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AN INVESTIGATION OF HEALTH AND SAFETY ISSUES AT HIGHWAY CONSTRUCTION SITES IN DEVELOPING COUNTRIES

R. K. Shah* and M. Alqarni

Senior Lecturer in construction management and civil engineering, Department of the Built Environment, Faculty of Technology and Environment, Liverpool John Moores University, Liverpool, L3 3AF, UK

Corresponding *Email: r.shah@ljmu.ac.uk

Abstract:

Construction activities on the highway projects are key source of the safety risks to workers and motorists. Workplace fatalities and injuries have significantly reduced since 1970 after implementation of the Occupational Safety and Health Administration (OSHA) regulations. However, ergonomic injuries caused by ergonomic risk factors such as awkward or sustained posture, forceful exertion or strain, contract pressure, exposure to vibration, extreme heat or cold environment have major impact on the productivity and safety on the highway construction sites. The paper focuses on identifying the existing safety practices that aid to prevent ergonomic injuries at the highway construction sites. A comprehensive review of literature reveals that majority of workplace injuries and fatality victims are from the private employment whereas a very few injuries coming from the state or local government employees. The primary data was collected using questionnaire survey, interview and observations. Spreadsheet was used to analyse the collected data about the causes of workplace injuries and possible measures. The survey results reveal that the most of the injuries such as musculoskeletal disorders, strain and accidents transpired due to the collision with equipment and vehicle's related incidents. Dump truck, tippers, motor graders and cars cause the frequently reported workplace injuries. The paper concludes that the use of Personal Protective Equipment (PPE), compliance to safety regulations, improving traffic control system and changing the culture of employers and employees are potential safety measures need to be adopted to mitigate the ergonomic workplace injuries in the highway construction projects particularly in the developing and least developed countries.

Keywords: Health and safety, highways, construction, injuries and fatality, PPE, workplace, construction workers

1. Introduction

Construction workplace fatalities and injuries have significantly reduced since 1970 after the implementation of OSHA (Occupational Safety and Health Administration) regulations. However, the construction work place are still responsible for majority of injuries and fatalities, which are around 1,200 annually within the United States alone (BLS, 2013). The construction works have been closely associated with a high increase rate of musculoskeletal disorders, a condition that always involve the body's soft tissue including the cartilage, nerves, tendons, muscles and other structures, which are mainly caused by work-related activity (Government of Australia, 2006). Hudson et al (2007) reported that data referred to self-reported illness related to work place surveys done in the Great Britain found that around 199,000 people suffered from health problems caused by the works at the highway construction site and construction work poses the highest prevalence rates of disorders of musculoskeletal including back pain, repetitive injuries, and joint injuries.

Hudson et al (2007) discovered that at least 40% of the construction workers reported being injured and hurt while working at construction site, causing in reduction of work performance and productivity. They also found the strain/sprain is the highest 38% of injury followed by back injury 27% and 22% injuries related to cuts. The most of the injuries within the construction industry caused by manual handling of materials and an awkward position like twisting the trunk or bending. These positions include working above the head, working below the knees and working on their backs but the reported

injuries in literatures include Carpal Tunnel Syndrome (CTS), cuts, burns, fractures, back injury, and strain/sprain in addition to eye and contusions injuries (Hudson et al, 2007).

Construction industry has witnessed far more fatalities and injuries in the recent days than it should statistically have. The work involved in the construction industry is quite rigorous and thereby increasing the likelihood of the road accidents caused by motor vehicles, construction equipment like excavators, rollers, grader, tipper trucks, falls, and collisions with other motors running on road during repair and maintenance (Hudson et al, 2007). In this context, it is necessary to ensure that there are safe working place for workers at highway construction and repair sites. Hence, this paper focus on how to address the health and safety issues of the workers at highway construction sites, particularly in the developing and least developed countries. The paper describes past research findings about health and safety issues in the highway construction work place and discusses the possible recommendation for the best practices for improving the health and safety of workers. The rest of the paper is organised under literature review, research methods with data collection and analysis, results discussion, conclusion and recommendation followed by references.

