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# Work-Related Musculoskeletal Disorders in the Construction Industry: Evidence from Southeastern Nigeria

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## Abstract

While some WMSDs are preventable, others are inherent to the nature of a job or the workplace. Work-related musculoskeletal disorders (WMSDs) are an important occupational health burden in construction, especially in labour-intensive workplaces where manual material handling and overexposure to working hours, as well as limited ergonomic protection, are still common. The study focused on the prevalence and occupational risk factors associated with the incidence of WMSDs among construction workers in Enugu metropolis, Enugu State, Nigeria with specific interest in ergonomic exposures and workers' experience of musculoskeletal pain. The convergent mixed methods approach was adopted, using a cross sectional survey of 356 construction workers, six key informant interviews and two focus group discussions. The quantitative data were analyzed using descriptive statistics, chi-square tests and logistic regression and qualitative data were analyzed thematically and synthesized with quantitative data. The overall WMSD prevalence was 80.3%. The most common 12-month symptom was for the lower back (62.9%), shoulders (55.6%), knees (51.1%) and neck (47.5%). Heavy lifting, previous occupational injury, awkward posture, repetitive movement, working over 10 hours per day and high job stress proved to be significant factors in multivariate analysis. Qualitative results indicated that the chronicity of pain was often justified as "part and parcel of construction work" and the lack of time was considered as an economic constraint that allowed to continue working despite pain. The results show that the WMSD are part of the task design, physical workload and broader organisational contexts. Prevention must thus go beyond individual coping to engineering measures, ergonomic redesign of the work, occupational health monitoring and early intervention that is accessible.

**Keywords:** *work-related musculoskeletal disorders, construction workers, ergonomics, occupational health, manual material handling, Nigeria, mixed methods.*

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## 1. Introduction

There are multiple occupational exposures that can place significant biomechanical demands on the musculoskeletal system during construction work. Manual material handling, repeated bending, forceful exertion, overhead work, prolonged standing, vibration and sustained non-neutral postures often occur together and are not individual hazards. This makes construction workers a job group of special interest for the prevention of work-related musculoskeletal disorders (WMSDs) (Rahman & Sakamoto, 2024; Santos *et al.,* 2025; Venkatachalam *et al.,* 2023). The problem is more significant in poor and middle income countries where physical labor is still largely used in the construction industry. The use of limited mechanisation can move activities to the worker that would be moved by lifting devices, material handling equipment, and/or engineering systems. Ergonomic exposure is thus not only the result of workers' individual habits, but also a result of the organisation and technological set-up of construction work. Physical workload has been identified as an important factor together with psychosocial and organizational factors in construction safety reviews (Howe *et al.,* 2024; Vijayakumar & Choi, 2022).

This concern is backed by evidence in Nigeria. There is a high prevalence of MS symptoms reported from occupation groups that involve repetitive manual work and physically demanding activity (Oluka *et al.,* 2020; Omojunikanbi *et al.,* 2022). Specifically, in the construction sector, Adedoyin et al. (2022) found high WMSD burden among bricklayers in Nigeria, and Mbada et al. (2022) revealed important patterns and risk factors among plumbers in Nigeria. Recent studies have also focused on the occupational injuries, ergonomic constraints and safety issues in the construction industry of Nigeria (Ojo *et al.,* 2024, 2025). However, biomechanical exposure is not enough to explain the occurrence of WMSDs. Modern evidence on the occupational health consequences emphasises that musculoskeletal outcomes are the result of physical, psychological, organizational and behavioral interactions. Job demands, occupational stress, insufficient recovery, low job control and precarious employment may interact with biomechanical loading in both the development of symptoms and recovery (Fajarudin *et al.,* 2021; Howe *et al.,* 2024; Jeong & Lee, 2024). This interaction is particularly relevant in informal and semi-formal construction settings, where workers suffering with pain may only be able to decrease their workload if they also decrease their income.

This is an important difference between having musculoskeletal symptoms, and responding to them. Lifting activities, long working hours, bending activities may cause pain and the worker might know that these activities are harmful but still perform them, as a sudden cessation of working activities may have immediate cost implications. This can then be normalised as part of the occupational identity, thus not seen as an early sign and requiring an ergonomic adjustment or clinical intervention. To understand WMSDs, it is not enough to consider the presence of symptoms, it is also important to consider the conditions of hazardous exposure that is sustained.

