

BOOSTING CONSTRUCTION EMPLOYEES' PERFORMANCE THROUGH SMART ERGONOMIC MOVES

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Abstract. Musculoskeletal disorders (MSDs) are construction workers' most prevalent occupational diseases due to awkward body posture, high repetition of work and vibration. The study sought to examine the different types of ergonomic moves that could improve construction workers' performance. Findings show that majority of the workers were males and their trade groups cut across different trade groups (masonry, carpentry, plumbing, and electricals). There was a scarcity of civil engineers and quantity surveyors in almost all the construction firms. The most influential factors that contributed to musculoskeletal injuries among construction workers were extreme temperature, static posture and exertion of force at work. These factors have contributed to the loss of concentration and absenteeism at work, which have also led to delays in the execution of work. Further findings show that engineering control measures should be employed, and training and education should also be given to workers to prevent MSDs among employees to enable them to work smarter but not harder to improve their performance. Employers should include education and specific task training in the company's policy for all newly employed personnel. Workers should also be monitored to ensure that they take a recess during the day's work.

Keywords: *Building trades, hazards, healthy environment, risk factors, WMSDs.*

INTRODUCTION

The construction industry comprises various trades with different skills and tasks (Choi et al., 2016), which can lead to hazards when appropriate safety measures are not put in place (Berglund et al., 2021; Choi et al., 2016). Accidents are inevitable in construction since the dangers are higher than in other occupations (Ling et al., 2009). An accident is a potentially catastrophic incident that causes personal harm or property damage (DeCamp & Herskovitz, 2015). According to an International Labour Organization report (ILO, 2015), the construction industry is linked to certain occupational fatalities around the world. Because of their dangerous character, Elsebaei et al. (2020) underlined that workplace health and safety problems have been of major concern to the construction sector globally. Construction jobs, by definition, expose workers to dangers that might result in

accidents, exhaustion, and stress (Ajayi, 2013).

Workers in the construction industry are constantly subjected to significant risk factors for work-related musculoskeletal disorders (WMSDs), which are connected to health implications (Choi et al., 2016; Ajayi, 2013). The majority of construction work is manual and relies on muscle power, which sometimes results in awkward positions (Wang et al., 2017; Nasl-Saraji et al., 2008). WMSDs commonly affect the lower back, spinal cord, and upper limbs (Maher et al., 2017). Every year, WMSDs are often the biggest reason for worker disability, affecting millions of workers (Nasl-Saraji et al., 2008). Ghana's construction sector heavily relies on labour, which has resulted in several workplace accidents (Ghana Statistical Service, 2020; OSHA, 2016; Kheni, 2008). Despite gradual improvements in the building and construction sector across the globe, overall trends of fatality, serious injuries, and illness are among the worst in any industry (HSE, 2013). The study examined the different types of smart moves in ergonomics that could be used to improve the performance of construction workers.

1. WRMSD RISK ASSOCIATED WITH DIFFERENT TRADES

Carpenters are the most common occupation in the construction field. Carpenters have a greater prevalence of injuries and illnesses than the sectoral limit, especially strains/sprains from manually lifting objects being the most widespread ailments (BLS, 2015). Static and/or awkward postures for long durations, physically strenuous handling of materials, severe and recurrent tool motions and inclement weather are all work-related MSD risk factors (Cheung et al., 2009). Drywall installers are carpenters who work with heavy and cumbersome components, frequent screw-driving activities, and unusual body postures (Yuan & Buchholz, 2014). Handling materials manually entails tasks that personnel physically lift, lower, push, pull, hold, or convey resources. These practices may raise the likelihood of sustaining unpleasant strains, sprains, and more severe soft-tissue injuries (NIOSH, 2015). Most building trades are often performed outside, exposing workers to harsh weather as well as working in awkward positions (BLS, 2015; OSHA, 2014).

Typical ergonomic dangers include uncomfortable body postures that strain the body (Batson, 2012). Also contributing to low-back injuries is the manual lifting of large objects (Cheung et al., 2009). Musculoskeletal problems of both the back, neck/shoulders, hands/wrists, and knees are common in this category of employees (Cheung et al., 2009). However, roofers' musculoskeletal complaints are closely linked to work limitations, missing work, and impaired physical performance. Roofing-related MSDs commonly affect the back, shoulders, hands/fingers, knees, and feet/ankles (Welch et al., 2019; Choi, 2007).

