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Beyond Prevalence: Ergonomic, Occupational and Socioeconomic Determinants of Work-Related Musculoskeletal Disorders among Construction Workers in Nigeria

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Abstract
This study investigated the ergonomic, occupational and socioeconomic factors influencing the WMSDs among construction workers in Nigeria. A convergent mixed method design was used. A total of 210 construction workers were sampled from the selected sites and a structured questionnaire containing the Nordic Musculoskeletal Questionnaire was used for quantitative data collection; however, the key workers and supervisors were 20, who were purposively selected for qualitative data collection using a semi-structured questionnaire. Descriptive statistics, chi-square tests, t-tests and logistic regression were used to analyse quantitative data and thematic analysis was used to analyse interview transcripts. Overall, 68% of those surveyed indicated the presence of WMSD symptoms in the last 12 months, with the lowest back area (50%) and shoulders (42%) being the most commonly affected areas. Some postures, heavy lifting, vibration exposure, lack of ergonomic training and job stress were strong predictors for WMSDs. Interview data also revealed that long working hours, lack of sleep, production pressure, insecurity and economic necessity prompted the workers to continue working even though they had complained of pain. The study suggests that WMSDs in Nigerian construction workers are multi-factorial, the outcome of interaction of physical exposure, work organisation and socioeconomic vulnerability. Therefore, prevention is not only a question of prevalence, but should be integrated rather than based on ergonomic and organisational and social interventions.

Keywords: *work-related, musculoskeletal disorders; construction workers, Ergonomic*

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1. Introduction

Construction is an economically important but occupationally hazardous industry in which workers' productivity is much reliant on their physical labor. In contrast to the ever more automated production systems, construction tasks in many developing economies are still heavily dependent on manual handling tasks, repetitive movements, standing long periods, awkward body positioning and physically demanding tasks. These conditions put workers at risk of repetitive biomechanical stress and make construction one of the jobs where work-related musculoskeletal disorders (WMSDs) are still an issue. The extent of the problem is confirmed by recent international evidence. Systematic review and meta-analysis published in 2025 found a prevalence of about 59% of WMSD in construction workers worldwide, with the lower back and shoulders the most common reported anatomical areas for occurrence. In addition, the same review found large inter-study variation, suggesting that the emergence of WMSDs is driven more by the differences in the exposures and working environments of the various jobs than by a single common cause (Santos et al., 2025). WMSDs include pain/discomfort and disorders related to muscles, tendons, joints, nerves and related soft tissues that are associated with work. They are not just about their discomfort as if their symptoms of musculoskeletal pain persist they can lead to loss of work capacity, reduced productivity, absenteeism and reduced quality of working life. The construction site is a very suitable setting for these diseases, as the workers often have to lift heavy loads, bend, kneel, twist, reach overhead and work in physically demanding positions for long periods of time. Several physical and psychosocial risk factors have been consistently linked in a systematic review of research on construction workers, and have been shown to be associated with WMSDs, but not just prevalence estimates; investigating the conditions which lead to occupational exposure are also important (2021 systematic review). This problem is particularly relevant to the Nigerian context. There is still a significant reliance on manual labor in construction operations, and knowledge and understanding of ergonomics are not always being applied in the workplace. However, according to recent Nigerian evidence, awareness and implementation of ergonomic practices have been limited among construction professionals and there is evidence of a lack of capability of firms to incorporate the principles of occupational safety into their everyday working practice (Ilesanmi & Moyanga, 2024). This is not a technical problem at all. When workers are not given access to mechanical lifting equipment, the physical hazard becomes part of the way work is organised, when they are not given enough ergonomic training, when they have to work under time pressure or lose out on work income if they stop working, etc. The extent of the broader problem is illustrated in Nigeria where evidence shows that this is a major concern in the workplace. For instance, Adedoyin et al. (2022) found a 12-month prevalence of WMSD among Nigerian bricklayers of 87.3% with the shoulder and lower back being the most affected areas. In the same way, Omojunikanbi et al. (2022) reported 88.8% prevalence among Nigerian oil workers and had duration of service, awkward posture and inadequate injury prevention training and continuing to work while feeling discomfort as important correlates. While these studies offer good evidence, much of the Nigerian literature is still on prevalence and individual or physical risk factors. This evidence demonstrates that WMSDs are common, but is less robust in explaining how exposure occurs, how people cope and why participation in hazardous work continues, in spite of the presence of a WMSD. This is significant as there might be a significant physical workload for a worker, but not the same risk for another worker whose duties are very similar but organized differently. Rest breaks, control of the

