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ASSESSMENT OF THE IMPART OF MUSCULOSKELETAL DISORDERS ON NIGERIAN CONSTRUCTION WORKERS

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ABSTRACT: *The purpose of the study is to assess the impact of construction activities as construction work entails non-ergonomic activities, range of in-situ work at various levels and construction workers; complain of pain, retire early from work, are frequently absent, are required to handle materials manually resulting in poor productivity as contractors are required to execute designs and excessive material wastage occurs. The focus is on reducing the impact of work related musculoskeletal disorders (WMD's) among construction workers through contractor's perception thereby creating effective and healthy construction workplaces. Given that the general contractors (GCs) responded relative to both general contractor (GC) and sub-contractor (SC). The impact of construction activities on construction workers in the Nigeria construction industry as it precipitates into WMDs affects the rate of productivity. The paper uses historic data on unfavourable ergonomic practices and quantitative survey method (based on a designed questionnaire) to establish a criterion for reducing WMD's in construction by providing an effective strategies to promote construction workplace health and safety. The study establishes various interventions on factors that negatively impact on the health and safety of construction workers. Based on the findings from empirical survey and the survey of literature, the study tends to establish a work organization that can influence process and activities in the construction industry through designing of work place to ameliorate the prevalence of musculoskeletal disorder among its workers. Furthermore, the contractors' perspective approach for health and safety as a panacea to reducing WMD's is established. The information provides an insight into the contribution to safety and health of construction workers. The study establishes various interventions on factors that negatively impact on the health and safety of construction workers.*

KEYWORDS: Design, Ergonomic practices, Construction workers, musculoskeletal disorders, Health and Safety (H&S), Contractors, Work organization.

INTRODUCTION

Construction industry is still one of the highest risk industries as far as its activities are concerned. The industry stands out from other employments as having the highest worker injury and fatality rates which makes it the highest risk sector in regard to work-related musculoskeletal disorders (WMDs). The construction sector represent strategically important sector in the provision of building and infrastructure on which all sectors of the economy depend. Construction worker face different kind of safety and health hazards while working in their work sites every day. With increasing industrialization of the construction process, its wide range of activities exposes its workers to unfavorable ergonomic challenges. Construction workers are two times work related injured compared to the average for all industries [1], [30]. The World Health Organization (WHO) has characterized "work-related"

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diseases as multifactorial to indicate that a number of risk factors (e.g. physical, work organizational, psychosocial, individual, and socio-cultural) contribute to causing these diseases [35]. The sum of these challenges affects the working capacity and decreases the satisfaction of the individual. The Musculoskeletal disorders (MSDs) remain the most prevalent form of occupational ill health, prompting examination of why attempts to manage the problem have been less successful than perhaps hoped [Ajayi 2]. Musculoskeletal disorders (MSDs) are the most common work related health problems. For instance, when we see how the problem is serious in Europe. Across the EU 25% of workers complain of backache and 23% report muscular pains. MSDs are the biggest cause of absence from work in practically all Member States [5]. In the United States, the most common types of non-fatal occupational injuries that result in days away from work are musculoskeletal injuries such as sprains and strains. A similar problem had been observed in Brazilian workers. The most frequently affected body was the shoulder (49%; 95% CI 42.0–55.3), followed by the neck (47%; 95% CI 40.6–53.9) and back (39%, 95% CI 32.2–45.1) [5]. In the Swedish construction industry, more than one man in five, twice as many as for all men employed, has reported work-related musculoskeletal disorders [18] and these disorders constitute about 69% of all reported work-related injuries in 2005. Based on the findings of ergonomics related research conducted among South African Construction management and workers, [31] conclude that the use of body force, reaching away from the body, reaching above the head, repetitive movements, bending or twisting the back, climbing and descending, were common and constitute work related job problems. The situation in developing countries is worst because research studies discover that accident and injury rates in many of the developing countries such as Nigeria, Thailand, and Tanzania are considerably higher than in European countries. Every construction worker is likely to be temporarily unfit to work at some time as a result of moderately serious injuries or health problems after working on a construction site [3],[16]. Construction work typically requires the adopting of awkward postures, lifting of heavy materials, manual handling of heavy and irregular-sized loads, frequent bending, bending and twisting of the body, working above shoulder height, working below knee level, staying in one position for a long period, climbing and descending, and pushing and pulling of load. These are all done under difficult circumstances.

[16] opined that in most developing countries, safety consideration of construction workers in construction project delivery is not given a priority and the employment of safety measures during construction is considered a burden as it is not addressed. Furthermore in Nigeria construction industry, the risks are transferred to the contractors by the client while the contractor extensively translate all operational risks to the operatives and disposition to knowledge transfer in terms of health and safety of the workers are being considered not so important. A number of studies had been conducted on the prevention, treatment and rehabilitation of work place injuries.