2. Literature review

A study carried out in the United Kingdom based on some of the possible factors that causes the most of accidents witnessed within the construction industry (LU and UMIST, 2003). The study suggested that everyone including the construction workers to management has a responsibility of carrying and enforcing a safe practice within the construction site, which must follow the management commitments and active employee involvement. In this case, employees need to be aware of the safety policies of their companies and at the same time understand the consequences that are likely to face when one fails to abide by them. Moreover, in such event that employee should allowed to provide their individual inputs on the issues of safety assuming that they will follow it without any external pressure. Employees' participation at workplace might results into increased practical ideas since they are the ones performing the work as well as realising with a sense of ownership and responsibilities (LU and UMIST, 2003).

2.1 General issues of health and safety in construction industry

It is assumptions that provision of Personal Protective Equipment (PPE) can help in reducing accidents and possible consequences but studies have shown that PPE are yet to be worn 100% of all the time by workers at construction sites. Safety glasses, hardhats, climbing harnesses, gloves, hearing protections among others are substances commonly referred to as PPE. Poor selection of materials and poor fit of PPE has been blamed for site incidents. It is therefore evidence that employers need to choose the most appropriate PPE as well as the selection of materials, equipment and tools. In most of sites, cost is the main determining factor when selecting suitable PPE for workers (LU and UMIST, 2003). In such event that PPE is selected based on the cost which is going to be involved in its purchase, chances that it is found bulky, ill-fitting, more prone to breaking, hot, and impeding performance are always very common.

Past studies reveals that pressurising workers to put on PPE even in the event when no possible risks might occur can be quite counterproductive. As scholars argues, forcing workers to put on PPE even in the event that there is no possible risk related to a particular injury might at time be considered as a joke of the safety program hence such program taken lightly even in the situation where real risk of injury or health hazards exists. For an example, lanyards and climbing gears might get in the way of performing the tasks, which is at hand that might consequently results into a fall or injury? Moreover,

over reliance on the PPE might also provide a false sense of security, making the employees to become less aware of the surroundings and the actions (LU and UMIST, 2003).

2.2 Health and safety of workers

The highway construction industry is traitorous since the works have to interact with the public traffic together with heavy construction equipment and vehicles that are operating within the area of construction site. A report of NIOSH exposed that more than 800 highway construction workers were killed in the road construction site with 490 being within their active workspace areas. A higher percentage of these fatalities occurred due to equipment or vehicle related cause (NIOSH, 2001). It is clearly shown in the report that workers who were on foot were equally likely to be struck by the construction vehicles just like the way as regular traffic cause accident and injuries. A case study conducted in Kentucky Transport Centre and found that worker safety programs can be very effective in reducing jobsite related accidents that can occur both to the workers at the highway construction sites as well as the public passing (Pratt, Fosbroke and Marsh, 2001).

2.3 Rumble strips and Balsi Beam

Numerous studies have suggested the use of rumble strips that are portable in improving the safety at the highway construction sites. Rumble strips are design to produce a warning that is vibratory and audible, which can draw the attention of the drivers to some existing control signs of speed (Dmochowski, Mohan and Zech, 2005). They reported that mix reactions on how effective rumble strips can be utilised in ensuring work place safety among the highway construction workers. Similarly, few studies have concluded that rumble strips can help reduce the speed of a moving car and trucks and hence preventing the possibility of occurrence of injury on the persons at the highway construction site. However, other studies have reported somehow different results indicating that rumble strips can only reduce such chances by a very limited margin and at times might fail to prevent the occurrence of construction related accidents along the highway (Dmochowski, Mohan and Zech, 2005).

In case of Basil Beam (BB), it is a portable work zone barrier designed by the transport department of California. This type of device was developed after a worker within maintenance devision experienced serious injuries while doing work on foot. BB barrier possess its own tractor-trailer with self-transportation along the road and it can be set up quickly just in a matter of minutes (Araya, 2006). BB is useful in protecting the site workers at work place from possible errant vehicles that are traveling along the highway at a high speed. It creates about 30 feet of the work zone and it is mainly useful in the potholes repairs, short-term patching, sawing joints, median work, bridge repair, and sign repair among other possible repairs that might be involved within the highway. The device is popular because of its ease of installation and its capability of improving the safety of workers at the highway work place (Araya, 2006).

