WOMEN HEALTH AND SAFETY IN CONSTRUCTION INDUSTRY

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Abstract
The research investigates the impact of ergonomics on health and safety of women in the construction workplace. Increased participation of women in the construction industry has been observed over the century. However, recent trends reveal a decline in women participation in the construction industry. Women participation in the broader economy is associated with economic growth. The argument makes a strong case for an investigation into women health and safety status and its impact to the construction industry. A quantitative study was done to give the discussion a local perspective with the objective to assess the impact of materials and tools handling over the health and safety status of women. The study surveyed a representative sample of 60 women found in 11 construction sites in Klerksdorp. Descriptive and inferential statistical tools were employed using the SPSS program to analyze the data and reach the study's conclusion. The research found that the women construction workforce is unhealthy and significant influence poor work ergonomics. The status quo impedes women's participation in the construction industry worsening the outcomes of poverty, unemployment and inequalities. The study concludes that health and safety education (HSE) programs need revamping to focus on long term goals that reduce health and safety outcomes for women. Progress made on tools and construction equipment design to improve work ergonomics has a limited impact without relevant HSE programs in place.

Keywords: Construction, Ergonomics, Health and Safety, Women, Workforce

1 Introduction

Ergonomics of the construction sector invokes the notion that construction work demand must not exceed the capacity of workers. Exceeding the capacity of workers has negative consequences for the health and safety of the workers. The negative consequences are severe particularly for women construction workers whose social burden is higher in the South African social context were 62% of households are women ran (Statistics South Africa (2014). This study investigates the effects of health and safety of women in construction industry. The global participation of women in the construction sector over the century has been observed to have risen according to U.S Bureau of Labour Statistics (2012) and locally confirmed by the South African Statistics of labour (2014). The increased participation of women construction workers in the construction sector and economies has also been linked to the economic progress of countries (IMF, 2010). However current global and local trends do show a decrease in the participation of women (Plascon, 2012). Part of the change in trends is explainable through the recent global recession and the post-world cup decline of the construction sector of South Africa. Empirical evidence suggests that a significant part of the decline in women construction

worker participation is also linked to bad ergonomics and the subsequent poor health and safety outcomes. OICI (2003) argued that construction work demands tremendous physical input to do the job. Schneider & Susi (1994) had also proffered that construction work is problematic for ergonomics as it involves handling of materials and tools which may not been suited for women.

Furthermore, the construction sector in South Africa is going through a recovery (Plascon, 2012). If this recovery is to be deepened towards economic inclusivity, ergonomics of the construction workplace particularly for women must be actively managed to obtain positive outcomes of health and safety. IMF (2012) associates women participation in the economy to the economic growth of a country. South Africa has launched the national blueprint National Development Plan (NDP2030) which hinges its success on the attainment of inclusive economic growth. The findings of this study would aid the efforts. This studies hypothesized that active management of the impact of construction workplace ergonomics positively influences women participation and subsequent productivity. Productivity and participation of women in the construction sector has positive outcomes for the economic growth of the country and in turn better outcomes of poverty, unemployment and inequalities.

2 Literature Review

Construction work is a problem for women as it involves handling of materials and tools which may not been suited for women (Schneider and Susi, 1994). According to Gibbons and Hacker, (1999) numerous construction tasks pose significant ergonomic risks to women workers. According to Safety and Health (2002), in 1999 the Bureau of Labor Statistics Advisory Construction Committee on Safety and Health found productive hazards ,ergonomic concerns, lack of adequate sanitary facilities, hostile workplace culture and ill-fitting personal protective equipment (PPE) and clothing as compassing issues in construction sector for women.

Kaminskas and Antanaitis, (2010) argue further that the high physical work demands are considered the primary risk factor for work-related injury disorders. In particular, the manual handling of materials in different awkward postures increases the risk of women injury disorders (Marras, 2000). Injury disorders cause sickness and decreased work capacity, thereby increasing the costs for trade site and interfering in social security systems on a national scale. Worldwide, the prevalence of muscle and tissue injury symptoms involving one or more body regions and occupational injuries among women bricklayers and bricklayers' assistants is higher than it is among construction workers in general. Interventions into the physical work demands placed on these workers are necessary in order to reduce the risk of injury disorders (Goldsheyder, 2002, Chau, 2004 & Rwamamara, 2006).