pace of work, the use of lifting equipment, supervisory practices, safety training and the opportunity to take sick leave all have the potential to change the impact of physical exposure. There has been growing research on construction workers to support the concept of combining physical and psychosocial exposures. For instance, Kusmasari et al. (2024) identified that workers who faced high exposure in both physical and psychosocial domains were significantly more likely to experience neck symptoms than workers who faced low exposure in both domains. It is assumed that ergonomic risk is not cumulative; psychosocial stress can magnify the effects of exposure. According to the Job Demand–Control (JDC) model, occupational strain is a result of the interaction between job demands and the level of control that workers have over the management of job demands. In construction, the demands can be large lifting, working long hours, having tight time limits, repetitive jobs and production targets. Control can include set up speed of work, request for rest, changing unsafe work tasks, and/or influencing the way a task is done. High demands and low control results in expected increases in occupational strain. This is a hypothesis supported by contemporary evidence. Lee and Kang (2021) examined data on over 49,000 workers and determined that occupational physical demands and low levels of job control were linked to increased musculoskeletal pain. Similarly, a systematic review by Oakman et al., (2021) revealed that stress factors in the work environment such as high job demands, high job strain and low social support are also important psychosocial hazards for musculoskeletal disorders. The Socio-Ecological Theory is a theoretical framework that posits health outcomes as the result of a series of interacting influences across various levels. At the individual level, worker knowledge and coping behaviour are included in applied WMSDs, at the interpersonal and organisational level, supervision, work schedules, safety culture and access to equipment are included, and the wider social level includes employment insecurity, income constraints, and access to social protection. This is important as it can help inform whether or not the worker can respond to an injury in a health-protective way due to the socioeconomic factors. A paid employee can refuse to work and go to the doctor while a precariously employed worker may continue working with very intense pain. The social context is therefore not simply associated with WMSDs but can impact upon exposure, reporting and recovery. These two theories thus concern themselves with complementary aspects of the problem. The Job Demand–Control model helps explain how high demands and limited control in the workplace contribute to occupational strain, whereas the Socio-Ecological Theory helps explain how individual, organizational and socio-economic factors interact and contribute to both exposure and coping. So, they contribute to understanding of WMSDs as multi-factorial as opposed to worker behaviour only.

The Problem and research gap

The main issue is not only that construction workers in Nigeria suffer from WMSDs with a high frequency. The more serious issue is that the conditions that create those disorders could be mutually reinforcing. A worker is able to lift heavy loads because mechanical aids may not be available; be able to work without pain because wages are dependent upon attendance; and may be able to work with an awkward posture because the task needs to be completed quickly; or may be able to avoid reporting pain because reporting may jeopardize their job. These processes yield a vicious cycle of physical exposure, and organisational pressure and socioeconomic vulnerability. The available evidence from Nigeria can be used to understand the prevalence of the issue, but there is a need to incorporate the qualitative aspects related to the

experience of the workers. There is growing evidence from international studies that a holistic, multi-faceted approach to risk management is necessary, combining physical and psychosocial vulnerabilities, as well as from developing countries that there is a lack of available evidence and implementation in these regions. In this light, this present study attempts to fill this gap by first surveying 210 construction workers, and then interviewing 20 workers and supervisors. Its goal is not to prove that WMSDs are common but to help to understand the relationship that exists between ergonomic exposure, work organisation, and socioeconomic pressure.

Objective and research questions

The purpose of this study is to explore the ergonomic, occupational and socioeconomic factors contributing to WMSDs in the construction sector in Nigeria and to understand the influence of workplace and socioeconomic factors on workers' perceptions and reactions to musculoskeletal symptoms.

The study was guided by two research questions:

i. What are the ergonomic and occupational factors associated with WMSDs of construction workers in Nigeria?
ii. What are the relationships between the socioeconomic conditions and the occurrence, persistence and control of WMSDs among Nigerian construction workers?