2.4 Safety climate

The “safety climate” idea has been generated out of the common beliefs that the most of the accidents are not necessarily caused by workers who are perceived to be careless but rather by control failure, which is the ultimate responsibility of the management (Mohamed, 2002). This term “safety climate” was a phrase developed to explain the perceptions of the employees in the importance of giving safety and healthy a priority within a construction industry. Literatures have discussed different areas that are strongly believed to be having some impacts on the safety climate of a construction organisation. These factors include work competence, work pressure, appraisal of work hazard and physical work

environment, personal risk appreciation, involvements of workers in decision-making process, supervisory environment, supportive environment, procedures and rules, communication, and commitment by management (Mohamed 2002). The problems of safety within the highway construction sites are always as a direct result of the inconsistency involved by those enforcing the regulations and policies related to the safety and health of workers found in such construction sites. Hence, work hazards, together with the personal perception of the associated risks to those hazards might have some serious effects on the safety climate of the company (Mohamed 2002).

2.5 Robotic safety cone

Robotic Safety Cone (RSC) developed by the University of Nebraska is designed in a way that it has the ability of travelling with mobile maintenance/construction operations. Within the safety cone, a small motor is fitted at the base of cone that provide power to move. The application of this device can help to reduce the chances of a worker when stuck by traffic and the cone could be moved in mobile operations (Farritor, 2002). When workers are close proximity with a moving traffic at work place, it helps to reduce the likelihood of accident severity. The only instance when there will be worker interface with the safety cones is at the initial set up and removing period after the operation. The development and research on RSC comprises the cost reduction of the safety cones and improving the path planning of the cone (Farritor, 2002). Even though the prototypes have recently been developed and successfully tested but the device is unobtainable for commercial practice.

2.6 Prequalification of highway contractors

Since the idea of contractor prequalification for highway project began, safety is considered as a key factor within the prequalification process. Some agencies in various governments have taken an approach that prequalification is more defined in their safety records. These agencies require specific limit of safety performance from the contractors. They do this by introducing common measures of safety that the contractor has to pass through like data originating from the occupational safety and health administration and the ratios of experience modifications (Rules Governing Prequalification Privileges, 2007).

3.0 Research methodology

The study is adopted mixed research method that includes both quantitative and qualitative approach. The secondary source used to conduct the systematic review of literatures. The findings from literature were summarised and used them to design a questionnaire survey for gathering the quantitative research data form the ongoing highway construction projects. Moreover, qualitative data collected via interviews from workers and site professionals about health and safety issues. Observations taken place to understand and verify actual situation of the health and safety issues at the highway construction workplace as part of quantitative research data.

The interview provides an opportunity to researcher to analyse the respondent views and gather information that is more reliable. This approach ensured that the validity and reliability of information was upheld. The use of observation method was motivated by the need to observe real life interaction of workers in their work environment. This was necessary to analyse and appreciate the health and safety measures that the workers adhere to in their working environment. Moreover, a review of health and safety records and regulations was conducted with aim of ensuring that there was a baseline for comparing actual health and safety issues with workers at road construction sites.

A random sampling method was selected to identify targeted the response among construction professionals within highway construction projects. Moreover, one-one interview via designed questionnaire to collect data and site observation was also used to validate the data. Fifty responses were used to analyse the data and present the research findings associated with health and safety issues in the highway construction. The data collected during the study was analysed both qualitatively and quantitatively data analysis methods. The collected data were first edited for consistency, readability and completeness. Univariate analysis was done first as a process of identifying the numerous proportions of the outcome of the study. These included health and safety issues faced by construction workers, and the measures taken towards preventing such health and safety hazards within the construction project. Moreover, data collected from physical observation of the highways construction site, past literatures and in-depth interview were analysed carefully to generate themes that were aligned according to the study objectives.

4.0 Data analysis and results discussion

Primary data was collected with a questionnaire survey that was conducted within the highway construction projects in Saudi Arabia. A total fifty questionnaires were distributed to workers and construction professionals associated with highway construction projects via online survey tool. The potential respondents such as consulting Engineers, project managers, consulting engineers and causal labours/workers are target randomly and some site observations were carried out to identify the actual situations on the highway construction sites.

4.1 Demographic information of the respondents

This section presents the type of individuals who were involved within the construction project, their current position and work experience. Based on the figure presented below, study participants included project managers (8%), consulting engineers (10%) and labours (82%) with several years of experience in the road construction projects. From the above figures, it is evident that labourers represented the highest number of participants with project managers and consulting engineers being the least represented in the study.