The paper presents contractors and subcontractors perception on strategies for reducing the impact of musculoskeletal that is work related among the construction workers in Nigerian construction industry via an exploratory study based on questionnaire. Furthermore the findings of the survey established relationships between the workplace exposure and health outcomes of a construction worker and further establish the basis for reducing MSDs in construction tasks.

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REVIEW OF LITERATURE

Over view of Work- related Musculoskeletal Disorder (WMDs) on Construction Worker

MSDs are part of musculoskeletal systems such as muscle, nerves, tendons, ligaments, joints, cartilage and blood vessels that are of chronic overuse and misuse [10]. WMDs, as defined by the International Commission on Occupational Health, are disorders and diseases of the musculoskeletal system that have a causal determinant that is work related [26]. WMDs are causally linked to physical loads resulting from occupational activities. Work related musculoskeletal disorder occurs when the mechanical workload is higher than physical capacity of the human body. Construction workers' are at high risk of developing WMDs in comparison with workers' in other occupations. Accurate data on the incidence and its prevalence are difficult to obtain and official statistics are difficult to compare across countries. The disorder generates a destructive impact on workers' life, such as persistence of pain in work or leisure and even permanent disability. WMDs are not just one of the major occupational health problems worldwide; it is also recognized as an economic burden on the society.These occupational illnesses include direct and indirect costs. The direct costs are associated with workers' compensation, medical care and rehabilitation while the indirect costs include work disability, sick leave; reduce productivity, decrease work quality, retaining costs and diminished morale. Based upon a survey in the UK construction industry in 1995, out of 2 million people who reported suffering from work-related ill health, 1.2 million people (60% of the total) suffered from MSDs. The 'Lighten the Load Campaign' by the European Agency for Safety and Health at work aims to tackle MSDs in the workplace [9]. It emphasised that across the EU, 27.9% of workers complained of WMDs, with the highest rate being found in the construction and agricultural sectors [6].

In the USA, an effort was made to establish a surveillance system and to collect data on WMDs specifically for construction in a cross-sectional study among construction workers in Oregon, Massachusetts, Iowa, and Ohio. The key findings from the studies were that: overall, WMDs were more common than expected from natural data; the pattern of WMDs varied between trades, with the trades that had more over-head work reporting a higher proportion of upper extremity disorders; trades with more lifting and carrying tasks reported a higher proportion of back disorders, and the WMDs were chronic and often impacted on the quality of life of construction workers. Therefore, workers with jobs that include some combination of physical force, repetitive motion, awkward or static body postures, contact stress, vibration or extreme temperatures are at risk of developing WMDs. The physically demanding nature of the work in construction, which includes manual materials handling, awkward and static postures, vibration and a harsh outdoor environment help explain why there is a high prevalence of WMDs among construction workers [8, 14].

[17], concludes from research findings that injuries on workers range from 0.35 to 49.4 injuries per 1 000 workers in the Southern African Development Community and fatalities range from 0.85 to 2.16 per 100 000 workers. The International Labour Organisation (ILO) estimates that some 6 000 workers die each day world wide and 337 million people are victims of work-related accidents or illnesses arising from occupational injuries [20]. In Nigeria the construction industry, [24], asserts that the industry looses at least 5% of its workforce annually to injuries and fatalities, while the influx of new blood has reduced by 17% compared to that of 1970s. However, studying WMDs and its impact in Nigerian construction industry is highly needed, taking into consideration the nature of construction

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work and characteristics of the industry so as to avoid industry specific challenges to implementing ergonomic improvements which includes:

- A work environment that is constantly changing;
- A mobile workforce and short term jobs that limit employer incentives to invest in the prevention of chronic conditions;
- Inadequate communication among contractors and subcontractors on Multi-employer worksites;
- The location of many construction tasks at floor or ceiling level, and
- The common practice of workers supplying their own tools, so tool interventions must often take place through individual workers rather than through employers.

Factors contributing to Work related Musculoskeletal Disorders (WMDs) in Construction

Construction work is distinctive for the high number of different contractors and subcontractors usually found working on a particular project, which in turn indicates the influence of procurement on construction ergonomics. [34], describes the coordination of this parallel and sequential work as being often so complex that a smooth work flow is virtually impossible, thereby exacerbating WMDs. However, the risk factors which can cause or have an association with WMDs in construction work include repetitive motion, forceful exertions of the hands, frequent or heavy lifting, pushing, pulling or the carrying of heavy objects, and prolonged awkward postures. The risk factors that contribute to WMDs which are detrimental to the health of construction workers especially when they occur at high levels and in combination thereof include the primary and the secondary risks. The primary risk factors for WMD complaints include forceful exertions, repetitive movements, working in awkward postures, working above the head level, climbing and descending, frequent bending and working above shoulder height, while contact pressure, vibration, temperature and combination effects are considered as secondary factors [19], [29], [11].