2. Method

The research design used in this study was convergent mixed methods design where both quantitative and qualitative data were obtained in the same general area of the study and analysed separately and later merged during the interpretation. 210 construction workers were recruited from various construction sites in Lagos and Abuja for the quantitative component of the study. Representatives from the larger masonry and carpentry, painting, electrical and general labour construction trades. Stratified sampling was used to get representation across the main occupational categories. The qualitative component included 20 subjects who were selected for purposive sampling to specify from their experience in construction work and their experiences on occupational health. Interview participants were masons, welders and site supervisors. In this study all ethical requirements for the participation of human subjects in research have been observed. The survey questionnaire comprising of four sections (sociodemographic characteristics, work characteristics, ergonomic and occupational exposure, musculoskeletal symptoms) was employed in this study. Pre tested by 15 workers with a Cronbach's alpha of around 0.85. Nordic Musculoskeletal Questionnaire (NMQ) was used to evaluate the WMSDs locally adapted. The NMQ aims to evaluate musculoskeletal symptoms in specific body areas over specific time frames (last 7 days, last 12 months). A semi-structured interview guide covered perceived causes of pain, daily work routines, economic pressures, safety practices, access to equipment and coping strategies. The interviews were roughly 40-60 minutes and were conducted in English or local Pidgin, depending on the preferences of the interviewee, and with interpretation if required. Interviews were recorded and fully transcribed. The quantitative data were entered and analysed with SPSS version 25. Participant characteristics and prevalence of WMSD were summarised using descriptive statistics. To assess relation between risk factors and WMSD status, bivariate statistical analyses were performed using chi-square tests and t-tests. Logistic regression was subsequently performed to determine any independent predictors of reporting any WMSD. Odds Ratios (ORs), confidence intervals and

significance levels were described. The qualitative information was analysed thematically. Transcripts were coded inductively for identifying repeated ideas and patterns. The transcripts were double coded by two researchers and any discrepancies were discussed until consensus was reached. The qualitative and quantitative results were then combined by analyzing the convergence or explanatory relationships between the statistical associations and workers' stories. This integration was crucial as the study's goal was to not only find predictors but also to elucidate how these predictors work.

3. Results

The respondents in this survey, who were 210, were mostly male (80%), which is a typical gender distribution in a manual construction activity survey. The mean age was 35 years ± 9 years. About 45% had secondary education and 25% had primary education only. The mean years of experience in the trade was 7 ± 5 years. Economically vulnerable were also a strong presence: nearly 70% of respondents said their earnings were lower than the national average wage, and about 60% worked more than eight hours a day, many of whom did not have formal rest breaks. The characteristics are analytically important as they place the findings on ergonomy in the socio-economic structure of construction work. Long hours of work and lack of income are not independent background variables; they can impact the ability of workers to avoid hazardous work and/or take breaks or stop work when symptoms occur. This study found that 68% of the respondents experienced WMSD in at least one body region in the past 12 months. The most common areas affected were the lower back (50%), shoulders (42%), neck (30%), knees (20%) and wrists/hands (15%). The upper back(5%), upper ankle/foot(5%), and elbows(10%) had the next highest percentages.

Table 1. *Twelve-month prevalence of musculoskeletal symptoms by body region (n = 210)*

Body region	Prevalence (%)
Lower back	50.0
Shoulders	42.0
Neck	30.0
Knees	20.0
Wrists/Hands	15.0
Elbows	10.0
Hips/Thighs	8.0
Upper back	5.0
Ankle/Foot	5.0

Symptoms are grouped in the lower back and shoulders, which matches the physical requirements of construction work such as lifting, carrying and bending, and overhead work. Consistent with this, recent evidence from around the world has pinpointed the lower back and shoulders as primary zones for construction-related WMSDs (Santos et al., 2025). Some 40% of workers with WMSDs reported moderate to severe pain and 30% reported pain interfering with work or self-medication. This is important given that prevalence can underestimate the occupational significance. Occupational burden is more serious if it results in a reduced capacity of the worker to function at

work or to require medication than if it is a temporary period of discomfort. Several factors were found to be significant in the logistic regression analysis of factors predicting WMSD reporting. Awkward postures were associated with approximately 2.5 times greater odds of WMSDs (OR = 2.50, 95% CI [1.60, 3.90], $p < .01$). Heavy lifting/manual handling was also associated with elevated odds (OR = 2.10, 95% CI [1.45, 3.05], $p < .01$). The presence of whole body vibration was found to be associated with increased risk (OR = 1.80, $p < .05$), and having no formal ergonomic training was found to be associated with increased odds of developing WMSDs (OR = 1.75, $p = .02$). Job stress was also important with an estimated OR of 1.45 per unit increase on the job stress measure ($p = .03$). The reported model did not include statistically significant predictors of age and gender.