4.2 Safety and health issues at workplace

The respondents were requested to identify the security concerns at their work places in highway construction sites. Different issues allied to workers' security were discovered at road construction sites in the survey. The findings from each questions are discussed in the following sub sections.

4.2.1 Personal protection equipment (PPE)

In response to question related to PPE, majority of responded suggested that safety glasses and hard hats as the most common types including hand gloves, hearing protection, dust mask and chaps but these are not available most of time at construction site. Many respondents believed that safety glasses should be more comfortable and resembling sunglasses to wear them during all day. The respondents indicated that PPE is a very important instrument on the daily operation of construction activities but construction companies have responsibility to purchase steel toe boots and gloves of different variety for different applications. Some participants reported that there was problem with safety belts and hard hats and they argued that it was counterproductive to make the use of hardhats be compulsory for all operations, even on the ones that do not pose threats of falling overhead objects.

Moreover, some respondents believed that safety vests are hazardous and uncomfortable with work but a common suggestion among them was to purchase of reflective shirts instead of safety vests. This would provide less material and better fit and less change to catch in equipment at the highway construction site. The best way in which the supervisors can enforce the usage of PPE is to stop the job, which was found common idea among participants. The respondents also believed that training was important just the same way having the right PPE would be perceived to be important. The common findings indicated that having PPE would not have any importance if the employees do not know how to use them in a proper way.

4.2.2 Heavy equipment operations

The common concerns raised by the respondents are the big demand of working back-up alarms fitted in the construction equipment. The survey exposed that back up was either not installed on all the equipment or not functioning correctly. Other than alarms, the use of horns and flashing lights was widely stated. It also confirms that the most operators regularly experience poor visibility within equipment cabs and mostly depends on the instruction provided by workers to get themselves away from the equipment instead of the other way round.

Majority of respondents suggested that being aware of the surrounding with alert system would be useful tool to completing the job itself. However, one of respondents highlighted that “it is necessary remove all non-essential equipment and workers from work zone so that visibility could improve and obstruction could be reduced on the way of the equipment movement.” It is also necessary to fixed more mirrors in equipment and regularly cleaned it. Other concerns raised by the workers were the lack of proper communication between the operators and the supervision staffs on the site. The respondents suggested mobile phones or Walkie Talkies might improve communication and assisting the operator to keep track of the worker and working place conditions.

4.2.3 Fall from heights and fall protection

This was another safety concern raised by some of the respondents in survey. The most concerns regarding fall protection was the fact that no employee reported wearing any PPE. However, respondents indicated that they experienced fewer accidents when there was proper usage of fall protection and additional training specifically on confined workspaces and hands-on is necessary. The appropriate use of lifelines and rescue training would be useful. Moreover, the respondents highlighted that each individual should provide PPE when climbing to work at height and the majority of fall incidents occur when workers are climbing in and out of trucks. In addition to having proper skip pads, bracing ladder and handrails on the side of dump bed, respondents suggested to have a training on three points of contact. Lack of proper housekeeping and jobsite cleanliness was reported as a safety concern for another contributing factor into falls. The adequate training and PPE must provide to prevent work place injuries and incidents from trips, slips and falls.

4.2.4 Heavy equipment rollovers

The largest concern among the workers regarding heavy equipment was lack of sufficient safety training of equipment operations at the highway construction work place. There is need for special training operators on the type of equipment they would be applying on the job site, not the general equipment that is usually used on other specific jobs. One respondent raised that seat belts are missing in some construction equipment. Rollover protection devices need to be in good working condition at all times. One of the respondents expressed his disbelief that operators should working on slopes in which they

are not comfortable and trained for. Another respondent suggested that tire pressure need to be checked 2 to 3 times a day. Putting the indicators of angle in each equipment as well as determining the centre of gravity of each equipment is another action need to be considered seriously. Overall, knowledge of equipment, good visibility and giving attention to the surrounding were some of the top measures suggested by the respondents to avoid accidents related to heavy construction equipment.

