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COMPARATIVE ASSESSMENT OF HAZARD CONTROL MEASURES INCORPORATED INTO SMALL, MEDIUM AND LARGE-SIZE ENTERPRISES IN SOUTHWEST NIGERIA

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ABSTRACT

This study compared the level of ergonomics inclusion into small-size (SEs), medium-size (MEs) and Large-size (LEs) enterprises in Southwest Nigeria. The primary objective was to value the gap of Hazard Control Measures (HCM) to be bridged so as to enhance Occupational Safety and Health (OSH) of the workers in these enterprises.Machine hazard and safety checklists were used to assess the HCM level of different machinery and workplace designs in 85 SEs, 65 MEs, and 15 LEs. By observation, numeric scores were assigned to safety levels under engineering, administrative and personal protective measures. A Questionnaire was also administered to 110, 140 and 150 SEs, MEs and LEs workers respectively to measure occupation hazards among the groups of workers and the HCM adopted by their various administrators. Around 56.2% and 52.5% of all SEs and MEs respectively were rated poor (insufficient HCM); 19.2% and 10.3% used engineering measures, 18.3% and 21% engaged personal protective measures, while 16.7% and 10.2% used administrative measures. However, only 1.5% of SEs and 2.6% of MEs used the combined measures. The mean of the rated SEs with poor HCM program was not significantly different from those of MEs (t (24) = -0.563, p = 0.579). Whereas the mean of the rated LEs with adequate HCM provisions were significantly different from those of the SEs and MEs (t (32) = 2.33, p = 0.002). The study concluded that there are opportunities for HCM improvement in the LEs but the inclusion of HCM in SEs and MEs operations was extremely low when compared to that of the LEs. Efforts at improving HCM level in SEs and MEs are urgent if the level of OSH advocated by International Labour Organization standards is to be sustained or enhanced among the groups of the workforce.

Keywords: *Hazard, control, measures, industry, workers, safety*

1. INTRODUCTION

Large-scale industries refer to those industries which require huge infrastructure, manpower and have an influx of capital assets (Shanya and Soham, 2014). The definition of Small and Medium-size Enterprises (SME) however varies from one country to another (Ayaggari *et al.,* 2003) and there is lack of a universal definition of what constitutes an SME (Ardic *et al.,* 2011).In developed countries, Small-size Enterprise (SEs) is defined in terms of annual turnover and the number of paid employees. In developing world such as Nigeria, SEs is viewed as those with an annual turnover not exceeding 500,000Naira (Central Bank of Nigeria; 1988). According to the European Commission (2005), the number of employees is a key factor. When less than 250 headcounts, it is categorized as Medium-sized Enterprise (MEs) while those with less than 50 are grouped under SEs. Therefore the common criterions to distinguish between small, medium and large scale businesses are the number of employees (Hatten, 2011), tendency to employ generalists by SEs and MEs rather than specialists, reliance on short-term planning, informal and dynamic strategies and decision-making process, and lack of standardization of operating procedures (Dibrell *et al.,* 2008), resources (Thong *et al.,* 1997).

Across several industries in the world, an estimated number of 271 million people suffer from work-related injuries, and 2 million die as a consequence of these injuries annually. The estimated economic loss caused was equivalent to 4% of the world's gross national product (WHO, 2003). According to a study conducted among smaller industrial workers in Norway, an injury rate of 317 per 1000 exposed workers was observed (Bull, 2002). That of Thailand in 2001 also reported that there were 189,621 cases of occupational injuries and 48,078 cases of over 3 days lost from work (Somkiat, 2004). Dembe (2004) reported the rate of 75 per 1000 workers exposed to occupational injury yearly in the United States Studies available on industrial injuries in Africa indicated that work-related injuries appeared with greater frequency and severity. In Nigerian factories, the annual injury frequency was 22 per 1000 exposed workers (Afamdi, 2001). According to Bill (2000) and Liv (2004), work-related injuries among young workers were more common. Though good management of SMEs improves the development of economy (Yunusa, 2018), International Labour Organisation (ILO) (2003), stated that risks of injury are more prevalent in SMEs than in LEs. The situation is particularly poor in developing

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countries, where most enterprises are small and informal. Among the risk factors reported for this development included lack of experience, lack of job knowledge and know-how, lack of health and safety training.