Recent studies had shown that to reduce work-related muscle and tissue disorders, tools, materials, and equipment should be designed based in part on ergonomic considerations (Schneider,1994).Tools and equipment are often designed to be used by normal sized men. Do not make hand tools for women, and women have different sizes, just like men (Morse & Hinds, 2000). OSHA, (1999), noted that designing equipment and tools to help women work more effectively can improve the health and safety of both men and women in construction workplace and points to the invention of a tool to lift manhole covers as one illustration of this. For women it was really difficult to lift them, but it was also very physically challenging for men. In this case, if we are concentrating on protecting women, we are also securing the entire construction workplace (NSC, 2010).

Women's size and body require reconsideration of methods for lifting and handling material. Not only that woman come in all sizes and with various degrees of muscular strength, but their pelvic structure is different and their Centre of gravity is lower than men's. This would impact jobs that require standing at a work station. Lower equipment handles would facilitate

the use of body weight in pushing and pulling jobs. Women's muscular strength is more equal to men's in their legs. Women will have more equal footing with men if the work load could be moved downward, with less confidence on the strength of hands and arms (OSHA, 1999). Women tend to have less upper body strength than men; they cannot use all of the methods men use for lifting and handling material. Out of necessity, construction women have to develop ways that make the job possible and safer for a woman. Personal protective equipment is intended to protect workers from hazards on the job. But PPE cannot perform normally if it does not fit properly. According to the 1999 report of OSHA's Health and Safety of Women in Construction workgroup and the Advisory Committee on Construction Safety and Health, ill-fitting PPE was a major problem for women in construction workplace. As surveyed and reported on PPE, women in construction used to wear multiple pairs of socks to fit into work boots designed for men, and women also used to roll up sleeves and hind legs on overly large protective clothing. Ever since 1999 report of OSHA`s, the issue of properly fitting personal protective equipment has been generally acknowledged (NSC, 2014).

Ergonomic risk factors are characteristics of a job that facilitate ergonomics stress on the body (Miosha, 2010). Risk factors occur at different jobs and tasks. The more women are exposed to these risk factors the greater the probability of ergonomics injury and what is called work related musculoskeletal disorders .According to Hagberg et al. (1995), ergonomics and human factors are often used interchangeably in workplaces. Both describe the interaction between the worker and the job demands. The difference between them is ergonomics focuses on how work affects workers, and human factors emphasize designs that reduce the potential for human error. Bongers et al. (2002) stress that by addressing traditional and environmental risk factors, it can keep workers injury free. Risk factors are defined as actions or conditions that increase the likelihood of injury to the musculoskeletal system. Applied ergonomics literature recognizes a small set of common physical risk factors across many occupations and work settings. The relationship between risk factor exposures and the level of musculoskeletal injury risk is not easily defined. Although physical risk factors are important first-line risk factors, there are other plausible factors such as organizational and psychosocial factors that may provoke a disorder or indirectly influence the effect of physical risk factors (Bongers et al., 2002).

Bongers and Kremer (2002) went on to identify the three categories of risk factors as biomechanical exposures, psychosocial stressors and individual risk factors. Biomechanical exposures include factors such as poorly designed workplaces and biomechanical exposures such as repetitive motion, high forces and deviations from neutral body alignments (National Research Council & the Institute of Medicine, 2001). Psychosocial stressors at work include factors such as high-perceived workplaces stress, low-perceived social support, low perceived job control, and time pressure (Bongers and Kremer, 2002; Huang et al., 2003). Individual factors include gender (female), age, negative stress reactions-especially stomach reactions, and unsatisfactory leisure time and/or additional domestic workload.