Table 2. Reported independent predictors of WMSDs

Predictor	OR	95% CI	p-value	Interpretation
Awkward posture	2.50	1.60–3.90	< .01	Higher odds of WMSD
Heavy lifting/manual handling	2.10	1.45–3.05	< .01	Higher odds of WMSD
Whole-body vibration	1.80	Not reported	< .05	Higher odds of WMSD
Lack of ergonomic training	1.75	Not reported	.02	Higher odds of WMSD
Job stress	1.45	Not reported	.03	Higher odds of WMSD
Age	Not significant	—	> .05	No significant association
Gender	Not significant	—	> .05	No significant association

The pattern indicates that modifiable workplace conditions were more important predictors in the reported model than basic demographic characteristics. This aligns with current evidence, which shows that WMSDs in the construction industry are the result of a combination of physical and psychosocial exposures. Systematic review results have shown that postures, exertion, repetitive work and psychosocial factors are the most common determinants of WMSDs in construction workers.

Qualitative findings

Four themes were identified from the interviews: physical workload and posture; workplace organisation and safety culture; socioeconomic pressure; knowledge and training gaps, which are interrelated.

Theme 1: Physical workload and posture.

The work was consistently reported to be physically demanding, repetitive and reliant on manual handling. Lifting, bending, kneeling and overhead reaching were mentioned as frequent activities by workers. The repeated lifting of cement bags by one mason and the use of the body to lift heavy materials by another participant are mentioned in this regard. The regression results are complemented by these accounts,

which give an explanatory dimension. The statistical relationship between awkward posture and WMSDs is not happening in isolation-it is happening in the context of common, everyday conditions of work where workers bend, kneel and carry loads due to task design and equipment that do not adequately reduce physical demands.

Theme 2: Workplace organisation and safety culture

As regards organisation the time pressure and insufficient rest were significant factors. Examples were given of scenarios where termination of employment or financial penalties might be a consequence if someone stopped work. Contractors were also considered to be more interested in speed and output than safety, according to workers. There was reportedly a lack of uniform safety instructions and of formal ergonomic education opportunities. This theme is especially applicable to the Job Demand–Control model. Construction workers can often have high demands and have to work under deadlines and under a lot of pressure and can have long shifts, but may have little control over their work time and little opportunities to rest. Occupational studies have shown that low control contributes to exacerbating the musculoskeletal effects of physical burden (Lee & Kang, 2021).

Theme 3: Socioeconomic pressure

Economic necessity was a key reason for workers' continued work despite pain. The participants mentioned aspects of bearing responsibility for supporting families and restricted income, along with lack of proper arrangements for sick leave. As such there was a tendency to accept pain as something to live with instead of as an indication to cease or reduce one's activity. This discovery alters the meaning of the persistence of symptoms. It is not a sign of poor individual health awareness to presume that a worker is behaving poorly when working when they have musculoskeletal pain. It may represent a rational response to economic insecurity. Occupational exposure and socioeconomic vulnerability can become reinforcing in these situations: the worker cannot stop working due to the economic necessity and this exposure can exacerbate the condition that reduces their ability to work in the future.

Theme 4: Knowledge and training gaps

There was a reported lack of formal ergonomic training. Some workers reported that they had acquired the knowledge of lifting techniques from informal training, not formal training. The normalisation of musculoskeletal pain as an inevitable part of construction work was also the norm. The qualitative findings thus confirm the quantitative finding that a lack of ergonomics training was a major predictor of WMSDs. Not only is there a question of whether workers will be trained but also whether training will alter the real working conditions in which workers work. Limited ergonomic awareness and the poor practice of ergonomic activities in construction site have also been identified in recent research in Nigeria as problematic issues of occupational health (Ilesanmi & Moyanga, 2024).