The ILO "In Focus" programme on boosting employment through SEs development (IFP/SEED) is commendable. However, practical experience clearly shows that the application of ILO standards is limited in SMEs. One of the primary reasons is the limited experience and knowledge of how to comply with the standards without jeopardizing business performance. However, ILO is devoted wholly or in part, as its major objective, to the promotion of values and standards in the area of Occupational Safety and Health (OSH) and provides more measures of the importance of achieving safe and healthy working conditions and environment (ILO, 2002).

It was reported (Ashi, 2003; Ahn, 2004; Nearkasen, 2004) that work-related injuries could be prevented if appropriate measures are put in place. To reverse the trend of the increased rate of work-related injury, ILO (2003), stated that SEs need new occupational safety and health measures as they are not able to sustain special OSH personnel. Takele (2007) also recommended that measures concerning functional OSH programs are essential to safeguard the health and safety condition of the workforce in SMEs. ILO (1991) earlier highlighted some measures which include the following among others: management plan and measure suitable to mitigate the consequences of potential hazards; effecting alarm systems, emergency services; information to, and training of, workers most especially on the effective use of personal protective equipment. Dul (2003) also mentioned the need to integrate ergonomics into workplace/system designs as a measure for an enhanced performance and for its health benefits.

Ergonomics, the study of the design of a workplace, equipment, machine, tool, product, environment, and system takes into consideration human beings' physical, physiological, biomechanical, and psychological capabilities and optimizes the effectiveness and productivity of work systems while assuring the safety, health, and well-being of the workers (Fernandez and Marley, 1998). Ergonomics can result among others in improved health and safety of workers; lower workers' compensation claims; compliance with Occupational Safety and Health Administration (OSHA) standards; increased work quality; improved morale of workers and; decreased absenteeism rate (Jeffrey, 2008). Poor ergonomics in workplace not only results in direct costs associated with injury treatment and compensation, but also in indirect costs related to factors such as absenteeism, costs of administration, employee turnover and training, poor employee morale, as well as reduced productivity and quality (Oxenburgh *et al.,* 2004; WSIB, 2001).

This present study compared the level of ergonomics inclusions for hazard control, in SEs, MEs and Large-sized Enterprises (LEs) in Southwest Nigeria. The objectives are to measure: the type(s),and level of availability, of hazard control measures in each group; the effect(s)of the measures on their workers' health and safety and; the level of gap to bridge in the provision of Hazards Control Measures (HCM) between LEs and SMEs.

2. MATERIALS AND METHODS

2.1 Study Location and Sample Selection

A research survey was adopted for this study which involved 85 SEs, 65 MEs and 15 LEs located in Lagos (Lagos State), Agbara (Ogun State), Abeokuta (Ogun State) and Ibadan (Oyo State) all within Southwest Nigeria. These study areas were selected because according to Dickson (2007), production industries are concentrated in the area. Among others, the job title selected for assessment included machine operators, artisans, and factory workers. The characteristics of these subjects were selected because all the group of machines and hazards associated with them were the major focus of the study. Administrators of each enterprise were equally involved in the survey. To minimize risk of harm and protect all participants, the research received ethical approval before the commencement of the study. All subjects were fully informed of the reason for the study so that they can decide whether to participate or not. They were all assured that only the researcher will be aware of who has contributed. All participated workers have spent not less than two (2) years on their current job title, while all managers were in business for not less than 5 years.

2.2 Machinery Hazard Check

The machine hazard checklist reported by Gorge Manson University (2011) and that of machine safety checklist highlighted by Industrial Accident Prevention Association (IAPA) (2008) were modified and used to carry out workplace inspections and assessment of machinery. According to the Ministry of Business, Innovation, and Employment (2013), physical inspections is one way by which the hazards associated with machinery can be identified. This was carried out by inspecting the machinery and assessing where a worker could get injured or be caught in the machinery. The Research Assessors (RAs) allocated scores (below 1 = poorly or not provided, 1-3 = available but not enough, above 3 to 5 = adequately provided) to measure the safety levels attached to

operating the machines and the workplace design. Methods at which workers performed their tasks were critically followed. Among condition checked included; machine guarding, mechanical hazards, operator controls, supervision, use of protective equipment and clothing among others.