Williams and Wiehagen (2004), argue that although the causes of any particular case of a MSD are exceedingly difficult to identify with complete accuracy, certain risk factors are typically discussed in the field of ergonomic studies. Musculoskeletal disorder is a condition or disorder that involves the muscles, nerves, tendons, ligaments, joints, cartilage, or spinal discs. These disorders are not typically the result of a distinctive, singular event, but are more gradual in their development. Thus, MSDs are cumulative-type injuries. It is essential to understand just what a risk factor is, or what is not. A risk factor itself is not necessarily a causation factor for any particular MSD. Many times it is not simply the presence of a risk factor, but the degree to which the risk factor is expressed that may lead to MSD. Similarly, to the extent a MSD case is attributable to a risk factor, often it will be a combination of multiple risk factors, rather than

any single factor, which contributes to or causes an MSD. The next section discusses the methodology adopted to investigate the effects of the health and safety outcomes to the construction industry in the context of this study.

3 Research Methodology

Data was collected from a sample of 60 women construction workers around construction sites found in the Klerksdorp town. Questionnaires were administered to willing participants. Response rate was maintained at 100% as the sampling design was designed to continuously visit construction sites until 60 willing participants were reached as the targeted sample. However, the researcher recorded all attempted and failed access to sites in addition to sites that did not have women these had implications on the study. The implication on the study is apparent 5 sites out of 11 sites visited had no women as construction workers: suggesting a significant strained women participation in the construction sector. The data collected were tabulated into SPSS and analysed. The likert scaled questions were checked for internal consistence using the Cronbach's alpha analysis.

The questionnaire was divided into three sections. One section is for the demographic data of the sample. The other two sections profiling the workplace ergonomics of the sample proceeded from the anchor questions that sought to establish the health and safety status of the sample prior to joining the construction sector and after engaging with the tasks of the construction workplace. The analysis work sought to establish whether the health and safety outcomes had substantial linkages with workplace ergonomics of the sample and what statistical conclusions regards the participation and productivity of women can be made between the ergonomics profiles and the health and safety outcomes. In the process reveal the impact of ergonomics on the sample.

4 Data collection

The data obtained in this research is based on the primary sources as well as secondary Sources. Primary sources includes sampled women construction worker participants were the survey questions collected data on the impact of ergonomics on their health and safety, their attitude towards the contribution of their work environment to the problems. Primary data was sourced from the field of study through structured interviews. This study employed the interview technique, specifically the structured interview technique. A questionnaire was designed incorporating a mix of structured questions, open ended questions as well as in depth analysis questions. These were filled in by the interviewer with the information obtained from the face to face interviews with the participants from targeted construction sites. Additionally the researcher was able to observe and record site specific data concerning the working environment for women working at the construction site. Secondary sources of data include the monetary and the fiscal policy statements from the Reserve Bank of South Africa and the Ministry of Finance respectively. The qualitative interviews also favour the explanatory and the exploratory research approaches which aided data collection. These interviews were completed in a space of three months.

Each interview took on average 20minutes. Responses were directly recorded on questionnaire through a local language interpreter. Each response was read backward for verification and confirmation of the responses given.

5 Summary and Research Findings

5.1 Demographics information

Age distribution was an important consideration as a crude indicator of women construction workers participation in current recovery. Any evening out of the age groups across the sample

would suggest continued participation and inclusion of women in the construction sector. The age groups that are dominant can also suggest changes and the period when these changes took place. The 45 to 54 year age group represented majority of the sample women participants. The age distribution shows the impact of the World Cup and the preceding contraction. The generation that benefitted from the construction boom was more likely to be in this age group having joined as 34 year olds and less. The 25-34 age groups joined the construction sector during the depression but only the minority of the boom time employment for the same age group. The 11.4% composition in the random sample represents a 36% of the boom time employment of women in the construction sector may signal the recovery which is underway. These statistics can be enhanced to demonstrate the elasticity of women employment in the construction sector as the economies move from boom times to deeps. The 14% composition of the 25 to less age represents a possible 8% current recovery in the participation of women in the construction sector.