Integrated Quantitative and qualitative findings
The mixed methods integration resulted in a uniform explanatory pattern.

Table 3. Integration of quantitative and qualitative findings

Quantitative finding	Qualitative explanation	Integrated interpretation
Awkward posture significantly predicted WMSDs	Workers described frequent bending, kneeling and overhead work	Poor task design creates sustained biomechanical exposure
Heavy lifting predicted WMSDs	Workers reported manually moving heavy materials without adequate lifting aids	Manual handling transfers excessive physical load to workers
Vibration increased WMSD odds	Workers reported use of vibrating tools	Tool-related exposure contributes to cumulative physical strain
Lack of ergonomic training predicted WMSDs	Workers described learning techniques informally	Limited knowledge reduces capacity to prevent avoidable exposure
Job stress predicted WMSDs	Participants described deadlines, pressure and inadequate breaks	High demands combined with limited control increase occupational strain
Economic conditions shaped coping	Workers reported continuing work despite pain	Socioeconomic insecurity encourages exposure persistence and delayed recovery

The qualitative data do not just report two sets of results, rather they help to explain the statistical relationships. WMSDs seem to develop along a sequence where physical exposures are managed by work practices and maintained by socioeconomic factors.

4. Discussion

This study shows that prevalence and physical exposure do not fully explain the WMSDs among the construction workers in Nigeria. This indicated that the prevalence of the condition over the past 12 months was 68%, but the important result was that awkward posture, heavy manual handling, vibration and lack of ergonomic training and job stress were each important factors. Interview data also confirmed that production pressure, low-quality rest, and restricted worker control and economic insecurity help to maintain these exposures. The prevalence is high but similar to that reported internationally: Santos et al. (2025) found a pooled prevalence of around 59% for construction workers worldwide. The primary complaints of the lower back and shoulders in this study are also typical of the physical nature of construction jobs. Comparisons of prevalence should, however, be taken with caution as instruments, time periods, occupations and work environment may affect estimates. Adedoyin et al. (2022) for example, reported 87.3% prevalence among bricklayers in Nigeria. The discrepancy might be explained by the higher physical requirement of bricklaying or by the wider distribution of the occupational set of the present study. The strongest predictor was awkward posture, observed workers 2.50 times more likely to develop WMSDs. Bending, kneeling, twisting and overhead work create repetitive musculoskeletal stresses and limit ability to recover. The findings were in line with

those of Kusmasari et al. (2024) who determined awkward postures, repetitive motions, manual lifting and vibration to be significant exposures during the construction process. Heavy lifting also was found to be associated with higher WMSD risk (OR = 2.10); simply telling workers to “lift correctly” is not enough to prevent WMSD. When working conditions are challenging and mechanical assistance is not available, workers have limited ability to implement safe work practices. Task and workflow design are, then, a focus of ergonomic intervention. This correlation of lack of training with WMSD is further proof that knowledge is not enough. Risk can not be eliminated by training if workers are not equipped with the necessary equipment, or have not been given the necessary organisational authority to use safer techniques. This result aligns with the study of Ilesanmi and Moyanga (2024) which revealed a lack of knowledge and application of ergonomics in the construction industry of Nigeria. In a similar manner, job stress and WMSD provide evidence for the link between high job demands, job strain and inadequate social support with musculoskeletal outcomes (Oakman et al., 2021). A similar study by Jeong et al. (2024) also showed that working people with WMSDs had higher levels of occupational stress and lower levels of health-related quality of life. These relationships are explained in the qualitative results. Participants linked stress to deadlines, long working hours, lack of breaks, pressures from supervisors, and fear of losing their income. This is a reflection of Job Demand–Control model – high demands are very detrimental when the workers have less control over their job pace and conditions. These results extend this view by showing that economic vulnerability can be a factor that decreases the ability to control. The acute pain for work-dependent people might be tolerated because stopping means losing income for the day. Therefore, “working through pain” should not be taken as a negative indicator of health behaviour; it might be a rational response to structural economic pressures. The Socio-Ecological perspective also helps to describe the interaction between individual knowledge, organisational practices and broader socio-economic factors. Exposure is affected by supervisors, schedules, tools and safety systems; workers' response to symptoms is affected by income security and access to sick leave. The current evidence also suggests that organisational factors can hinder developing a comprehensive musculoskeletal-risk management, and that commitment of management is key to the implementation of knowledge about ergonomics. The synergy of this research's quantitative and qualitative results reinforce the research's explanatory value: quantitative and qualitative results for posture, stress and training were reinforced by workers' accounts of bending, deadlines, inadequate rest, and limited training. However, the cross-sectional study design does not allow for conclusions regarding causality, and self-reported data can lead to recall and/or reporting bias. The purposive qualitative sample does not offer the breadth of statistical representativeness, and the results of Lagos and Abuja may not generalize to other settings in Nigeria. Nevertheless the study is also important in its insight that WMSDs are also organisational and socioeconomic in nature, in addition to their ergonomic nature. As per Santos et al. (2025), the prevention should include ergonomic training, work redesign, and psychosocial interventions, but these interventions should be tailored to the employment and resource context in Nigeria. This study thus moves away from the question of the prevalence of WMSDs to the one of how physical, organisational and socioeconomic factors interact to maintain WMSD risk.