2. ERGONOMICS RISK FACTORS IN CONSTRUCTION

In construction, several different working postures are experienced during the execution of work (Ajayi et al., 2015). By its very nature, the construction sector is labour-intensive, and it is exceedingly rare for workers to evade exertions of force

and awkward positions (Golabchi et al., 2015). Construction job sites seem to be more unsafe than almost any work environment due to the incorporation of heavy machinery, physically demanding tools, and shifting work conditions.

When compared to other industries, work-related musculoskeletal disorders (WMSDs) are the primary cause of work-related injuries in the construction industry, accounting for approximately half of all non-fatal injuries (Golabchi et al., 2015; CPWR, 2013). Poor posture in performing professional activities, force and regularity of particular actions, like vibration, are all ergonomic risk factors (Jaffar et al., 2011). Ergonomic solutions have helped to avoid accidents and fatalities while also improving safety and health practices for construction workers (Hess et al., 2010; Entzel et al., 2007).

Construction employees should be familiar with ergonomics risk factors (ERF) in their works and methods of reducing such hazards (Diego-Mas & Alcaide-Marzal, 2014). A repetitive motion for a long period without any rest may lead to muscle strain. Loaders or excavators may experience body vibration when the ergonomic programme is not practised on construction sites (HSE, 2016; Myers, 2015). Lifting heavy loads, pinch grips, and operating levers/buttons are a result of excessive force (OSHA, 2016). Contact stress may be a result of pressing against hard edges, sharp surfaces or supporting excessive weight and gripping tools (Reiher & Krajewski, 2012). Working in a cold environment may lead to sensory sensitivity, fatigue, reduced grip strength and dexterity or trouble breathing. Stress which increases muscle tension or decreases break frequency directly impacts work techniques (Taylor & Green, 2015).

3. SMART MOVES IN ERGONOMICS

A safe, healthy and efficient workplace is important in ergonomics to enhance communication (Marras & Karwowski, 2006). Despite all of the remedies, movement-related injuries (soft-tissue fractures, strains/sprains, accidental falls, hand fatalities, bodily reaction injuries, and repetitive motion) have remained a big problem for some firms (Pater, 2019). According to Marras & Karwowski (2006), in-depth instruction, sensitivity training, and retraining can raise employee awareness.

According to the Labourers' Health and Safety Fund of North America (LHSFNA, 2016) and Choi (2007), staff training should address ergonomic dangers related to the handling of materials, the usage of material handling systems, precise materials that need to be utilised, and the dangers related with their utilization. Marras & Karwowski (2006) were of the view that a documented training program is important to sustaining and augmenting ergonomics, as well as decreasing the risk components. Furthermore, Albers & Hudock (2007) stated that changing the way work is performed may lower input cost, the time required to accomplish a project, and the quantity of reaching work necessary. The employment of material handling equipment (e.g., mechanical, hydraulic, or vacuum lifts) as an alternative to physical material handling is an additional successful method.

The use of mechanical devices such as a portable ergonomically designed hand tool in a repetitive job task (e.g., ergonomic rebar-tying machine) as an engineering

control measure may contribute to the reduction of the physiological burdens imposed on the employee (Albers & Hudock, 2007). Ergonomic injuries can also be avoided by altering the tool's handle design (LHSFNA, 2016; Choi et al., 2007). Exercise and stretching are now used on construction sites as a preventative approach to preventing upper-limb MSDs (Choi & Rajendran, 2014; McGorry & Courtney, 2006). Workers should take brief breaks frequently to extend their backs while hunched over (OSHA, 2014).