### Problem Statement

Although there is increasing evidence regarding the occurrence of WMSDs in Nigerian occupational populations three problems remain of importance. Firstly, evidence of risk in one specific construction trade does not imply evidence of risk in other trades found in heterogeneous construction workforces (masons, labourers,

carpenters, electricians, painters, steel fixers and others). Various trades result in variations of lifting, postures, and repetitions and durations of exposure.

Secondly, a large proportion of prevalence studies has linked exposures to musculoskeletal symptoms, but failed to provide adequate description of the mechanisms through which the exposures are thought to occur during regular construction activities. When paired with evidence about the factors driving the continued use of heavy lifting, the factors driving inadequate recovery periods and the factors driving the continued use of strenuous activities after symptoms appear, the statistical associations between heavy lifting and WMSD are more useful for prevention. Third, the evidence is still limited in the semi-urban construction setting in south-eastern Nigeria, where the informal nature of work arrangements and smaller construction sites could lack the Occupational Health infrastructure found in highly formalised settings. In these contexts, locally available evidence is essential as ergonomic risk is influenced by work organisation, technology available, safety culture and access to healthcare.

This can be overcome by a mixed methods approach that looks at both measurable risk relationships and workers' experience. Quantitative data sets can quantify the magnitude and the antecedents of WMSDs, and qualitative data can help to shed light on the working environment and the human reactions where they gain relevance.

## Objective

This study investigated the prevalence of work-related musculoskeletal disorders and identify their occupational and ergonomic risk factors among construction workers in Enugu metropolis (Enugu North, Enugu East and Enugu South) of Enugu state, Nigeria.

## Research Question

What are the prevalence rates of work related musculoskeletal disorders and the occupational and ergonomic exposures that could significantly determine prevalence amongst construction workers in Enugu metropolis?

## 2. Literature Review

WMSDs include those that involve pain, discomfort and functional impairment of muscles, joints, tendons, ligaments, nerves and other structures that are aggravated or caused by work. WMSDs develop gradually over time as a result of repeated biomechanical loading, as opposed to acute traumatic injuries. This is the case especially in construction, where one can be in the job but gradually accumulate microtrauma, fatigue, and pain. The lower back is always in the spotlight due to its exposure to repeated compressive and shear forces during manual material handling. Physical demands low back pain is a significant issue in physically active workforce in sub-Saharan Africa (Atalay *et al.,* 2024). It also appears that lower back symptoms have been noted in the Nigerian studies among occupations that involve lifting, bending and prolonged physical exertion (Adedoyin *et al.,* 2022; Mbada *et al.,* 2022). But a unilateral emphasis on the lower back may overlook the multi-site nature of exposure to construction-related musculoskeletal disorders. Shoulders, knees, neck,

wrists and upper back could be involved at the same time, as construction activities involve lifting, overhead work, kneeling and crouching activities, as well as repetitive upper-limb work.

One of the most direct ergonomic pathways is heavy lifting. Conveying of cement, blocks, reinforcement, tools, etc., and other construction materials, repeatedly transfer loads to the spine and extremities manually. Where mechanical aid is not available, the importance of this exposure is magnified. Manual handling and forceful activities have also consistently been found to be involved with the development of musculoskeletal morbidity in various construction settings (Kashif *et al.,* 2022; Rahman & Sakamoto, 2024; Venkatachalam *et al.,* 2023). Related, but conceptually different, to posture is the exposure to posture. Bending, twisting, squatting, kneeling, reaching over your head and working in confined spaces are often required in construction tasks. These jobs can be based on job shape and not worker's choice. Therefore it is not always feasible to tell workers to “take a correct posture” when they cannot do so due to the height of the scaffolding, the working surface or where the material is stored or the tool to be used is designed differently. Intervention that focuses on ergonomy, however, should not only involve workers' behaviour but also the design of work (Mokhtarinia *et al.,* 2024; Odebiyi & Okafor, 2023).

Exposure is compounded by repetition. The health effect of a move is related to the force, as well as frequency, duration, and recovery. Cumulative loading can occur if a relatively moderate movement is done repeatedly over the course of a working day, especially if there is not enough rest. Construction activities can also be "rotated" without truly decreasing the biomechanical loading on the body if the same anatomical structures are being loaded in the different activities. Working time is then no longer just an administrative variable but also an ergonomic one. Excessive hours = excessive exposure and less opportunities for physiological recovery. This association of working time and WMSD can thus be considered a working time/working exposure-dose relationship: longer exposure to lifting, bending and repetitive movement equals higher accumulated working strain. It is especially important if there is a pay-for-performance system that rewards the workers for completing tasks or for daily production and thus sets an incentive to stay active even when tired.

