Physical Ergonomics and Human Factors, Vol. 147, 2024, 148–157
https://doi.org/10.54941/ahfe1005187

Musculoskeletal Disorders Among Construction Workers

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ABSTRACT

Construction is a physically demanding process, and its activities entail exposure to a range of health and safety (H&S) and ergonomics hazards and risks. Given the persistence of H&S and ergonomics hazards and risks, a quantitative study was conducted to interrogate the related issues and evolve a response. The quantitative study included members of the Association of Construction Health and Safety Management (ACHASM) who completed a self-administered questionnaire delivered per e-mail. The findings indicate: workers are exposed to ergonomic hazards and risks, which leads to musculoskeletal disorders (MSDs); workers do report incidents; not all stakeholders are likely to be committed to H&S, and seven construction management factors impact H&S and ergonomics. Conclusions include: design hazard identification and risk assessment (HIRA) and construction HIRA is ineffective; exposure to ergonomic hazards and risks results in MSDs; workers do not fear losing their jobs due to reporting incidents; construction H&S is not receiving the necessary and potential multi-stakeholder support, and contractors are not adequately resourcing H&S and ergonomics. Recommendations include: multi-stakeholder commitment to and support for H&S and ergonomics should be engendered commencing the client brief; designers should consider the impact of design, details, and specifications on construction H&S and ergonomics during the construction process and subsequent maintenance; contractors should adequately resource H&S and ergonomics at tender stage, and ensure that the requisite H&S systems, procedures, and protocols are implemented when construction commences, and workers should be empowered through HIRA training, and participation in H&S processes.

Keywords: Construction, Ergonomics, Health and safety, Musculoskeletal disorders

INTRODUCTION

Painful disorders of soft tissues such as cartilage, joints, ligaments, muscles, nerves, and tendons, constitute MSDs, which are referred to using various terms (Anagha and Xavier, 2020). These include, carpal tunnel syndrome, tendonitis, tennis elbow, trigger finger, sciatica, herniated discs, and low back problems, which constitute the most frequent MSDs experienced by construction workers. Pain, aching, stiffness, numbness, tingling, and swelling are common symptoms of these illnesses in the back, shoulders, neck, legs, wrists, fingers, elbows, and arms (Anagha and Xavier, 2020). Furthermore, MSDs develop from workers, *inter alia*, undertaking repetitive movements

such as using a claw hammer to nail timber battens to roof trusses. Adopting awkward, and improper postures are a further hazard and are one of the key factors for developing MSDs among construction workers – installing the waste outlet to a wash hand basin is an elementary activity which will result in such postures.

According to The Centre of Construction Research and Training (2018), overexertion is a major cause of MSDs resulting in days away from work in the American construction industry – overexertion (lifting-lowering) constituting 29.9% in terms of cause, overexertion (except lifting, pushing, holding) 16.4%, overexertion (pushing-pulling) 11.2%, and overexertion (holding-carrying) 9.5%. Overall, the rate of overexertion injuries resulting in days away from work is 37.0 / 10 000 full-time workers, and the rate of back injuries resulting in days away from work is 22.3 / 10 000 full-time workers.

Within the context of South Africa, The Federated Employers Mutual Assurance Company (RF) (Pty) Ltd (FEM) (2024) reports the following MSD-related percentage contributions in terms of the nature of all injuries for the year 2023: joint injury e.g., dislocation, sprain, or injury to cartilage (10.4%); muscle injury e.g. strain, torn ligaments, muscles, or tendons (11.4%), and muscle overstraining - any work involving the handling of or exposure to repetitive movements (0.2%).

Given the incidence of MSDs in South African construction vis-à-vis American construction, previous South African research findings, which confirmed the physical nature of the South African construction industry, and anecdotal evidence, a study was conducted to determine the:

- frequency at which ergonomic hazards are encountered;
- likelihood of six ergonomic hazards leading to the development of MSDs;
- likelihood of incidents being reported by construction workers;
- likely commitment of 50.0% of project stakeholders to construction H&S;
- extent to which seven factors impact H&S management on construction projects, and
- likelihood of the implementation of strategies to mitigate risks on construction projects in the form of monitoring and controlling of H&S risks.