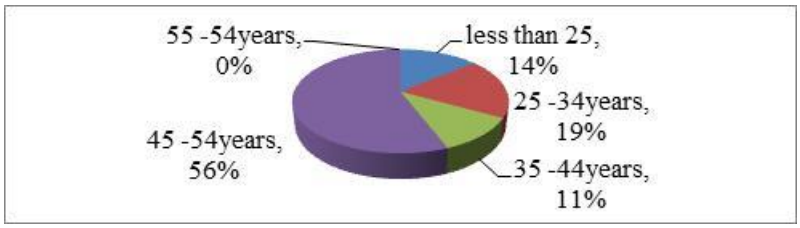

Figure 1. Age distribution

5.2 Health and safety outcomes

The impact of ergonomics of the construction workplace is apparent in the massive shift of health outcomes from the point of employment up to the point of the field work of this study.

Only 10% of the sample participants were nursing different illnesses under investigation in this study at the point of their employment in the construction sector.

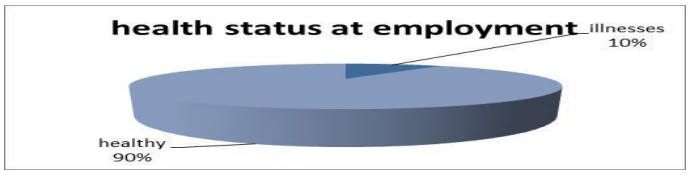

Figure 2. Health status at employment

At the point of the field study 72% had joined in with new illnesses with higher chance of having getting these illnesses from the ergonomics of the construction workplace.

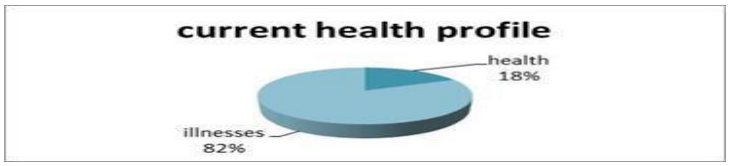

Figure 3. Current health profile

From a safety outcomes point view 56% of participants had been involved in some accident of some sort leaving them with different illnesses. For those who were involved in accidents none had been involved in similar accidents prior to joining the construction sectors.

Figure 4. Safety profile

If the impact of confounding factors such as aging and other diseases are factored in the figure is still excessive pointing to an unhealthy women construction workforce. These outcomes have a direct negative impact on women participation and subsequent productivity in the sector. The outcome partly explains why 5 out of 10 construction sites had no women employee. Negative health and safety outcomes amongst women employees of the construction sector are also driven by poor ergonomics according to literature. The literature review process for the study identified ergonomics risks in working postures, work surfaces, tools and equipment. These risks manifest in employees picking up ailments in different parts of their body depending on their assigned tasks. Active management of ergonomics by the employee, the construction company and any other stakeholder is paramount to the arrest of the negative effects for this socially important and burdened demographical group. The ergonomics profiles for the sample where investigated as follows:

5.3 Working Surface Causing Injuries

Participants mostly felt safe working on the ground as shown by a skew of the responses; to the left. The roof top was also considered safer with responses skewed to the left. The respondents were unanimous in the identification of risks with working on stair cases, scaffolds and on construction ladders. The study adds percentages from the sometimes vote, the often vote and the always vote, to give the risk factor for a particular working surface. This is illustrated below:

Sometimes1/2 (%) +often (%) +always (%) =Discomfort factor ( )

Never (%) + Seldom (%) +sometime1/2(%) =comfort factor ( )

Ergonomic Risk factor = decision between (-) risk factor & comfort factor

Table 1. Working surface

	Discomfort factor	**Comfort factor**	**Ergonomic risk factor**
Stairs	½(.10)+.267+55=**.867**	.4+.07+1/2(12)=**.013**	**-.867**
Ground	.3255	.6745	**.6745**
Ladder	.8745	.1255	**-.8745**
Scaffold	.767	.233	**-.767**
Roof	.3745	.6255	**.6255**
Perfect discomfort(-5)	**-3.2085(-64.17%)**		**-1.209 (-24%)**
Perfect comfort(5		**1.7915(35.83%)**	
deviation			**2.66**