This is complicated by psychosocial conditions. Occupational stress can lead to increased muscle tension, changes in pain perception, a reduction in recovery, and economic insecurity can lead to “presenteeism” which is staying at work when you have pain or illness. Fajarudin et al. (2021) has found that psychosocial factors are consequential in construction health and Jeong and Lee (2024) have illustrated that the occupational stress, WMSDs and health-related quality of life among construction workers are interrelated. However, physical and psychosocial risks should not be considered as two separate explanatory systems. These relationships are in line with a biopsychosocial approach to musculoskeletal health. Tissue loading, fatigue and injury are explained by biological processes, stress and pain interpretation by psychological processes, and workload, autonomy, health care utilisation, and recovery by social or organisational conditions. An ergonomic systems approach is used to add to this framework, placing the risk in the interaction of the worker(s), the task(s), the tool(s), the technology and the organisation of the workplace. These views combine to move the focus of explanation from a worker-deficit view in which injury is blamed largely on workers' behaviour.

Such a change is significant in the real life situation in Nigeria. Despite the potential benefits, human-factors and ergonomic practices are not uniformly institutionalised in workplaces (Nwanya & Achebe, 2023) and barriers to implementing ergonomic interventions can make evidence-based recommendations not a routine part of the workplace (Virmani & Salve, 2021). Enforcement and occupational health surveillance are further complicated by the informal nature of some parts of the construction industry. So, the key to preventing WMSDs is to identify possible changing exposures and recognise the structural conditions that are contributing to these exposures. Another important methodologically unexplained gap is left open by existing evidence. Cross-sectional symptom reporting is the major basis of many investigations. Such designs are useful for estimating prevalence and associations, but do not give an explanation of why exposures occur or how workers interpret symptoms. This limitation can be addressed by qualitative evidence which will provide a context for the statistical relationships. The present analysis therefore does not take workers' accounts as an alternative to epidemiological evidence but as additional accounts of the occupational context where the observed associations take place.

## 3. Methods

The convergent mixed methods design was employed in this study. The quantitative portion took a descriptive cross-sectional survey approach to estimate the prevalence of WMSD and explore relationships with occupational and ergonomic exposures. To learn more about workers' experiences and interpretations of occupational risk, the qualitative component used key informant interviews (KIIs) and focus group discussions (FGDs). All strands were harvested at the same time, examined separately and combined when interpreting. The study was carried out in construction workers, Enugu metropolis. There were 356 valid respondents which yielded a valid response rate of 93.7%. The participants were construction workers who were directly working on the construction site doing either manual or semi-skilled activities. Occupational groups included masonry, carpentry, electrical, painting, and steel fixing and general construction labour. The respondents were sampled from construction sites using a multistage sampling procedure within the study area. The qualitative study involved six key informant interviews and two focus group discussions. Key informants were site supervisors and artisan leaders and occupational health personnel who have familiarity with construction work and worker health. The focus groups consisted of 8 people in each group who were selected from different construction trades such as bricklayers, carpenters, welders, electricians and painters/iron benders. The duration of the KIIs was around 30-45 minutes, and the FGDs were around 60-90 minutes. A structured questionnaire with an adapted Nordic Musculoskeletal Questionnaire was used to collect quantitative data. Socio-demographic information, occupational exposure, musculoskeletal symptoms and relevant ergonomic factors were captured by the instrument. Before the main data collection was conducted, a pilot study was conducted with 38 construction workers in Aba, Abia state. The internal consistency of the parts of the structured questionnaire ranged from 0.78 to 0.89 and the adapted Nordic questionnaire resulted in a reliability of 0.86.

Semi-structured guides were used for KIIs and FGDs. Musculoskeletal experiences, physically demanding tasks, ergonomic practices, work organisation and

impact of symptoms and responses to pain were discussed. Participants agreed to be audio-taped during interviews and discussions and audio tapes were supplemented with notes from the field. SPSS version 27 was used to analyse quantitative data. Prevalence and anatomical distribution were summarised using descriptive statistics. Categorical associations were tested using chi square and logistic regression was used to determine independent predictors of WMSD. A p value of $< .05$ was considered statistically significant. Qualitative recordings were transcribed word for word and analysed thematically. Recurring experiences and explanations were organised into themes relating to perceptions of WMSDs, occupational exposure, causes, consequences, coping and prevention. Integration was carried out during interpretation, with quantitative relationship explanations being compared to qualitative accounts of the convergence of some aspects of the context. Prior to the collection of data, ethical approval and all necessary permissions were secured. It was a voluntary participation with written informed consent and confidentiality was maintained.