[19], argues that there is strong evidence that WMDs are associated with lifting, high exertion, and awkward postures. Table 1 below, highlights the risk factors that causes the impairment of WMDs in construction workers. This is achieved by identifying the factor/action, possible result of the body action, direct and indirect impact on the construction worker relative to workplace.

[14], posits that a fairly large percentage of construction accidents could have been eliminated, reduced or avoided by making better choices in the design and planning stages of a project. Paying attention to health and safety issues of construction workers in the design phase could have a significant impact in reducing the risk of injury during construction.

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TABLE 1: Factors related to Work-related Musculoskeletal health of Construction Workers

Factor / Action	Possible result or consequence	Action / Causes	Direct impact	Indirect impact
Forced exertion	Acute overloading of body tissues	Lifting, carrying, pushing, pulling heavy objects	Restricted activity days	Low productivity
Handling heavy loads over long periods of time	Degenerative health disorders	Manual handling of materials	Sprain and strain on the back	Loss of income to workers, absenteeism
Working in unfavourable/awkward Postures	Pains and strain	Working heavily bent, or twisted trunk, or hands and arms above shoulders	Non-coordination of body system	Non-achievement of quality
Working in the same position	Long muscular activity and overload body tissue	Working overhead, working in a confined space	Sprain and repetitive strain injuries.	Early retirement
Repetitive manipulation of the body	Unspecific Complaints in the upper extremities	Repeated activation or muscles without relaxation	Ill health	Fatigue Absenteeism

Source:[2]

Ergonomics Problem in Workplace Activities

Construction is a physically demanding process and its construction activities expose workers to numerous ergonomic challenges .Many authors submitted that occupational ergonomics has to do with the design modification of the workplace and the organisation of work to match the worker and aim to decrease injuries at the workplace and increase productivity. In a review of epidemiological evidence for WMDs, [29], submittes that there is evidence of an association between MSDs and certain work related factors in which there is an exposure to the physical factors, injury is the outcome. Substantial evidence exists that indicates that MSDs were a major cause of construction injuries requiring compensation to be paid. A large volume of existing research identified the affiliation of construction injuries to different construction trades [31], [14].

[32], analysed a research conducted among construction workers representing six trades in the USA on the extent to which 15 job factors constituted a problem on a scale of: minor-problem, minor- moderate problem, and major problem. Based upon a score of 10 the following were determined to be the top five work site problems resulting from little or no ergonomic input:

- Working in the same position for long periods
- Bending or twisting the back in an awkward way

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- Working in awkward or cramped positions
- Working when injured or hurt and
- Handling heavy materials or equipment.

RESEARCH METHODOLOGY

The methodology adopted for the study is the use of historic data in exploring the unfavourable ergonomic practices in construction as well as quantitative survey method based on questionnaire to achieve its objectives.

A structured questionnaire survey was developed from relevant literature to establish the perception of the contractors (both GCs and SCs) on the onset of WMDs and the intervention in reducing its onset. In this way the questionnaire were designed based on the terms of their involvement in construction activities and process, actions that results in WMDs. The objective of the study were to determine the strategies through contractors perception relative to: the extent to which construction activities impact on construction workers' health; the extent to which frequent bending , bending and twisting of the body, working below knee level, lifting, manually handling heavy and irregular sized loads, working in awkward posture, staying in one position for a long period, climbing and descending, working while hurt or injured are performed on construction site and the effect of these activities on the physical nature of workers thereby precipitating into WMDs. The sample was drawn from registered general contractors with the Ministry of works and housing in six states of South West Nigeria. The States are Oyo, Ogun, Lagos, Ekiti, Ondo and Osun states.

A total of 100 contractors were surveyed and only 48 responded to the survey constituting a response rate of 48%. However a total of 48 completed questionnaires were included in the analysis of the data. All the respondents were working as fulltime contractor within the construction industry. The data were captured using epi- info statistical package and exported to SPSS for a univariate statistical analysis to measure the relationship between the variables and the frequency distribution.

Discussion and Analysis of Surveyed samples

The findings emanated from the survey indicates that there is a link between WMDs, body actions and processes as the physical demanding nature of the job helps to explain its prevalence and effects on health and safety of the construction workers on a limited scale. The findings amplifies the strategy to reduce the impact of WMDs among construction workers through the design process as the respondents were required to indicate the extent to which construction activities impact on construction workers, extent of performing the activities on construction site and the effect of these activities on the physical nature of the workers and to what extent does these activities precipitates into work related musculoskeletal disorders relative to a five point scale: minor extent; near minor extent; some extent; near major extent and major extent. A mean score (MS), was computed for each activities and its effects to enable interpretation of the percentage responses to the five point scale: minor extent (1); near minor extent (2); some extent (3); near major extent (4) and major extent (5).