2.3 Semi-Structure Interviews

Questionnaire was distributed among 400 workers (110 from SEs, 140 from MEs and 140 form LEs) to measure subjective injury and/or occupation hazard (past or present) by the written response, using the modified version of the questionnaire developed from the job demand-control-social support model detailed by Karasek and Theorell (1990). Workers in each category of the enterprises were equally asked to allocate scores as above to measure their opinions about their employers' HCM program under engineering, administrative and personal protective.

All potential volunteers agreed, and consents were taken in written form after they were informed that their participation in the study was voluntary. The purpose of the study and the confidentiality of the information provided were emphasized.

2.4 Data Analysis

Independent sample t-test and descriptive statistical procedure, using SPSS version 16.0, were used to analyze the recorded data. The Independent sample t-test, probably the single most widely used test in statistics (Matthew, 2004), evaluated the significance of unrelated groups' means (allocated scores by RA for each category of enterprises and the means ratings assigned by their respective workers) at $p < 0.05$. The descriptive statistical procedure was however used for presentations.

3. RESULTS

3.1 Description of Responses and Questionnaire Return Rate

Three hundred and sixty-two (90.5%) of the total of 400 workers who participated in the study completed the questionnaire. The demographics of the workers are presented in Table 1.

Table 1: Statistic of the demographic information of workers in the studied SEs, ESs, and LEs

Descriptions	Age	Work hours	Years of Working Experience
Mean	33	8.6	4.5
Mode	28	10	6.0
Std. Deviation	4.3	0.7	0.42

From Figure 1, among the LEs categories that effectively made use of the measures, 69.5% enforced the use of personal protective, 67.8% use administrative measures, while 59.5% effectively engaged the use of engineering measures. A similar trend but at a lower level was noted with MEs where 21% of them used Personal Protective Equipment (PPE), 16.2% used administrative measures and 10.3% used engineering measures. In SEs however, 19.2% effectively used engineering measures, followed by PPE (18.3%) and administrative measures (16.7%).

Considering the enterprises with non-availability of HCM (Figure 2), 71.2, 56.7, and 53.3% among SEs lacked administrative measures, engineering measures, and PPE for hazard control. Among the MEs category, 61.1% were without administrative measures, 26 % were rated poor with engineering measures and 11.5% had no provision for PPE. Only 13.2% among the LEs, however, were rated poor in their use of administrative measures, PPE (9.2%) and engineering measures (6.3%) to eliminate hazards.