REVIEW OF THE LITERATURE

Ergonomics as a Multi-Stakeholder Issue

In terms of the Occupational Health and Safety Act (OHSA) (Republic of South Africa (RSA), 1993), clients, construction project managers (CPMs), designers, quantity surveyors, and contractors have a range of duties in their capacity as employers, which includes awareness, and interventions relative to hazards and risks arising from visiting construction sites. However, contrary to popular belief, within the context of South Africa, designers have been liable for construction H&S in terms of Section 10 of the Act since 1993, not just since 2003 upon the promulgation of the 'first' version of the Construction Regulations Section '10. General duties of manufacturers and

others regarding articles and substances for use at work' states, *inter alia*, that designers are required to ensure, as far as is reasonably practicable, that an article is safe and without risks to health when properly used.

In terms of the Construction Regulations (RSA, 2014), clients are required to, *inter alia*, conduct a baseline risk assessment (BRA), and evolve an H&S specification based thereon, which in turn is provided to designers. Designers in turn are required to, *inter alia*: consider the H&S specification; prepare a report for the client before tender stage that includes all the relevant H&S information about the design; identify any hazards relating to the construction work; modify the design or substitute hazardous materials, and consider maintenance-related hazards post construction. This in turn requires hazard identification and risk assessment (HIRA). In theory, designers should prevent design-originated hazards, which requires commitment.

Contractor-Related H&S Interventions

In addition to clients including the H&S specification in tender documentation for principal contractors (PCs), they must, *inter alia*: ensure that potential PCs have made provision for the cost of H&S in their tenders; ensure that the PC to be appointed has the necessary competencies and resources; discuss and approve the PC's H&S plan, which responds to the H&S specification, and conduct monthly audits to ensure the PC's compliance with the H&S plan (RSA, 2014).

In terms of the OHSA (RSA, 1993), the Construction Regulations (RSA, 2014), and the Ergonomics Regulations (RSA, 2019), contractors must conduct HIRA, and produce a plan and applicable safe work procedures (SWPs) to mitigate, reduce, or control the hazards and risks. Furthermore, contractors are required to provide the necessary information, instructions, training, and supervision in terms of the aforementioned.

Worker-Related H&S Interventions

In terms of the OHSA (RSA, 1993), workers are required to, *inter alia*: take reasonable care for their H&S and that of their fellow workers who may be affected by their acts or omissions; report any unsafe or unhealthy situation to their employer, and report any incident which they were involved in, which resulted in an injury or may affect their health.

RESEARCH METHOD AND SAMPLE

Due to the nature of the data that needed to be gathered, a quantitative study was embarked upon. The self-administered questionnaire, which consisted of primarily Likert scale type questions, was sent to potential respondents per e-mail.

ACHASM constituted the sample stratum, which is a recognised voluntary association of the South African Council for the Project and Construction Management Professions (SACPCMP). Professional and candidate Construction H&S Agents (Pr CHSAs and Can CHSAs), Construction H&S Managers (CHSMs), and Construction H&S Officers (CHSOs), registered with the

SACPCMP, constitute the membership base of ACHASM, their 'professional home', as opposed to the SACPCMP, their 'statutory council'.

The questionnaire was sent to a total of 516 members of ACHASM on behalf of the lead author as ACHASM fulfilled the function of 'gatekeeper' in terms of the university's research ethics policy and requirements. Of the 124 questionnaires returned, 21 were disqualified due to incompleteness, which equates to a net response rate of 20.0% (103 / 516).

RESULTS

In terms of gender, 64.1% of respondents were male, and 35.9% were female.

In terms of the highest qualification of respondents, three-year 'National Diploma' (35.9%) predominates, followed by 'Other' (23.3%), and the three-year 'BA / BSc / one-year BTech' (21.3%). Matric, which is the highest secondary school level was identified by 10.7% of respondents, and Honours, a fourth-year level qualification by 7.8%, and Masters, by only 1.0%.

In terms of years of experience in the construction industry, respondents recorded a total of 1 205 years, which equates to a mean of 11.7 years. This finding indicates that the respondents can be deemed experienced, which enhances the reliability of the findings.

The respondents' category of registration with the SACPCMP is as follows: CHSO (49.5%); CHSM (31.1%); Pr CHSA (11.7%), and Can. CHSA (7.8%).

Table 1 indicates the frequency at which seven ergonomic hazards are encountered on construction projects in terms of percentage responses to a frequency scale of never to 5–8 hours, and a MS between 0.00 and 5.00. Given that all the MSs are > 2.50, the ergonomic hazards can be deemed to be encountered frequently, as opposed to infrequently. However, a review of the MSs in terms of ranges enables a more scientific review.

The 1 / 7 (14.3%) MSs > 4.17 $\leq$ 5.00 indicates 'handling heavy equipment' can be deemed to be encountered between 0 – 4 hours and 5 – 8 hours / 5 – 8 hours.