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The survey found that the percentage respondent of contractors is 83.3%, while the subcontractor is 16.7%.

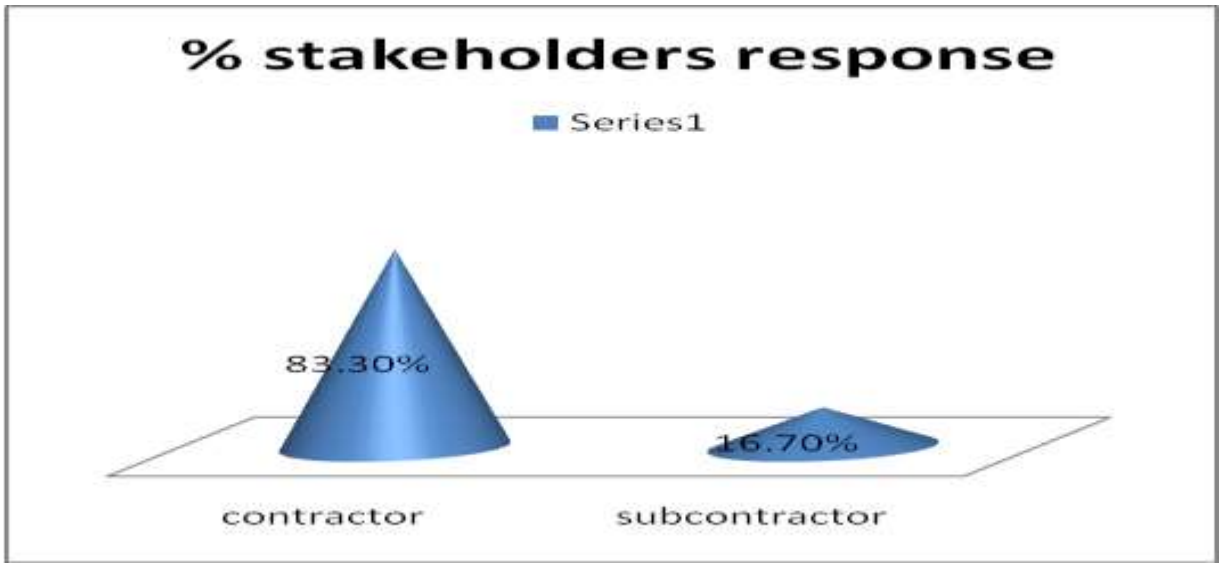

Figure 2: Stakeholder's response.

below it was found that the number of employees of the company varies as < 10 is 2.5 %, >10 ≤29 is 60% and > 30 is 37.5%.

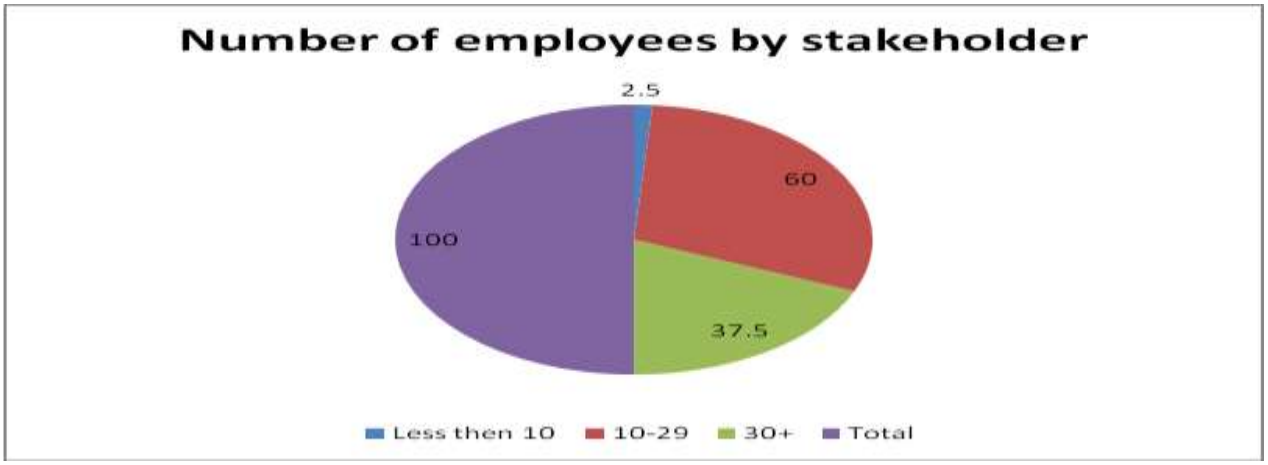

Figure 3: Percentage no of construction employees in the organisation

Figure 4 below indicates the perceived extent to which construction activities impacts on the health of construction workers on a scale 1 (minor) to 5 (major)and a mean score(MS) ranging between 1.00 and 5.00. Data revealed that the respondents perceived that the activities deemed to have an impact on construction workers with Ms > 3.00 which is near major extent (MS =3.98). In theory an instrument to identify the risk groups with respect to work related musculoskeletal disorders with the aim of taking strategic measures of prevention should only contain items which show a perspective relation with musculoskeletal symptoms.