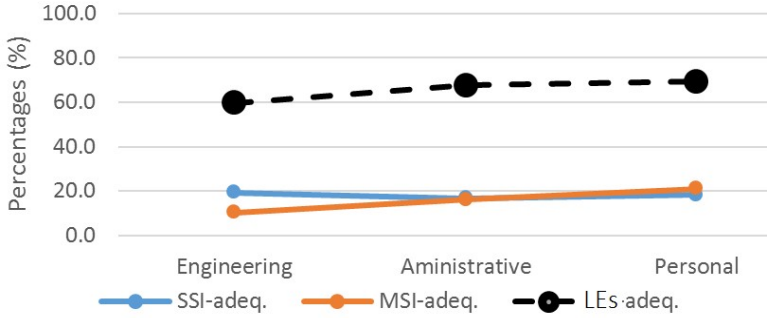

Figure 1: Level of adequately provided hazard control measures

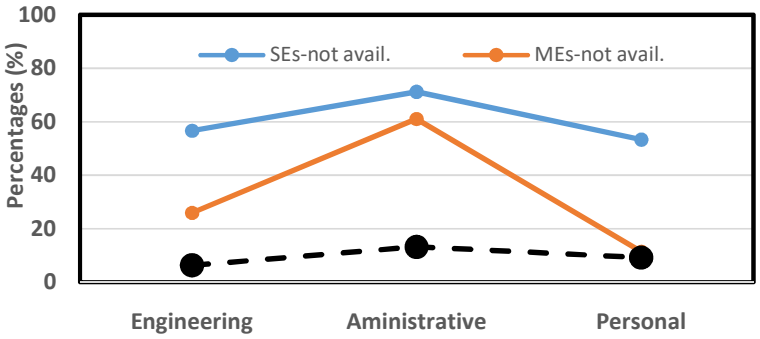

Figure 2: Level of non-availability of hazard control measure

In addition, Figure 3 shows the level of inadequate hazard control measures for the SEs, MEs, and LEs. MEs was observed to have the most inadequate provision of HCM – rated 66.7%; inadequate administrative measures accounted for 68.9% of this rating, while inadequate PPE and engineering measures accounted for 67.5% and 63.7%, respectively. The inadequacy of the HCM provision by Les was estimated at 24.8% which comprises 34.2, 21.3 and 19.0% for inadequate engineering measures, PPE and administrative measures. Lastly, the inadequacy of HCM provided by and 14.2% SEs was estimated as 14.2%; comprising 28.4, 12.1 and 2.1 inadequate PPE, administrative measures and engineering measures.

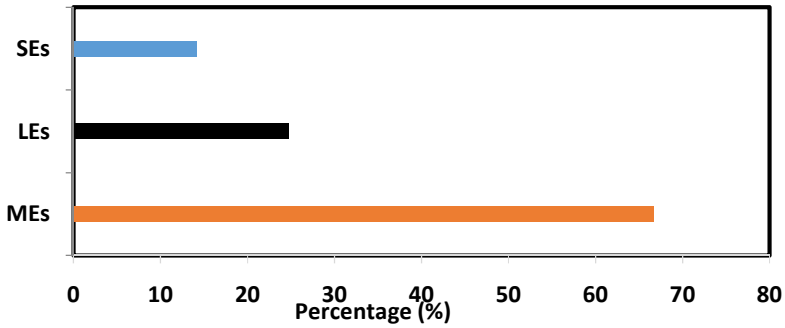

Figure 3: Level of inadequate hazard control measure

Figure 4 shows the comparisons of the level at which all three measures were put into use by SEs, MEs, and LEs to minimize occupational hazards. Figure 4 reveals that 65% of LEs evaluated enforced the combination of engineering, administrative and personal protective measures; 14.5% of MEs adopted the same, while only 1.6% SEs was recorded with such efforts. The remaining percentages in all the three categories of the studied enterprises engaged either one or a combination of two of the three measures.

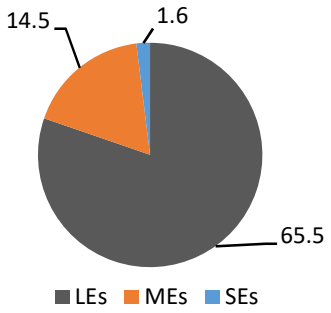

Figure 4: Effective usage of the three HCM elements

3.2 Prevalence of work-related injuries among workers

Three hundred and ten (85.6%) workers complained to have suffered from one injury or the other on their job (Figure 5). Among the SEs workers surveyed, 52.2% had suffered from various musculoskeletal disorders (MSDs) in one parts of their body, 32.2% reported cuts and/or bruises and 31.4% were ones entangled with

machine rotating parts. In addition, 20.4% were caught in running machine nips. Among other notable reported injuries included; burnt (17.6%), foot pain (15.5%), skin disorders (11.8%).

The prevalent injury observed amidst MEs workers include; hearing loss (23.5%), entanglements with machine rotating parts (21.4%), drawing into in-running machine nips (18.5%), cuts and/or bruises ((15.6%), exposures to arc ray (15.5%), skin disorders (14.5%), burnt (12.5%), electric shock (12.5%) and fire explosion (8.5%).