4.2.5 Head/ hand/ eye injuries

This was the most prevalent safety concern raised by the workers. Almost all the employees reported cases of hand/head/eye injuries. In fact, they had a major concern with such injuries though they acknowledged that such accidents could be avoided by putting on a proper Personal Protection Equipment (PPE) like safety shoe, hand glove, ear and dust masks and glass. Lack of stock at construction site is another issue, which is necessary for all jobs within the highway construction site. Induction training and common sense among the workers would help to eliminate the most of injury related PPE.

4.2.6 Hearing and visibility

As mentioned previously, the most construction companies do not provide hearing protections at same level of hard hats. Lack of proper enforcement was evident that high numbers of responded that hearing protection is responded as not applicable. It was apparent that most of the respondents and construction companies were less concerned with the hearing protection because they thought that it is the responsibility of government to provide hearing test and eye test on a yearly basis. With respect to public traffic accidents within highway construction zone, it appears that the respondents had a lot of concern based on the kind of responses witnessed in this survey. The participants argued that there is need for enforcing slower speed limits. Others even stated the need of placing more police officers at highway construction sites to control the speeding traffic. Message board with specific and updated information and sign would be helpful to control the vehicle speed. They argued that barricades could be safer than just using signs while closing the roads. Enforcement by police was identified as the effective means to avoid traffic accidents near highway construction zones.

4.2.7 Workplace injuries

In response question related to workplace injuries, respondents listed a few including those that results from injuries that are minor like smashed fingers and cuts on legs in addition to sprained shoulders and back injuries. It is worth noting that the most respondents never listed accidents within their survey but the accidents are likely within highway construction sites if proper measures are not control at construction site safely.

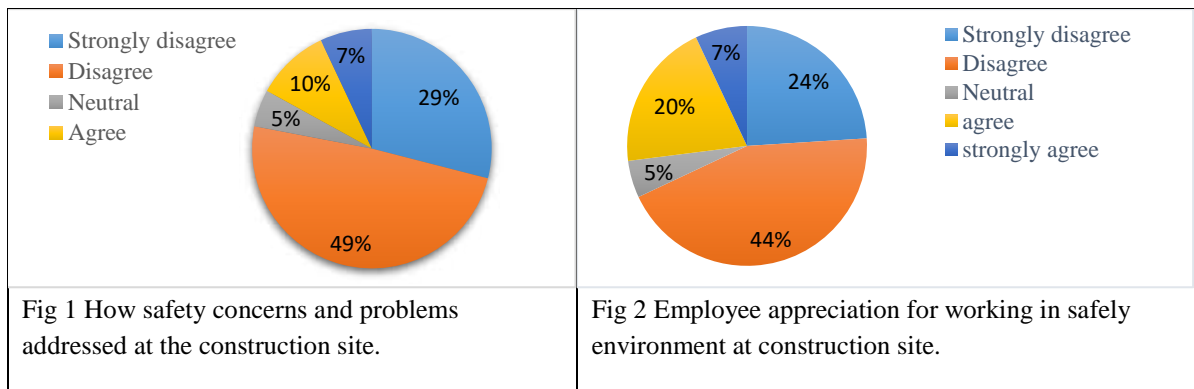
4.2.8 Existing practices of managing safety

In response to existing practices of managing safety at the highway construction sites. Survey results (see table 1) expose that communication of safety information and lesson learned from highway construction sites to the employees made a dominant contribution with a mean score of 4.04. This was followed closely by safety being considered to be important just the same way of getting the job done with a mean score of 3.93 and the third being the employees believe that it is their responsibility to maintain their safety and health at construction sites.

Table 1: Treatment of safety issues at highway construction sites

Management of site	N	1	2	3	4	5	Mean	Std. Dev	Rank
Safety information and lesson learned from construction sites are communicated to the employees	50	3.9	9.3	7.8	32.5	45.2	4.04	1.18	1
Safety is considered to be important just like of getting the job done	50	1.3	14.2	6.6	44.8	32.9	3.93	1.05	2
Employees believe that maintaining safety is workers responsibility	50	1.3	11.9	14.1	46.7	26.7	3.86	0.99	3

Additionally, the respondents were asked to provide their views about how safety concerns and problems are addressed at the workplace. Results showed that majority respondents (49%) disagreed and 29% strongly disagreed but 10% agreed and 7% strongly agreed that such cases are addressed very quickly while 5% were unknown (see figure 1).