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TABLE 2: Perception on impact of construction activities on workers' health.

Impact on construction workers health	Minor……Major				MS
	2	3	4	5	
Ratings	5.00	12.00	10.00	21.00	3.98
Percentage Response	10.42	25.00	20.83	43.75	

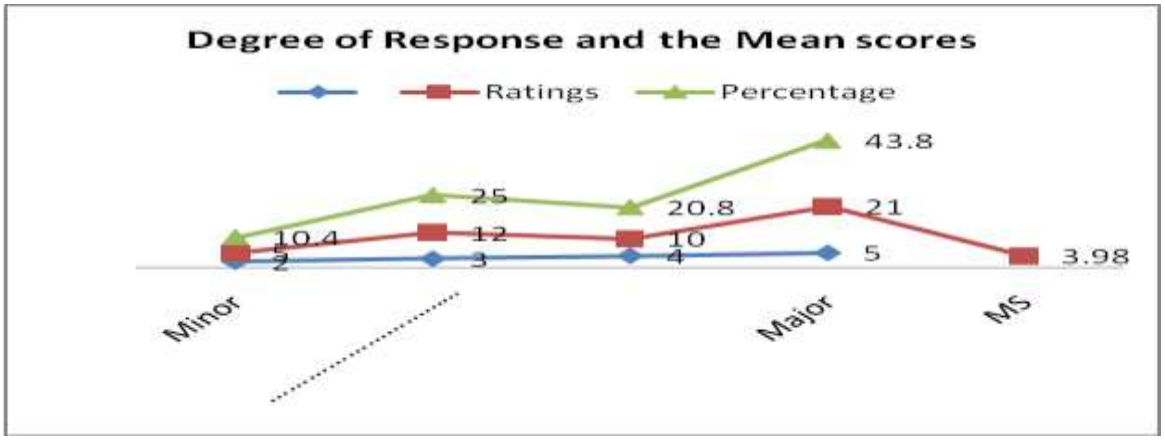

Figure 4: Degree of response and the mean scores

In figure 5 below the respondents perceived that the list of activities deemed to occur on construction site with the MS > 3.00 with activity frequent bending having the mean score (MS) = 4.31, lifting, MS =4.40, Manually handling heavy and irregular loads MS= 4.22, climbing and descending MS= 4.27, and staying in one position for a long period MS= 4.

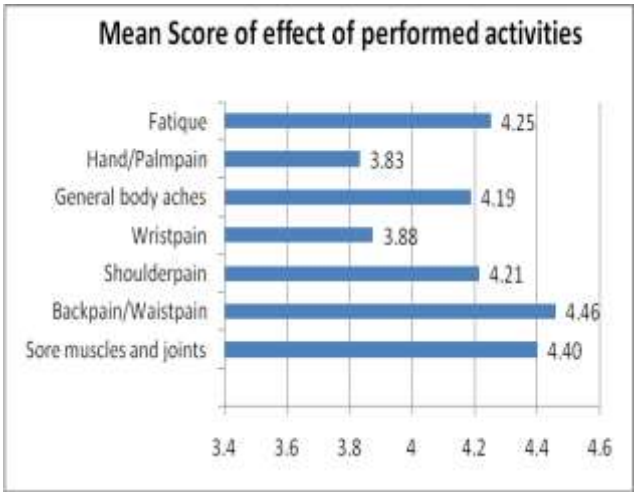

Figure 5:Extent performance of activities on construction site

Figure 6: Extent effect of performed activities on Construction site

With the activities listed in Figure 5, the respondents perceived their effect on the physical nature of construction workers in Figure 6. It is notable that the sore muscles and joints, back pain / waist pain, shoulder pain, fatigue, falls within the range >4.20 ≤ 5.00 (between a near

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major / major extent). Furthermore wrist pain, hand / palm pain, falls between >3.40 ≤ 4.20 (between some extents to a near major extent).

In Figure 7 below the respondents looked at the extent of the activities listed and how it precipitates into WMDs. The received data was subjected to analysis and the mean scores (MS= 3.73) falls between >3.40 ≤4.20 which indicate some extents to a near major/near major extent. This implies that the respondents deemed perceived that the activities do precipitates into the disorder.