## 4. Results and Discussion

**The prevalence and anatomical pattern of a product.**

Of the 356 respondents, 286 (80.3%) reported WMSDs, while 70 (19.7%) did not. This makes musculoskeletal symptoms a common issue of occupational health among the sampled construction workforce, instead of it being a one-off complaint.

**Table 1. Twelve-Month WMSD Prevalence by Body Region (n = 356)**

| Body region | Reported, n | Prevalence (%) |
|---|---|---|
| Lower back | 224 | 62.9 |
| Shoulders | 198 | 55.6 |
| Knees | 182 | 51.1 |
| Neck | 169 | 47.5 |
| Wrist/hand | 138 | 38.8 |
| Upper back | 124 | 34.8 |
| Ankles/feet | 116 | 32.6 |
| Elbows | 89 | 25.0 |
| Hips/thighs | 81 | 22.8 |

The significance of the anatomical distribution is that it reflects very closely the mechanical needs of construction activities. Nearly two-thirds of respondents had symptoms affecting the lower back and more than half had symptoms affecting the shoulder and knee in the previous 12 months. The lower back pattern is in line with the evidence that identifies the occupational low back pain as an important problem among physically demanding occupations in sub-Saharan Africa (Atalay *et al.,* 2024) and the findings in bricklayers and plumbers of Nigeria (Adedoyin *et al.,* 2022; Mbada *et al.,* 2022). However, the pattern suggests that the construction-related WMSD should not be limited to low-back pain. With a shoulder prevalence of 55.6% and a knee prevalence of 51.1% this indicates significant loads on the upper body, and that the knee was associated with kneeling/squatting, climbing, and handling of material. The simultaneous burden in multiple anatomical sites is indicative of multiple ergonomic hazards; not a single harmful task. The symptoms of recent were in the same order. Seven-day prevalence remained highest for the lower back (48.3%),

shoulders (42.4%), knees (40.4%) and neck (36.0%). Such persistence between the annual and recent symptom measures implies that the burden reported cannot be due to remote symptom episodes alone.

**Ergonomic and Occupational Predictors**

The multivariate logistic regression showed that WMSDs were related to a number of interacting occupational exposures.

**Table 2. The number of multivariate predictors of WMSDs among construction workers (n = 356)**

| Predictor | OR | 95% CI | *p* |
|---|---|---|---|
| Heavy lifting | 2.573 | 1.609–4.118 | <.001 |
| Previous occupational injury | 2.440 | 1.384–4.301 | .002 |
| Awkward posture | 2.394 | 1.468–3.903 | <.001 |
| Repetitive movements | 1.958 | 1.205–3.179 | .006 |
| Working >10 hours/day | 1.842 | 1.257–2.698 | .001 |
| High job stress | 1.686 | 1.087–2.616 | .019 |

*Model: $\chi^2 = 86.214$, $p < .001$; Nagelkerke $R^2 = .438$.*

The greatest odds ratio was obtained for heavy lifting. For workers who were exposed to frequent heavy lifting, the odds of reporting WMSD were about 2.6 times higher than for those who were not exposed to frequent heavy lifting, after accounting for the other factors in the model. This confirms previous research studies on hand-based material handling as a major ergonomic risk factor in construction (Kashif *et al.,* 2022; Rahman & Sakamoto, 2024; Venkatachalam *et al.,* 2023). This association is explained by qualitative evidence. Participants reported manually handling a large amount of cement, blocks, sand and reinforcement materials many times in a day. One worker said that construction sites often were lacking in lifting equipment and workers would often have to carry materials across sites or upstairs without any lifting equipment. These stories imply that the practice of heavy lifting isn't just an individual worker's habit of unsafe working practices. In certain workplaces it is part of the production process as mechanical alternatives do not exist.

The importance of this difference for intervention. Education doesn't mean removing the load, but may lessen some risk if workers are trained in the proper lifting technique. Mechanical handling equipment, team lifting, material staging and task redesign are examples of engineering and organisational controls where manual, heavy material handling is required to complete a task repeatedly. Also awkward posture was significant (OR = 2.394). The participants reported continuing bending in block laying and reinforcement work, and some activities needed to be performed in a position that was not easily accessible. This bolsters the case that posture can be seen as a part of the design of the task. Increasingly, ergonomic literature highlights interactions between workers and work systems, not just individual technique (Mokhtarinia *et al.,* 2024; Odebiyi & Okafor, 2023).