4. METHODS

A quantitative research design was selected for this research following the objectives outlined for the research (Naoum, 2007). The study's population was made up of site workers on projects in Ghana's Central Region. The convenience sampling technique was utilized in the study and made it easy for the researcher to obtain adequate information on the size of the population that was lacking in October 2021 (Sekaran & Bougie, 2010). Cochran's formula (1977) was used to get the sample size for the investigation. The formula is as follows:

$$s = \frac{(Z^2) \cdot p \cdot (1 - p)}{(m^2)},$$

$$s = \frac{(1.96^2) \cdot 0.5 \cdot (1 - 0.5)}{(0.098^2)},$$

$$n = 0.9604/0.096;$$

$$n = 100.04 \cong 100,$$

where

s – a sample size for unknown population;

$Z = 1.96$ (Z score is based on the chosen confidence level of 95 %);

p is estimated population proportion (50 %);

m is the limit of error (9.8 %).

The study's sample size was 100, with a 95 % confidence level and a 9.8 % limit error. In research, a 10 % margin of error is acceptable (Yin, 2009). As a result, using a margin of error of 9.8 % improved the validity of the data gathered for this investigation. To collect the necessary data for the investigation, a quantitative research design was used (Damoah, 2015). The researchers utilized a questionnaire as a research instrument (Nayeem, 2017). Statistical approaches were employed throughout the data gathering and analysis to conduct a systematic study of the notion (Apuke, 2017).

Data from the completed questionnaire were cleaned and coded to ensure uniformity. The data were presented in figures and tables before being graded based on their relative relevance by using Relative Importance Index (RI) analysis and Excel software (Hossen et al., 2015).

5. RESULTS

The section discusses the findings of the field study's data. It begins with the demographic data and factors that influence musculoskeletal injuries, their effects and smart moves to improve the performance of construction workers respectively. The demographic data of the respondents are as follows: gender, age groups, educational qualifications, number of years spent in the construction firm, trade groups and position on the construction project.

The majority (87 %) of the respondents were males indicating the nature of work in the construction industry. Figure 1 shows that the majority of respondents (27 %) were aged between 20 and 25, (24 %) between the age range of 26 and 30, while 23 % fell between 31–35 years. Only (1 %) represented the age group 46 years and above.

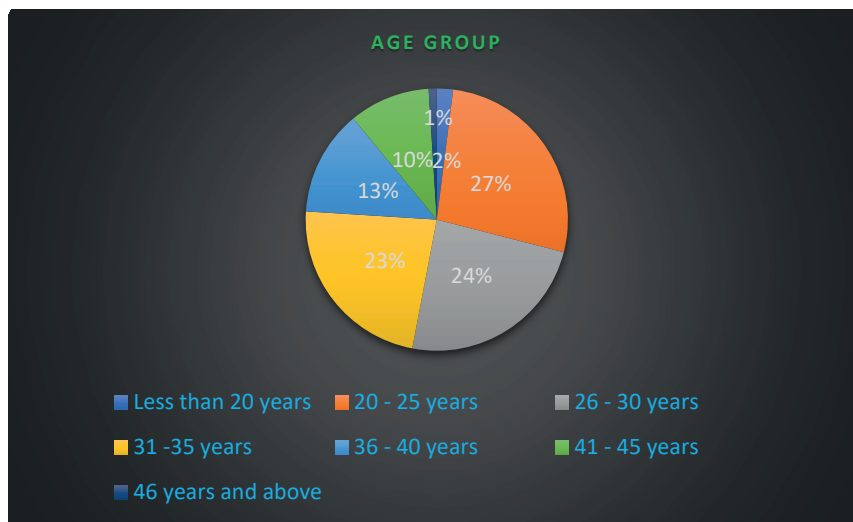


Fig. 1. Proportion of age groups.

Figure 2 shows that the majority (35 %) of the respondents possessed a Diploma or Higher National Diploma, 34 % had a secondary school certificate, and 25 % had a Bachelor's Degree. Respondents with a master's degree constituted only 2 % of the population. The results inferred that all respondents in the study were adequately educated to understand and contribute relevant information to the study.

The results established that the majority (33 %) of respondents had worked 6 to 10 years in their respective firms, 28 % had spent 11 to 15 years, and 12 % from 21 to 25 years as depicted in Fig. 3. Out of the total percentage, only 1 % had stayed for 31 years and above. The results inferred that majority of construction personnel in the Central region had spent about 6 to 10 years in their respective construction firms.

