 21, 1, 587. doi: 10.1186/s12891-020-03615-5.

Omojunikanbi, O. A., Akinpelu, A. O., & Ekechukwu, E. N. D. (2022). Prevalence, pattern and predictors of work-related musculoskeletal disorders among oil workers in Nigeria. *Work*, 71, 1, pp. 151-163.

Omokpariola, D. O., & Daramola, A. A. (2025). Challenges and opportunities in enhancing workplace safety and health for Nigeria's fertilizer manufacturing industry: A discussion on current practices and future directions. *Toxicology and Industrial Health*, 41, 8, 9, pp. 459-472.

Onawumi, A. S., Akinrinade, N. A., Abisoye, A. S., Olalere, S. O., Okojo, F. E., & Sanyaolu, O. O. (2023). Mismatch between anthropometric measurements of occupational drivers in southwest Nigeria and vehicle seat design parameters. *Valley International Journal Digital Library*, 11, 9, pp. 918-931. Doi10.18535/ijsrm/v11i09.ec05

Onovughe, E. C. (2025). Musculoskeletal Disorders among Nurses: A systematic literature review.

Ozobu, C. O., Onyekwe, F. O., Adikwu, F. E., Odujobi, O., & Nwulu, E. O. (2023). Developing a national strategy for integrating wellness programs into occupational safety and health management systems in Nigeria: A conceptual framework. *International Journal of Multidisciplinary Research and Growth Evaluation*, *4, 1, pp.* 914-927.

Price, J. W. (2021). Osteopathic model of the development and prevention of occupational musculoskeletal disorders. *Journal of osteopathic medicine*, 121, 3, pp. 287-305.

Roy, D. (2022). Occupational health services and prevention of work-related musculoskeletal problems. In *Handbook on management and employment practices* (pp. 547-571). Cham: Springer International Publishing.

Santos, W., Rojas, C., Isidoro, R., Lorente, A., Dias, A., Mariscal, G., Benlloch, M., & Lorente, R. (2025). Efficacy of ergonomic interventions on work-related musculoskeletal pain: A systematic review and meta-analysis. *Journal of Clinical Medicine*, 14, 9, 3034. https://doi.org/10.3390/jcm14093034

Tveten, K. M., Skaar, A., Onni, A. T., Dragesund, T., Magnussen, L. H., Tvedt, M. N., & Ask, T. (2025). Assessment of Work Ability in People with Musculoskeletal Disorders in Primary Health Care: A Scoping Review of Self-Reported Tools. *Journal of Occupational Rehabilitation*, 1doi: 10.1007/s10926-025-10323-1

Ugwu, E. N. (2025). Resilience And Recovery of Healthcare Systems Post-Emergency: Nigerian Context. *Multi-Disciplinary Research and Development Journals Int'l*, 7, 3, pp. 122-136.

Unegbu, H. C. O., Yawas, D. S., Dan-Asabe, B., Alabi, A. A., & Vedad, R. C. (2025). Assessing the environmental and economic benefits of integrating solar energy in Nigerian construction. *Discover Civil Engineering*, 2, 1, pp. 114-131.

World Health Organization. (2024). *Health system resilience indicators: an integrated package for measuring and monitoring health system resilience in countries*. World Health Organization.

Declaration

Consent for publication

Not Applicable

Availability of data and materials

The publisher has the right to make the data public

Ethical Considerations

Not applicable

Competing interest

The authors report no conflict or competing interest

Funding:

The authors declared no external source of funding

Authors' Contribution

Oluwaseun Ibuife Oluwaniyi conceptualized the study, developed the theoretical framework, conducted the literature review, and prepared the initial manuscript draft. Abiodun Adebola Omoike contributed to the study design, critical review of ergonomic methodologies, data interpretation, manuscript editing, and overall supervision of the research. Both authors reviewed, approved, and agreed to the final version of the manuscript for publication.