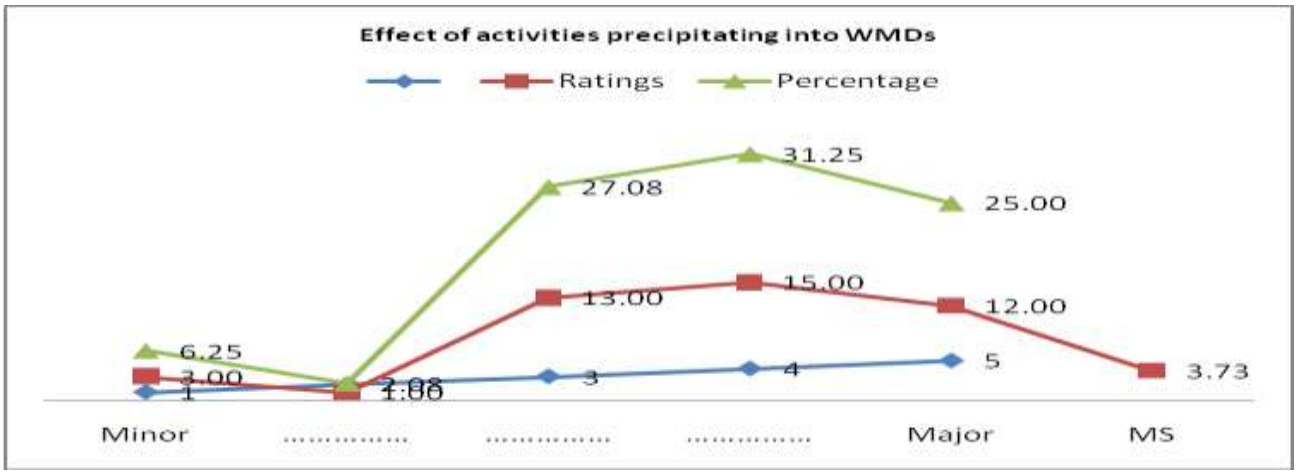

Figure 7**:** Extent effect of activities in figure 5

Figure 8 below gives the responses of the stakeholders on the availability of the ergonomic programme to their employees. It was noted that 91.7 % of this stakeholders does not have an ergonomic programme in place, 4.2% established that their employees do stretch training before construction work, 81.3% ascertained that there is lifting programme in place for their workers. 77.1% does not have weight restriction while 41.7 % of the respondents have a work practices and protective equipment for vibrations.

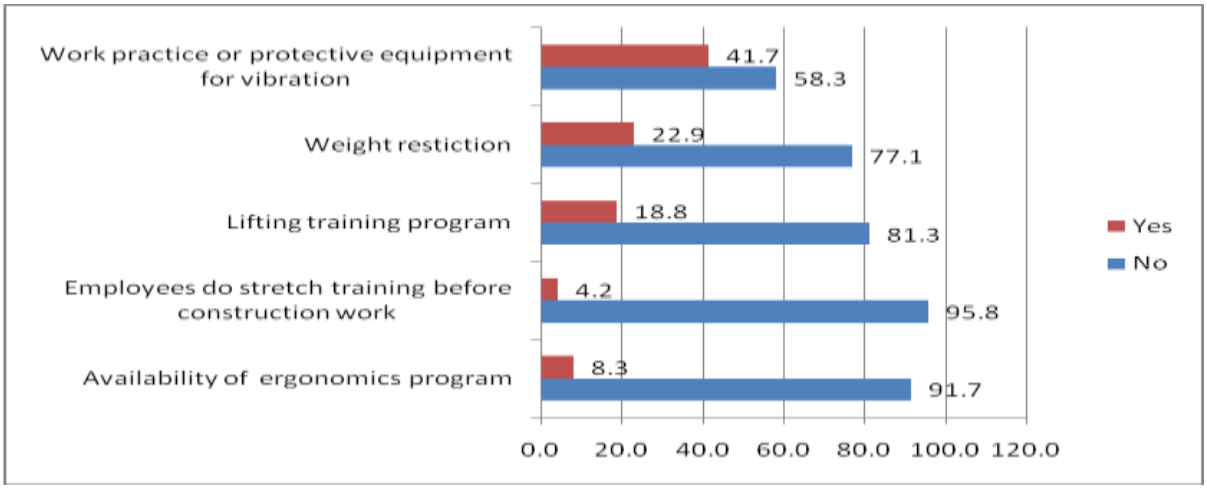

Figure 8: Ergonomics program in construction workplace

Table 3 and 4 below enumerates the response to management concern for safety procedures and feedback from their employees, having the mean score of 3.67 and 4.04 respectively

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which falls between the range >3.40 ≤ 4.20 – between some extent to a near major extent / major extent. The survey found that the respondents perceived that a construction activity hampers the physical nature of construction workers. Although the perceptions may not be the representative in terms of the size of the construction firm, the findings clearly indicate that there is a need to reduce the onset of the WMDs among the construction workers.