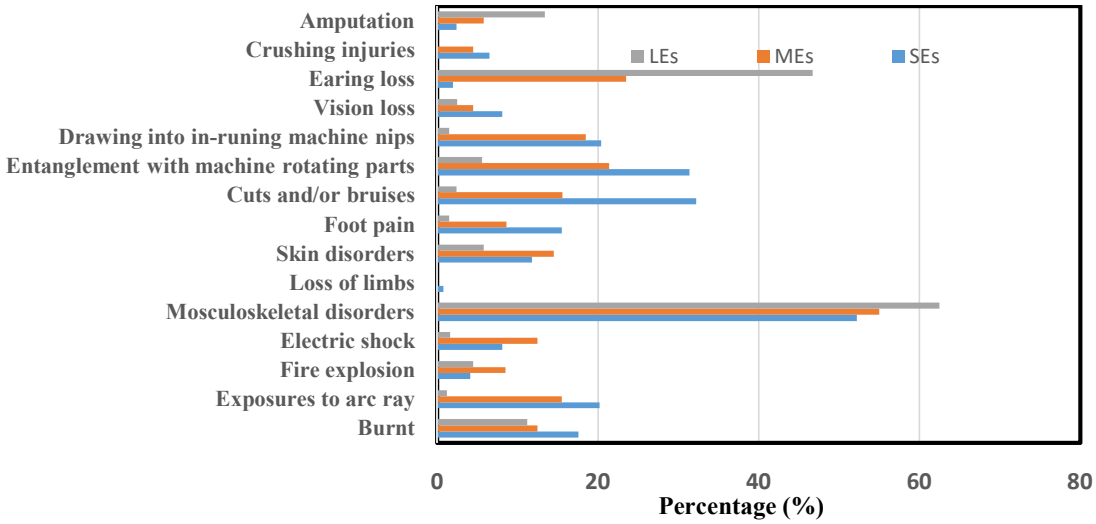

Figure 5: Workers' reported work-related injuries type

About 62.5% of LEs reported suffering from MSDs, 46.7% reported hearing loss, 13.4% reported amputation injury, 11.2% have burnt injury. Only 5.8%, 5.6%, and 4.5% reported skin disorders, entanglement with machine rotating parts and fire explosion respectively. Electric shock (1.6%), drawing into in-running machine nips (i.5%), foot pain (1.5%), exposures to arc ray (1.2%) were among the least reported injuries. Crushing injuries and loss of limbs were not observed.

3.3 Statistic test

The result of independent-samples t-test which appraised whether means of the number of SEs, MEs and LEs rated low (insufficient or no hazard control measure program) by RAs are significantly different from the mean of that reported by their respective employees, is presented in Table 2.

In the case of SEs, the RAs' report had statistically significantly lower number (mean=.7900, SEM=.01623) compared to that of the employee (mean= 0.8592, SEM = 0.0464), with t (238) = -1.388, p = 0.166. With "Sig. (2-tailed)" value greater than 0.05, the groups' means are significantly not different. Hence, the SEs rated low by RAs were also confirmed same by the workers. The RAs' and workers' ratings for MEs and LEs are also significant. This result can be interpreted to mean that both the RAs and the employees in SMs agreed that the hazard control measure programs made available in SMs are poor and/or may not be available at all.

In a similar trend, the RAs' and workers' ratings for MEs and LEs are significant.

Between LEs and MEs, the RAs' report had statistically significantly higher number (mean=4.5042, SEM=.1240) compared to that of the employee (mean=3.8920, SEM = .1263), with t(238) = 5.330, p = .002. With "Sig. (2-tailed)" value less than 0.05, the groups' means are significantly different. Hence, though the average mark allocated to MEs (3.8920) by the RAs could be interpreted as 'adequately provided', the rating is lower compared to that reported by LEs. As reported by Oliver (2014), it is difficult for an employer to completely satisfy her workforce and fulfill their needs. From this result, the employees may have commended the efforts of their employers at providing for their safety, the rating when compared with that of the RAs revealed that the workers may have desired to enjoy improved safety conditions.

Between LEs and MEs, the RAs' report had statistically significantly higher number (mean=4.5042, SEM=0.1240) compared to that of the employee (mean=3.8920, SEM = .1263), with t (238) = 5.330, p = 0.002. With "Sig. (2-tailed)" value less than 0.05, the groups' means are significantly different. Hence, though the average mark allocated to MEs (3.8920) fall within 'adequately provided', it is of a lower rating to LEs. In a similar trend, the RA ratings for LSI and SEs are also not significant.

Table 2: Independent sample t-test comparing the rating means of RAs for HCM availability in each group of enterprises with the rating means of their correspondent employees.