The 5 / 7 (71.4%) MSs > 3.33 $\leq$ 4.17 indicate 'handling heavy material', 'bending and twisting the back', 'awkward working posture', 'climbing and descending', and 'excessive use of body force' can be deemed to be encountered between weekly to 0 – 4 hours / 0 – 4 hours.

The 1 / 7 (14.3%) MSs > 2.50 $\leq$ 3.33 indicate 'repetitive movements' can be deemed to be encountered between monthly to weekly / weekly.

These ergonomics hazards were identified during three previous studies in the form of a mean rank out of 18 such hazards as follows: handling heavy equipment (10th); handling heavy material (3rd); bending and twisting the back (6th); awkward working posture (9th); climbing and descending (2nd); excessive use of body force (4th), and repetitive movements (1st) (Smallwood, 1997; Smallwood *et al.*, 2000; Smallwood, 2002). Although the order of rank has changed, the seven ergonomic hazards, which are the subject of the current study, featured among the top ten in terms of the mean of the three previous studies.

Table 1. Frequency at which ergonomic hazards are encountered.

Ergonomic hazard	Response (%)							
	Never	Monthly	Fortnightly	Weekly	0 - 4 hours	5 - 8 hours	MS	Rank
Handling heavy equipment	0.0	2.9	2.9	16.5	27.2	50.5	4.20	1
Handling heavy material	0.0	1.9	11.7	7.8	25.2	53.4	4.17	2
Bending and twisting the back	0.0	3.9	4.9	29.1	46.6	15.5	3.65	3
Awkward working posture	1.0	7.8	17.5	5.8	50.5	17.4	3.50	4
Climbing and descending	7.8	8.7	10.7	15.5	16.5	40.8	3.47	5
Excessive use of body force	1.9	14.6	16.5	16.5	14.6	35.9	3.35	6
Repetitive movements	1.0	8.7	15.5	29.1	23.3	22.3	3.32	7

Table 2 presents the likelihood of six ergonomic hazards leading to the development of MSDs in terms of percentage responses to a likelihood scale of 1 (very unlikely) to 5 (very likely), and MSs between 1.00 and 5.00. It is notable that all the MSs are > 3.00, which indicates that in general, the respondents perceive the six ergonomic hazards are likely to lead to the development of MSDs, as opposed to unlikely.

However, 4 / 6 (66.7%) MSs are > 4.20 ≤ 5.00, which indicates the six ergonomic hazards are between more than likely to very likely / very likely to lead to the development of MSDs. The remaining 2 / 6 (33.3%) MSs are > 3.40 ≤ 4.20, which indicates the six ergonomic hazards are between likely to more than likely / more than likely to lead to the development of MSDs. These findings align with the statistics reported by The Centre of Construction Research and Training (2018) in terms of the linkages between ergonomics hazards and MSDs, and linkages between construction activities and MSDs (Anagha and Xavier, 2020).

Table 2. Likelihood of six ergonomic hazards leading to the development of MSDs.

Ergonomic hazard	Response (%)							
	Un-sure	Very unlikely ..... Very likely					MS	R
		1	2	3	4	5		
Handling heavy machinery	1.0	0.0	0.0	11.6	29.9	57.7	4.42	1
Excessive use of body force	1.9	1.0	1.9	4.8	29.8	60.6	4.41	2
Repetitive movements	1.9	0.0	1.0	19.2	25.0	52.9	4.23	3
Handling heavy equipment	1.0	0.0	0.0	5.8	60.6	32.7	4.22	4
Working in an awkward posture	1.9	0.0	1.0	9.7	68.3	19.2	3.99	5
Bending and twisting the back	1.9	0.0	1.0	27.9	29.8	38.5	3.98	6

Table 3 indicates the likelihood of incidents being reported by construction workers in terms of percentage responses to a likelihood scale of 1 (Highly unlikely) to 5 (Highly likely), and a MS between 1.00 and 5.00. However, given that the MS is > 3.40 ≤ 4.20, it can be deemed that construction workers are likely to more than likely / more than likely to report incidents. This

is a notable finding as the literature indicates that construction workers in developing countries are reticent to report incidents.

Table 3. Likelihood of incidents being reported by construction workers.

Response (%)						
Un-sure	Highly unlikely…..Highly likely					MS
	1	2	3	4	5	
0.0	4.9	9.7	7.8	33	44.7	4.03

Table 4 indicates the likelihood of factors impacting the reporting of incidents by construction workers in terms of percentage responses to a likelihood scale of 1 (Highly unlikely) to 5 (Highly likely), and a MS between 1.00 and 5.00. Given that the MSs are < 3.00, it can be deemed that construction workers are less than likely, as opposed to be likely, to be impacted by the factors in terms of the reporting of incidents.

