The Effects Of Coupling Repetitive Motion Tasks With A Manually-Stressed Work Environment

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ABSTRACT
This paper presents an ergonomic evaluation conducted at a bottling plant in Ilorin, Nigeria. Virtually, all complaints from employees are from two key areas in the plant which ranged from occupational disorders such as carpal tunnel syndrome to other ailments of components of the upper extremities. A five-step regimen method was used to achieve desired solution. The occupational disorders were predictable due to the synergistic effects associated with repetitive production and hand intensive stress. Engineering improvements coupled with simple workstation modifications and an employee wellness program was recommended. [Researcher. 2009;1(2):37-40]. (ISSN: 1553-9865).

Key words: carpal tunnel syndrome, engineering improvements, repetitive motion tasks, wellness program

INTRODUCTION

The increase in concerns for ergonomic issues in the workplace is well founded; as it is related to work/machine interaction, workstation design, working position; the suitability of instruments to the physical and physiological characteristics of the workers, psychological factors and environmental conditions (heat, cold, noise, air pollution) which may affect workplaces (workstations) and affect the health of the workers (Bazroy, et al. 2003, World Health Organisation,1998; Ajimotokan, 2008). Thus, ergonomics improvement tends to lower the physical demands of work tasks, thereby lowering the incidence and severity of the musculoskeletal injuries (Ajimotokan, 2008).

Scientific evidence has demonstrated the effectiveness of ergonomic interventions, both in controlled and uncontrolled studies, in reducing both the exposure to potential workplace risk factors and the prevalence of work-related musculoskeletal disorders (Westgaard and Winkel, 1997; Smith, et al. 1999).

With reference to the bureau of labor statistics, over 50% of all occupational illnesses reported were associated with repetitive motion trauma (Bureau of Labor Statistics, 1997). A repetitive motion injury is not an acute or short-term result of a one-time accident, but instead, the chronic result of gradual, repeated trauma. The three most common repetitive motion injuries are muscle, tendon, and nerve injuries (MacLeod, 2000; American Industrial Hygiene Association (AIHA), 2003).

Carpal tunnel syndrome (CTS is the term used to describe the set of symptoms that result when the median nerve in the wrist is damaged or compressed (AIHA, 2003; Handy and Lafreniere, 2006). The symptoms of CTS range from mild numbness or faint tingling to extreme pain and/or loss of the use of the thumb (Handy and Lafreniere, 2006; Canadian Center for Occupational Health and Safety (CCOHS), 2001). CTS has shown up in studies of workers in frozen food plants, pork processing plants, and among supermarket workers (Chaing, 1993; Fairris and Brenner, 2001; Moore and Garg, 2001; Osorio, 1994). By the inherent nature, light manufacturing operations such as buffing, grinding, cutting, and packing (as well as palletizing and depalletizing) could all result in prevalence of CTS cases.

Body postures determine which joints and muscles are used in an activity and the amount of force or stresses generated or tolerated (Putz-Anderson, 1998), because the skeleton is essentially a lever system, there is certain postures in which it can absorb force more easily than in others. Phrased another way, there are certain postures in which the body is more susceptible to injury. Extreme postures, combined with force and frequency, will cause damage more quickly than when the postures are more natural or neutral (Kerst, 2003). Thus, the combination of force, frequency, and posture (FFP) contributes to wear and tear injuries. Effects of repetitive motions coupled with the performance of the same tasks are increased only when awkward postures and forceful exertions are involved.

As little information exists on the effectiveness of preventive measures in reducing work-related injury rates, several studies have been conducted to examine specific risk factors for work-related injuries in an attempt to identify workers at higher risk (Brenner, 2004; Zwerling, et al. 1996).

Ergonomic problems like those realized in these key areas – bottling and maintenance departments were most likely explained by the premise that the exposures are a part of a complex multiple risk factor function. It could be that the evolving of the problem was likely due to the combination of synergistic

effects resulting from the existence of repetitive tasks under hot and dry and/or cold and humid conditions. For multiple risk exposures, the most effective solution is to reduce risk factors by carefully analyzing what was currently being done, and then come up with the best solution to ultimately benefit both the worker and the company (National Institute of Occupational Safety and Health (NIOSH), 1997).

The study presents ergonomics evaluation of a workstation environment, coupling both the effects of repetitive tasks and manual stress, conducted at a beverage bottling plant in Ilorin, north central Nigeria. While there were a few work areas that utilized automated equipment, the bottling and maintenance workstation was partly labour-intensive with a few key ergonomic problem areas.

MATERIALS AND METHODS

This randomized intervention trial study was conducted at a beverage bottling plant in Ilorin, Nigeria for a six-month period. The facility operates four shifts – three production shifts and a general shift; and the workers donned, at a minimum, long coats and anti-slip boots.