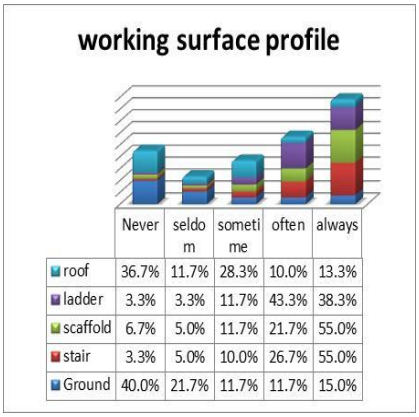

Figure 5. Working surface

The samples show a higher discomfort factor for an exhaustive list of the surfaces that women work in the construction sector. The findings show that 64% of the women were uncomfortable and at risk of either getting an injury or illnesses associated on this basic working surface with a 2.66 deviation on the downside. Six women construction workers in every ten were likely to come off worse by simply engaging in their daily tasks which involves working on the ground, the roof, stairs, scaffolds and construction ladders. The outcome puts pressure on women participation in the construction sector and subsequently negatively affects their productivity. This is further highlighted by the finding that out of the targeted sites 46% of the sites did not employ women. If out of 10 women construction workers 9 are going to end up with some ailment of some sort this place a dumper on the overall productivity in the sector and employers are likely to hold back on employing women. The recovery in the construction sector, therefore, risks the exclusion of women and may not result into an inclusive economic growth for South Africa.

5.4 Working Postures

The common work postures profile confirms a finding that identifies awkward postures, reaching away, lifting/bending, twisting/pulling, kneeling/holding and standing as the common risk factors for ergonomics in the construction work. The sample, however, reflects twisting and pulling not being part of the common task assigned to these women construction workers. The sample shows an almost perfect discomfort of 80.5% with the different postures required to complete the construction work tasks.

Table 2. Working posture

	Discomfort factor	**Comfort factor**	**Ergonomic risk factor**
Awkwar posture	½(.333)+.25+25=**.6665**	.05+.083+1/2(.333)=**.3335**	**-.6665**
Reaching Away	-.7165	.2835	**.-7165**
Lifting/bending	.-8335	.1665	**-.8335**
Twisting/ pulling	.-8415	.1585	**-.8415**
Kneeling/holding	.-7995	.2005	**.-7995**
standing	**-**.975	.025	**-.975**
Perfect discomfo(-6)	**-4.8325(-80.5%)**		**-4.8325(-80.5%)**
	Perfect comfort(6)	**1.1675(19.6%)**	
deviation			**0.06**

5.5 Women Construction Worker Opinions

There is a lack of consensus in the data in terms of whether these employees believe that tools, materials and equipment expose them to risks on their work places. An agreement factor of 57.5% does not put a convincing agreement amongst the sample participants as to the effect of these risk factors to their ergonomics. Most were neutral (undecided) as revealed by the tower in the middle. This outcome means the sample members had not been adequately educated so as to engage with their environment from a point of knowledge. Active management and engagement with the ergonomics risk factors in construction workplace has been found to cause a reduction in outcomes of health and safety. The finding went against literature findings that had proffered that the design of tools and equipment were heavily contributory the negative outcomes in the ergonomics of the construction workplace.

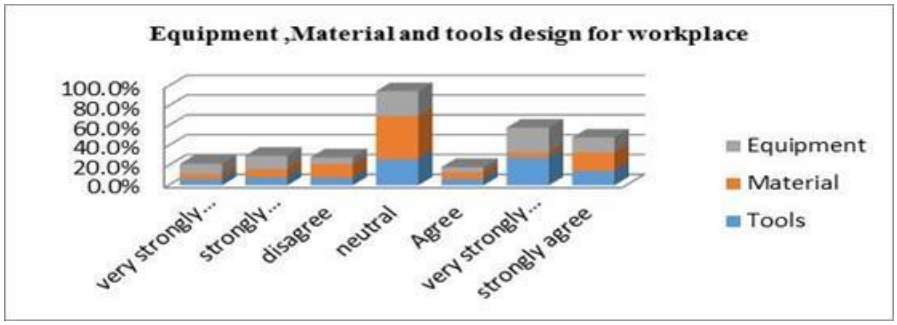

Figure 6. Equipment, material and tools

5.6 Common Tools causing Injuries

The data on common tools causing injuries shows a left skew on the responses suggesting that respondents do not find tools as causing harm to their health and safety. The problem with their workplace ergonomics is probably somewhere else. Crudely, the data suggests and confirms progress in the design of tools to actively manage ergonomics at the workplace. If such an outcome is held true attention then centres on ability of the workers to use the tools ergonomically. Tools recorded a comfort factor of 76.5% with a 0.01 deviation.