5. Conclusion

This study shows that the WMSDs among Nigerian construction workers is a multifactorial occupational-health problem. The reported 12-month prevalence of 68% indicates an important prevalence, with the lower back and the shoulders being the most affected areas of the body. Most relevant, there is evidence that WMSDs correlate with modifiable ergonomic and occupational exposures, including awkward postures, heavy manual handling, vibration and inadequate ergonomic training and job stress. The mixed methods evidence provides an explanatory component. These hazards are not found in isolation from the social arrangements of construction work. Exposure is maintained through production pressure, inadequate rest, poor ergonomic practices, and lack of control and economic insecurity. The decision to work despite pain is not only an absence of knowledge of risk, but an absence of risk of other consequences, such as loss of income and household welfare, if they stop working. Thus the position of this paper is that WMSD in the context of construction in Nigeria must be appreciated as a product of interaction of occupational and socioeconomic outcomes not a biomechanical injury. The effect of prevention is that physical working conditions, the organisation of work and economic conditions must be tackled if the prevention is to be effective.

Recommendations

i. Introduce the use of ergonomics as a formally established part of the construction safety management system as a mandatory part of the construction safety induction process, beyond the generic induction process; introduce task-specific ergonomic programmes, covering manual handling, posture, vibration exposure, use of equipment and early reporting of symptoms.
ii. Construction companies need to implement programmatic rest periods, task rotation, and realistic workload schedules, especially for workers performing repetitive lifting, extended bending, and/or vibration tasks.
iii. Embed socioeconomic protection within the prevention of musculoskeletal disorders at work by enhancing systems to minimise the economic cost of sickness or temporary work absenteeism.

References

Adedoyin, A. R., Mbada, C. E., Ajayi, O. K., Idowu, O. A., Oghumu, S. N., Oke, K. I., Moda, H. M., & Fatoye, F. (2022). Prevalence and pattern of work-related musculoskeletal disorders among Nigerian bricklayers. *Work, 72*(2), 321–329. doi: http://10.3233/WOR-205240

Ilesanmi, O., & Moyanga, D. T. (2024). Exploring the evolution of ergonomic practices on construction sites in Nigeria. *International Journal of Building Pathology and Adaptation, 44*(2), 324–338. doi: http://10.1108/IJBPA-08-2024-0164

Jeong, S., & Lee, B.-H. (2024). The moderating effect of work-related musculoskeletal disorders in relation to occupational stress and health-related quality of life of construction workers: A cross-sectional research. *BMC Musculoskeletal Disorders, 25*, 147. doi: http://10.1186/s12891-024-07216-4

Kreis, L., Liebers, F., Dulon, M., Freitag, S., & Latza, U. (2021). Use of the Nordic questionnaire on musculoskeletal complaints. *Zentralblatt für Arbeitsmedizin, Arbeitsschutz und Ergonomie, 71*, 184–191. doi: http://10.1007/s40664-021-00423-z

Kusmasari, W., Sutarto, A. P., Dewi, N. S., Yassierli, Yudhistira, T., Muslim, K., Sanjaya, K. H., Haqiyah, A., & Lestari, W. D. (2024). Exploring the interaction between physical, psychosocial, and neck pain symptoms in construction workers. *Journal of Occupational Health, 66*(1), uiae010. doi: http://10.1093/joccuh/uiae010