Chronologically, five types of interrelated data indicators were used, to determine whether musculoskeletal problems are present and whether coupling both repetitive jobs with manual stress conditions that pose a significant risk for such disorders exist. These include:

1. A critical review of the literature was made to identify comparable studies that had been performed by other researchers. The databases of Environmental, Health & Safety, PubMed, among others were utilized and manually searching key relevant journals and conference proceedings to research comparable studies.
2. A review of injury and illness investigation register was conducted to identify areas of ergonomics concern, to understand the magnitude, pattern and seriousness of injury and define opportunities for intervention.
3. Interviews were completed with 104 affected employees during the fifth and sixth months of this study. Typically, the workers were incognito interviewed on the root of the ergonomic problems at hand.
4. A job- or task-based worker survey examining the likelihood of excessive physical fatigue or discomfort can also be an important indicator of potential disorder concerns. These surveys, which were typically administered on a one-on-one basis to avoid group bias, focus on relating discomfort sources to specific jobs or tasks. These job survey results were prioritized by the frequency and severity of discomfort to workers.
5. The primary method of job or hazard analysis system for risk assessment based on the Occupational Safety & Health Administration (OSHA) factors - the observational qualitative worksheets was completed during a walk-through review of job or task to identify obvious ergonomic concerns. These worksheets, which helped to identify mismatches between applied force, frequency, and assumed postures, provides a systematic risk screening method for an ergonomic job analysis. Factors such as stress, posture, force, repetitiveness, temperature extremes and priorities for change were subjectively evaluated and given a number ranking or a yes/no or true/false response.

RESULTS

The literatures found were comprehensive though not exhaustive on ergonomic issues couple with manually-stressed work environments, but the studies that were sited assisted in the recognition, evaluation and control of potential ergonomic problems.

Injuries and work-related illness investigation register provide a historic look at occurrences of strains, sprains, and RTDs such as CTS, wrist tendonitis among other ailments. These injury and illness rates and incidents yielded valuable information about the types of traumatic disorders present and facilitated the prediction of potential future losses, stemming from the situation.

The employee interviews brought out several key points. While it appeared to have some bias, the information gathered from individual worker history and questionable facility processes was significant and credible. Most of the workers complaints range from mild numbness or faint tingling to extreme pain and/or loss of the use of the thumb, worker fatigue or report of related problem. A few complaints were directed at soreness in the wrist and hand, and other complaints were directed at soreness in the elbow and shoulder areas which seem to either cause or complicate existing discomfort.

From qualitative assessments, several bottling tasks from arrangement of bottles into the bottle washer (depalletizing) to bottle screening operation, beverage bottling and crowning, palletizing, etc have been categorized as high risk for developing disorders in at least one body area.

DISCUSSION

The findings of this randomized trial imply that an engineering improvement coupled with simple workstation modification and an employee wellness program can reduce ailments of components of the upper extremities and prevent musculoskeletal disorders among workers in bottling facilities.

The review of observed complaints depicted that most of the disorders had been carpal tunnel syndrome or similar ailments of the wrist or other components of the upper extremity (e.g., fingers, hand, arm, elbow, etc.).

The qualitative worksheets used assisted in identifying the major problematic workstations within each of the two work areas. Careful evaluation of the completed worksheets resulted in the identification of arrangement of bottles into the bottle washer and palletizing tasks in beverage bottling as the most ergonomically unsound. These are manual tasks involving excessive folding/unfolding of fingers and bending of the wrist(s) with a repetitive sequence completed in hardly a second duration. Other high-risk tasks identified included bottle screening workstation, beverage bottling and crowning workstation in the bottling department and painstaking manual routine maintenance of machineries in the plant by maintenance department employees. The fit between the work piece and the employee in these high-risk areas were within the guideline values for these jobs except for few defined improvements.

RECOMMENDATIONS

As a result of the ergonomic issues identified from the ergonomics evaluation of this facility, the following was a list of recommendations deem indispensable.

1. The distance to the work piece should be kept at a minimum so that the arm movements or extensions of more than 15 inches are minimized (AIHA, 2003; Handy and Lafreniere, 2006). While the workstations that violated this principle in these two areas of concern were few in numbers. Stool height issues were particularly noticed during the evaluation of the bottle screening operation.
2. For the conditions, it appeared that the production rate for beverage bottling was too fast, so it was recommended that a qualified ergonomist, industrial engineer, work physiologist or time study expert to conduct a time motion study at this workstation.
3. An employee wellness program should be employed that included finger/hand exercises aimed at alleviating conditions that lead to RTDs, and in particular, CTS. Simple stretching exercises should be performed before the shift begins and/or during the first 5-20 minutes of each shift and after the lunch break. This would facilitate the overall body blood circulation and aid in the warming up of the muscles. However, an ergonomics awareness program should be put into operation plant-wide. This program would provide training on ergonomic-related issues and be the vehicle to move the wellness program in the right direction.

CONCLUSIONS

The combination synergistic effects coupled with the repetitive motions in a manually-stressed work environments can lead to premature development of occupational disorders such as CTS. However, the execution of appropriate engineering improvements with simple workstation modification and an employee wellness program can help to alleviate the seriousness of such work-related conditions.

Before this study, this facility had about 17 individuals/ month with some degree of disability attributed to RTDs. As indication of success, only six individuals (in the following month) have been diagnosed with a disorder in this area. While the counteractive action instigated from the results of this work cannot be seen as the only reason for the desired achievements, at least, the impact has been incredibly beneficial. Successful ergonomics processes follow a systematic, proactive approach driven by risk reduction strategies (Kerst, 2001). Though reactive steps are the typical beginning point, proactive approaches should be instituted to prevent these kinds of problems from developing.

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