TABLE 3: Perception on Management concern to safety procedures

Concern of Management to safety procedures	**Minor……..Major**					**MS**
	1	2	3	4	5	
Ratings	0	3	22	11	12	3.67
Percentage Response	0.0	6.3	45.8	22.9	25	

Table 4: Encouragement of Feedback from site employees

Encouragement of feedback from site employees	**Minor……..Major**				**MS**
	2	3	4	5	
Ratings	1	8	27	12	4.04
Percentage	2.1	16.7	56.3	25.0	

Thus based on the findings and the fact that construction is a project based industry is an important contextual issue, when attempting to manage a dynamic changing work environment such as a construction site, it should be borne in mind that there is need to be in place of an appropriate safety structure to deal with the changing nature of the project. Enhancing organisational safety culture and workplace safety climate can have positive impacts on work environment and safety performance (Mohamed, 2003; Zhou et al., 2007; Oh and Sol, 2008). Therefore safety through design in reducing the onset of the WMDs among the construction workers is a fundamental principle of both ergonomics and occupational safety and health. The practice of ergonomics in the workplace is premised on designing the job and the workplace to meet the capabilities and limitations of the construction worker (Hecker et al., 2006; Mroszczyk, 2007; Belle, 2000; Ajayi and Thwala 2012a).

STRATEGIES FOR REDUCING THE IMPACT OF WMDs AMONG CONSTRUCTION WORKERS

In the Nigerian construction industry, it is clear that there is urgent need for construction stakeholders to educate and create awareness among their workers as well as at management level in fostering education in health and safety in construction workplace. Better understanding of hazards should be taken as a priority and that strategies on harzard prevention should be made from the onset of construction operations**.** The following strategies have therefore been recommended based on the review of literature and the research findings. Hopefully these will reduce the impact of WMDs at the workplace in the Nigerian construction industry.

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Promoting Ergonomic Principles in Construction Workplace

In the construction environment in relation to work systems, ergonomics is associated with the wellness of human beings. Establishing an effective ergonomic process is useful in addressing the onset of WMDs in the construction workplace. The research findings emphasised that different construction trades are exposed to various kinds of physical workload involving different parts of the body and hence causing different ergonomic problems.Therefore to fit the job to the worker, work station design, equipment and tools, work organisation and work environment must be considered. This is best achieved by the design of the specific work or by developing the capacity of humans to do the work after training and vocational adjustments [30], [9]. In summary, ergonomic principles should be followed to eliminate physical risks faced by the employees (construction workers). Furthermore, the management of the project must be committed to the processes, participate in the process and provide the necessary resources to ensure its success in the construction operation.

Workstation Area Design in Construction Workplace

Poor layout and design of workstations can increase the risk of injury by causing construction workers to work in awkward postures affecting the back, neck, shoulders and wrists. Therefore the following strategies apply:

- Work should be performed below shoulder height, lower the work piece or use a platform to reduce working above shoulders, and
- Work heights should let you work with your elbows close to your body. The heights adjustments are necessary to suit workers of different heights

Workplace Environment

This is considered a risk factor that relates to floor or ground surface, temperature, Noise, inadequate housekeeping and lighting condition in construction workplace. Consequently, all individual workers enter the construction work environment with variety of strength and weakness. These include age, general health status, motivation, and skill level, performance knowledge of the required work, expectation and ways of interacting with co-workers, supervisors and management. Therefore, a healthy environment builds on those strengths and motivations to develop a continuous learning and sharing work environment that rewards productivity, problem solving initiative, responsibility and team work [12].

The principles that are important for successful intervention include:

- Participatory approach which will involve the workers, their representatives and the stakeholder in a construction project. The positive effects using a participative approach in terms of greater comfort and higher productivity have been found to depend on implementation strategy.
- Multidisciplinary approach in assessing and monitoring of the risk of the disorder, and
- Adopted solution from another work place should be tailored to a specific condition on a certain project.