Furthermore, the respondents were asked their appreciation about working in safely environment at construction site. Result exposed that 40% disagreed that they are working safely at the construction but 20 percent agreed that working safely (see figure 2). This figure is evident that majority workers unhappy for the safe working environment and any encouragements for adhering to safety procedures at the highway construction sites.

4.5 Key factor poor safety at work place.

The respondents were requested to state the reasons why they thought Saudi Arabia was considered poor record in health and safety in highway construction projects. The survey result exposed that absent of H & S monitoring body at work place is major factor and lack trained supervisor and PPE cause least important factor for poor safety records (figure 3).

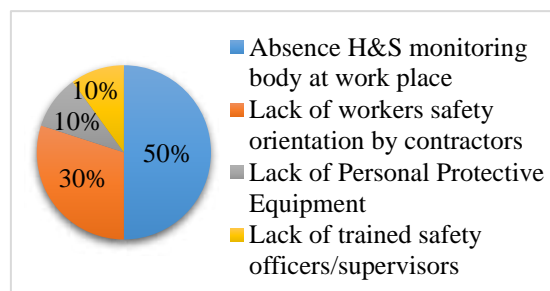


Fig 3 Key factors for poor safety at work place

4.6 How to improve highway worksite safety

In a response to question about how to improve worksite safety during construction process, results shows mixed suggestions. The first suggestion was to use sensors or cameras mounted near the equipment or vehicle to help detect objects that are in blind areas. Apart from increasing training to the truck drivers, the respondents also suggested that the use of rear-mounted cameras on larger trucks like dump trucks and pickup trucks might decrease the likelihood of any backing up accidents. Other suggestions were to use a back-up alarms to keep the workers attentive, use of tractors that poses closed cabs, and usage of auto-shutoff when dealing with moving operations so that the operator is thrown from the seat and engine will automatically go off. The respondents also emphasized on the need of proper PPE as well as additional training and management commitment in improving site safety.

4.7. Current practice of reduction in health and safety risks

In response to a question about current practice of reducing safety risk, respondents highlighted that workers are at a high risk either of fatal and nonfatal accidents working upstairs or on the ground along the roadside. Currently there are different practice being implemented to reduce health and safety risks at the construction site such as creating a department for the safety and training of members on safety operations, remove chemical and environmental risks, surround the site with temporary fences, using safety signs information in the site and engineers control the aspect of health and safety.

4.8. Lack of health and safety regulations

The respondents were asked why health and safety regulations not being implemented in construction project. The respondents expressed that contractors do not offer health and safety orientation to their workers how to protect themselves while at work. These cause workers highly susceptible to accidents while working on these projects. Workers are not motivated to continue adhering to safety procedures when working on highway construction projects. Another reason highlighted by respondents that there is the absence of trained safety personnel in highway construction projects to provide daily safety induction and monitor safety practices of workers about their safety. Additionally, the absence of trained safety personnel implies that there is nobody to administer first aid for minor injuries and maintain safer highway construction site.

5.0 Results Discussion

From the above data analysis, it is evident that there exist many safety concerns within highway construction sites. Most of the fatalities within the construction industry occur at the work zone due to collision with equipment and vehicle related incidents. This study reveals that the frequently reported causes of injuries at the construction site are truck, surfacing and road construction machinery and cars. However, the literature review indicates that the majority of fatality victims at the work place are from private employment and only few around thirteen percentage are coming from state or local governments. Fatalities involving workers on foot normally struck by a moving vehicle is the most common accidents at workplace. Apart from the equipment and vehicle-related hazards, literatures have also reported that highway construction workers are at high risk of death or injury from the contacts with overhead power lines, fall from structures or machinery, explosion of gas line, or struck by materials or objects that are falling. According to the survey findings, it reveal that there are no government agencies controlling health and safety regulation properly in Saudi Arabia. The reason is

that contractors have no set rules to adhere and no consequences for their actions. The second reason for the poor ranking of safety is that contractors do not offer health and safety orientation to their workers causing the workers highly susceptible to accidents while working on these projects.

Third reason for the low ranking in health and safety is the absence of trained safety personnel in highway construction projects. This means that there are no people to train other workers about their safety while working on highway construction projects. The absence of trained safety personnel implies that there is nobody to administer first aid for minor injuries and this greatly influence the poor safety ranking at work place. The last reason for the poor ranking in H&S is the lack of protective equipment for personnel working at construction site. The provision of protective equipment such as hardhat that protects from head injuries.