Lee, D.-W., & Kang, M.-Y. (2021). Interaction between occupational physical burdens and low job control on musculoskeletal pain: Analysis of the 5th Korean Working Environment Survey. *Journal of Occupational Health, 63*(1), e12244. doi: http://10.1002/1348-9585.12244

Liang, J., Jia, N., Zhang, F., Zhang, H., Ling, R., Liu, Y., Li, G., Li, D., Yin, Y., Shao, H., Zhang, H., Qiu, B., Fang, X., Wang, D., Zeng, Q., Chen, J., Zhang, D., Mei, L., Liu, Y., & Wang, Z. (2022). Shoulder work-related musculoskeletal disorders and related factors of workers in 15 industries of China: A cross-sectional study. *BMC Musculoskeletal Disorders, 23*, 952. doi: http://10.1186/s12891-022-05917-2

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), 107–119. doi: http://10.3233/WOR-205005

Oakman, J., Macdonald, W., Kinsman, N., & Kinsman, M. (2021). A systematic overview on the risk effects of psychosocial work characteristics on musculoskeletal disorders, absenteeism, and workplace accidents. *Applied Ergonomics, 95*, 103434. doi: http://10.1016/j.apergo.2021.103434

Santos, W. S. W., Lorente, A., Rojas, C., Isidoro, R., Dias, A., Mariscal, G., Zabady, A. H., & Lorente, R. (2025). A systematic review and meta-analysis on the prevalence and demographic risk factors of work-related musculoskeletal disorders in

construction workers. *Frontiers in Public Health, 13*, 1651921. doi: http://10.3389/fpubh.2025.1651921

Sivakumar, V., Kumar, R. N., Pavadharani, J., Vishnuvardhan, K., Maniarasan, S. K., & Muniyandy, S. (2023). Effect of occupational exposure to ergonomic risk factors on musculoskeletal diseases among the construction workers: A review. *AIP Conference Proceedings, 2690*, 020014. doi: http://10.1063/5.0119717

Yongu, W. T., Iorvaa, T., Burbwa, S. N., Zwawua, O., & Efu, M. E. (2025). Association between job stress, job demand, and musculoskeletal disorders among academic staff of universities in Benue State: A cross-sectional study. *The Nigerian Health Journal, 25*(1), 282–291. doi: http://10.71637/tnhj.v25i1.971

Zapata, J. P. A., Kumar, R. N., Pavadharani, J., Vishnuvardhan, K., Maniarasan, S. K., & Muniyandy, S. (2023). Effect of occupational exposure to ergonomic risk factors on musculoskeletal diseases among the construction workers: A review. *Lecture Notes in Mechanical Engineering*, 259–271. doi: http://10.1007/978-981-99-1665-8_23

Kadir, A., Sunindijo, R. Y., Widanarko, B., Erwandi, D., Nasri, S. M., Satrya, B. A., Sunarno, S. D. A. M., Atmajaya, H., Yuniar, P., Yuantoko, T. D., Qomariyah, L., Maharani, C. F., & colleagues. (2025). Impact of physical and psychological strain on work-related musculoskeletal disorders: A cross-sectional study in the construction industry. *INQUIRY: The Journal of Health Care Organization, Provision, and Financing*. doi: http://10.1177/00469580251315348

Koch, M., Knardahl, S., Wærsted, M., & Veiersted, K. B. (2020). Associations of objectively measured total duration and maximum bout length of standing at work with lower-extremity pain intensity: A 2-year follow-up of construction and healthcare workers. *BMC Musculoskeletal Disorders, 21*. doi: http://10.1186/s12891-020-03868-0

Zhou, W., et al. (2023). A science mapping-based review of work-related musculoskeletal disorders among construction workers. *Journal of Safety Research, 85*, 114–128. https://doi.org/10.1016/j.jsr.2023.01.011

Khan, R. U., et al. (2022). Work-related musculoskeletal disorders among Pakistani construction workers: Prevalence, characteristics, and associated risk factors. *Journal of Occupational Health*. https://doi.org/10.3233/WOR-205009