However, repetitive movement was independently associated to WMSDs (OR = 1.958). Its effect is especially important when taken in conjunction with long working hours. Those who worked more than 10 hours a day were about 1.8 times more likely to have WMSDs. The frequency of loading of tissues depends on repetition and the length of working hours will affect the amount of time available for recovery. The two exposures are hence two exposures of cumulative biomechanical dose. Another strong predictor was previous occupational injury (OR = 2.440). Individuals who have been injured before may continue to have a physiological

susceptibility to re-injury, especially when they are exposed to the same factors in the workplace without rehabilitation or work modification. This discovery reinforces the point that early reporting and rehabilitation is crucial as an injury that is not reported or not fully recovered can contribute to a larger progression of occupational musculoskeletal disease.

The results also indicated that, after including ergonomic exposures in the analysis, high job stress remained statistically significant (OR = 1.686). This aligns with a biopsychosocial approach to WMSDs. Psychosocial conditions can act upon physiology and be a source of stress, muscle tension and pain perception, and influence behaviour such as willingness or economic capacity to rest, and reduced ability to recover. There are also other studies that support the association of psychosocial and occupational stressors with musculoskeletal disorders in construction workers (Fajarudin *et al.,* 2021; Howe *et al.,* 2024; Jeong & Lee, 2024). This model accounted for about 43.8% of the variation in the occurrence of WMSD. This is very large and also shows that the measured exposures are not enough to explain musculoskeletal outcomes. This is likely to be due to individual susceptibility, non-measured work conditions, psychosocial factors, and/or other environmental exposures. The cross-sectional design also cannot determine time order.

**Construction Trade and Unequal Exposure**

Construction trade had a strong association with the prevalence of WMSD ($\chi^2 = 18.734$, df = 5, p = .002). Labourers, masons and steel fixers had higher reported incidences than electricians and painters. Here's an occupational change that reinforces an exposure-based interpretation. The workforce of construction workers is not homogenous ergonomically. General labourers and workers doing masonry work, concrete work and handling reinforcing materials could end up spending more time lifting, carrying, bending or manipulating heavy materials. Prevention programmes based on the broad concept of “construction worker” therefore may fail to recognise differences in intensity of exposure between trades. Analogous evidence justifies task-specific ergonomic evaluation. It has been shown that various musculoskeletal patterns are produced by different construction occupations, with bricklayers and plumbers exhibiting different patterns of musculoskeletal issues (Adedoyin *et al.,* 2022; Mbada *et al.,* 2022). Studies conducted in other regions of the world also report significant linkages between the construction activities and musculoskeletal outcomes (Kashif *et al.,* 2022; Lee *et al.,* 2023; Mustapha *et al.,* 2022). This means that, practically, ergonomic surveillance should be based on tasks and exposures, not just job titles. The musculoskeletal risks faced by two workers on the same construction site can be very different, depending on the weight of the loads lifted, how often loads are lifted, the position in which the worker lifts the load, the height of the load, the number of times the load is lifted, and the time allowed between each lift.

**Normalisation of Pain as an Occupational Risk Process**

The most significant qualitative finding is in regard to worker's interpretations of pain. Both participants referred to MSD as a "normal" aspect of the construction job. A participant described body pain as being “almost part of the job” and one explained that workers can expect body pain after lifting blocks, cement or reinforcement materials. The interpretation of the prevalence data is extended to this normalisation. If the worker can at the same time assume that the symptoms are common by-products of working, the 80.3% symptom prevalence is more than a widespread physical exposure. Normalisation can reduce the connection between

symptoms and reporting, treatment and modification of exposure as well as the behavioral trigger for which these are supposed to occur.

The qualitative accounts also suggest that failure to use health care services is not just being due to a lack of knowledge. Employees showed good knowledge of the physical sources of their symptoms. They perceived heavy loads, long shifts, repetitive work and awkward working positions very well. The problem was that recognition did not necessarily translate into prevention. This knowledge-behaviour gap can be explained by the economic status. In absence, workers reported that their income would be reduced, which is why they continued working. One of the participants explained that they were taking painkillers to ease the pain because "if he or she stops working, he/she won't be able to earn income." This shows one of the drawbacks to awareness-only occupational health interventions. Where the most economical option is to proceed with work, a worker can be aware of a hazard and still be exposed. This is in line with other reports of informal coping and delayed health care seeking among the working population (Fang *et al.,* 2021; Yarfi, 2021). It also provides examples of how psychosocial and organisational factors need to be included with the ergonomic explanations. Tissue strain occurs at the site of the physical exposure, and employment factors will affect whether workers can cease exposure when symptoms occur.