Table 3. Tools causing injuries

	Discomfort factor	**Comfort factor**	**Ergonomic risk factor**
Hammer/nail	½(.25)+.1+.83=**.-309**	.283+.283+1/2(.25)=**.691**	**-.691**
Pliers/screw driver	.2585	.7415	**.7415**
Hand saw/ hand drills	.-2085	.7915	**.7015**
Shovel/mixers	.-192	.808	**-.808**
Chisels/ trowel	.-2085	.7915	**.7915**
Perfect discomfo(-5)	**-1.177(-23.53%)**		**3.8235 (76.5%)**
Perfect comfort(5		**3.8235(76.5%)**	
deviation			**0.01**

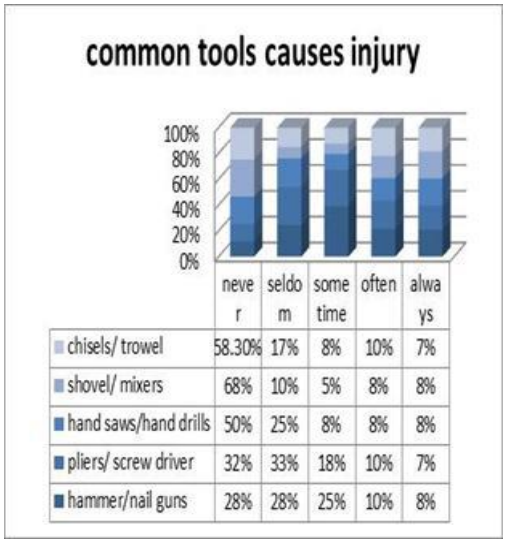

Figure 7. Tools causing injuries

5.7 Areas of Common Injury

Distribution of responses on the common types of injuries show a decisive right skew in line with literature findings that identified sprain/strain, neck/shoulder/back, hand/wrist and knee/foot/ankle as the common types of injuries arising from poor ergonomics of the construction workplace. An agree factor of 60% is decisive that these injuries are prevalent and still pause significant risks for their sample in the ergonomics of their workplace.

Table 4. Areas of common injury

	Discomfort factor	**Comfort factor**	**Ergonomic risk factor**
Sprain/ strain	½(.267)+.20+.167=**.-0.5005**	.117+.25+1/2(.267)=**.4995**	**-.5005**
Neck/back	.-2665	.7335	**.7335**
Hand/wrist	.-3755	.6245	**-.575**
Knee/foot/Ankle	.-459	.541	**-.541**
Perfect discomfo(-4)	**-.16015(-40%)**		**-1.209**
			(-24%)
Perfect comfort(4			
		2.3985(60%)	
deviation			**0.9568**

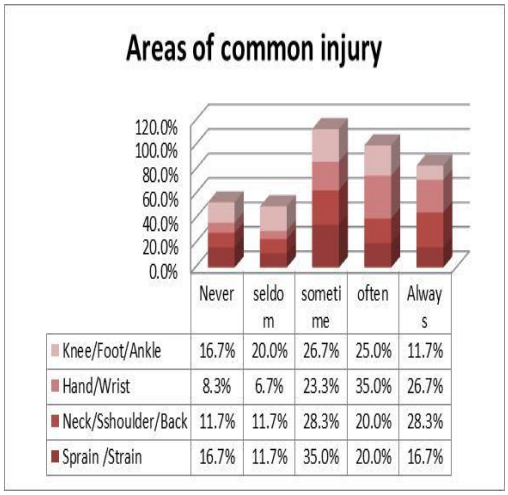

Figure 8. Areas of common injury

5.7 Construction Equipment causing injury

As confirmation of prior findings that participants do not find the design and their interaction with construction equipment in handling materials as resulting in significant risks for their health and safety, a 0.96 deviation and a decisive left skew with a higher (71.9%) disagree factor is found. While this result maybe evidence for progress in the design of the equipment for good ergonomics of the construction workplace, the higher outcomes for health and safety for the sample is still suggestive of problems regardless.