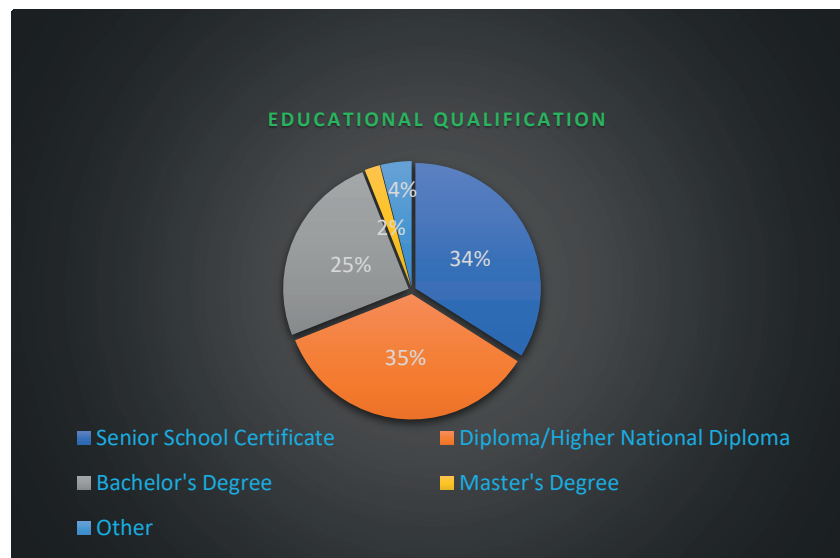


Fig. 2. Data on educational qualification.

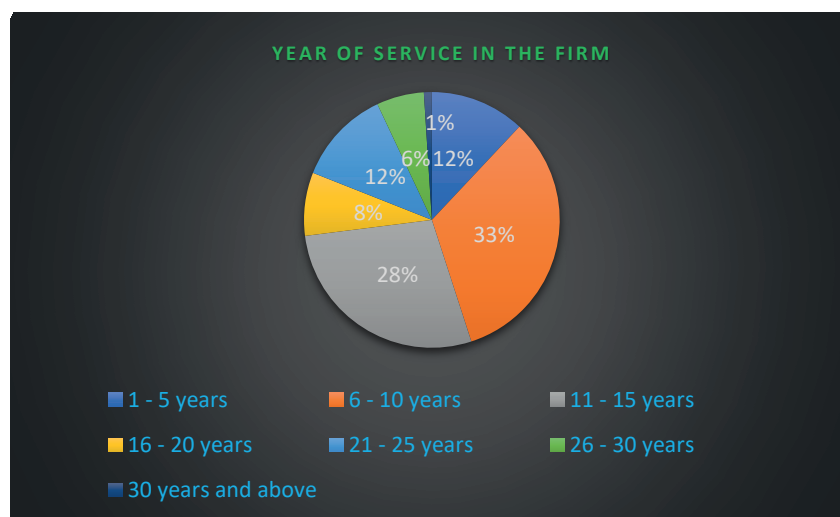


Fig. 3. Years of service in the firm.

According to Fig. 4, the majority (19 %) of the respondents identified with the mason's trade group. This is followed by 18 % who were identified with the carpenter's trade group and 15 % of the electrician's trade group. Least of the respondents (9 %) were identified with the steel metal workers trade group. The results inferred that most of the respondents in this study were affiliated with the masonry trade group.