However, given that 2 / 3 (66.7%) of MSs are > 2.60 ≤ 3.40, it can be deemed that construction workers are less than likely to likely / likely to be impacted by 'pressure to accept full responsibility', and 'management's attitude towards H&S' in terms of the reporting of incidents. Then, given that the MS of 'fear of losing their jobs' is > 1.80 ≤ 2.60, it can be deemed that the factor is unlikely to less than likely / less than likely to impact construction workers reporting incidents. These findings are notable as the literature indicates that construction workers in developing countries are reticent to report incidents as they are invariably blamed for the incident, management is not committed to H&S, the focus on projects is on production and not H&S, and workers fear losing their jobs.

Table 4. Likelihood of factors impacting the reporting of incidents by construction workers.

Factor	Response (%)						MS	R
	Un-sure	Highly unlikely…..Highly likely						
		1	2	3	4	5		
Pressure to accept full responsibility	0.0	19.4	22.3	17.5	26.2	14.6	2.90	1
Management's attitude towards H&S	4.9	17.5	26.2	20.4	11.7	19.4	2.80	2
Fear of losing their jobs	13.6	16.5	25.2	20.4	16.5	7.8	2.30	3

Table 5 indicates the likelihood of stakeholders' commitment to construction H&S in terms of percentage responses to a likelihood scale of 1 (Highly unlikely) to 5 (Highly likely), and a MS between 1.00 and 5.00. MSs > 3.00 indicate that in general, the stakeholders are likely to be committed to construction H&S – contractors, and engineers, whereas MSs < 3.00 indicate that in general, the stakeholders are unlikely to be committed to construction H&S – architects, and clients.

However, in terms of ranges, 2 / 4 (50.0%) of MSs are > 3.40 ≤ 4.20, which indicates that contractors and engineers are between likely to more

than likely / more than likely to be committed to construction H&S. The remaining 2 / 4 (50.0%) of MSs are > 2.60 ≤ 3.40, which indicates that architects, and clients are between less than likely to likely / likely to be committed to construction H&S. This is notable as all stakeholders, including clients and designers such as architects, are subject to certain requirements in terms of the OH&S Act, and several in terms of the Construction Regulations, and therefore they should be committed to construction H&S.

Table 5. Likelihood of stakeholders' commitment to construction H&S.

Stakeholder	Response (%)						MS	R
	Un-sure	Highly unlikely…..Highly likely						
		1	2	3	4	5		
Contractors	0.0	4.9	15.5	15.5	18.5	45.6	3.84	1
Engineers	0.0	6.8	13.6	9.7	32	37.9	3.81	2
Architects	4.9	14.6	28.2	16.5	10.7	25.2	2.89	3
Clients	6.8	13.6	26.2	18.5	19.4	15.5	2.77	4

Table 6 indicates the extent to which seven factors impact H&S management on construction projects in terms of percentage responses to an extent scale of 1 (Minor) to 5 (Major), and a MS between 1.00 and 5.00. MSs > 3.00 indicate that in general, the 5 / 7 (71.4%) factors impact H&S management on construction projects to a major as opposed to a minor extent, as opposed to MSs ≤ 3.00, which indicates they do so to a minor extent.

However, in terms of ranges, 3 / 7 (42.9%) of MSs are > 3.40 ≤ 4.20, which indicates that the factors impact H&S management on construction projects between some extent to a near major / near major extent - poor resource control, management and business control, and application of scientific knowledge. Controlling resources is necessary as supervisors, and workers are exposed to, and / or may handle resources such as materials and plant and equipment, which are potential agencies in terms of accidents. Management and business control is necessary as projects are undertaken from the business of construction, which is responsible for implementing H&S management systems, including H&S policies, procedures, and protocols. Application of scientific knowledge is a key factor as construction and construction H&S management is a science. The remaining 4 / 7 (57.1%) of MSs are > 2.60 ≤ 3.40, which indicates that the factors impact H&S management on construction projects between a near minor extent to some extent / some extent - insufficient professional knowledge, practical scientific skills, poor documentation, and ability to contain unusual complications. Insufficient professional knowledge militates against H&S management as H&S practitioners interact with clients, CPMs, designers, quantity surveyors, and contractors. Practical scientific skills such as conducting HIRA, which requires, *inter alia*, knowledge relative to the mass and density of materials is a relevant factor. Documentation is a legal requirement relative to many aspects of H&S management, and therefore poor documentation is not an option. The ability to contain unusual complications, or in 'core competency'

language, 'handle ambiguity' is a key factor, as construction is a dynamic process that entails unexpected developments.