Table 5. Construction Equipment

	Discomfort factor	**Comfort factor**	**Ergonomic risk factor**
Crane	½(.172)+.18+.57=**.-0.836**	.067+.11+1/2(.172)=**.164**	**-.0.836**
Concrete pump	.-7915	.2085	**.7915**
Wheel loader	.-808	.192	**-.808**
Scaffolding/dumper	.-459	.541	**-.541**
Concrete mixer	-.7	.3	**-.7**
Perfect discomfort (-4)	**-.3.5945(-71.9%)**		**-1.349 (-33.7%)**
Perfect comfort(4		**2.3985(28.1%)**	
deviation			**0.96**

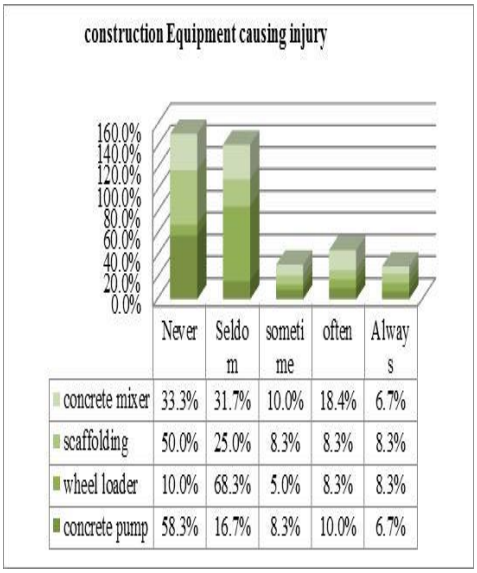

Figure 9. Construction equipment

6 Conclusion and Further Research

The study concludes that material handling in the construction sector still pause significant risks for women construction workers. The risks are having a negative influence on their productivity in the construction sector hence their participation has stayed very low. The findings are not consistent with a developing inclusive economy or a deep recovery in the construction sector. A divergent outcome for women and men emerges particularly when the sector is faced with headwinds. Women construction workers are far more severely affected by problems in the construction sector than their male counterparts. The situation is making a negative contribution to the social ills of poverty, unemployment and inequalities among women who seem to carry a larger social burden.

Sector wide efforts to curb the effects of material handling on women ergonomics include tools and equipment design, safety and health education and awareness programs to ensure active management of ergonomics. The study concludes that the design of tools and equipment is running in the right direction. HSE programs have, however, waned in their efficacy and require reinvestment and refocusing to target longer term objectives which secures participation and productivity for women in the construction sector. Without these programs coming on board to complement efforts elsewhere, the risks for women remain and the long term outcomes on women productivity and participation remain depressed to positively influence the economy and society.

The implications of these findings are that the inclusivity of the construction sector greatly impacts the inclusivity of the national economy. The construction sector contributes about 10% of the national GDP (Plascon, 2012). Current recovery in the construction sector runs the risk of excluding women construction workers if the negative impact of materials handling on work ergonomics for women workers are not actively managed to significantly reduce the associated risks. New and emerging construction companies must be convinced and even incentivized to make HSE investments. The sample could be enlarged and extended to increase the study's utility. The impact of ergonomics on the health and safety of women construction workers would be better concluded on from the viewpoint of men construction workers, construction sector management and the women construction sector to give balance and rigor to the study. Future studies could be enhanced to investigate these key players as well by:

1. Enlarging the representation made in the study such that it could be generalized over the whole construction sector in South Africa under reasonable error margins.