**Coping to Prevention.**

The most common responses for those who reported experiencing WMSDs (286) were: rest after work (83.2%), self-medication with pain relievers (75.5%), massage (64.3%) and hot-water treatment (59.8%). Only 33.2% used stretching exercises and 51.4% reported reduced intensity of work. The strategies show the symptom management approach predominately. Temporary relief may be obtained with rest, analgesics and massage, but this will not change the exposure that produces the symptoms. This is especially a problem if medicine allows an individual to continue to do the same dangerous activities.

The qualitative results support this interpretation. Employees reported buying pain medication from local pharmacies and coming back to work.Workers reported buying pain medication from local pharmacies and returning to work. Co-workers were sometimes called in to help with heavy lifting jobs, but this was not always possible as co-workers also had work commitments. The use of professional physiotherapy and occupational health services was reported to be infrequent. The pattern is therefore indicative of an occupational health system which is functioning mostly after exposure. The first experience of physically demanding work, the onset of symptoms, managing symptoms on an individual basis, and requesting professional intervention occurs mostly when pain is high. Preventive occupational health reverses this sequence by preventing the disabling symptoms that would otherwise occur by controlling hazards.

Interventions related to workplace design and organisational controls, as well as individual-level interventions, are gaining support with evidence of ergonomics (Daruis *et al.,* 2025; Nyamboki *et al.,* 2023, 2024; Virmani & Salve, 2021). In the construction environment under study, this involves minimising unnecessary manual handling, optimising material handling, altering the height and/or the posture of the task where possible, providing structured recovery periods, and reinforcing reporting of symptoms and early access to occupational health or physiotherapy services. The findings also suggest a need to avoid relying solely on workers to provide prevention.

These are useful, however, they do not fully compensate for loads that are too heavy, for prolonged working periods of 10 hours or for work stations that structurally demand prolonged bending. Prevention needs to be a hierarchy – using engineering and organisational controls will always be better than relying on individuals to adapt.

## 5. Conclusion

The prevalence of WMSDs among construction workers in Enugu metropolis was high with 80.3% of the workers reporting symptoms. The burden for the lower back, shoulders, knees and neck over the last 12 months was the highest. Most significantly, the findings show that this load is not random, but rather patterned. The risk of WMSD was also found to be significantly associated with heavy lifting, previous occupational injury, poor posture, repetitive movement, long daily working hours and high job stress, each of which was individually associated with WMSD prevalence.

This is reinforced through the use of mixed methods evidence. Strikingly, workers identified the physical causes of their pain, but dangerous exposure continued because manual material handling was part of the construction process, mechanical help was minimal, long work was economically significant and musculoskeletal pain had become accepted as a fact of construction work. The issue is not just lack of knowledge about safe work practices. The main contribution of this study is to show how measurable ergonomic exposure is linked with social organization of workers' reaction to this exposure in a semi-urban environment of the workers in Nigeria construction industry. The quantitative evidence pinpoints the places of risk; the qualitative evidence provides an explanation for the reasons risk can exist despite workers knowing about it.

These results appear to corroborate a biopsychosocial/ergonomic-systems interpretation of occupational musculoskeletal health theory. WMSDs occur when multiple exposure pathways (biomechanical loading, individual vulnerability, psychosocial pressure and organisational conditions) interact. In practice the emphasis for prevention should be on reducing manual handling, having suitable lifting assistance, work and task redesign, regular breaks and rotation of tasks, early reporting of symptoms, supplying ergonomic education and access to occupational health and physiotherapy. Those workers who have had prior injuries should be given special consideration, as they may be at increased risk when exposed again.

These findings have however limited temporal causality due to the cross-sectional design and limited clinical diagnosis of symptoms, which were mostly self-reported. The results should, therefore, be viewed as indicative of high occupational associations more than as evidence of a specific exposure causing a specific disorder. However, the convergence of statistical relationships with workers' accounts reinforces the conclusion that ergonomic and organisational conditions are intervention targets important to consider. The ultimate goal of reducing the risk of WMSD in the labour-intensive construction setting is to shift the focus for occupational health practice from pain caused by exposures to the redesign of work before it causes pain.

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