Table 6. Extent to which seven factors impact H&S management on construction projects.

Factor	Response (%)						MS	R
	Un-sure	Minor.....Major						
		1	2	3	4	5		
Poor resource control	4.9	1.0	10.7	29.1	40.8	13.6	3.58	1
Management and business control	0.0	7.8	16.5	14.6	38.8	22.3	3.51	2
Application of scientific knowledge	6.8	3.9	15.5	26.2	25.2	22.3	3.50	3
Insufficient professional knowledge	2.9	12.6	22.3	10.7	16.5	35.0	3.40	4
Practical scientific skills	8.7	11.7	17.5	9.7	32	20.4	3.35	5
Poor documentation	3.9	18.5	22.3	23.3	11.7	20.4	2.93	6
Ability to contain unusual complications	9.7	12.6	20.4	20.3	20.4	13.6	2.92	7

Table 7 indicates the likelihood of the implementation of strategies to mitigate risks on construction projects in terms of percentage responses to a likelihood scale of 1 (Highly unlikely) to 5 (Highly likely), and a MS between 1.00 and 5.00. MSs > 3.00 indicate that in general, the strategies to mitigate risks on construction projects are likely, as opposed to unlikely, to be implemented.

However, in terms of ranges both MSs are $> 3.40 \leq 4.20$, which indicates that both controlling of H&S risks, and monitoring of H&S risks are between likely to more than likely / more than likely to be implemented. This is a requirement of the OH&S Act, Construction Regulations, and Ergonomics Regulations. Furthermore, monitoring requires pre-activity HIRA, and activity HIRA as the activity proceeds, which requires empowerment of construction managers and supervisors, CHSOs, and workers in terms of HIRA. Then, controlling includes the development and implementation of method statements, and safe work procedures (SWPs), accompanied by 'close supervision' including appropriate inspections, in cases, more frequent than daily.

Table 7. Likelihood of the implementation of strategies to mitigate risks on construction projects.

Strategy	Response (%)						MS	R
	Un-sure	Highly unlikely.....Highly likely						
		1	2	3	4	5		
Controlling of H&S risks	1.0	1.9	7.8	18.5	39.8	31.1	3.90	1
Monitoring of H&S risks	6.8	3.9	15.5	17.5	21.4	35.0	3.50	2

CONCLUSION

Given the frequency at which ergonomic hazards are encountered on construction projects it can be concluded that the construction process and

its activities entail exposure to ergonomic hazards and risks. Furthermore, the frequency alludes to the likelihood that designers are not eliminating or substituting hazards, and construction HIRA is not effective.

The likelihood of six ergonomic hazards leading to the development of MSDs leads to the conclusion that the construction process and its activities are physically demanding and militate against the health and wellbeing of workers.

Given the likelihood of incidents being reported by construction workers, it can be concluded that they do not fear 'losing their jobs' due to reporting such incidents. This conclusion is underscored by the unlikelihood of factors impacting them reporting incidents.

The likely commitment of 50.0% of project stakeholders to construction H&S leads to the conclusion that construction H&S is not receiving the necessary and potential multi-stakeholder support.

Given the extent to which seven factors impact H&S management on construction projects, it can be concluded that effective construction management is required to optimise ergonomics and H&S.

The likelihood of the implementation of strategies to mitigate risks on construction projects in the form of monitoring and controlling of H&S risks leads to the conclusion that optimum ergonomics and H&S requires focus on HIRA.

RECOMMENDATIONS

Multi-stakeholder commitment to and support for H&S and ergonomics should be engendered during the client brief and upon appointment of all stakeholders and underscored by requiring multi-stakeholder project H&S plans, as opposed to solely a PC H&S plan. Such plans should indicate all stakeholders' required H&S and ergonomics-related interventions per project stage.

Designers should consider the impact of design, details, and specifications on construction H&S and ergonomics during the construction process and subsequent maintenance, and contractors should inform designers when design-originated H&S and ergonomics hazards and risks are encountered.

Contractors should adequately resource H&S and ergonomics at tender stage, and ensure that the requisite H&S systems, procedures, and protocols are implemented when construction commences. Monitoring and controlling of hazards and risks is imperative.

Workers should be empowered through, *inter alia*, HIRA training, and participation in the development of SWPs. Furthermore, they should be encouraged to report incidents.

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