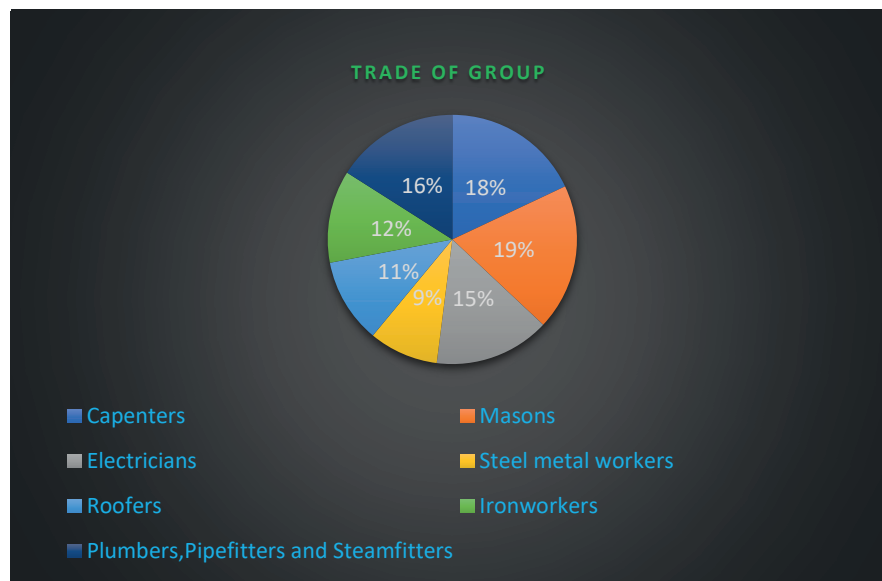


Fig. 4. Trade groups.

The study revealed that majority (44 %) of respondents were identified as general workers, 31 % were identified as foremen, with 11 % identified as site supervisors as noted in Fig. 5. The least of respondents (1 %) were identified as quantity surveyors. The results inferred that majority of respondents were general workers.

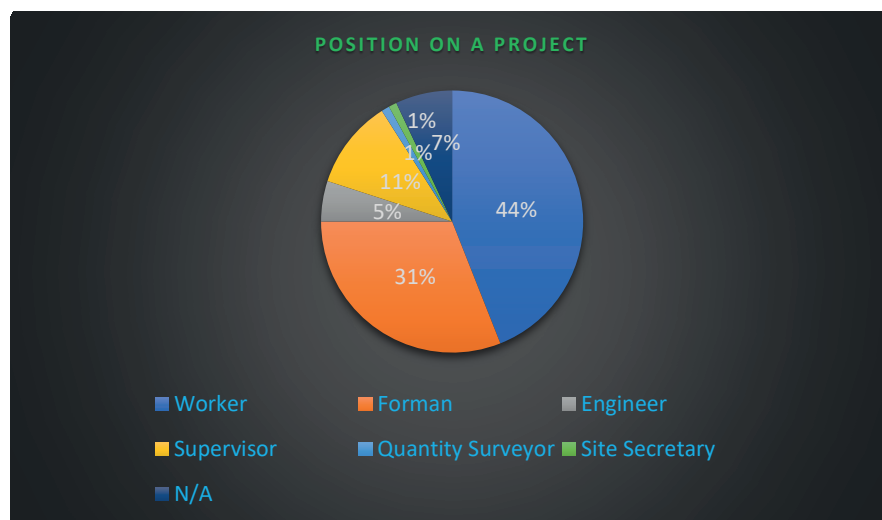


Fig. 5. Position on a project.

6. FACTORS THAT INFLUENCE THE MUSCULOSKELETAL INJURIES OF CONSTRUCTION WORKERS

In this section, respondents were asked to rank in terms of their agreeability to the factors that influence the musculoskeletal injuries of construction workers. Table 1 presents the rankings of the factors.

Table 1 shows that respondents ranked extreme temperature as the key factor among the six factors, with RII = 0.862, which influences musculoskeletal injuries of construction workers. This is followed by static posture, with RII = 0.860, and force as the third factor, with RII = 0.858. Repetition was the least among the six factors and registered RII = 0.836.

Table 1. Factors that Influence the Musculoskeletal Injuries of Construction Workers

Factors	RII	Rank
Extreme temperature	0.862	1
Static posture	0.860	2
Force	0.858	3
Vibration	0.852	4
Awkward posture	0.850	5
Repetition	0.836	6

Source: Field Study, 2022.

7. MUSCULOSKELETAL INJURIES EFFECTS ON CONSTRUCTION WORKERS

Respondents were enquired in this section to rank the effects of musculoskeletal injuries on construction workers based on their agreeability.

Delay of work was considered the main impact of construction workers' musculoskeletal injuries, with RII = 0.870. This is followed by loss of concentration, with RII = 0.850, and absenteeism, with RII = 0.840. Loss of contract was ranked the least factor among the seven factors which influence musculoskeletal injuries of construction workers, with RII = 0.806. The ranking of delay of work concurred with the findings of Marras & Karwowski (2006), which stated that injuries or illnesses resulted in major unproductive times, leading to delays of work in projects.