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Reducing the onset through Designing

The role of design professionals is to design the facility or structure that conforms to the accepted engineering practices, local building codes and safe for the public. Design presents a great opportunity for injury prevention and designers have a strong influence on construction workers' health and safety [27]. Design decisions made during the schematic and design development phases of a construction project directly impact on health and safety of the construction workers as they incur WMDs on work site. Therefore, the hierarchy of controls and elimination of hazards in occupational health and safety recognizes that engineering controls and the elimination of hazards through design are preferable to administrative control and personal protective equipment in limiting worker exposure to the onset of the disorder [14]. Traditionally, [11], emphasise that a design boundary has been created between design and construction by defining the expected scopes of work and standards of practice, however, new safety knowledge exposes the design professional's significant influence on worker safety and further established that design changes reduces ergonomic risks and likely to alleviate problems associated with congestion, access and material handling. [31], submitted that the design practices are employers and therefore need to address health and safety within the confines of their practices. The designers are allocated the responsibility to ensure that any 'article' or execution of work on a worksite is safe without risks to health of the worker.

Designers are required interalia: make available all relevant information about the design; design loadings of the structure and methods and sequence of construction; inform general contractor of any known or anticipated hazards or dangers or special measures required for the safe execution of the works. Designers are also required to ensure that during commissioning, cognizance is taken of ergonomic design principles in order to minimise ergonomic related hazards in all phases of the lifecycle of a structure.

[33], submits that the designing for health and safety of a construction worker as process that incorporates health and safety analysis at the beginning of a design which starts with hazards identification and with the application of engineering measures, the hazard is eliminated or reduced in its risks. If the risk of injury cannot be eliminated by engineering design or reduced by incorporating a safety device, warnings, instruction and training are considered to be the last resort [36]. The design community should adopt the philosophy of incorporating in their scope of work to include designing for construction workers' safety; thereby through a proactive effort a safer workplace in construction industry will be achieved.

Above all in the prevention of WMDs, various individual factors and physical and psychosocial work factors are related to musculoskeletal symptoms in the different body regions mainly neck, shoulders, low back, hands, and knees. Thus, the identification of risk factors might have far-reaching implications for the way in which effective health programs for prevention should be designed. General health promotion at the work place might be an additional strategy to prevent WMDs [3]. Avoidance of physical load primarily heavy physical work and prolonged sitting are the primary mechanisms for the prevention of low back pain which is the frequently occurring problem in work place [8]. Public Services Health and Safety Association Report on General Musculoskeletal Disorder Prevention [26] opines that: (1). If possible, lower rather than lift- Lowering loads from a higher to a lower level uses gravity as an advantage. This may help to reduce stresses placed on the body. (2). Always use the proper lifting technique (3). Push rather than pull- Pushing provides a mechanical advantage, since an individual‟s body weight helps to move the object. Pushing

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also allows for better body positioning, Reducing stresses on the musculoskeletal system. (4). Push or pull rather than carry. Pushing or pulling a load reduces stresses placed on the musculoskeletal system from carrying. (5). Work within the „power zone". The „power zone" is typically considered the area between the shoulders and the knees. Doing work within this area maximizes the body"s strength. Heavier objects should be stored in this area so that the body can more effectively handle them. Lighter objects may be able to be stored outside of the power zone. (6). Avoid awkward postures- Work should be designed so that most of it is done with neutral postures (Joints in their natural position).

RECOMMENDATIONS AND CONCLUSION

The study however established that various interventions impacts on the risks associated with health and safety of the construction workers and construction ergonomics**.** Based on the findings from empirical survey and the survey of literature, the awareness relative to ergonomics is needed in the Nigeria construction industry and there is a need for designers to consider in their designs how to reduce or eliminate construction work injuries such as WMDs. The study determined that baseline knowledge regarding the WMDs is inadequate as there are major concern about safety procedures and feedback from site employees (table 2&3). The result of the analysis relative to the mean scores indicate that there is need for an increase in training knowledge on strategies to reduce the onset of WMDs among construction workers. However, there may have been an improvement to baseline knowledge, but the need to address the knowledge areas of health and safety of construction workers is significant. To this end, health and safety plan or programme for construction workers hardly happen. Regrettably there is no evidence of medical surveillance mechanism in the study to show how the health status of workers were monitored. There is need to detect early signs of illness on construction workers so that intervention may be taken to prevent permanent health damage of occupational illnesses due to construction tasks.

Furthermore, the study confirmed that construction activities impact negatively on the construction worker as a result of various body actions and affects the physical nature of the workers (Figure 4, 5 & 6). Thus design dictates most of the activities and however contributes to the onset of WMDs. In the conceptual model, for minimizing WMDs through a participatory team, indicates that designers are to get inputs from other stakeholders in a construction project in order to produce a participatory health and safety design that is not detrimental to construction workers during the phases of construction. The result of such partnerships benefits namely the health and safety of the construction workers and end users and enhanced productivity and quality.

The professional designers should promote awareness of ergonomics in the construction sector as there are needs to protect the construction workers in relation to the menace that impaired on the body systems during construction activities. However the construction process should be re- engineered and reviewed to improve the activity environment against WMDs.

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