Comparing RA and Employees ratings	Means	SEM	t-value	p-value	Decision
RAs and employees low ratings	0.7900	0.01623			
in SEs	0.8592	0.04636	-1.388	.166	Significant
RAs and employees low ratings	2.1592	0.11456			
in MEs	1.9572	0.11688	.4680	.640	Significant
RAs and employees low ratings	3.3483	0.12135			
in LEs	3.0817	0.12357	1.540	.125	Significant
RAs low ratings among SEs and	0.7900	0.01823			Not
MEs	2.1592	0.11456	-11.803	0.000	Significant
RAs adequate ratings between	4.5042	0.1240			Not
LEs and MEs	3.8920	0.1263	5.330	0.002	Significant
RAs adequate ratings between	4.5042	0.1240			Not
LEs and SEs	3.6430	0.1268	6.370	0.010	Significant

4. DISCUSSION

The most effective hazard control measures are engineering controls that physically change a machine or work environment to prevent employee exposure to hazards. As noted across the entire study, there was generally low percentage (less than 20%) of SMEs that effectively adopted the use of engineering measures as compared to about 60% of LEs that effective use same to enhance the safety of their workers. Operators and other workers who had one thing or the other to do with the machines were exposed (more in SMEs) to different types of machine related hazards. From the research assessors' point of view, most of the machines used in SMEs were not provided with guards. Though some of such were also recorded among LEs but fewer when compared to SMEs. This may form parts of the reasons why the reported mechanical-related injuries such as entangled with machine rotating parts, draw into in-running machine nips and cuts and/or bruises, to mention few, were more pronounced in SMEs than in LEs. There were also little or no enclosures for noisy equipment.

Some of the workers opined that the use of PPE, like hand gloves, for example, reduced their work pace, hence underused the available ones provided by their managers. Some group of workers was perceived to have limited knowledge of the importance attached to using PPE. However, in SMEs, protective clothing was inadequately provided and/or used as most workers dressed casually in their jobs. There was better usage of PPE in LEs, however, the use of hearing protectors was not common in the noisy environments. As the improper usage of PPE might have contributed to the high prevalence of cuts, brushes and burnt injuries reported by the group of SMEs workers, their counterpart in noisy LEs might be exposed to injuries related to hearing loss.

According to the Ohio Centre for Occupational Safety & Health (2008), administrative controls involve changing how employees do their jobs. This include among others; written operating procedures, safe work practices; exposure time limitations to control temperature extremes and ergonomic hazards; alarms, signs, and warnings; buddy system; and training of the workforce. Usage of this measure was observed low among SMEs. This was confirmed with the low level of administrative will to implement necessary measures, with the highest percentages of poor administrative measures recorded among SEs operators (71.2%), followed by MEs managers (61.1%). The reason may not be far from ILO (2002) point of view that knowledge of how to comply with the safety measures standards without jeopardizing business performance is limited among SMEs operators. Large-size enterprises equally need to improve their efforts. Though the percentage was low (31.2%) compared to the average SMEs (66.2%), yet this level needs to be further reduced to enhance OSH among the workers.

The study discovered a very wide gap between the hazards control measures available to LEs group of workers and among the SMEs group. This was confirmed by the statistic tests which affirmed the significance of the research assessors' and the employees' same low ratings for SMEs and not the significance of adequate ratings between Les and SMEs. Hence exposures to some frequently occurring work-related ergonomics hazards are less among the LEs workers and more among the SMEs group of workers.

5. CONCLUSION

This study compared the level of ergonomics inclusions, as HCM, into small-size (SEs), medium size (MEs) and Large-size (LEs) enterprises in Southwest Nigeria. HCM considered for this study were engineering,

administrative and personal protective. Results showed that above 50% of all SMEs evaluated were rated poor (insufficient) using the combination of engineering, administrative and personal protective measures. Majority used only one or combined two of the measures. Less than 3% of SMEs, compared to 65% of all LEs evaluated enforced the operation of the combination of the three measures; leading to higher reported work-related injuries prevalence among the SMEs group of workers. The study observed, opportunities gap for improvement of HCM in the LSI, an extremely wide gap between the HCM available to LSI group of workers and among the SMEs group (low ratings of HCM in SMEs). Efforts at improving the measures among the later are therefore urgent if the level of occupational health and safety advocated by International Labor Organization standards is to be sustained among the groups of the workforce.

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