Table 2. Musculoskeletal Injury Effects on Construction Workers

Effects	RII	Rank
Delay of work	0.870	1
Loss of concentration	0.850	2
Absenteeism from work	0.840	3
Not working to specifications	0.836	4
Working to low standards	0.834	5
Lateness to work	0.818	6
Loss of contract	0.806	7

8. ERGONOMICS MOVES THAT CAN BE EMPLOYED TO IMPROVE ON WORKING SMARTER BUT NOT HARDER

In this section, respondents were asked to rank ergonomics moves that can be employed to improve on working smarter but not harder based on their agreeability.

Respondents, according to Table 3, ranked the stretching and exercising programme as the main factor among the twelve factors under ergonomics moves that can be employed to improve on working smarter but not harder, with $RII = 0.892$. This is followed by engineering controls, with $RII = 0.890$, and training and education, with $RII = 0.888$. The least ranked factors were new finishing techniques, pre-fabrication of parts, employee participation and written programme, with $RIIs$ of 0.862, 0.860, 0.856, and 0.854, respectively. The ranking of the stretching and exercising programme as the best smart move to improve the work of construction workers agreed with the studies conducted by McGorry & Courtney (2006) and Choi & Rajendran (2014).

Table 3. Smart Moves to Improve the Performance of Workers

Smart Moves	RII	Rank
Stretching and exercise programme	0.892	1
Engineering controls	0.890	2
Training and education	0.888	3
New building materials	0.888	4
Work process improvement	0.884	5
Hand tool selection and use	0.884	6
Safety management	0.878	7
Communications	0.864	8
New finishing techniques	0.862	9
Pre-fabrication of parts	0.860	10
Employee participation	0.856	11
Written programme	0.854	12

9. SUMMARY OF FINDINGS

It was realised that majority (87 %) of the respondents were males and between the ages of 20–25 years, which indicates that they were very strong and were able to carry out heavy-duty works on site. The majority (35 %) of the respondents had Diplomas/Higher National Diplomas, with only a few (2 %) having a master's degree. Most (33 %) of the respondents had been engaged between 6–10 years at their respective firms, and few (6 %) of the respondents had spent between 26–30 years at their workplaces.

The respondents were mostly (between 18 % and 19 %) masons and carpenters. The rest of the respondents cut across various trade groups: plumbers, pipefitters and steamfitters, and electricians (16 % and 15 %). The rest were ironworkers, roofers and steel metal workers. Most (44 %) of the respondents were general workers or labourers at their various workplaces. The engineers were very few (5 %) at the various construction sites. Extreme temperature, static posture and force were found to be the most influential factors that contributed to musculoskeletal injuries of construction workers.

The use of force by workers at their workplaces concurs with the findings of OSHA (2016) and Golabchi et al. (2015). Delay of work, loss of concentration and absenteeism from work were identified as contributing to construction workers' musculoskeletal injuries effect. Stretching and exercising, engineering controls, and

training and education were found to be the ergonomics moves that can be employed to improve on working smarter but not harder for these workers. Stretching and exercising programme, which was found to be the leading factor for ergonomics moves that can be employed to improve on working smarter but not harder, concurs with the findings of McGorry & Courtney (2006) and Choi & Rajendran (2014), which indicated that stretching and exercising programme was an easy, cost and time effective way to prevent numerous types of musculoskeletal injuries (lower to upper extremities) and improve the performances of workers.

CONCLUSIONS AND RECOMMENDATIONS

The study sought to examine different types of ergonomic moves that could be employed to improve construction workers' performance. Distribution of quantity surveyors and civil engineers was limited indicating the scarcity of qualified and competent personnel in the construction industry. Extreme temperature, static posture and exertion of force at work are the most influential factors in the construction industry contributing to musculoskeletal injuries. In addition to these factors, there was also loss of concentration and absenteeism from work, which have led to delays in work.

The introduction of engineering control measures and training of all workers immediately after employment, in addition to providing adequate education on specific tasks to be carried out, would assist in preventing musculoskeletal disorders and improve the performance of workers. Employers should also ensure that workers abide strictly by the company workplace policy to ensure the safety of workers and enable them to achieve their set targets at work.

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