Moreover, survey findings exposed that workers are not motivated to continue adhering to safety procedures when working on the highway construction projects. This is proved by the fact that a high number of respondents advocated that they never praised for adhering to safety procedures. It is important that some workers would feel motivated by just being praised for adhering to safety practices. This would make them more willing to such procedures even in the future causing the reduction in injuries and fatalities at highway construction sites. The findings also support that highway construction poses a potential risks for musculoskeletal disorders and its associated injuries. It is obvious that sprains/strains are the most prevalent types of injury that result into the back part of the body mainly affected, which is similar findings from the review of existing literature (NIOHS, 2001) and past survey in construction health and safety.

Furthermore, the survey also reported that highway construction industry poses the highest prevalence rates for musculoskeletal disorders such as back pain, repetitive strain injuries and joint injuries. Similarly, highway workers reported that materials are handling manually and the most construction companies encourages their employees to use back belts. However, literature shows that it does not recommend the usage back belts in preventing injuries. Hazards in lifting might vary from one job site to another, hence the need of having lifting training. Before any attempt to develop any kind of training program, there is a need for the company to evaluate the site of the job and materials that will be utilised throughout the process of construction. Scholars believe that proper set up of site at the start of the project might help prevent back injuries (Kim, Ryoo, Kim and Huh, 2013). Sufficient amount of proper material and equipment handling like forklifts and handcarts need to be available so that workers do not develop a feeling that they always have to move the materials manually (Kim, Ryoo, Kim & Huh, 2013). There is great need of training to employees on the type of material handling and use of equipment. There is great need for highway construction individuals to involve the occupational safety training involving the roadway safety policies and actions that have direct affect to all individuals using road and workers associated with road construction activities.

6.0 Conclusions and Recommendations

The study concludes that highway construction workers are constantly at a high risk either of serious fatal and nonfatal injury while working upstairs or on the ground along the roadside construction. Each year, a dozen of workers are killed and a large numbers of workers sustained serious injuries. Vehicles and equipment that operates around the work zone are responsible for more than half of the work fatalities within the industry. Historically, efforts of reducing equipment and vehicle related injuries within the construction industry has majorly focused on improving the devices of traffic control and configuration of the work zone in order to minimize confusion that might arise from moving individuals

and equipment within construction zones. It has widely been believed that injuries will be highly minimized by reducing collisions.

The study also discovered that highway contractors do not motivate their employees into adhering to safety procedures during construction. Motivational methods may include simple things such as praising workers for adhering to safety procedures. Therefore, contractors should have a culture of recognising the efforts that construction workers make in ensuring that they are safe. This would help in improving safety of workers and reducing injuries at work place.

Moreover, the OSHA approach to work safety, which mainly involves around proper and frequent use of Personal Protective Equipment as well as being constant to compliance to safety regulations must be implemented at all times so that safety of the workers could be ensured. Other approaches that protect the workers from hazards include improving the organisation's culture on safety and the usage of incentives to reward those who embrace safe practices. How a highway construction industry chooses to protect their workers might be unique depending on the organisation itself though all construction organisations are required to follow safety guideline strictly set by OSHA. In other words, there is need for a safety program to encompass OSHA compliance together with unique and broad safety policy and it was for this reason that this study had focused on how to improve safety issues at highway construction site.

The absence of legislations to govern health and safety in construction projects was found as the reason for poor records of health and safety. Therefore, there is need for the government to come up with health and safety legislations for the construction industry. Examples of these legislations include the requirement to provide all workers with safety equipment when working on the construction projects and offering basic safety training prior to commencement of construction work. Additionally, these legislations should be accompanied by penalties for non-adherence. These penalties would serve as deterrence to practices that would pose health and safety risks to highway construction workers.

Finally, it is also recommended that future study should focus on the identifying in depth health and safety issue in the highway construction sites with different geographical areas and different project complexity level. Benchmarking is necessary to compare the improvement in the safety issues after implementing the recommendation. As highway construction and maintenance activities evolve, new safety hazards and measures are likely to be identified according site conditions and adopted construction technology. Continuous research is required to improving the safety and health of workers and reducing serious injuries and fatality at the highways construction sites.

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