2. The impact of ergonomics on the health and safety of women construction workers would be better concluded on from the viewpoint of men construction workers, construction sector management and the women construction sector to give balance and rigor to the study. Future studies could be enhanced to investigate these key players as well.
3. Further investigations maybe conducted to find the discrepancies between men and women on their exposure to accidents and the equipment putting them at risk of accidents.
4. The study could be enhanced by recording the number of HSE programs these workers were exposed to and investigating the relationship between health and safety impact and number of HSE programs attended.
5. This conclusion can be enhanced by removing any confounding factors in the women construction workers varying lifestyles but what the study finds is still catastrophic especially if generalized on the population of women construction workers in the country.

7 References

Jaffar, N., H, a. -t., Mohd- Kamar, I. F., and Lop, N. S. (2011). A literature review of ergonomics risk factors in construction industry. *The 2nd international building control conference.* www.sciencedirect.com.

James, T. A. (2007). ergonomics for construction workers. *National institute for safety and health (NIOSH).*

Plascon (2012). *The state of the South African construction Industry.* Gauteng: industry - insight-2nd quarter.

Schneider, S and Susi, P. (1994). Egonomics and construction: A reveiw of potential hazards in new construction. *American Industrial Hygiene Association Journal.* , 55 (7), 635-649.

US, BLS. (2012). Ergonomics Challenges for women construction workers. *Bureau of Labour Statistics, United States Department of Labour.*

William, S., and Marras, W.K. (2003). Ergonomics working for cement and concrete construction labourers. *Occupational and Industrial Orthopaedic Centre (OIOC).2003*.

The Occupational and Industrial Orthopaedic centre .(2003), NYU Hospital for Joint Diseases Orthopaedic Institute and Graduate Program in Ergonomics and Biomechanics 2003, ergonomics working for Heavy and Highway Construction Labourers.

IMF (2010). *World Economic outlook: a survey by the International Monetary Fund.* Washington, DC: IMF.

Statistics, S. A. (2012; 2014). *Quarterly Labour Force Survey.* Pretoria.

Creamer, M. (2015). *Construction 2015: A review of South Africa construction sector,* South Africa.

Bongers, M. P.; Kremer, A.; and Ter Laak, J (2002). Are psycosocial factors risk factors for symtoms and signs of the shoulder, elbow or hand/wrist? *A review of the epidemiological literature. American Journal of Industrial Medicine,* 41 (5), 315-342.

Gibbons, B. and Hecker, S. (1999). Participatory approach to ergonomic risk reduction: case study of body harnesses for concrete work. . *Second lnternational conference of CIB working commission W99 Implementation of safety and health on construction sites,* (pp. 373-380). Honolulu, Hawaii.

Hagberg, M. B., Silverstein, R., Wells, J., Smith, M. ., Hendrick, P., and Carayon, J. (1995). Work related muskelosketal disorders (WMSDs). *Taylor and Francis, Inc*.

Huang, G., Feuerstan, M. J., Kop, W. K., Schor, and Arroya, F. (2003). Individual and work organisation factors in work-related musculosketal symtoms. *American Journal of Industrial Medicine*, (43), 495-506.

Miosha. (2010). MIOSHA fact sheet construction safety and health division. *Ergonomics in construction*.

Occupatinal safety and health Administration (OSHA) (1999). Women in the construction workplaces: providing equitable safety and health protection . *Advisory Committee on construction safety and health (ACCSH).* Department of labour: OSHA.

Occupatinal safety and health Administration (OSHA) (1999). Women in the construction workplace . *providing equitable safety and health protection.*

Occupatinal safety and health Administration (OSHA) (2010). Protecting workers from Effects of heat (Extreme temperature). *http:// www.osha.gov, OSHA fact sheet*.

Rani, M. R. (2003). Managing ergonomics risk factors at workplace. *Paper presented at NIOSH 6TH National Conference and Exhibition on Occupational Safety and Health,*. Sunway, Pyramid Convention Centre, Petaling Jaya, Malaysia.: NIOSH.

William, J., Wiehagen, T., and Fred, C. (2004). *Ergonomics assessment of muskelosketal risk factors art Four Mines States.* Underground Coal, Surface Copper, Surface phosphate and underground limestone.